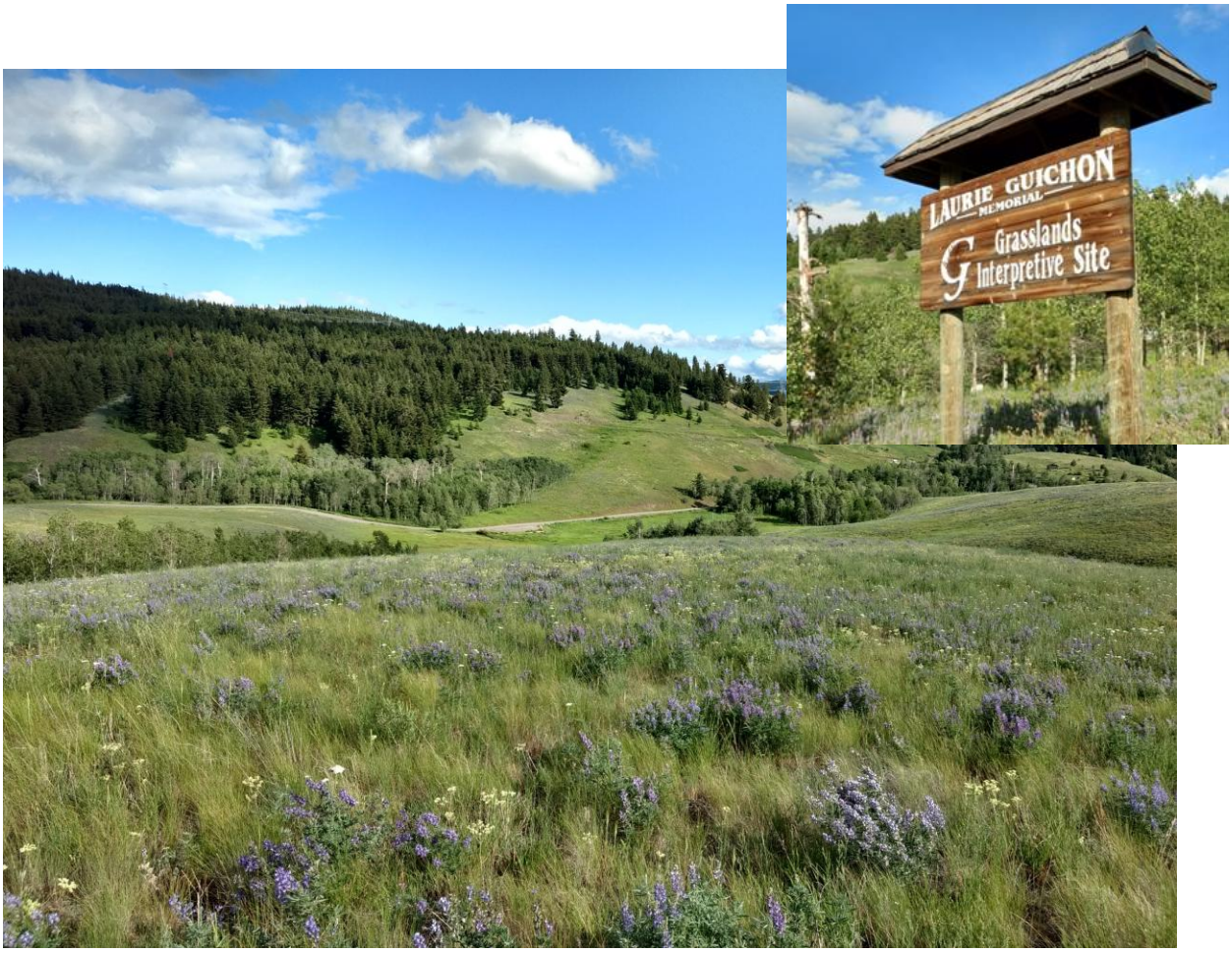
Laurie Guichon Memorial Grasslands Interpretive Site:

A Baseline Inventory



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Grasslands Conservation Council of British Columbia

Laurie Guichon Memorial Grassland Interpretive Site Baseline Inventory

Prepared by

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In partnership with

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Baseline inventory team

The baseline inventory fieldwork was done by Dennis Lloyd, Kristi Iverson, and Ken Mackenzie. Mapping and reporting results about ecosystems, seral stage conditions, Spotted Knapweed density classes and the overall range condition of the grasslands was completed by Kristi Iverson and Dennis Lloyd. Ken MacKenzie participated in the field survey, completed the wildlife assessment and written descriptions. Ken also provided GIS support to generate map products and associated area summary statistics. Heather Richardson provided administrative support, digitized initial ecosystem maps and completed an editorial review of this manuscript. Liis Jeffries from the Merritt Naturalist club and Kristi Iverson also provided and editorial review. All Photographs were provided by Dennis Lloyd.

Executive Summary

The Laurie Guichon Memorial Grassland Interpretive Site (LGMGIS) was established in 2001 to honour a local rancher who brought people together to share knowledge and responsibility for the land. The objective of this document is to characterize the ecological conditions of the LGMGIS. It's hoped that the resulting maps and descriptions will serve as a basis for developing weed and range management plans, contribute to education and outreach opportunities and highlight the cultural, historic, economic and ecological importance of local grasslands.

The 102 hectare LGMGIS is ecologically diverse for such a small area. Fifteen ecological types have been observed, characterized and mapped including; four grassland, five forest, four wetland, one rock outcrop and one shrubland ecosystem types. Four successional stages of the grassland types have also been, identified, characterized and mapped based upon four seral stages (early, mid, late and potential natural climax conditions). Knapweed is the dominant weed species of concern on the grasslands and 5 cover classes have been recognized, mapped and displayed. The overall range condition of the grasslands has been assessed and mapped. Wildlife capability and suitability has been assessed and mapped for the nine most likely species at risk that may occur on the LGMGIS. The appendices include a check list of potential and observed fauna and flora anticipated to occur on the site.

This document is considered to be the start of a living document that can be added to through time. Some sections are still incomplete and fauna and flora lists for the site are expected to be revised as more people visit the site. This document will be stored on the GCC and NWCRT web sites, with annual updates as new information becomes available.

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Introduction

The Laurie Guichon Memorial Grasslands Interpretive Site (LGMGIS) was established in 2001 by the Nicola Watershed Community Round Table (NWCRT) in partnership with the Grasslands Conservation Council of BC (GCC). The goal for the site is to educate both residents and visitors about the ecological significance of the interior grasslands. The LGMGIS showcases the importance of grassland ecosystems and how they are an integral part of the ecological, cultural, and economic fabric of the region.

Figure 1. Location of Lauire Guichon Memorial Grassland Interpretation Site.

The 102 hectare area is located approximately 11 km southeast of Merritt, British Columbia, east of highway5A/97C at the junction with an access road to Lundbom and Marquart Lakes.
The site was established to honour Laurie Guichon (October 15 1944 – July 19 1999), a fourth generation rancher in the Nicola Valley and founding member of the NWCRT and GCC. Laurie was passionate about creating a grasslands interpretive site and the site was part of his vision to bring people together to share knowledge and responsibility for the land.

On April 1 2012, the NWCRT entered into a "Recreation Sites and Trails BC Partnership Agreement" with the province under the Forest and Range Practices Act. The primary purpose of the agreement is to have the land managed and maintained for the purposes of recreational and/or conservation activities. Volunteer members of the NWCRT have been crucial stewards of this land, adding interpretive signs and trails to educate visitors about the grasslands' history, use, and biodiversity. They have looked after the site by picking up garbage, weeding, and maintaining the outhouses.

Baseline Inventory

Objectives

Since the site opened, it has seen increasing pressures from recreational use, cattle grazing, habitat fragmentation, climate change, and invasive species. In early 2017, the NWCRT convened a meeting to discuss the degradation of the site, calling on various stakeholders including the GCC; Ministry of Forests, Land and Natural Resource Operations and Rural Development (FLNRO); Thompson Rivers

University (TRU); British Columbia Cattlemen's Association; Nicola Tribal Association; Lower Nicola Band; Upper Nicola Band; Chutter Ranch; and interested citizens. While education and infrastructure maintenance were the primary goals of the site, the NWCRT and GCC now sees the possibility of an expanded role of active management and stewardship of the site. The various pressures to the site demonstrated a need for a baseline inventory and comprehensive management plan.

The goal of the initiative is to conserve biological diversity by increasing active management and stewardship of the site while concurrently providing opportunities for research and public education. To help accomplish this, the GCC has partnered with the NWCRT to establish a management plan for the area. The first phase of this plan was to complete a baseline inventory of the ecosystems, invasive species, wildlife, and range conditions at the site.

The aim of this document is to provide a foundation which summarizes the characteristic of the LGMGIS and suggests stewardship recommendations. There is no intention of publishing a hardcopy, but this is intended to serve as a "living" electronic document that will be loaded on the GCC and NCWRT web sites. It's anticipated that wildlife and plant species check lists will be added to as more time is spent on the site. It's expected that research projects and results, stewardship plans and monitoring results, and site infrastructure and interpretive trail developments will be added to the document with time.

General Area Description

The site occupies 102 ha at an elevation of 1120 to 1200 meters. It occurs on Provincial crown land on the SW corner of the Lundbom Commonage. The commonage covers about 5000 hectares and was set aside by the provincial government to provide access to the public and smaller ranchers in the area, because most open range was privately owned by large cattle companies. The gently rolling landscape is dominated by grasslands with small aspen patches occurring in moist depressions and Douglas-fir dominated forests occupying cool north aspects. There are

Figure 2. A view of the LGMGIS look east toward Marquart Lake

scattered ponds and associated wetland plant communities in shallow basins from which there are no outlet streams. The underlying soil is derived from primarily glacial till consisting of a heterogeneous, non stratified mixture of particle sizes ranging from clay to rocks. A thin veneer (2-20 cm deep) made up of fine sands and silts blankets most of the area. This windblown material was deposited immediately following deglaciation and lacks rock and stone sized particles. A broad overview of the area from satellite images indicates the grasslands are associated with a drumlinized till plain formed by the general north-south movement of the last continental ice sheet, 10-20 thousand years ago. The parent material is derived primarily from volcanic bedrock which underlies most of the surrounding area. The climate is characterized by hot dry summers, cold winters and four distinct seasons. The area receives about 35-40 cm of precipitation annually, 35% percent of it as snow (Ryan and Lloyd 2018). Accumulations of snow rarely exceed 50 cm in depth and snowmelt is generally complete by late March, although there is considerable variability in snow accumulation patterns depending on the slope, aspect and shade on individual sites.

Ecosystem Mapping

Purpose

Ecosystem mapping is used to show the spatial distribution and extent of ecological communities. It also provides a key baseline for understanding, distinguishing, mapping and interpreting a plant community's successional status, the range condition and the habitat capability and suitability for wildlife. This information enables users to set spatially explicit management objectives across the mapped landscape. In the case of seral stage or range condition, this mapping can provide a baseline against which broad changes in condition can be assessed over time. Mapping can also inform decisions about spatially explicit priorities and resource management treatments.

Methods

We have used the biogeoclimatic ecosystem classification (BEC) (Meidinger and Pojar 1991, Lloyd et. .al. 1990, and Ryan and Lloyd 2018) to provide the foundation for characterizing and mapping ecosystem at LGMGIS. At the regional level, vegetation, soils, and topography are used to infer the regional climate and to identify geographic areas that have a relatively uniform climate. These geographic areas are termed biogeoclimatic units.

The classification system is based upon broad macroclimatic conditions and localized patterns in topographic, floristic and soil conditions. At the climatic scale, the LGMGIS lies within the

Thompson very dry, hot Interior Douglas-fir biogeoclimatic variant (IDFxh2). The IDFxh2 landscape consists of a mosaic of grasslands and forests. Forests are typically dominated by mixed stands of open Douglas-fir and ponderosa pine. Within this landscape the majority of late seral grasslands are dominated by rough fescue.

Ecosystems were identified and mapped using the current draft site series classification for the IDFxh2 (Ryan and Lloyd 2018). Each site series is defined and identified based upon climax or late seral vegetation and factors that control a site's soil moisture and nutrient regime such as slope, aspect, soil depth, parent material, and slope position. These factors are combined with late seral vegetation to identify the type of ecosystem (site series). In situations where the vegetation has been disturbed by grazing, forest harvesting, or invasive alien species such as spotted knapweed, site features are used to identify the ecosystem.

Site series names and map codes follow conventions developed by the scientific community responsible for the BEC program. Forested site series are named according to one or more of the three dominant tree species found at the site. To shorten the tree species portion of the name, tree species codes are used, with Fd for Douglas-fir, Py for Ponderosa pine and At for aspen. The tree species code is followed by one or more plant species which are generally dominant, distinctive and indicative of the plant community being represented. Fd Py – Pinegrass is an example of a forested ecosystem. For the purpose of mapping this name also corresponds to a numerical series map code ranging from 101 to 113. For non-forested ecosystems, the name is restricted to one to three dominant, distinctive species and the mapping code follows a convention in which wetland marshes are Wm, rock outcrops are Ro, shrublands are Ff and grasslands are Gg. These 2 letter codes are followed by two numbers, ranging between 01 and 20 which correspond to provincially standardized and scientifically recognized site associations. For example Wm05 is used to represent the Cattail wetland marsh site association.

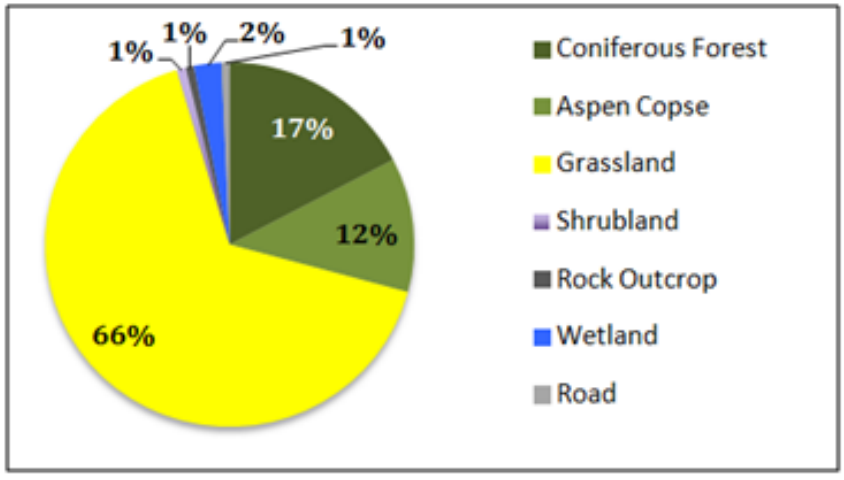


Figure 3.The percent cover of broad ecosystem types in the project area.

Aerial photographs were viewed in stereo to determine patterns of dominant vegetation (e.g. grassland vs. forest vs. wetland) and the topographic relief including slope positions such as ridges, depressions and upper slopes, and aspect, slope gradient and soil depth. The tone and textural patterns on the aerial photos combined with field verification provided a basis for mapping. Polygons were drawn on 1:2,000 scale orthophotos and then digitized. The minimum polygon size was 0.25 ha. The initial polygon delineation was done by D. Lloyd and refined by K. Iverson. The area was divided into relatively uniform polygons that contained no more than two ecosystem types (site series). In many instances grassland polygons were further subdivided to reflect broad scale distribution and variability in seral stage, the cover class for knapweed, and range condition. The characteristics and spatial distribution for each is noted below and a detailed map legend is provided in Appendix 1. Together they also compiled a list of plant species observed, and prepared a check list of plants observed compared to species D. Lloyd anticipated for the sites ecological conditions, see Appendix 2.

Results

The LGMGIS supports six broad ecological types. As shown in Figure 1, grasslands dominate the project area; coniferous forests occur primarily as one large patch in the southeast corner and aspen copses occupy depressions and swales scattered throughout the study area. There are a couple of shrubland patches, each covering less than ½ hectare, rock outcrops and wetlands also occur, but are limited in extent. Each ecosystem type supports a distinct assemblage of plants, animals and microflora that contribute to the site's overall biodiversity. This diversity contributed to the rationale in selecting this area for the LGMGIS, as it provides an excellent opportunity for education and demonstration purposes.

Grasslands Ecosystems

Grasslands are areas where the vascular plant cover is dominated by grass species. These ecosystems tend to be too dry for tree establishment and are generally associated with semi-arid climates and commonly occupy very dry, droughty southern exposures in forested zones. Historically, wildfire has played a strong role in the development and maintenance of grasslands. First nations burning in the Merritt area likely also played a role in the early establishment of grasslands in the Lundbom Commonage. These grasslands are commonly referred to as the "upper grasslands" and constitute some of the most productive grasslands in BC. At LGMGIS, these areas were historically dominated by rough fescue and bluebunch wheatgrass. Bluebunch wheatgrass dominated the driest ridge crests and upper slopes, particularly those with shallow and/or coarse textured soils and rough fescue dominated gentler slopes. Both species are highly preferred forage for cattle and over-grazing of these

species results in an increase of less palatable species including buckwheat, cheatgrass, Kentucky bluegrass and knapweed. In areas that have received heavy continuous grazing, the fescue and bluebunch wheatgrass have been entirely eliminated. Grassland soils at the site are generally fine textured loams and the surface soil horizons have been enriched by the accumulation of organic material derived primarily by the annual die-back of the fine roots of bunchgrasses. The amount of incorporated organic material varies and is depends upon history, rooting depth, soil textures, soil moisture regime, climate and history.

Four grassland site series have been recognized and mapped at the LGMGIS.

The ***Bluebunch wheatgrass — Balsamroot*** (Gg02) is a dry grassland ecosystem which occurs on dry, moderate to steep warm aspects, generally on crests and upper slopes, often with shallow or coarse textured soils. It is dominated by bluebunch wheatgrass with a low cover of junegrass, Sandberg's bluegrass, and forbs. This unit typically has balsamroot although the cover is sparse and generally absent on this site, except in the area adjacent to the forest at the extreme SW corner of LGMGIS. There is often exposed soil, especially on steeper slopes. Seral stages and ecological condition classes are similar to those described below for the Gg10 but they lack fescues. The Gg02 is the least extensive grassland type in the LGMGIS, but due to its distance from water, is the one grassland type which is primarily in late seral or climax condition. Ironically these dry grasslands are least resilient to disturbance and will require more time to recover if disturbed than the other grassland ecosystems in the LGMGIS. This is the driest grassland ecosystem in the LGMGIS and the site's droughty nature leads to a more widely spaced bunchgrasses competing for limited soil moisture.

Figure 4. A photographic example of the ***Bluebunch wheatgrass — Balsamroot*** (Gg02) grassland ecosystem.

The ***Rough fescue — Bluebunch wheatgrass*** (Gg10) grassland ecosystem is common on moderate to gently sloped warm aspects and ridges with deep soils. Climax and late seral plant communities are dominated by a mixture of rough fescue, bluebunch wheatgrass and a variety of forbs often including junegrass, Sandberg's bluegrass, nodding onion, silky lupine, desert-parsley, parsnip-flowered buckwheat, small-flowered blue-eyed Mary, timber milk-vetch, long-leaved fleabane and pussytoes. This ecosystem also has some of the most northerly populations of Idaho fescue. Anecdotal observations indicate that Idaho fescue was not historically abundant at this site and its current abundance may be a reflection of its northern movement in response to climate change, as it historically was more abundant at more southerly latitudes. The total herb cover at climax typically amounts to 65-75%. These sites are more productive and have less exposed mineral soil than the Gg02. The Gg10 is intermediate between Gg02 and Gg12 for productivity and resilience to disturbance. The seral stages of the Gg10 are recognized according to the following:

Figure 5. A photographic example of the ***Rough fescue — Bluebunch wheatgrass*** (Gg10) grassland ecosystem.

- **Climax** (C) vegetation is dominated by high cover of rough fescue and bluebunch wheatgrass with diverse, scattered forbs, a good cover of litter on the soil surface and the plant community consists of 75-100% of the composition and cover of climax vegetation.
- **Late Seral** (L) vegetation is dominated by bluebunch wheatgrass with minor rough fescue, and often with some Idaho fescue. Forbs such as silky lupine, parsnip-flowered buckwheat are common and the plant community consists of 50-75% of the composition and cover of climax vegetation.
- **Mid Seral** (M) communities have little or no rough fescue, some bluebunch wheatgrass, junegrass, Sandberg's bluegrass and scattered forbs and the plant community consists of 25-50% of the composition and cover of climax vegetation.

- **Early Seral** (E) vegetation consists of little or no bluebunch wheatgrass. May be dominated by weedy forbs, Sandberg's bluegrass and junegrass but is also often dominated by spotted knapweed. The plant community consists of 0-25% of the composition and cover of climax vegetation.

Figure 6. A photographic example of the ***Rough Fescue – Yarrow – Old man's whiskers*** **(Gg12)** grassland ecosystem.

The ***Rough Fescue – Yarrow – Old man's whiskers*** **(Gg12)** is the most common grassland ecosystem at LGMGIS. It occupies level and gently sloping ground with deep soils. A 60-75% cover of rough fescue dominates the vegetation at climax, and the mix of other plants commonly includes a varying cover of junegrass, yarrow, timber-milk-vetch, silky lupine, sticky geranium, old man's whiskers and scattered other forbs. Anecdotal observations indicate there has been an increase in the presence and abundance of Idaho fescue in these grasslands, although rough fescue still dominates at climax. Seral stages of the Gg12 are distinguished by the following characteristics:

- **Climax** (C) Dominated by high cover of rough fescue with diverse, scattered forbs. Good cover of litter on the soil surface and the plant community consists of 75-100% of the composition and cover of climax vegetation.
- **Late Seral** (L) Some rough fescue, often with some Idaho fescue, abundant forbs such as silky lupine, parsnip-flowered buckwheat sticky geranium and some Kentucky bluegrass and the plant community consists 50-75% of the composition and cover of climax vegetation.
- **Mid Seral** (M) Little rough fescue, some bluebunch wheatgrass, junegrass, Sandberg's bluegrass and scattered forbs and the plant community consists 25-50% of the composition and cover of climax vegetation.
- **Early Seral** (E) Generally no visible rough fescue. Often dominated by spotted knapweed and the plant community consists 0-25% of the composition and cover of climax vegetation.

The ***Rough Fescue – Yarrow – Old man's whiskers*** (Gg12wet) represents a wetter variation of the Gg12. It occurs in swales, draws and flats where more snow tends to accumulate and it receives run-off and subsurface seepage from the surrounding uplands. Late successional conditions do not occur on the sites historically occupied by this ecosystem type because they have been heavily grazed due to their favourable topographic position, general proximity to water and high density of preferred forage species. These sites also support plants which are more palatable later in the season which also has contributed to a long history of overgrazing. These sites are now dominated almost exclusively by rhizomatous agronomic grasses such as smooth brome, quackgrass, and Kentucky bluegrass that leave little opportunity for rough fescue to re-establish. At climax, these sites were likely dominated by 85-95% cover of rough fescue, almost to the exclusion of any other species. A low cover of old man's whiskers, sticky geranium and timber milk-vetch may also have been present. At LGMGIS this site series has only been observed in an early seral condition. This ecosystem has by far the greatest potential for forage production in the area.

Figure 7. A photographic example of the wetter variation of **the *Rough Fescue – Yarrow – Old man's whiskers* (Gg12wet)** grassland ecosystem.

The following graphic provides a simplified comparison of grassland ecosystems. From left to

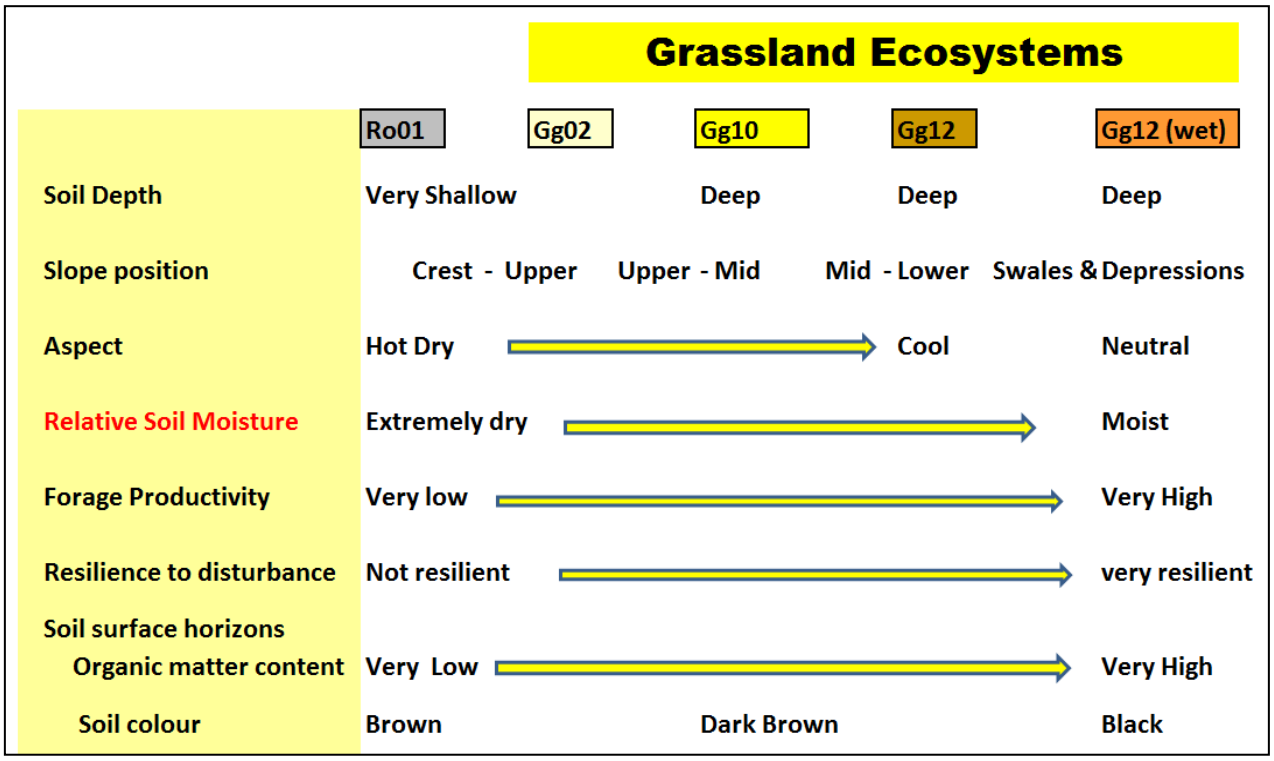


Figure 8. Characteristics and comparative differences among the grasslands at the LGMGIS.

right they follow a moisture gradient from the driest to wettest conditions. In general this corresponds to a topographic sequence of slope positions ranging from ridge crests to depressions. Aspect also influences this moisture gradient with the hottest southern exposures supporting the drier ecosystems. With increasing soil moisture there is a corresponding increase in potential forage production. A grassland's resilience and natural ability to recovery from disturbances such as fire, grazing, trampling and even ATV damage is better as you move to the right hand side of the graphic, primarily due to increasing soil moisture. The moister sites tend to support more plant growth, and deeper, denser rooting which result in more organic matter stored in the soil. This corresponds to a soil surface horizon that is blacker in colour as you move to the right. This is significant because organic material serves as a source of nutrients and it also improves soils properties such as moisture retention, friability, and the abundance of micro flora and fauna. Most gardeners would be excited to inherit the surface soils found on Gg12 and Gg12wet sites. In recent years carbon capture in the grasslands rooting zone has also been recognized as a means of sequestering carbon in the fight against global warming.

Forested Ecosystems

Coniferous forests cover 17% of the LGMGIS. They are dominated by Douglas-fir (Fd) with a minor amount of ponderosa pine (Py). These forests appear to be the product of a wildfire event about 120-130 years ago, as the age of the majority of the overstory trees corresponds to this timeframe. In some areas, a small number of the larger stems have been selectively logged. Stands also contain large, scattered, individual 200-300 year old Fd and Py vets that survived wildfire events and they provide important wildlife habitat today. Most of the ponderosa pine were killed by a mountain pine beetle attack in the early 2000's. However, remnant Py snags remain as a sign of this disturbance. The stand density and multi-storied nature of these forests make them vulnerable to stand destroying wildfires. Stand expansion into the grasslands, commonly referred to as encroachment, does not appear to be a major issue at this site, likely because of the well established nature of grassland community and the dry summer climate that precludes survival of Fd germinants and seedlings.

Deciduous forests cover about 12% of the area. They are clonal patches of aspen that tend to occur on lower slopes and depressions that receive supplemental subsurface seepage, primarily during spring snowmelt. These aspens copses tend to regenerate from belowground roots following disturbances such as fire and insects attacks. The aspen stems rarely exceed 60-80 years of age on these sites before succumbing to various diseases. Cyclical leaf minor and caterpillar attacks also reduce the vigour of these stands leaving them susceptible to disease and fungal attacks.

Three Douglas-fir and two aspen-dominated site series are recognized at LGMGIS.

The ***FdPy - Selaginella - Bluebunch wheatgrass*** **(102)** is the driest forested sites series. It is associated with rock outcrops and occupies relatively small areas with pockets of very shallow soils and exposed bedrock. It has a very open multi-story canopy of scattered, stunted Douglas-fir. In LGMGIS large ponderosa pine snags resulting from a beetle attack are are associated with this type. The size and age of trees is highly variable and sites often support many older trees that have survived numerous surface fires, as evidenced by basal fire scars.

Figure 9. A photographic example of the ***FdPy - Selaginella - Bluebunch wheatgrass*** **(102)** forested ecosystem.

The shrub and herb layers are sparse and characteristic of rock outcrops including kinnikinnick, shrubby penstemon, common juniper and saskatoon. There is often scattered bluebunch wheatgrass. Selaginella is often present, growing in small soil pockets on exposed bedrock along with pelt and clad lichens and awned haircap moss. Forested rock outcrops are distinguished from grassy rock outcrops (Ro02) by the presence of at least 10% tree cover. These sites have very slow growing trees

and limited forage production due to the shallow soils and extended periods of drought. Often located on ridge crests, these sites serve as excellent viewpoints for both humans and wildlife.

The ***FdPy - Bluebunch wheatgrass - Balsamroot*** **(103**) site series occurs on steep, warm aspects and is restricted to a relatively small area on the slope south of the kiosk and adjacent parking lot. The stands have an open canopy of Douglas-fir and ponderosa pine, although most of the pine has been killed by pine beetle. Many trees have been felled for safety reasons. The understory is dominated by bluebunch wheatgrass with scattered saskatoon, common juniper and birch-leaved spirea. Silky lupine and balsamroot are also common. Mosses and lichens are sparse. The presence and abundance of bluebunch wheatgrass distinguishes this site series from the 101.

These sites are very dry and soil moisture deficits prevail for most of the growing season. If clearcut, or severely burned, these sites may revert to an open grassland state for long periods. The soils on steep warm slopes are prone to surface erosion and pose problems for trail construction and cattle movement.

Figure 10. A photographic example of the ***FdPy - Bluebunch wheatgrass - Balsamroot*** **(103) ecosystem.**

The ***FdPy - Pinegrass*** ***(*****101*****)*** site series occurs on gently sloping north aspects with medium-textured soils. The forest canopy is dominated by Douglas-fir, sometimes with scattered ponderosa pine. Douglas-fir is commonly found regenerating in the understory where the canopy is more open, often resulting in a multi-layered understory of Douglas-fir. The shrub layer is sparse to moderate depending on the tree density. Common shrubs include saskatoon, snowberry, tall Oregon-grape, birch-leaved spirea and rose. The herb layer is dominated by pinegrass with a minor cover of showy aster, yarrow, nodding onion and kinnikinnick. Mosses include scattered patches of ragged-moss and red stemmed feathermoss with heron's-bill moss on coarse woody debris. Some areas have been selectively logged.

Figure 11. A photographic example of the *FdPy - Pinegrass* (101) forested ecosystem.

Figure 12. A photographic example of the *At - Snowberry - Rose* (112) forested ecosystem.

The ***At - Snowberry - Rose*** **(112)** site series occurs as patches in grassland-dominated areas. These are moist trembling aspen stands that have a shrubby understory dominated by snowberry, rose and saskatoon with only a few scattered grasses and forbs such as blue wildrye, violets, American vetch, star-flowered false Solomon's seal and mountain sweet-cicely. Shrub cover declines with grazing and trampling, and is replaced by Kentucky bluegrass and other agronomic grasses. Scattered burdock and Canada thistle may occur on disturbed sites. These sites provide important nesting, feeding and hiding cover for wildlife. Berry production is particularly important for many species. The annual accumulation of leaf litter on these sites contributes to the development of rich soils.

Figure 13. A photographic example of the *At - Snowberry - Rose* (112) ecosystem in poor condition, note lack of shrub cover

- **Good Condition**: has a nearly continuous cover of shrubs in the understory.
- **Fair Condition**: patchy cover of shrubs mixed with patches of Kentucky bluegrass or other agronomic grasses.
- **Poor Condition**: has few shrubs, and the understory is dominated by agronomic grasses (usually predominantly Kentucky bluegrass).

The ***At - Dogwood - Rose*** **(113)** site series is more limited in extent and is wetter than the 112, which tends to occur upslope of the 113. The 113 occurs in moist to wet gullies and depressions where soils remain saturated for much of the year. These sites may be inundated for short periods following spring snowmelt. At LGMGIS, this site series tends to occur immediately adjacent to ponds and some deeper depressions. It commonly has the 112 on the slightly drier slopes above it. It has a shrubby understory that includes red-osier dogwood, snowberry, roses and gooseberries. The dense shrub cover seems to deter cattle access and consequently this unit is generally in good condition at the few locations where it was observed. This site series can be observed when you cross the bridge along the trail to the pond-side viewing platform.

Figure 14. A photographic example of the *At - Dogwood - Rose* (113) forested ecosystem.

Rock Outcrops

Rock outcrops represent non-forested sites where the soils are shallow and discontinuous and exposed bedrock is common. The plant community consists of a low cover of drought-tolerant mosses and lichens and xerophytic vascular plants. The soils are generally < 10 cm deep although commonly there are small pockets of deeper soil.

The ***Selaginella — Bluebunch wheatgrass – Sidewalk moss*** **(Ro01)** ecosystem is limited in extent and covers less than 1% of the LGMGIS. It is dominated by exposed bedrock and low, scattered cover of bluebunch wheatgrass and patches of selaginella. Other common species include Sandberg's bluegrass, clad and pelt lichens, sidewalk moss and haircap mosses. This site series occurs primarily in two locations, one at the top of the ridge north east of the parking lot and the other is located north of the main pond and south of a secondary pond immediately adjacent to highway 5A. Here Ro01 forms a complex with the Gg02, which has deeper soils.

Figure 15. A photographic example of the ***Selaginella — Bluebunch wheatgrass – Sidewalk moss*** **(Ro01)** rock outcrop ecosystem

Shrublands

Shrublands consist of persistent, self-maintained shrub-dominated plant community. The woody shrubs are drought tolerant and of moderate stature. The rhizomatous nature of the shrubs permits them to quickly regenerate following disturbances such as fire and likely prevents conifer establishment.

The ***Snowberry — Rose*** **(Ff02)** ecosystem occurs in grassland-dominated areas on sites receiving some subsurface moisture. Soils are silty with very dark, deep organically enriched surface soil horizons and the vegetation is dominated by shrubs, especially snowberry, rose and saskatoon. This ecosystem occurs in two areas at LGMGIS covering a total area of less than 1 hectare. One area is bisected by a road and occurs immediately east southeast of the main parking lot. The other area lies adjacent to the ridgeline rock outcrop on the north side of the LGMGIS. These sites are a source of berries and browse for birds and other wildlife species.

Figure 16. A photographic example of the ***Snowberry — Rose*** **(Ff02)** shrubland ecosystem in the foreground.

Wetlands

Wetlands are areas where water strongly influences a site's biological, physical, and chemical characteristics. Many wetlands are transitional zones between upland and open water aquatic ecosystems, although they may be scattered across the landscape in upland depressions that collect water or receive groundwater. Soils are generally water-saturated or seasonally inundated and support wetland adapted plants. Swamp, bog, fen and marsh wetland types are common and widespread in BC as described by MacKenzie and Moran (2004).

Figure 17. A photograph of the wetland complex north of the Kiosk which illustrates the concentric rings of wetland communities surrounding the pond.

Only marsh wetland types occur at the LGMGIS. A marsh is a shallowly flooded mineral wetland dominated by emergent grass-like vegetation. A fluctuating water table is typical in marshes, with early season high water tables dropping throughout the growing season. Exposure of the substrate in late season or during dry years is common. Marshes generally have a mineral substrate, but may have a thin, well-decomposed organic layer derived primarily from decaying marsh vegetation. Nutrient availability is high due to a neutral or a slightly basic pH, water movement, and aeration of the substrate. Four marsh ecosystems are recognized at the site. The most diverse and extensive wetlands surround the main pond adjacent to highway near the entrance to LGMGIS. Concentric rings around the pond representing different levels of seasonal water and correspond to different wetland types.

The ***Awned sedge Marsh*** (Wm03) occurs north of the cattail marsh and pond and is intermixed with the Wm07. This marsh is alkaline and is extremely limited in extent. The vegetation is dominated by awned sedge with few other species. There are some patches of beaked sedge intermixed with the awned sedge.

The ***Common spike-rush Marsh*** (Wm04) occurs at one site intermixed with shallow open water. There is prolonged flooding. The vegetation is dominated by fairly low cover of spike-rush and a few other species including foxtail barley.

The ***Cattail marsh*** (Wm05) occurs around the small pond adjacent to the wetland observation platform and trail near the entrance to the site. Part of this type once was dominated by willows; many willow "skeletons" are visible in amongst the cattails. Changing water levels or possibly a willow borer beetle may have killed off these willows. Soils are saturated most of the year but often there is no surface water by late in the summer. The vegetation is dominated by cattail with low species diversity. This is the most widespread of the marsh ecosystems observed at LGMGIS.

Figure 18. A photographic example of the ***Cattail marsh*** (Wm05) wetland marsh ecosystem.

The ***Baltic rush marsh*** (Wm07) occurs north of the cattail marsh around the pond and in a narrow gully east of the main road in the northern half of the site. The plant community is dominated by Baltic rush with some field sedge; often there is Gg12wet upslope of this plant community. Vegetation is patchy. This unit is often transitional between marsh, meadow and upland grassland conditions. This marsh type has commonly been disturbed by cattle and now supports a mix of Baltic rush and Kentucky bluegrass and other agronomic grasses.

Figure 19. A photographic example of the *Baltic rush marsh* **(Wm07)** wetland marsh ecosystem.

Ecosystem Mapping results

Fourteen ecosystem types (site series have been identified in the study area including five forest, four grassland, four wetland, one shrubland and one rock outcrop types. This represents a very high level of biodiversity for such a small area. Mapping the occurrence and spatial distribution of each provides a framework for understanding, planning and managing a wide range of natural resource activities. The ecosystem mapping has been used as a framework for understanding and predicting habitat capability and suitability for wildlife, the potential for forage production and predicting the responses to weed management activities. It is anticipated that design work for an interpretive trail network will also rely on this mapping.

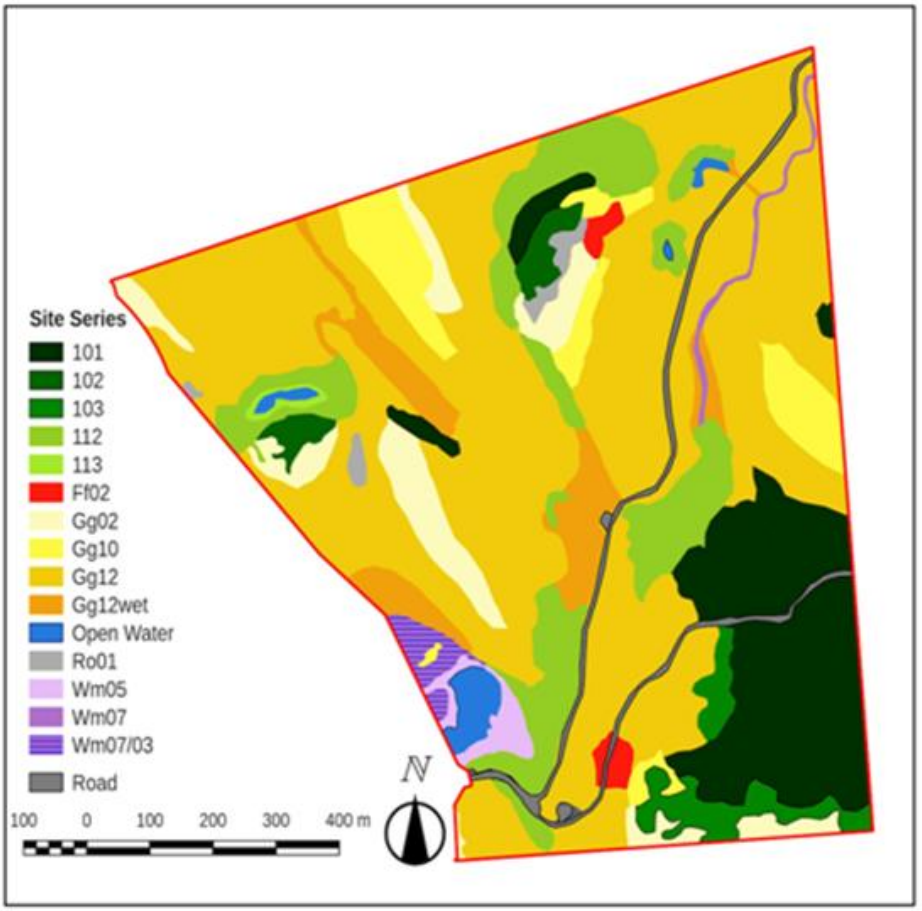


Figure 20. A map showing the distribution of site series in LGMGIS.

The Gg12 fescue grasslands cover 50 ha and dominate gentle slopes. The coniferous 101 forested and aspen copse 112 site series occupy 13% and 11% of the area respectively. As a consequence, despite the area's ecological diversity, 75 % of the site is dominated by three of the 14 identified site series at the LGMGIS.

There are a few situations were delineating individual ecosystem types was impossible because two or more site series intimately occur together and form a complex. Generally this occurs where site features such as soil depth varies over short distances and is highly variable with in a small area. The Ro01, Gg02 and 102 site series commonly form such complexes. The wetland types also commonly form complexes which reflect subtle variations in the depth to the water table over a small area. For simplicity, the map above shows only the dominant site series found in the complex. However, for

Table 1. The percent occurrence of ecosystem types

	Site Series	Percent of Area
Grasslands	Gg02	5.6
	Gg10	5.2
	Gg12	51.3
	Gg12wet	4.6
Forests	101	13
	102	1.4
	103	2.6
	112	11
	113	0.3
	Ro01	0.7
	Ff02	0.8
Wetland	Wm05	1
	Wm07	0.4
	Wm07/03	0.8
	RZ	0.3

those interested in the more detailed mapping, it is available in a GIS database. The more detailed mapping was used for the purpose of assessing and mapping seral stages and range conditions.

Seral stage mapping

Understanding grassland succession is fundamental to good range management. Bare ground is generally considered to be the starting point of succession and the end point is commonly referred to as climax or potential natural community (PNC). A progressive improvement or decline in the grassland condition between these two end points is referred to as the seral stage. In range management, four seral stages are commonly recognized; early, mid, late and climax. In grasslands the climax plant community is deemed to be in equilibrium with its environment and typically is dominated by a high cover of perennial native bunchgrasses such as rough fescue and bluebunch wheatgrass. The composition of climax plant communities varies according topographic and soils characteristics. The Gg02, Gg11 and Gg12 noted above represent three distinct climax site series, each with a different level of sensitivity to disturbance and a different ability to recover from disturbance. Characteristics of seral stage conditions are summarized in the previous section describing each grassland site series. The successional pathway may move forward or backward in response to levels of disturbance.

There are multiple natural and anthropogenic forces influencing plant community composition and vigour and therefore succession. Southern interior grasslands formed following deglaciation in response to climate, topography and soil conditions and the influences of wildfire and native grazers. 1st nations burning likely contributed to expansion and maintenance of local grasslands. Since the late 1700's the introduction of cattle and other domestic grazers, coupled with recreational activities, road construction and subsequent invasion by weeds has led to severe degradation of the grasslands.

In the early years, year-round cattle grazing resulted in severe degradation leading to a reduction in plant cover, an increase in less palatable pioneer species, more bare mineral soil, erosion and less organic material in the soil. Overall, this led to unhealthy grasslands in an early seral condition. As a consequence, provincial range legislation was implemented to influence the duration, frequency, intensity and seasonal grazing practices on crown lands. In general, short, intensive grazing periods with adequate rest in between favours an upward movement in succession. The grassland health improved as indicated by an increase in the presence, abundance and vigour of the preferred, more palatable bluebunch wheatgrass and rough fescue and a corresponding decrease of unpalatable and/or invader plants. This trajectory also led to a reduction in exposed mineral soils.

Twenty years ago, the LGMGIS site was well on its way to recovery. Mid- and late-seral conditions prevailed. Since then, land use activities have reversed this improving trend, weed cover has increased, there is more exposed mineral soil and the abundance of rough fescue and bluebunch wheatgrass has declined (personal observations Dennis Lloyd and Judy Guichon).

Late seral conditions are desirable for range managers because they have several attributes that are economically and ecologically important. They tend to have a higher cover of preferred forage species, less evaporation, have greater productive, have a greater variety of species, have soils with a higher concentration of organic nutrients, and are more resilient to extreme climatic events and therefore climate change. Many wildlife species rely on late successional grasslands. Late succession communities also tend to reflect the public's perception about what looks most "natural". That said, overall ecological biodiversity tends to occur when there are a wide variety of successional conditions.

Some plants tend to decrease from a range site when animals overgraze them because they usually are the most palatable and desirable forage plants. The loss of cover results in much higher rates of evaporation and lower soil moisture. Some plants tend to increase when a range site is overgrazed. If the overgrazing continues for a long time, they too will decrease in favour of the less palatable species which also tend to provide less forage. Additional over-grazing and site disturbance allows invasion by annuals and weeds.

Purpose

The objective was to map seral stage as a basis for assessing the overall health of the grasslands and generally reflects the consequences of range management practices. It also provides a baseline against which current conditions can be compared to determine the direction in which succession is proceeding. This form of assessment can be combined with photo-point monitoring to document levels of change through time.

Methods

Seral stage mapping at LGMGIS was restricted to the grasslands. Notes were kept describing the successional variability and distributional patterns for the entire study area. With intensive grazing, grasslands plant composition is altered. Key bunchgrasses such as bluebunch wheatgrass and rough fescue are usually reduced in cover and forbs and small, shallow-rooted bunchgrasses such as junegrass and Sandberg's bluegrass tend to increase. Larger, less palatable forbs such as buckwheat, lupine, yarrow and sticky geranium also tend to increase in abundance. Other less palatable species including salsify, lemonweed and mullein opportunistically seed into areas vacated by the dominant bunchgrasses as will invasive weeds such as cheatgrass, spotted knapweed and Kentucky bluegrass. These changes in the species composition and abundance will vary depending on the ecosystem and the intensity, frequency, duration and nature of the disturbance. The presence and abundance of each species or combination of species is considered in the seral stage assessment. Seral stage was visually assessed by estimating the cover of key bunchgrasses compared to their expected cover in a climax community. Seral

Table 2. Area and percent of ecosystems.

Seral Stage	Similarity to Potential Natural Community (PNC)
Early	0-25%
Mid	26-50%
Late	51-75%
Climax	>75%

stages are defined below in. For our purposes, the criteria used for distinguishing the four seral stages (early, mid, late and Climax/PNC) has been simplified. In general, the total cover of key bunchgrasses under climax conditions for individual site series has been divided into for equal classes. As illustrated in Table 2, this leads to four classes divided by 25% intervals.

Changes in the relative cover of bunchgrasses preferred for forage are heavily relied upon in the seral stage assessment. The presence and abundance of aforementioned smaller grasses, less palatable forbs, and weeds are also compared to what occurs in climax communities. Broad landscape-level pictures were taken during the field season. The colour tones and textures observed on the photographs were used as calibration points were the seral stage was known. This formed the basis for mapping the successional status in some areas. Unfortunately, there was a great deal of small-scale variability in seral stage (i.e. lots of small patches of different seral stages within relative small areas). As a consequence, mapping generally averages the overall seral stage for a given polygon.

Results

due to year round grazing and very little hay production for cattle winter forage.

Since then many areas have experienced considerable recovery due to improve range management practices. Loss of deep-rooted perennial bunchgrasses from these sites not only leads to a reduction in preferred forage, but also impacts the below ground storage of organic material derived from the annual dieback of roots and increases evaporation. The organically enriched subsoil acts like a bank; the capital being nutrients and moisture. Continuous, long-termed root reductions will impact a site's nutritional and moisture status and therefore potential forage production.

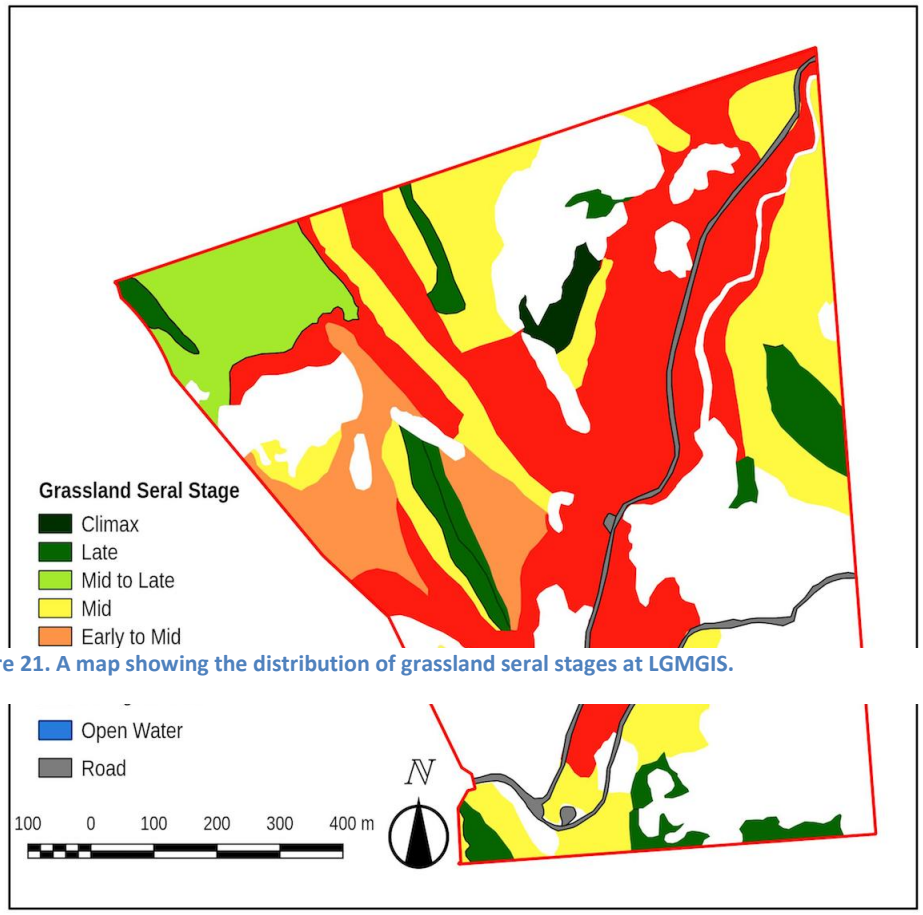


Figure 21. A map showing the distribution of grassland seral stages at LGMGIS.

Many areas of rough fescue grassland (Gg10 and Gg12) have lost most or all of the rough fescue cover that would have been expected had they not been grazed. The loss of large bunchgrasses also reduces wildlife habitat (e.g. cover for nesting birds such as Vesper's sparrows, western meadowlark, and sharp-tailed grouse) and forage values. Native forbs such as silky lupine, parsnip-flowered buckwheat, and tall annual willowherb and non-native species such as yellow salsify, prickly sow-thistle, and cheatgrass tend to increase with grazing. Pocket gophers and recreational activities that create soil disturbance can also result in a greater cover of these species.

Compared to climax sites that are usually dominated by thick cover of bunchgrasses, late seral sites tend to have an overall higher plant species diversity as a result of increased forb cover and diversity. Further disturbance tends to cause a decline in plant species diversity and shift to more non-native species.

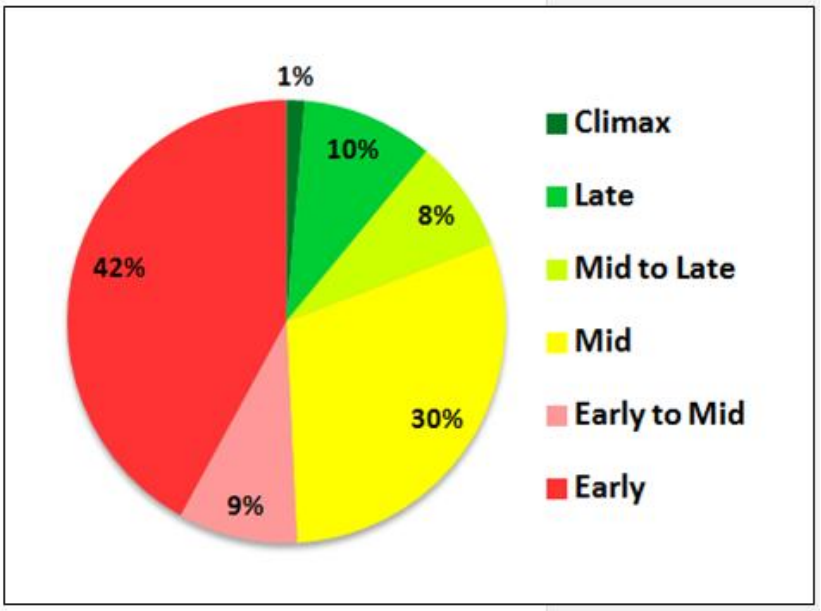


Figure 22. The percent distribution of different grassland seral stages at LGMGIS.

Moderate to steep warm aspects are dominated by bluebunch wheatgrass at climax (Gg02) and tend to be used less by cattle, because these sites tend to less accessible due to slope steepness. They are also further from water. With disturbance, overall cover of bluebunch wheatgrass declines, and cover of cheatgrass, Sandberg's bluegrass and invasive weeds tend to increase. Silky lupine and buckwheat also tend to increase in abundance as they are less favoured by cattle.

All moist Gg12wet grasslands in the study area are in an early seral condition and are dominated by non-native rhizomatous grasses including Kentucky bluegrass, smooth brome, and quackgrass. These grasses form a thick mat that once established are nearly impossible to replace.

Weed Inventory

Purpose

The goal of the weed inventory was to identify the presence, abundance and distribution of noxious weeds at LGMGIS. The results aim to inform weed management planning and priorities. Noxious weeds pose a serious threat to grasslands and other ecosystems in the LGMGIS. Vehicles, off road ATVs, mountain bikes and hikers are all capable of transporting weed seeds, especially along access corridors and trails. They also create disturbances that expose mineral soil, an ideal substrate for the germination of weed seeds. Livestock have also played a role in the introduction and spread of weeds. Seeds from species like hound's tongue readily stick to the animals' fur and are dispersed as they move across the landscape. Livestock also influence the spread and abundance of weeds by preferentially grazing on native plants which reduces competition for soil moisture and light. They are also responsible for exposing mineral soil.

Figure 25. A photograph of a Spotted Knapweed flowering stalk.

Knapweed and its biology

A few invasive weeds species were observed in the study area but spotted knapweed was by far the weed of greatest concern and most widespread. Spotted knapweed is a highly competitive weed that invades disturbed areas and degrades native plant communities. It is a biennial or short-lived perennial with strong taproots and lateral support roots. Plants produce numerous terminal and auxiliary flowers that are pink to lavender in colour, 6-13 cm across and surrounded by oval black-tipped bracts which distinguish spotted knapweed from other species of knapweed (Parrish, Coupe and Lloyd 1996). At LGMGIS plants tend to flower in late July to early August. Mature plants can grow to a height of 1 meter. Reproduction is primarily by seed which is dispersed by wind, water, animals, humans and various other forms of transportation. Seeds, which germinate from spring through early fall, are usually dispersed in the immediate vicinity of the parent plant due to their weight. However, seeds have a tuft of persistent bristles that assist with some wind dispersal. Each flowering head produces 12 - 74 seeds. A single flowering plant can produce more than 1,000 seeds, or up to approximately 140,000 seeds per square meter in one year.

Figure 24. A photograph showing Spotted Knapweed seeds with their short tufts to aid in dispersal.

Figure 23. A close-up photograph of a spotted Knapweed flower.

The number of flowers and seeds produced depends upon

environmental factors such as site condition and precipitation. Once seeds disperse, they can remain viable in the soil for five years or more. Seeds often germinate in the fall, overwinter as a rosette of leaves, and resume growth in the spring (Sherman, Kellie and Powell, Kate. 2017).

At the peak of the growing season this invasive weed can dominate portions of the landscape with up to a 100% ground cover. There is some evidence that it may produce allelopathic chemicals, a biological phenomenon by which a plant produces one or more chemicals that influence the germination, growth, survival and reproductions of other plants. Once established, it can dominate an area and significantly reduce perennial grasses and forage production for wildlife and livestock.

Figure 26. A photograph of a Spotted Knapweed basal rosette of leaves prior to the plant bolting to form a flowering stalk.

Methods

The presence, abundance, location and distribution of noxious weeds encountered in the field were recorded and GPS locations were noted (Appendix 3 Noxious Weed List). Spotted knapweed was the primary weed of concern in the area. Canada thistle, bull thistle, common hound's tongue, and perennial sow-thistle were seen on the property and sulphur cinquefoil was seen just SE of the LGMGIS. Canada thistle and common hound's tongue occur primarily in moister areas, usually within the aspen copses, especially where there is more cattle disturbance and lower shrub cover. Numerous other alien plants were noted (Appendix 2).

Many historical iterations of spotted knapweed mapping exist for the area. Unfortunately these maps generally show only where knapweed is present and lack information about its abundance. We chose to map five classes of knapweed cover as illustrated in Table 3. The classes selected were deemed appropriate for developing weed control strategies. The stratification is simple, relatively easy to visually identify, and the results were considered repeatable and reliable. The class system employed also provides a more meaningful baseline than a simple presence / absence map provides. Mapping was done when the weed was in full flower. The distinctive purple hue from knapweed flowers made

Table 3. Cover classes used for spotted knapweed mapping.

Cover Class Code	Percent Cover of Spotted Knapweed
K1	0 - <1
K2	1 – 5
K3	6 – 25
K4	26 – 50
K5	>50%

identification of plants much more reliable, and led to greater confidence in the accuracy of mapping. We mapped the knapweed cover class by making notes and drawing polygons on orthophoto maps while in the field. Many areas were also mapped from viewpoints.

The resulting photos were then used to refine mapping. Pictures were taken and compared to field observations. Each grassland polygon was assigned a knapweed cover class. A few polygons contained two or more knapweed cover classes and an average cover class was assigned to the polygon. In a few instances, mapped polygons contained two cover classes and delineating each small polygon making up the complex was impossible. In this circumstance a complex was mapped.

Wet grasslands (Gg12wet), wetlands and aspen copses may have a few scattered individual spotted knapweed plants but have no potential to be overtaken by spotted knapweed. Coniferous forests seem to lack knapweed as well. As a consequence, knapweed mapping was restricted to grasslands. Knapweed cover was highly variable and an overall average cover class was assigned to these polygons, although we endeavoured to map all large, high cover class K5 infestations.

We also looked for knapweed biocontrol agents during our fieldwork and noted those observed and their location. Records of the biocontrol agents historically released on the site are summarized below.

Figure 27. A Photographic example of knapweed cover class K5 (>75% cover).

Table 4. . Dispersal of biocontrol agents for spotted knapweed in Lundbom Commonage (extracted from 2015 FLNRO files 2015).

Bioagent	Dispersal Year	Number of Dispersal sites
Agapeta zoegana	2005 - 2015	10
Cyphocleonus achates	2005 – 2015	7
Larinus minutus	2005 - 2014	9
Larinus spp.	2014	1
Urophora spp.	2014	3

Results

Spotted knapweed is the principle weed of concern at LGMGIS. It was apparently first noted west of Merritt in 1959. The province actively sprayed herbicides on knapweed in the Nicola grasslands from the 1970s through 1990s. Invasive plant herbicide spray programs were severely curtailed in 2002. Biocontrol agents were released in the Lundbom range unit. However, spotted knapweed appears to have spread since that time and is now widespread in the project area. Recreational use has also increased substantially in that time period. (Ministry of Forests, Lands and Natural Resource Operations 2015)

Knapweed has replaced native vegetation on many sites and presents a serious threat to native grasslands. Knapweed results in serious loss of forage and can lead to soil erosion. It also reduces wildlife habitat values (e.g. forage and cover for nesting) and aesthetic values of the site. Knapweed mapping was incorporated into the project to provide information about the distribution and abundance of knapweed as a means to document the scale of the weed problem and to guide planning efforts on where to focus different treatment options.

Figure 28. shows the distribution and extent of each spotted knapweed cover class. About 40% of the grasslands support populations of knapweed with more than 50% cover, the vast majority of it growing on sites mapped as site series Gg12 which represents areas capable

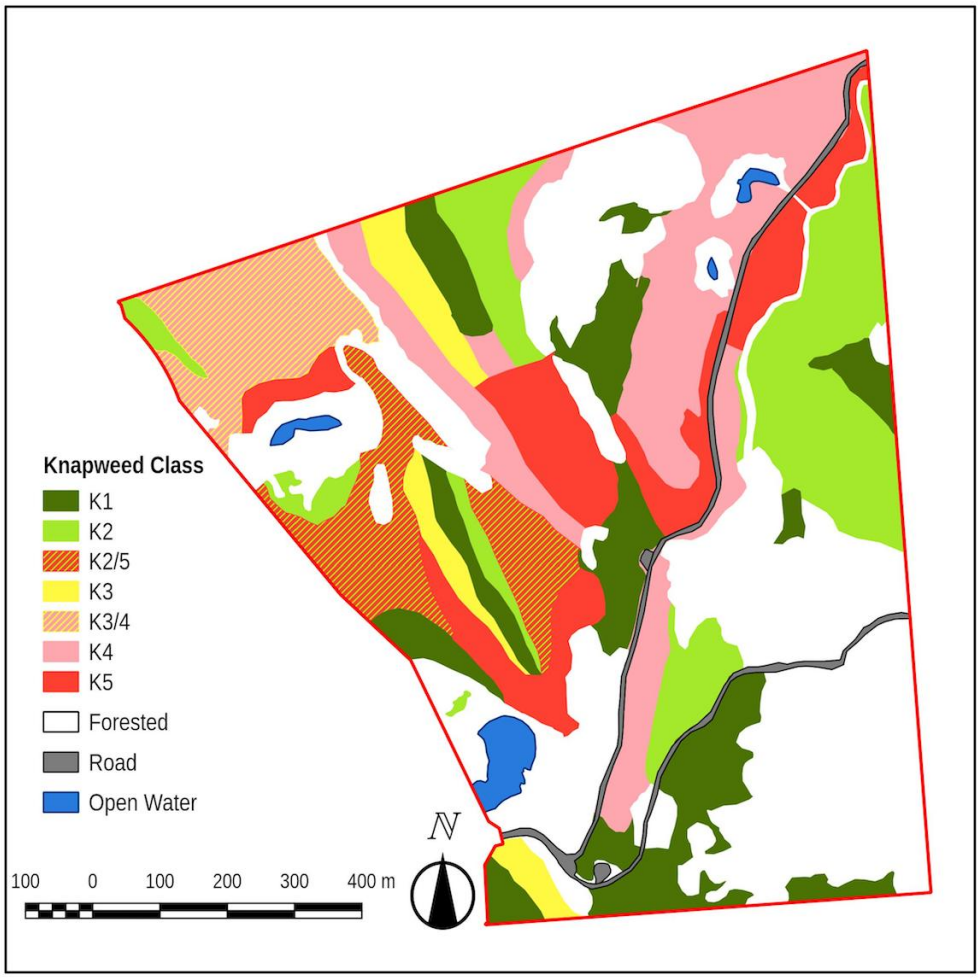


Figure 28 A map showing the distribution of Spotted Knapweed cover classes in LGMGIS Grasslands.

of produce a high cover of rough fescue. As a consequence of the knapweed invasion significant forage production has been lost.

Areas with more than 75% knapweed cover (colour themed red) will likely require a costly rehabilitation treatment in which the knapweed is killed with herbicides, these areas will then require seeding to reintroduce grasses to these sites. A tried and true simple approach to rehabilitation is unknown and research activities in the area are under investigation to address this issue.

About 40% of the grasslands also have less than 5% cover of knapweed. This includes the Gg12wet grasslands which does not seem to have been impacted by knapweed despite heavy historical grazing pressure. It is believed that agronomic grasses that now occupy these sites have out competed knapweed and the density of these grasses simply precludes germination of knapweed seeds. The majority of other areas with a low cover of knapweed appear to correspond to Gg02 and Ro01 sites. This can likely be attributed to their location on drier, less accessible steep upper slopes and ridges the greatest distance from water. Efforts should be made to prevent expansion of knapweed into these areas. These sites should be the focus of spot treatment of knapweed. Both herbicide spraying and hand pulling treatments may be appropriate.

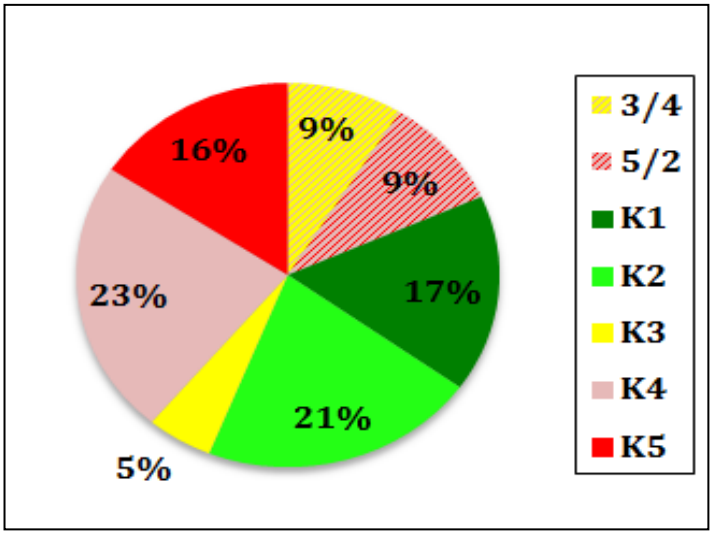


Figure 29. The relative abundance of spotted knapweed cover classes in LGMGIS grasslands.

Knapweed is largely restricted to grasslands, except for the Gg12wet where a thick rhizomatous grass mat prevents its establishment. Although a few scattered knapweed individuals may occur in aspen copses and coniferous forests, knapweed is largely shade intolerant and unlikely to present a threat to these ecosystems. Wetlands are too wet for knapweed to establish. *Larinus spp*. were observed and widely distributed in the LGMGIS across all elevations and site types. *Agapeta* moths were also seen at two sites.

Spotted Knapweed Cover Class	Area (ha)	Percent of all grasslands
K1	10.1	15.5
K2	12.8	19.6
K5 & K2	5.7	8.8
K3	3.1	4.7
K3 & K4	5.4	8.2
K4	14.1	21.6
K5	9.5	14.6
Total	**65.2**	**100**

Table 5.Area and percent of different knapweed cover classes in LGMGIS.

Range Condition

Range condition is a broader look at the ecological condition of grasslands than seral stage which focuses on the plant community composition and structure compare to the characteristic of climax conditions. In addition range condition considers

- the presence and abundance of weeds and non-native plants,
- structure of the plant community, are expected life forms & sizes of plants present
- soil disturbance
- the amount of exposed mineral soil,
- evidence of soil erosion,
- amount of surface plant litter, and
- presence and extent of the microbiotic crust

Range condition is an evaluation of the current status of the ecosystems characteristics relative to climax conditions. When assessed over time this provides a measure of the trend in range deterioration or improvement. Plant species composition and abundance of key bunchgrasses is important as an indicator of forage productivity and successional status. Plant community structure is also important because it affects the distribution of light, water and nutrients and ultimately the potential of the plant community to support wildlife and livestock. Litter contributes organic material and minerals to the soils. It slows water movement across the soil's surface and therefore prevents erosion and nutrient loss. Litter and plants also shade the soil surface which help to reduce water losses to evaporation. The presence and abundance of invasive weeds negatively impact rangelands by reducing light, growing space, water and nutrients required by key bunchgrasses. Erosion is a sign of site deterioration and an indicator of soil instability. Erosion leads to a loss of soil and nutrients and the silt-laden runoff muddies waterways and ponds which supply water to wildlife and livestock. Microbiotic crusts consisting of bacteria, fungi, algae, lichens, and bryophytes colonize most soil surfaces. They are important in promoting water infiltration, reducing surface erosion, stabilizing surface soils, capturing nutrients from the atmosphere and reducing evaporation.

Purpose

Range condition is important for assessing the overall health of the grasslands. The results should supply range managers with both an overall assessment and a mapped showing the areas most in need of improved stewardship activities. During the assessment it should be possible to get a better understanding of the status of indicators used to assess range health.

Methods

Range condition was visually assessed by comparing field observations to conditions anticipated if areas were in a climax condition. The site series polygons (subdivided to capture seral stage and knapweed

cover classes) formed the basis for mapping range condition. The approach taken follows the concepts and principles outlined in the GCC grassland monitoring manual for BC (Delesalle et. al. 2009).

Four range condition classes have been used as a basis of our assessment. Criteria for defining excellent, good, fair and poor range condition are defined according to the following criteria;

- **Excellent** (E) Vegetation is very close to what would be expected in the absence of any livestock grazing or other anthropogenic disturbance. No alien invasive plants. Good microbiotic crust and/or litter cover as would be expected for the particular ecosystem. No signs of soil erosion.
- **Good** (G) Late seral vegetation with scattered alien invasive plants such as knapweed, cheatgrass, and agronomic grasses (e.g. smooth brome, quackgrass and Kentucky bluegrass). It could also be mid-seral vegetation (key bunchgrasses reduced by up to 50% of climax cover) with few or no alien invasive plants. Litter and/or microbiotic crust cover are close to what is expected at climax. Few or no signs of soil erosion.
- **Fair** (F) Mid to late-seral vegetation with substantial cover of alien invasive plants or agronomic grasses. It could also be early seral vegetation (with low cover of key bunchgrasses) with few or no alien invasive plants. There is some litter and microbiotic crust present, but less than expected. Often are signs of soil erosion.
- **Poor** (P) Vegetation is early seral and is dominated by non-native species, particularly knapweed. Exposed soil common with low cover of microbiotic crust and grass litter. Key bunchgrass species are absent or represent a very minor component of the plant community.

Results

The inventory focused on assessing and mapping grassland condition, however notes were kept to permit an overall evaluation of the condition of wetlands and aspen copses.

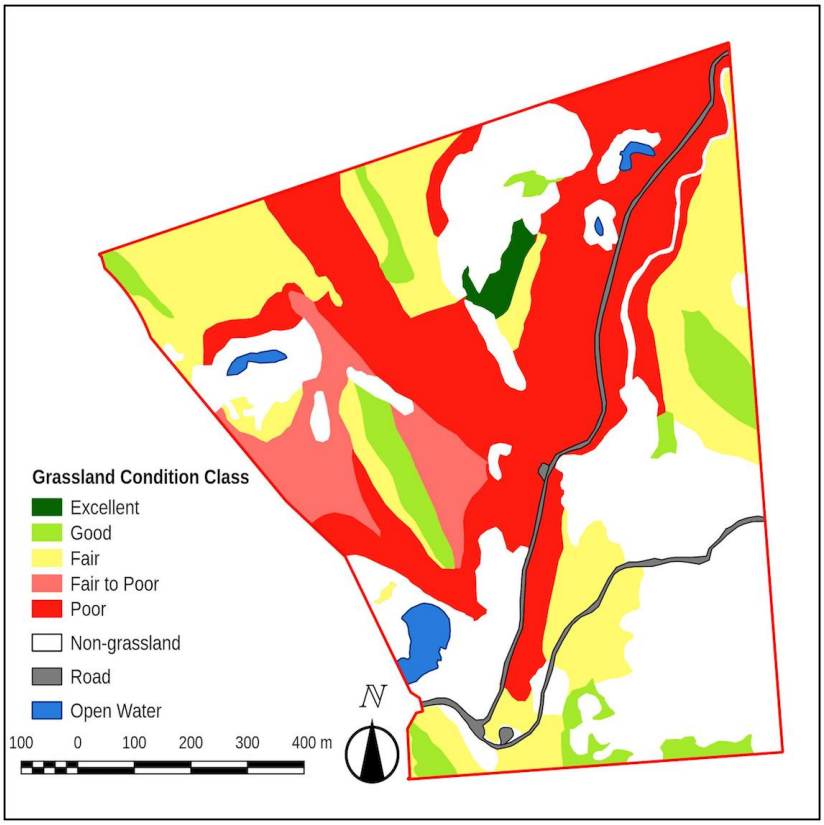


Figure 30. A map showing range condition classes for LGMGIS.

The distribution and aerial extent of range conditions at LGMGIS are illustrated in Figure 30. Most of the grasslands are fair or poor condition. The results are very similar to the seral stage results, except in a few places where substantial spotted knapweed has invaded mid- or late-seral grasslands and reduced the condition of those sites. Thus, there is slightly more area of fair and poor condition grasslands compared to early- and mid-seral grasslands. About ½ of the LGMGIS grasslands are in poor range condition. Most of this overlaps with the gentle lower slopes depressions and flats and corresponds to predominantly Gg12 and Gg12wet site series. This means that the grasslands with the highest potential to produce forage for wildlife and cattle have been most seriously compromised. Only 10% of the grasslands are in good condition and they are restricted to a single dry, unproductive upper slope and ridge crest far from water.

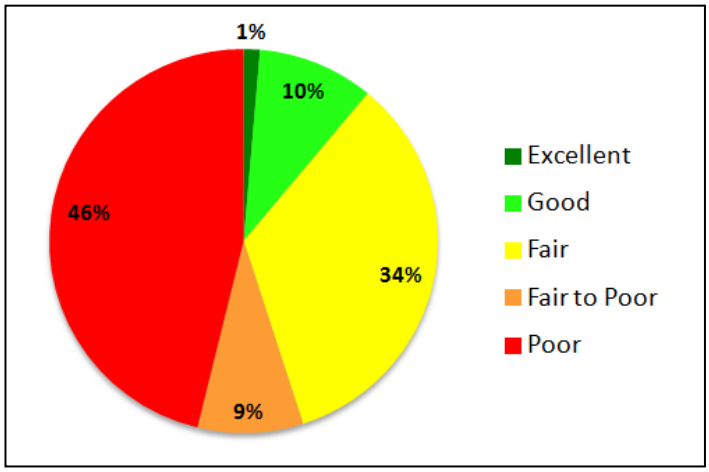


Figure 31. Percent cover of different range condition classes for grasslands in LGMGIS.

Livestock have also altered the vegetation composition, reduced the cover, exposed soil and changed water chemistry of wetlands. The divots formed by cattle hoofs can trap amphibian larvae. Wetlands would likely benefit from offsite watering installations, which may prevent the need for fencing. In aspen copses, livestock disturbance has reduced or eliminated shrubs important for nesting, hiding and food production. The resulting shift to Kentucky bluegrass and other agronomic grasses constitutes poor habitat conditions.

Wildlife Habitat Attributes

Purpose

A substantial number of wildlife species may occur in the LGMGIS due to the diverse range of wetland, grassland, forest, shrubland and rock outcrop habitats. A list of terrestrial vertebrates that may occur in the area are listed in Appendix 4 along with and indication of the habitats where they are most likely to be encountered.

Some important wildlife habitat features were identified and mapped. More specifically the location of groups of old Douglas-fir trees, and large individual Douglas-fir and ponderosa pine trees and snags have also been noted and mapped. The location of two rodent burrows were also located and mapped. By mapping wildlife habitat attributes, valuable attributes are identified for conservation while areas that lack sufficient habitat attributes are identified for potential enhancement.

Methods

Key wildlife habitat attributes were identified in the field, marked with a GPS, and mapped in ArcGIS.

Results

Key wildlife habitat attributes found on the LGMGIS are shown in Figure 32. These features are often required features for some wildlife species. Wildlife trees, standing dead or dying trees provide homes for a large number of species that use them for feeding, nesting and roosting, or denning. Wildlife trees are often lacking in managed forests because they are often felled to protect workers from the dangers of falling trees. Ponds and other water bodies also provide critical habitat attributes for many species.

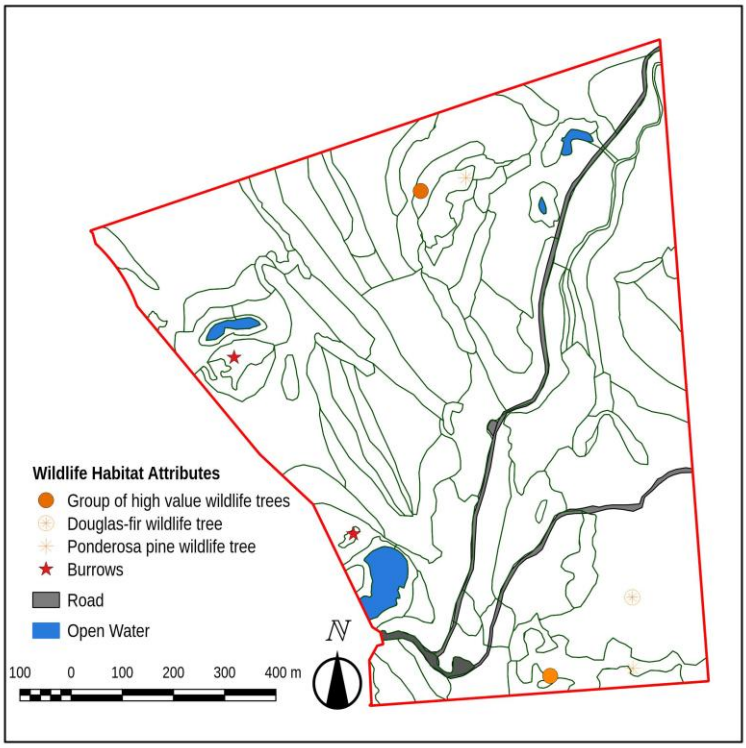


Figure 32. Key wildlife habitat attributes in LGMGIS.

Habitat Mapping for Species at Risk

Purpose

Management to retain older stands of Douglas-fir along with cavity-bearing snags is critical for a number of passerine birds as well as owls and woodpeckers.

Methods

A list of potential vertebrate species at risk that could occur on the Laurie Guichon Memorial Grassland Interpretive Site (LGMGIS) was obtained from the BC Ecosystem Explorer website (see Appendix 5. The criteria used to filter the search included red-, blue- or legally designated species found in the Thompson-Nicola Regional District in Interior Douglas-fir (IDF) or Bunchgrass (BG) biogeoclimatic zones. From the 51 species on this list, nine were selected for analysis based upon their likelihood of occurring in the study area, that the conditions of habitat in the LGMGIS had the potential to support the species for its critical life history stages, and the confidence of knowledge about habitat requirements were sufficient to rate the habitats in LGMGIS for habitat capability and suitability (Table 6).

Table 6. . Red- and Blue-listed wildlife species selected for habitat mapping in LGMGIS.

Species	Scientific Name	Status	Main Habitat Type
American Badger	*Taxidea taxus*	Red	Grasslands with deep, fine-textured soils.
Sharp-tailed Grouse	*Tympanuchus phasianellus columbianus*	Blue	Grasslands with high cover of bunchgrasses
Flammulated Owl	*Psiloscops flammeolus*	Blue	Warm aspect Douglas-fir forests with old trees
Short-eared Owl	*Asio flammeus*	Blue	Moist grasslands
Lewis's Woodpecker	*Melanerpes lewis*	Blue	Open forests, especially those recently burned
Williamson's Sapsucker	*Sphyrapicus thyroideus*	Blue	Old forests with high densities of wildlife trees
Olive-sided Flycatcher	*Contopus cooperi*	Blue	Open forests
Rusty blackbird	*Euphagus carolinus*	Blue	Moist forests and riparian areas
Great basin spadefoot	*Spea intermontana*	Blue	Grasslands near shallow open water with loose sandy soils.

For each of the selected species, the habitats that are most limiting for that species were determined. These were usually nesting or denning habitats for most species, but others are more limited by habitats used during other parts of their life history. These critical habitats are listed in the species descriptions below.

Ecosystem mapping was used to rate areas for habitat capability, which reflects the ecosystems characteristics when they are in their optimum habitat condition. This best condition is not always a late seral or climax condition, as the best habitat conditions for some species occurs following a disturbance. Habitat suitability, which is the habitat quality provided by the vegetation in its current condition, was also rated for all areas. Maps were generated for habitat suitability and capability for each of the nine selected species.

Results

American Badger

American badgers inhabit a wide range of open and semi-open habitats provided the soils are suitable for burrowing. Critical habitats were defined as those where dens can be constructed. Suitable soils are those that are relatively deep and where burrow holes can be easily excavated. Few places seen in LGMGIS had good quality soils for badgers

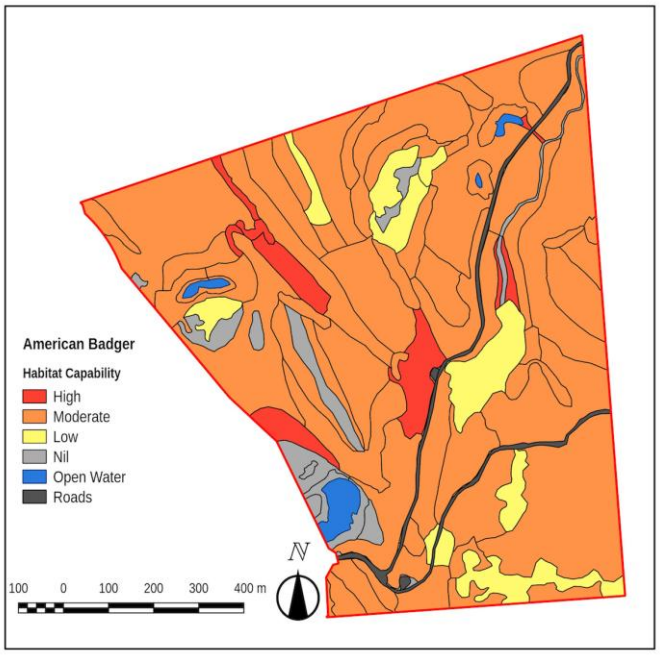


Figure 34. Habitat capability for American badger in LGMGIS.

Those habitats with deepest soils were the wetter grassland areas (Gg12wet), which currently have a high cover of rhizomatous grasses with abundant roots that can impede digging by badgers. These areas may also be seasonally too wet for suitable badger burrows. These wet grassland habitats were ranked moderate for habitat capability because of their potential to be seasonally inundated. All other grassland and open forest habitats were given low habitat capability because soils are generally too shallow for burrows. Capability of wetland and shallow soil habitats were rated nil as no suitable burrows are possible in these sites Figure 33). Gg12wet ecosystems were all heavily vegetated at the time of this assessment and are therefore ranked low for habitat suitability for American badger (Figure 34).

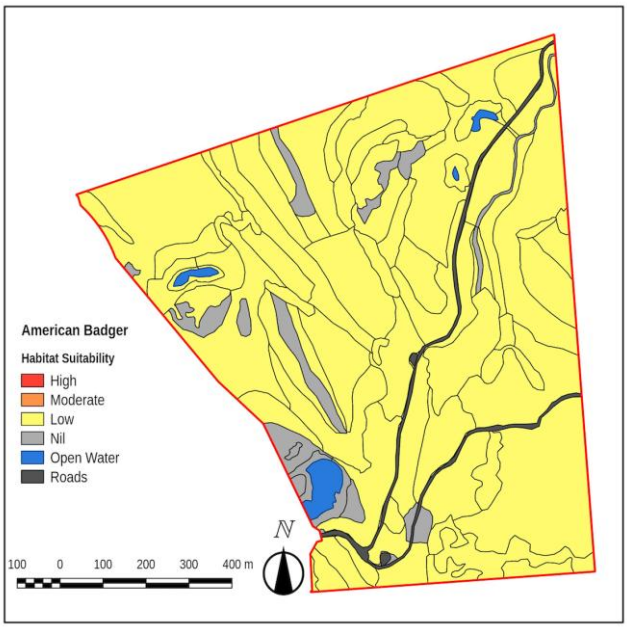


Figure 33. Habitat suitability for American badger in LGMGIS.

Sharp-tailed Grouse

Sharp-tailed grouse inhabit open grassland sites for most life history stages. Nesting habitats, the critical habitat for sharp-tailed grouse, are late seral grasslands with abundant bunchgrasses of sufficient height and density to conceal nests. All of the grassland and open forest areas in the LGMGIS, with the exception of dry, warm aspect or shallow soil sites, have the potential to provide good quality nesting sites for sharp-tailed grouse and are rated high for sharp-tailed grouse nesting habitat capability (Figure 35). Dry and shallow soil sites are rated moderate. Aspen stands are lower quality potential nest sites and are rated low for sharp-tailed grouse nesting capability. Other habitats are rated nil.

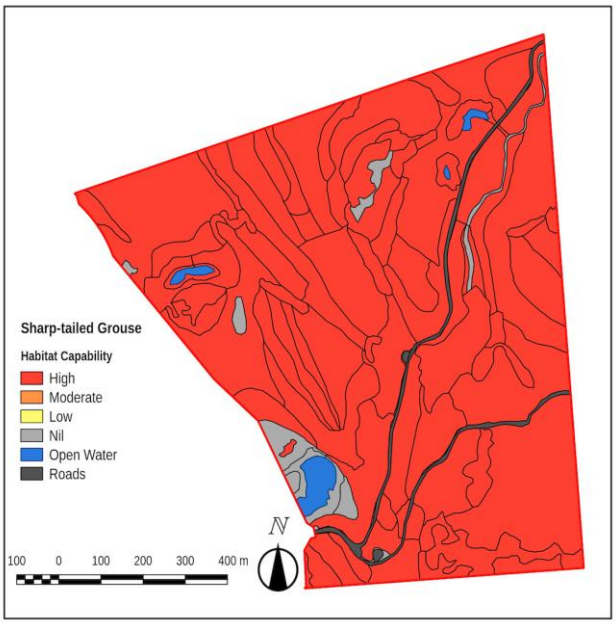


Figure 35. Habitat Capability for sharp-tailed grouse in LGMGIS

Very little of the grassland areas in LGMGIS are in suitable condition for sharp-tailed grouse nesting. One grassland polygon is in excellent condition and it was rated as high habitat suitability for sharp-tailed grouse nesting habitat (Figure 36). Those grasslands that are in good condition class were rated as moderate habitat suitability for sharp-tailed grouse nesting since the bunchgrass cover was insufficient to provide good nest cover, and all other habitats were rated nil because they do not have enough grass cover for nesting.

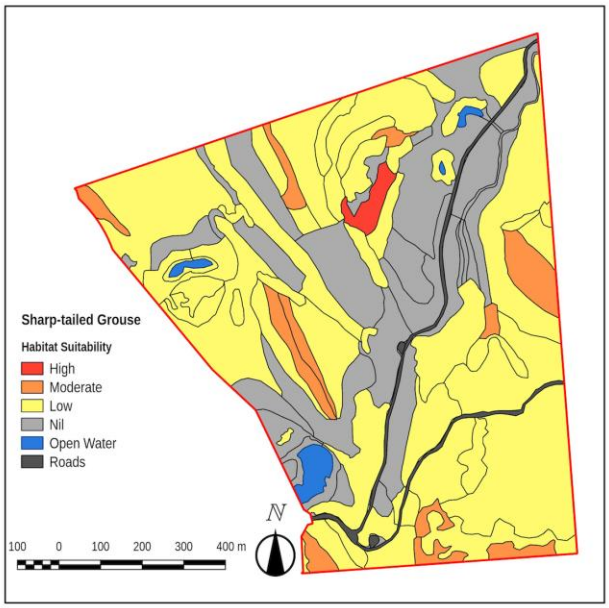


Figure 36. Habitat suitability for sharp-tailed grouse in LGMGIS.

Flammulated Owl

Flammulated owls prefer to nest in cavities in large trees on warm aspects. They prefer older forests with abundant large trees, an open understory with clumps of smaller trees or bushes, and that span a wide elevation range. In British Columbia, the preferred nesting habitat for flammulated owls is Douglas-fir forests often with a component of Ponderosa pine, but they also will nest in aspen or spruce stands. Those stands that lie on significant slopes were rated as high habitat capability for flammulated owl in LGMGIS (Figure 37). Other forested habitats were rated moderate capability and non-forested habitats were rated nil.

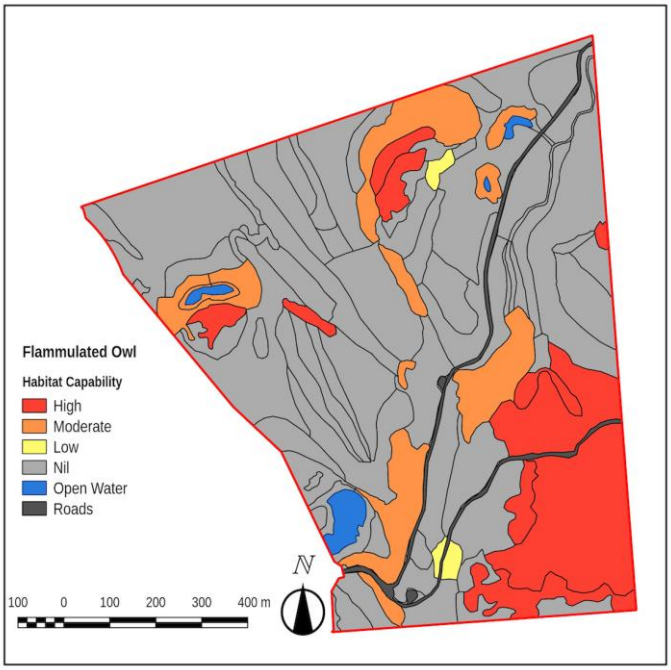


Figure 37. Habitat capability for flammulated owls in the LGMGIS.

Mature forest stands were rated as having flammulated owl nesting habitat suitability equal to the stands' capability (Figure 38). Younger forests were rated as low suitability nesting habitat.

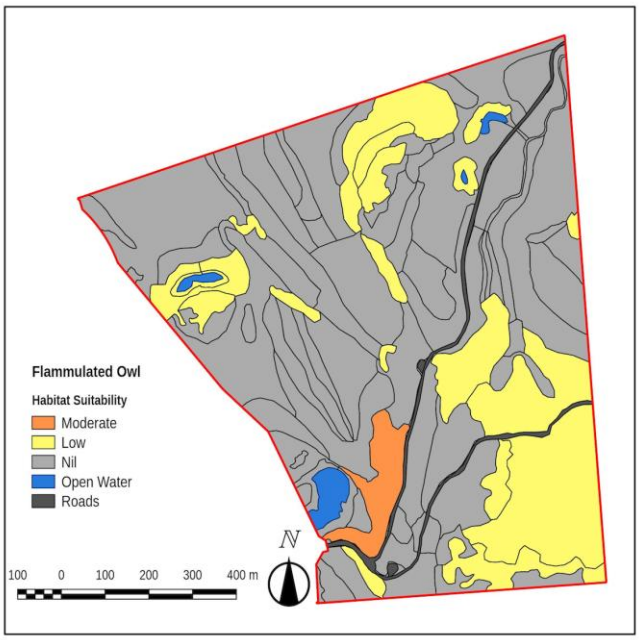


Figure 38. Habitat suitability for flammulated owl in LGMGIS.

Williamson's Sapsucker

Williamson's sapsuckers use a wide range of forested sites with a high density of large, old, dead trees. Dead or decaying Douglas-fir, aspen, and ponderosa pine trees are all used for nesting by Williamson's sapsucker. Since all forested sites in LGMGIS could have large and dying trees, all forested sites were rated as high habitat capability (**Error! Reference ource not found.**). Other, non-forested habitats were rated nil.

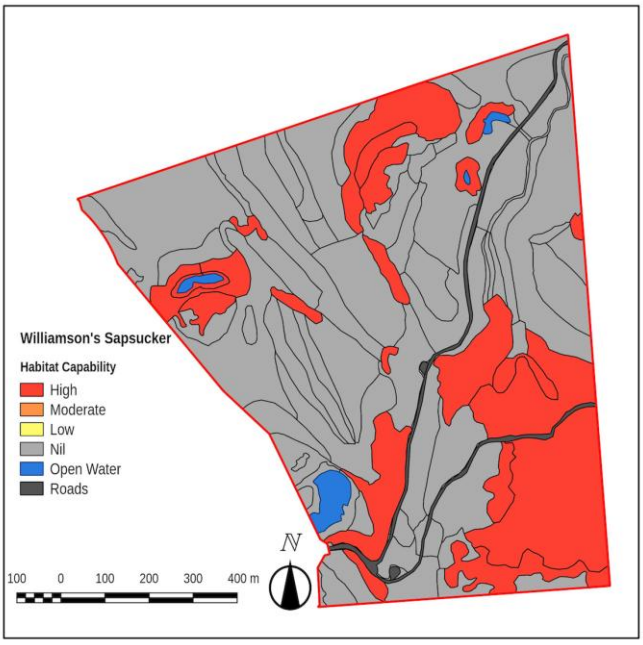


Figure 39. Williamson's sapsucker habitat capability in LGMGIS.

None of the forested polygons in LGMGIS had high densities of dead trees, but the Douglas-fir forests (ecosystems 101 and 102) had more than other forested units. These polygons were rated moderate suitability, (Figure 40). While other forests (aspen-dominated 112 and 113 ecosystems) were rated low. Other habitats were rated nil.

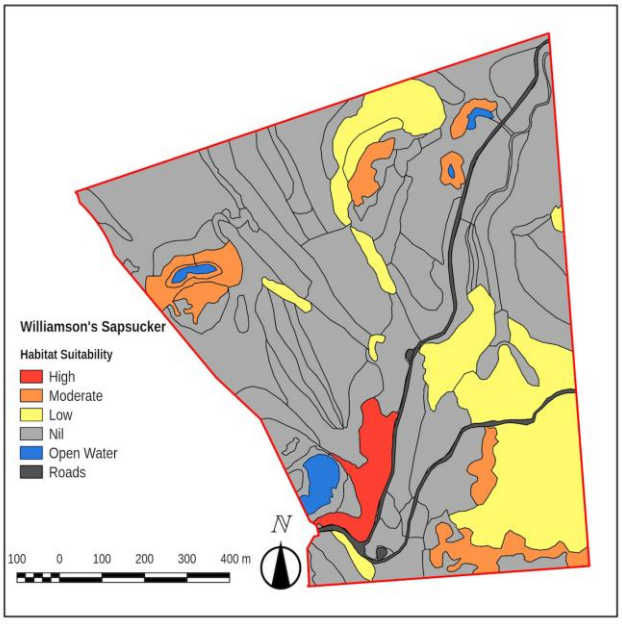


Figure 40. Williamson's sapsucker habitat suitability in LGMGIS.

Lewis's woodpecker

Lewis's woodpeckers nest in large dead or decaying trees in dry ecosystems, usually Douglas-fir, ponderosa pine or cottonwood. They are weak excavators, so they will use cavities made by other species or nest in wildlife trees with very soft wood. They prefer stands with very open canopies and berry-bearing shrubs in the understory or in adjacent areas. They are often found in burned forest stands with open canopies and abundant dead trees. All of the forested units in LGMGIS are rated high for habitat capability (Figure 41). All other units are rated low.

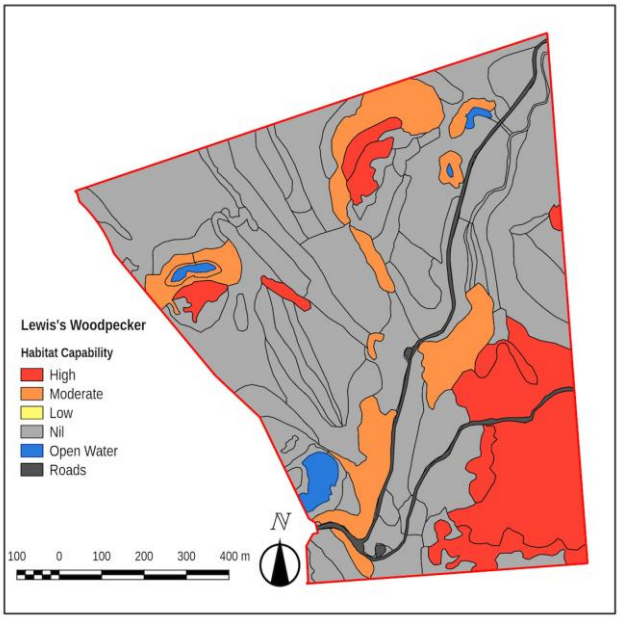


Figure 41. Habitat capability for Lewis's woodpecker in LGMGIS

All forested units in LGMGIS are too dense, have insufficient dead trees, or have insufficient berry shrubs to be rated more than moderate for habitat suitability (Figure 42).

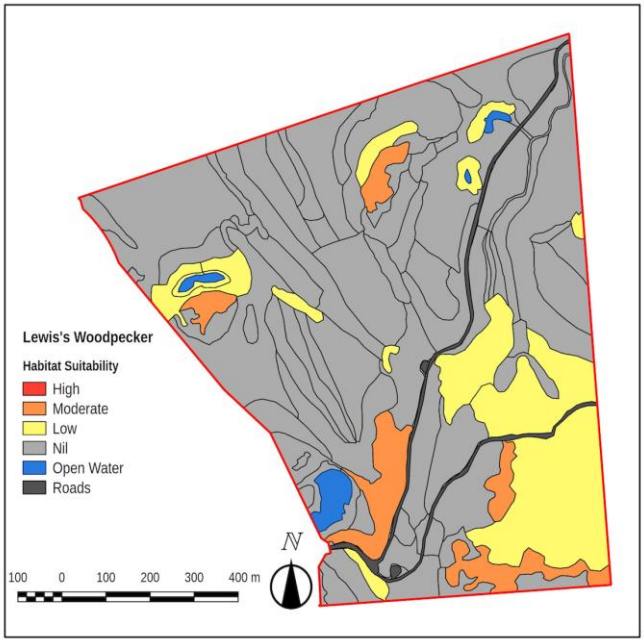


Figure 42. Habitat suitability for Lewis's woodpecker in LGMGIS

Rusty Blackbird

Rusty blackbirds nest in moist, shrubby areas, wetlands, moist forests and riparian areas. Areas meeting these conditions occur in LGMGIS in the aspen stands (ecosystem unit 112 and 113) (Figure 43). The one shrubby ecosystem unit (Ff02) generally has low shrubs and provides moderate nesting habitat capability. Other forested units have low habitat capability for rusty blackbird nesting habitat. Other ecosystem units are rated nil.

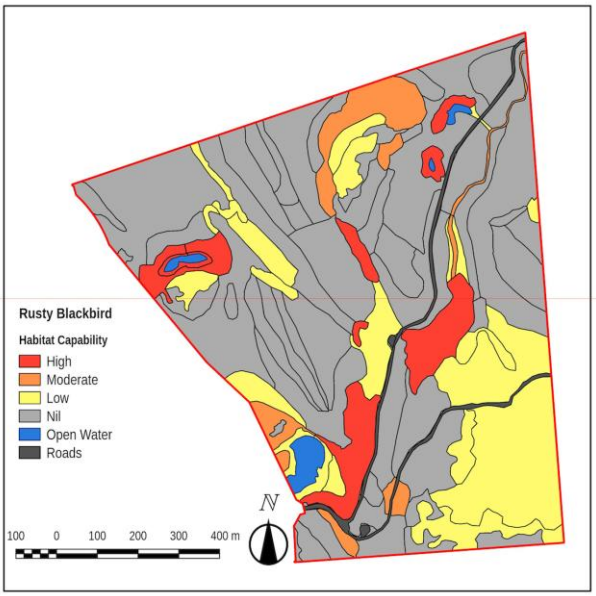


Figure 43. Habitat capability for rusty blackbird at the LGMGIS.

Habitat suitability for rusty blackbird nesting is only moderate in aspen units because in many cases the shrub density and height has been reduced by livestock grazing (Figure 44) Other forested sites are rated low for rusty blackbird nesting habitat suitability.

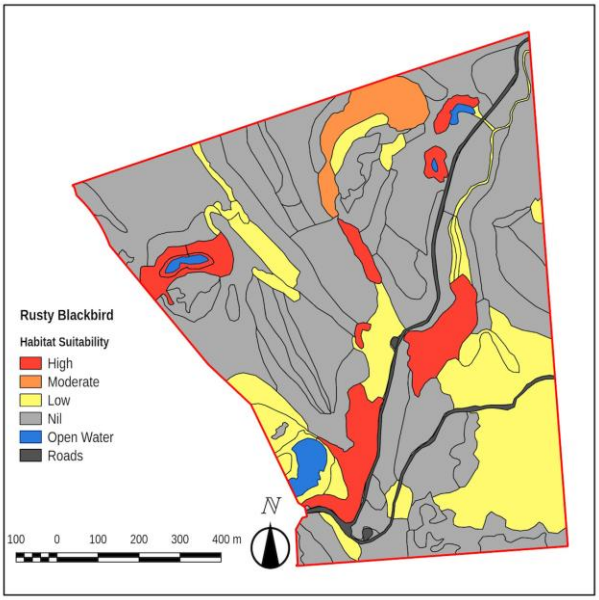


Figure 44. Rusty blackbird habitat suitability at the LGMGIS

Short-eared Owl

Short-eared owls nest on the ground in wet meadows, wet grasslands and other habitats with short, dense, non-woody vegetation. The Gg12wet ecosystem unit provides high habitat capability; other open habitats have moderate habitat, and the wetland units are too wet for ground nesting and have low capability (Figure 45).

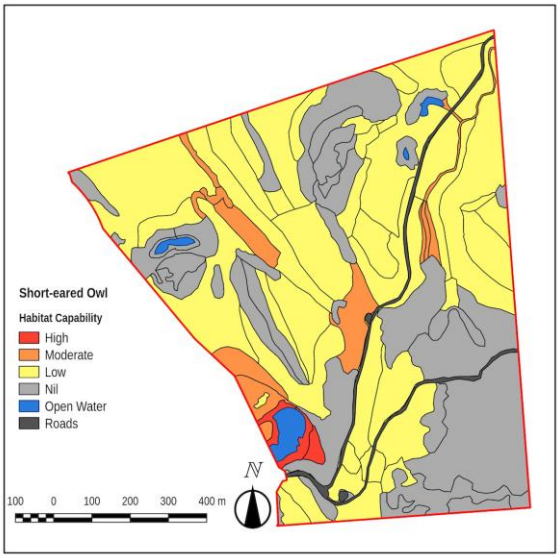


Figure 45. Short-eared owl habitat capability in LGMGIS.

The wet grasslands in LGMGIS are currently moderately suitable for short-eared owl nesting habitat, mostly because the surrounding habitats provide poor foraging habitat due to their generally poor condition (Figure 46). Other open habitats are rated low suitability.

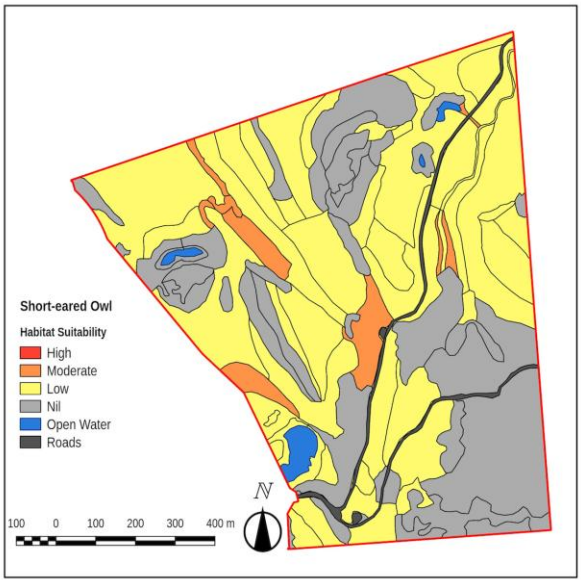


Figure 46. Short-eared owl habitat suitability in LGMGIS.

Olive-sided flycatcher

Olive-sided flycatchers nest in trees in stands with very open canopies, and abundant perching sites. They are most common in burns and logged areas with scattered reserve trees. All forests in the LGMGIS have a high capability of providing good nesting habitat for olive-sided flycatchers (Figure 47).

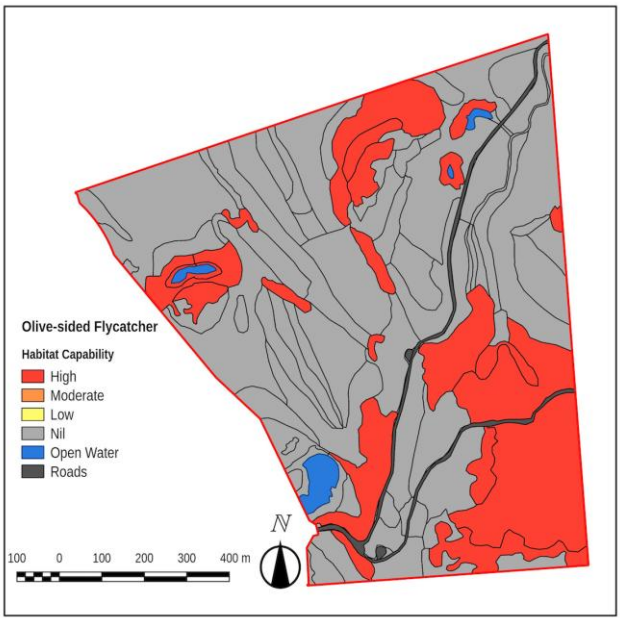


Figure 47. Olive-sided flycatcher habitat capability in LGMGIS

Most forested polygons in the LGMGIS are too dense to provide suitable nesting habitat for olive-sided flycatchers. Those polygons that do have suitably open forests, are too small to provide sufficient habitat for a nesting pair (Figure 48).

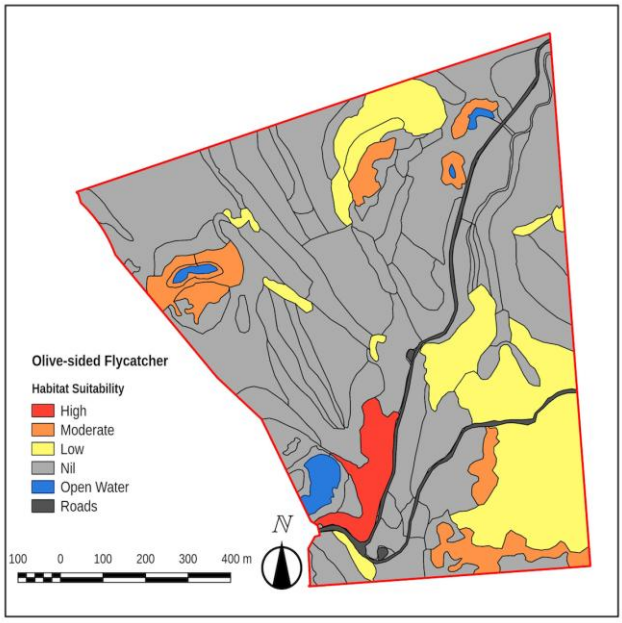


Figure 48. Olive-sided flycatcher habitat suitability in LGMGIS

Great Basin Spadefoot

Great basin spadefoots breed in a wide range of shallow open water habitats. They require suitable aestivating habitats within about 500 m of these water bodies for avoiding unsuitable environmental conditions. They require very loose, sandy soils for estivating, as they cannot dig through soils with coarse fragments or plants roots, or highly cohesive soils. No highly suitable soils were seen in LGMGIS. All open habitats were rated low capability and suitability for burrowing habitat for great basin spadefoots (Figure 49 and Figure 50). Other habitats are rated nil.

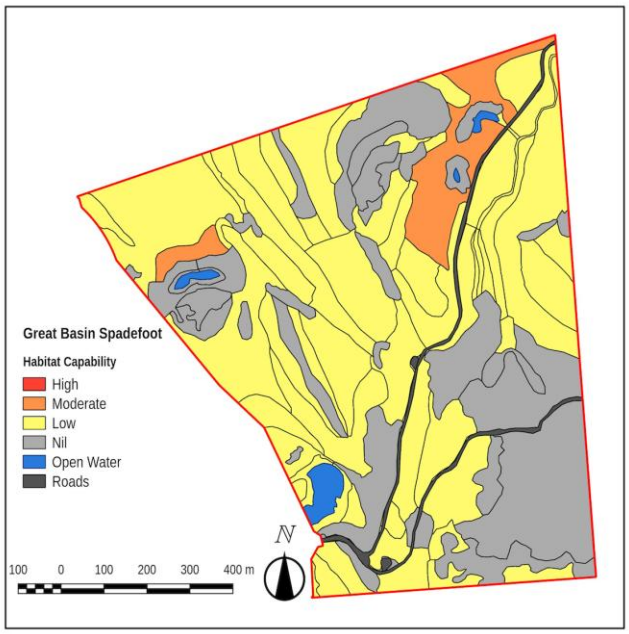


Figure 49. Great basin spadefoot habitat capability in LGMGIS.

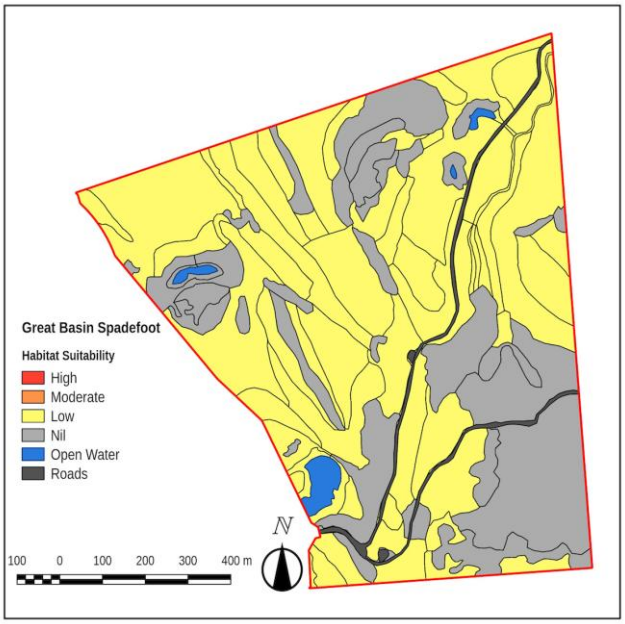


Figure 50. Great basin spadefoot habitat suitability in LGMGIS

Habitat Supply

Forest-dwelling Species

Since about 67% of the LGMGIS area is grassland, and only about 17% and 11% are conifer and aspen forest respectively, it is expected that habitat for forest dwelling red- or blue-listed species would be in low supply. This is seen for flammulated owl (Figure 51), Lewis's woodpecker (Figure 52), olive-sided flycatcher (Figure 53.), rusty blackbird (Figure 54), and Williamson's sapsucker **(**Error! Reference source ot found.**).** Less than 30% of the land area in LGMGIS provides high or moderate quality habitat for these species.

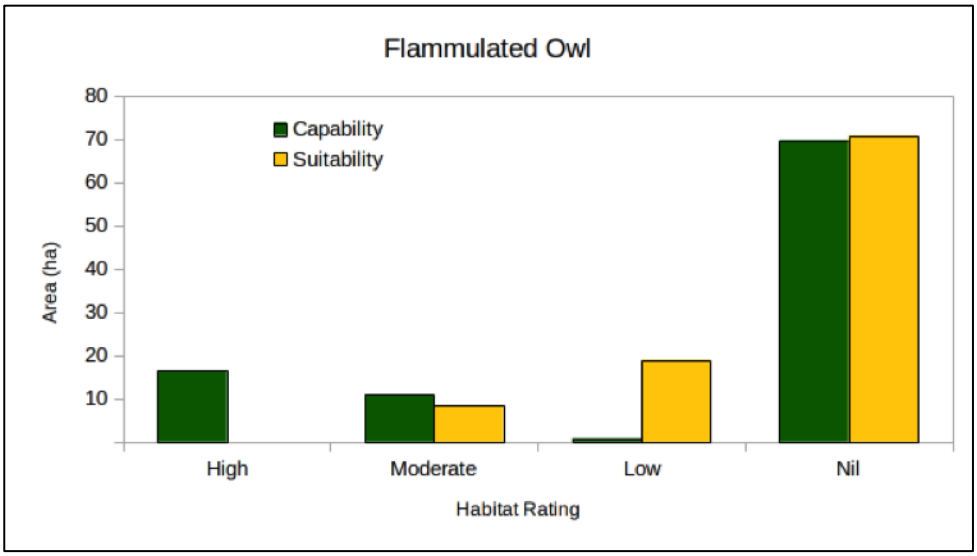


Figure 51. Comparison of habitat capability and suitability for flammulated owls in LGMGIS.

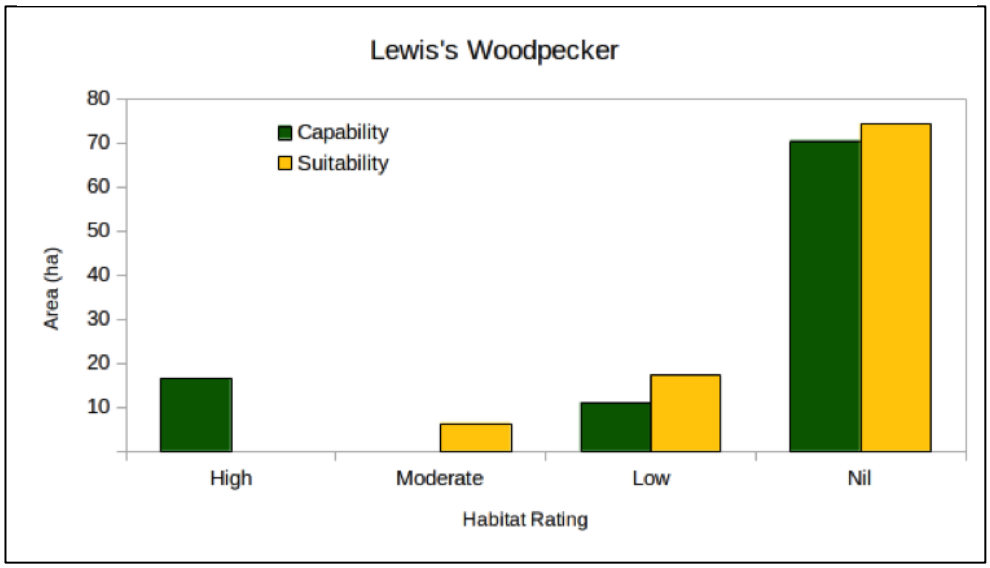


Figure 52. Comparison of habitat capability and suitability for Lewis' woodpecker in LGMGIS

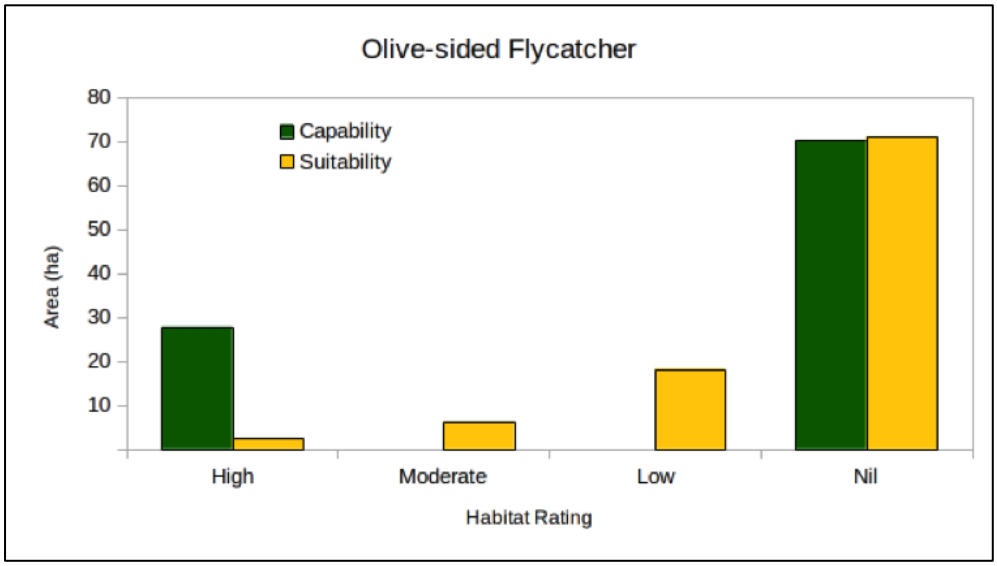


Figure 53. Comparison of habitat capability and suitability for olive-sided flycatcher in LGMGIS.

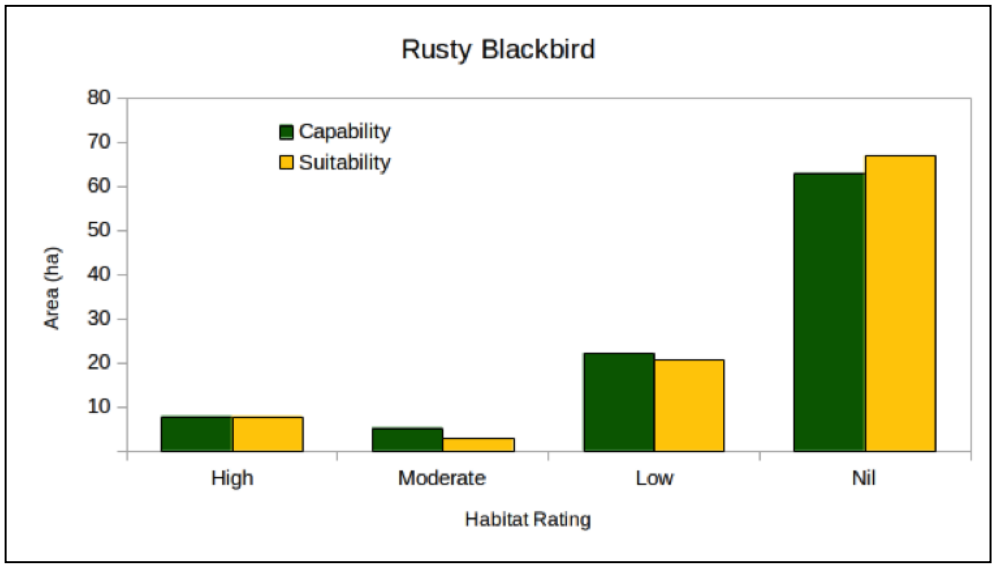


Figure 54. Comparison of habitat capability and suitability for rusty blackbird in LGMGIS.

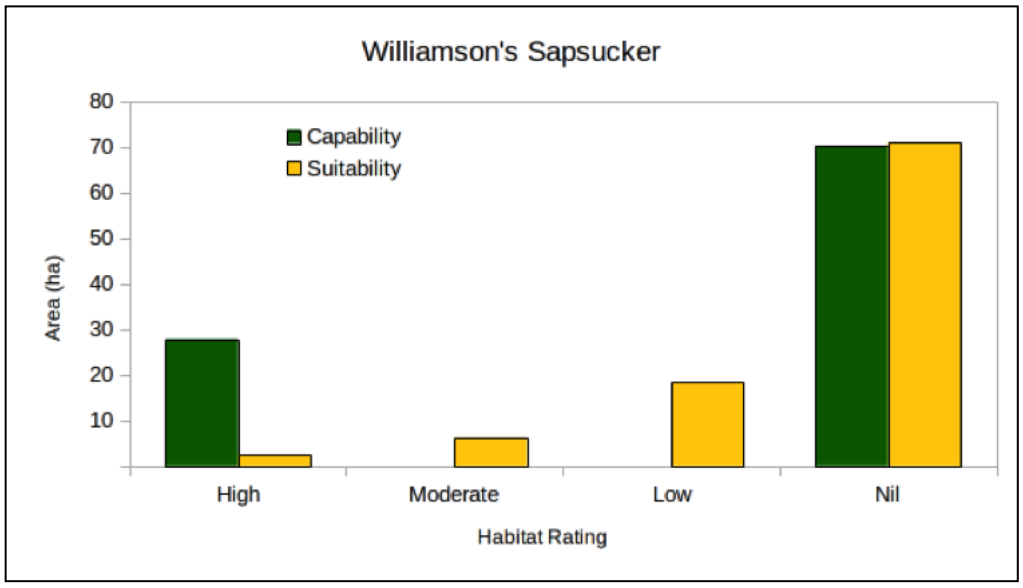


Figure 55. Comparison of habitat capability and suitability for Williamson's sapsucker in LGMGIS.

Habitat Supply for Grassland and Wetland-dwelling Species

The grassland-dwelling species American badger and sharp-tailed grouse have the high habitat capability (Figure 56) and (Figure 57)

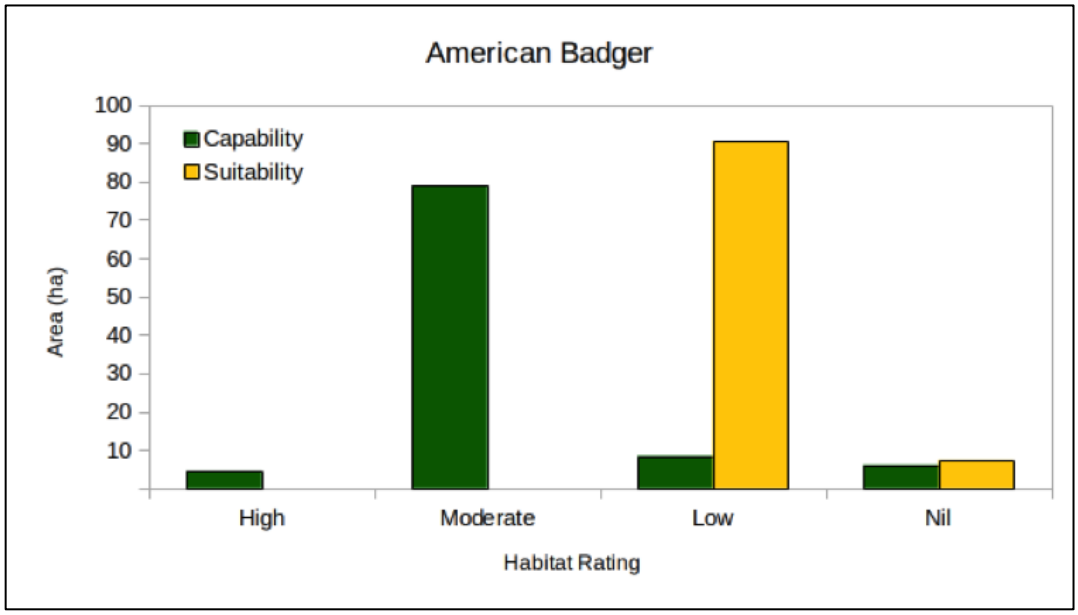


Figure 56. Comparison of habitat capability and suitability for American badger in LGMGIS.

Sharp-tailed grouse may use a wide range of grassland habitats, provided they have tall and dense grass cover. Most of the grasslands in the LGMGIS could provide this habitat, so the capability is mostly high, however current suitability is mostly low due to the condition of the grasslands.

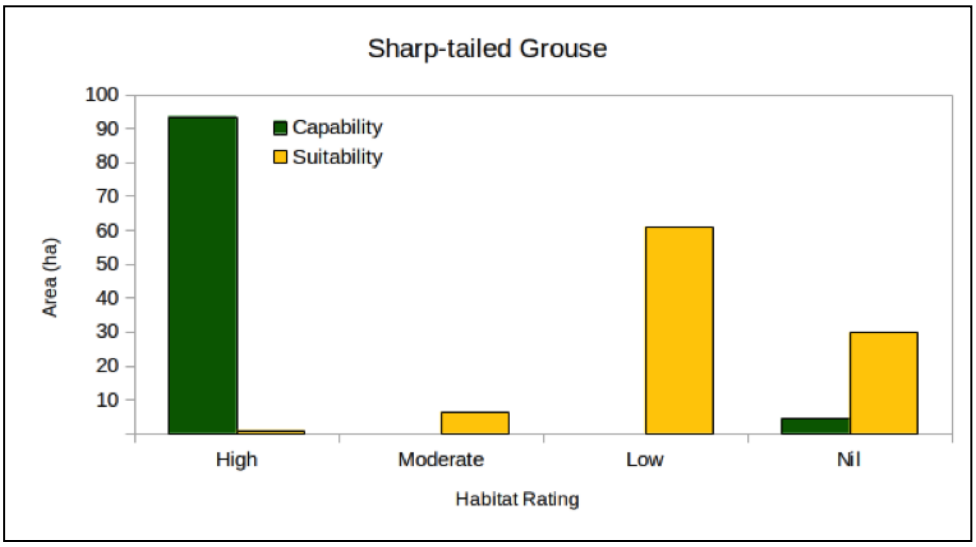


Figure 57. Comparison of habitat capability and suitability for Sharp-tailed Grouse in LGMGIS.

Great basin spadefoot requires loose soils for digging in relatively close proximity to water bodies. The grasslands in the wetter areas of the LGMGIS have fine-textured soils that are not sufficiently loose to provide burrowing habitat for spadefoot. Most of the LGMGIS does not have the potential for high quality spadefoot habitat (Figure 58) Habitat capability and suitability are fairly similar for this species.

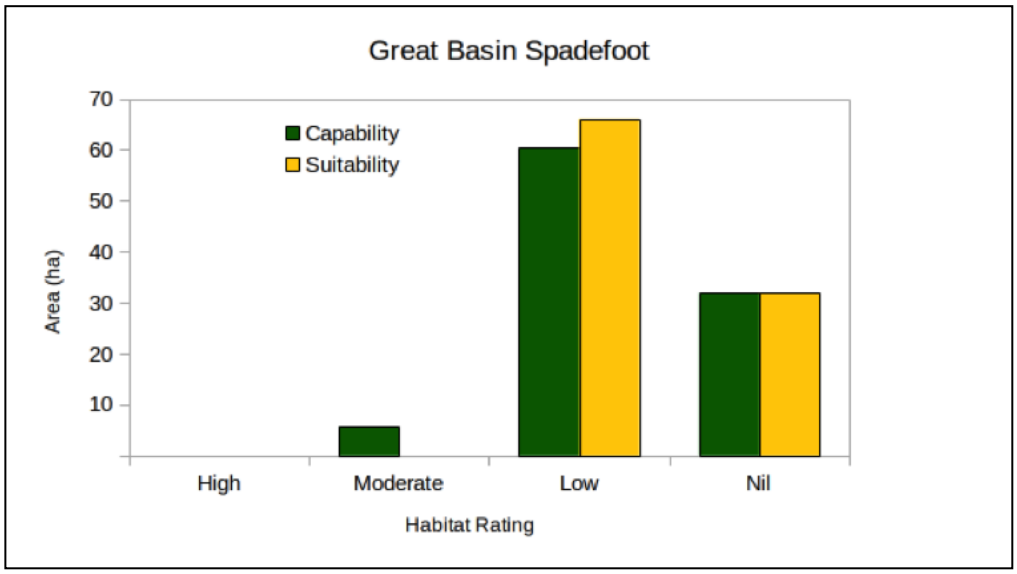
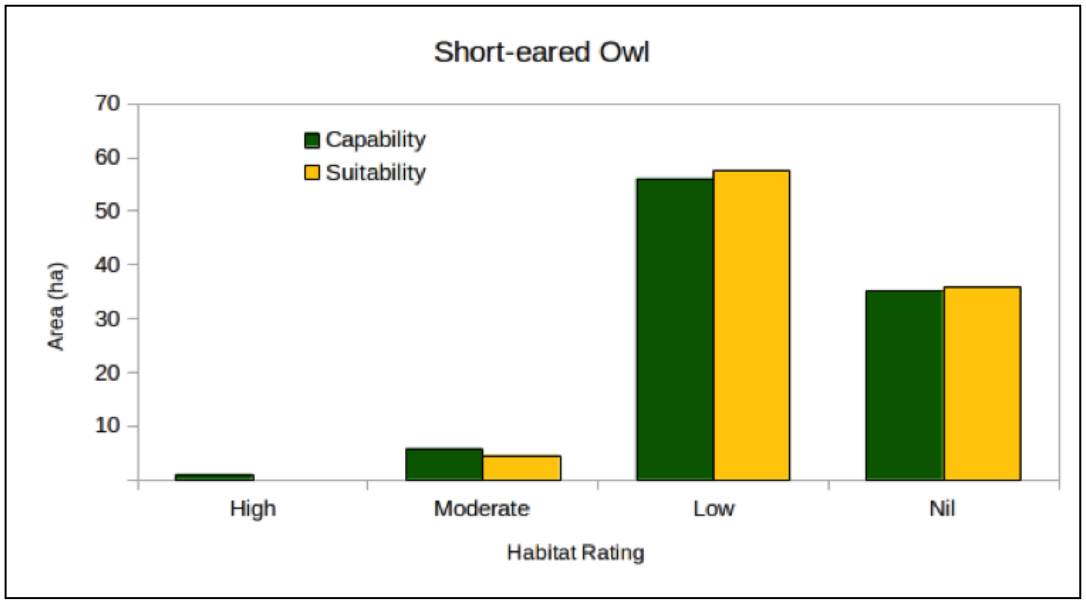


Figure 58. Comparison of habitat capability and suitability for great basin spadefoot in LGMGIS.



Short-eared owls use wet meadows and productive grassland area for nesting. Only small amount of the LGMGIS has the potential for high quality nesting habitat for short-eared owls. Habitat capability and suitability is relatively similar for this species (**Error! Reference source not found.**)

Figure 59. Comparison of habitat capability and suitability for short-eared owl in LGMGIS.

Management Recommendations

Range Management

The condition of grasslands in the LGMGIS has probably improved since the late 1800's, when grazing was most widespread in the British Columbia interior. Since then, spotted knapweed and other invasive alien plants have become established in the province, and their distribution and abundance are partially related to livestock grazing and disturbance.

Additionally, the overall condition of the grasslands in LGMGIS is well below its capability. In total, 81% of grasslands are early to mid-seral. This has greatly reduced the habitat suitability for grassland species at risk such as American badger and sharp-tailed grouse.

Thus, there is a need to reduce the overall amount of grazing in the project area and to carefully examine options for the timing, duration, and distribution of grazing and how it will affect knapweed, grasslands, wetlands and other ecosystems. For example, grazing in fall may cause livestock to target remaining areas of rough fescue and avoid areas with knapweed.

Additionally, wetlands and aspen copses have also been affected by livestock use. Pursuing options for off-site watering and reducing levels of grazing would benefit these ecosystems.

A committee should be formed consisting of government range staff, weed specialists, range tenure holder and representatives of the GCC and NCWRT organizations to develop a coordinated weed and range management plan to address concerns identified in this document.

Forest Management

Coniferous forests in the study area have all been logged in the past and fire has been excluded from them for many decades. Present forest densities are much higher than historical densities and the understory vegetation has been altered and diminished because of this. These forests are also vulnerable to catastrophic wildfire effects because the thick canopy and ladder fuels that could easily carry a severe crown fire.

Careful thinning of the forest to open the canopy while retaining the largest trees could improve wildlife habitat suitability for most of the red- and blue-listed species reliant on forested habitats.

Spotted Knapweed

Spotted knapweed is pervasive and presents a serious threat to grasslands in the LGMGIS. Research from Lac du Bois (Fraser and Carlyle 2010, Kuany 2015) indicates that knapweed alters soil properties such as phosphorus, nitrogen, carbon and temperature. Additionally, the size of spotted knapweed patches affects soil conditions (Fraser and Carlyle 2010). Soil phosphorus (P) and temperature increase with patch size while soil nitrogen (N), soil carbon (C), and soil moisture decrease with patch size. Thus,

it seems apparent that smaller patches have the greatest potential for recovery and should be prevented from becoming large patches. Knapweed produces abundant of seed, much of which can remain dormant for many years until conditions for germination are suitable (Davis et al. 1993). This makes eradication difficult because most treatments generally deal with only the current year's growth. Knapweed is known to also produce allopathic chemicals which inhibit or prevent establishment and growth of other plants.

Biological control appears to have been effective in reducing diffuse knapweed in B.C. after the release of various insects starting from 1970 to 1987; cover of diffuse knapweed was reduced by 74% from five sites in the Bunchgrass and Ponderosa Pine biogeoclimatic zones; biocontrol likely contributed to this decline (Newman et al. 2011). Gayton and Miller (2012) looked at data from 1983 to 2008 from a number of grassland range exclosures and found that diffuse knapweed declined significantly at 14 or 15 sites and spotted knapweed declined at three of four sites.

However, spotted knapweed has a much more extensive range and occurs at much higher elevations than diffuse knapweed (Kuany 2015). Gayton and Miller (2012) speculate that spotted knapweed may not respond as well to biocontrol agents as diffuse knapweed. Also, it is not known if biological control agents will be as effective at higher elevations such as LGMGIS with moister, cooler climates, where spotted knapweed occurs but diffuse knapweed does not.

It is apparent that biocontrol agents require monitoring to determine treatment effectiveness.

Stay in touch with results from ongoing spotted knapweed treatment research in LGMIS (Dr. Fraser); consider implementing larger scale treatments of research trials. Management strategies may need to be different for each of the knapweed classes. Eradication may be the goal in classes 1 and 2 and containment for class 5 to prevent further spread.

Possible treatments –

- **Herbicide** (research the most effective ones; new ones are developed regularly), any herbicide treatments must include actions to reduce the ability of knapweed seeds in the soils to germinate and become established without competition, or for off site knapweed seeds to re-invade and become established.
- **Mechanical control** with or without herbicide treatments. These treatments can be effective at reducing the vigour of existing plants and seed production. This treatment must be long-term to have any chance of reducing or eliminating knapweed abundance.
- **Biocontrol** – the best hope long-term control. Note that other treatments will reduce the abundance of biocontrol host plants and reduce the effectiveness of biocontrol treatments. Successful biocontrol does not eliminate the target alien plant, but reduces the abundance, density and vigour of remaining plants allowing native species to coexist with the weed.

Wildlife

Much of the forested area is not currently suitable to provide habitat for these species, so the area of highly or moderately suitable habitat is less than the areas of highly and moderately capable habitat. Management of the forested areas in the LGMGIS to promote older stands, a greater number of larger trees, but relatively open canopies will improve habitat supply for most of the red- and blue-listed species reliant on forested habitats. Olive sided flycatchers and Lewis's woodpeckers are two species whose habitats are improved with fire. Historically, fire in the Douglas-fir stands in LGMGIS would have thinned the understory, by killing most of the smaller trees, but retained an overstory of larger trees with a relatively open canopy. Some of the larger trees would have been killed by these fires, providing high quality snags for those species requiring cavities. The open forest structure provided by frequent, low intensity fires provides good habitat for most of the forest dwelling species rated for this report.

Improved range condition / seral stage of the grasslands will also improve wildlife habitat for a number of species.

Infrastructure

Roads, range fences, trails, a bridge, signs, an informational kiosk, a wetland viewing platform, out houses, research installations and parking lots all constitute infrastructure improvements at the site. The Nicola Watershed Community Round Table (NWCRT) has been responsible for making significant investments at the site. Their primary objective is to share knowledge about the historic, social, economic and environmental value of the areas grasslands.

Figure 60. LGMGIS informational kiosk with panels characterizing the cultural, historic and economic value of the areas grasslands

A long list of public, corporate and government supporters have contributed to building and maintaining these structures. Volunteers have been instrumental in the success and have been entirely responsible for maintenance activities. The volunteer contingent is represented by an aging group. A source of funding to support maintenance activities is small and subject to the success of annual funding applications. It would be great if a more reliable source of funds could be secured to ensure this site does not fall in to disrepair and a potential legal liability. Many of the structures are constructed with wood materials that are subject to weathering and even rot. There needs to be a more formalized mechanism for annual inspection of these structures.

Informal comment sheets located at the informational kiosk indicate the site receives visitors from a variety of age groups, travelling from local, regional and international destinations. Most visits are from late spring to early fall. The dual-toilet outhouse adjacent to the kiosk area serves as a pit-stop for the travelling public. The outhouses are also used during the winter by locals who gather to participate in sledding, snowmobiling, snowshoeing and cross country skiing. Traditionally, fires are built, and activities like wiener roasts contribute to the experience. The smaller parking area midway along the road bisecting the LGMGIS serves as a focal point for these activities. We are unsure if this parking lot is of adequate size to meet the need and eliminate roadside parking which may contribute to safety concerns. The outhouse at the base of the sledding hill is an older structure that may need to be upgraded. The local school district has also been using the site to introduce kids to the outdoors and as a base to explore many aspects of environmental, historic and cultural education. The proximity to Merritt, combined with the location of parking, the presence of an outhouse and diverse ecological conditions favours continued use of this site for these activities.There are two parking areas at the site. The one closest to the kiosk is currently in rough condition and could stand to be graded and surfaced to promote drainage and eliminate the seasonal rutting and mucky conditions.

Figure 62. Outhouse at LGMGIS

Figure 61. Viewing platform overlooking the primary pond at the LGMGIS

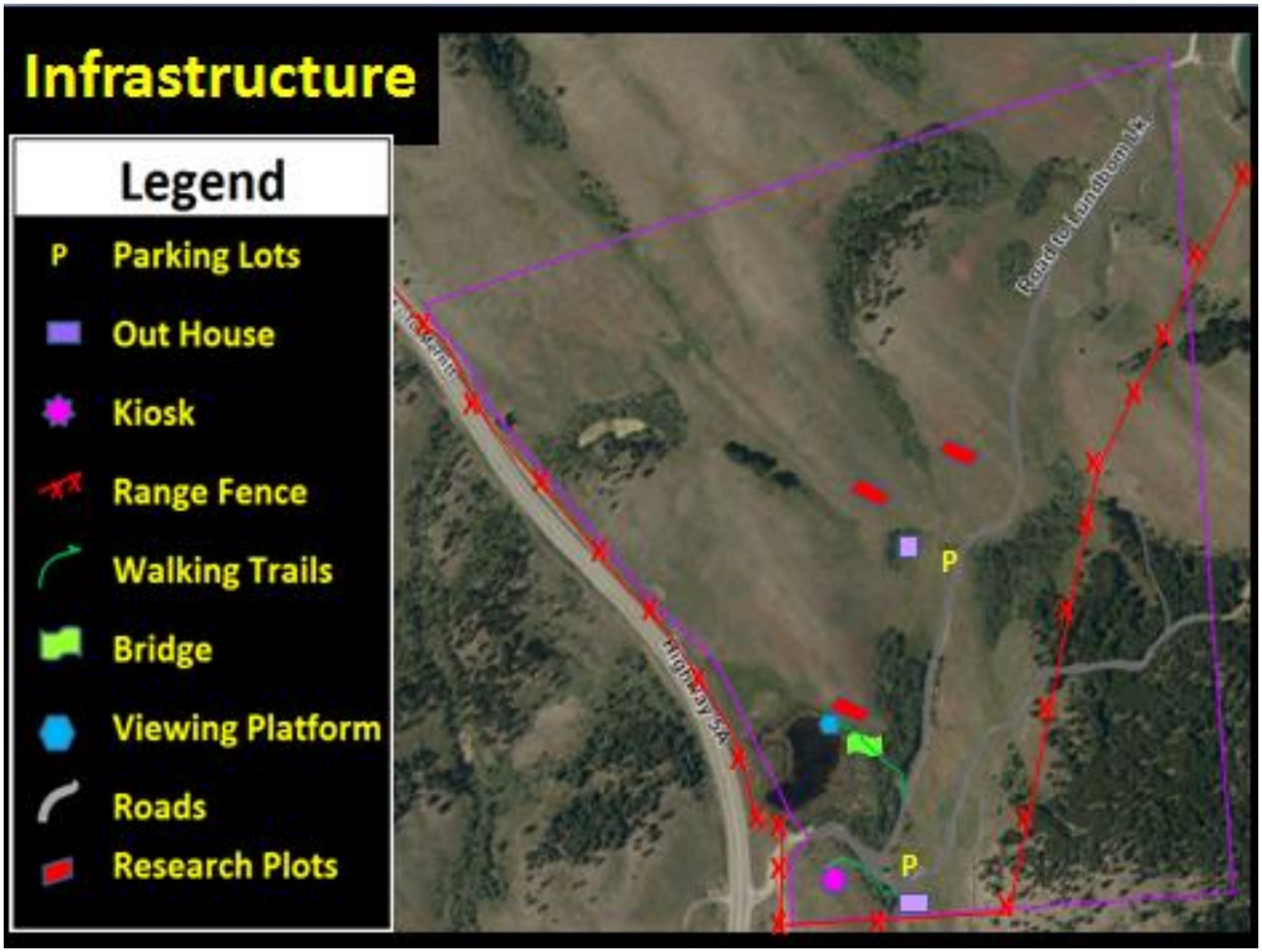


Figure 64. Map showing the location and nature of historic infrastructure investments made at the LGMGIS site.

Education programs

Additional educational materials could be developed for use by local teachers interested in making use of the site.

Recreational activities at the site and ATV damage

There should be additional commentary added here.

Kiosk Panels

Consideration should be given to adding an appendix containing the content of the panels on display at the kiosk location. A summary of the contents and acknowledgements should be included. The back side of the kiosk panels are currently not in use. This area is protected from the climatic elements and the space could be used for addition educational information such as the results of research activities that are on-going at the site.

Research at the Site

This section should be completed in the future by Lauch Fraser and his students from Thompson Rivers University

Photo-monitoring Points

Photomonitoring can be an effective way of qualitatively assessing changes in grassland condition. We recommend that photomonitoring points be established at a number of sites within the LGMGIS using the BC Grasslands Conservation Council method. Photomonitoring plots should be established in at least two grassland polygons of combination of seral stage and range condition. Additionally, they should be established in conjunction with quantitative plots for any knapweed treatment sites.

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Appendix 1 –The components of the baseline inventory map legend.

In addition to recording the site series, the following attributes were collected for each mapped polygon: cover class for spotted knapweed, ecosystem site series(s), grassland seral stage, and grassland condition, and structural stage.

The following summarizes fields used in the projects mapping database.

Field	Definition
Ecotype	Site series based upon the current draft BEC classification
SK Class	Cover class for spotted knapweed
	K1 = 0 - <1% cover
	K2 = 1 – 5% cover
	K3 = 5 – 25% cover
	K4 = 25 – 50% cover
	K5 = >50% cover
	na = not applicable; not mapped for forests or wetlands
Decile 1	Cover of dominant ecosystem where 10=100%, 9=90% etc.
Eco 1	Site series code for first decile
Decile 2	Cover of secondary ecosystem (blank if not present)
Eco 2	Site series code for second decile
Seral Stg	Seral stage for polygons with grasslands present; applies to grassland component only.
Condition	Ecological condition of polygon for grasslands, wetlands, and aspen copses (112 & 113).
StrStg1	Structural stage of first decile (2=grass, 3=shrub, 4=pole sapling forest, 5=young forest, 6=mature forest)
StrStg2	Structural stage of second decile

Codes and descriptions of grasslands, forests, shrublands, rock outcrops and wetlands are shown below. The following table which might also serve as a broad map legend for all features mapped in the baseline inventory. This table also shows the characteristics of sites series, related seral stages, range conditions and the relationship among these factors.

Codes, names and characteristics of mapped non-forested ecosystems

Map Code	Name of Unit	Description of Non-Forested Ecosystems
Ff02	Snowberry — Rose	The Ff02 occurs in grassland-dominated areas on sites receiving some subsurface moisture. Soils are silty with very dark and deep Ah horizons and the vegetation is dominated by shrubs, especially snowberry, rose and saskatoon.
Gg02	Bluebunch wheatgrass — Balsamroot	The Gg02 occurs on dry, moderate to steep warm aspects in the IDF. It is dominated by bluebunch wheatgrass with small amounts of junegrass, Sandberg's bluegrass, and forbs. This unit typically has balsamroot although cover is sparse and generally absent on this site, except in the area adjacent to the forest at the extreme SW corner of LGMGIS There is often exposed soil, especially on steeper slopes. Seral stages and ecological condition classes are similar to those for Gg10 but lack fescues. Gg02r occurs on ridge top rather than steep warm aspect. Gg02s has shallow soils <50 cm deep.
Gg10	Rough fescue — Bluebunch wheatgrass	The Gg10 is common on moderate warm aspects and ridges with deep soils. It is dominated by a mixture of rough fescue, bluebunch wheatgrass and a variety of forbs on late seral sites. Slopes are never steep, but where they are >25% it is mapped as Gg10w. Shallow soils (<50 cm deep) are mapped as Gg10s. This unit is intermediate between the Gg02 and Gg12.

Map Code	Name of Unit	Description of Non-Forested Ecosystems	
Gg10 Seral Stages – % of climax vegetation [Seral Stg]		Gg10 Range Condition Classes – vegetation + weeds + soils [Condition]	
C Climax	Dominated by high cover of rough fescue and bluebunch wheatgrass with diverse, scattered forbs. Good cover of litter on the soil surface. 75-100% of climax vegetation.	E Excellent	Climax vegetation with few or no weeds.
L Late Seral	Dominated by bluebunch wheatgrass with minor rough fescue, and often with some Idaho fescue. Forbs are such as silky lupine, parsnip-flowered buckwheat are common. 50-75% of climax.	G Good	Late seral vegetation with scattered weeds. OR Mid-seral vegetation with few or no weeds. Good litter and/or microbiotic crust cover.
M Mid Seral	Some bluebunch wheatgrass, junegrass, Sandberg's bluegrass and scattered forbs. 25-50% of climax. Buckwheat and lupine cover often increases significantly in response to preferential grazing on the bunchgrasses and other species	F Fair	Mid to late-seral vegetation with substantial weeds including spotted knapweed, sow thistle, cheatgrass. OR early seral vegetation but with few or no weeds, some litter and microbiotic crust.
E Early Seral	Generally little or no bluebunch wheatgrass. May be dominated by weedy forbs, Sandberg's bluegrass and junegrass but is also often dominated by spotted knapweed. 0-25% of climax	P Poor	Dominated by non-native species, particularly knapweed. Early seral. Exposed soil common.

Map Code	Name of Unit	Description of Non-Forested Ecosystems
Gg12	Rough Fescue – Yarrow – Old man's whiskers	The Gg12 is common on level and gently sloping. Rough fescue dominates the vegetation at climax with a variety of scattered forbs. Anecdotal observations indicate there is increasing Idaho fescue in these grasslands although rough fescue still dominates at climax. Gg12k occurs on cool aspects.

Gg12 Seral Stages – % of climax vegetation [Seral Stg]		Gg12 Range Condition Classes – vegetation + weeds + soils [Condition]	
C Climax	Dominated by high cover of rough fescue with diverse, scattered forbs. Good cover of litter on the soil surface. 75-100% of climax vegetation.	E Excellent	Climax vegetation with few or no weeds.
L Late Seral	Some rough fescue, often with some Idaho fescue, abundant forbs such as silky lupine, parsnip-flowered buckwheat sticky geranium and some Kentucky bluegrass. 50-75% of climax plant community.	G Good	Late seral vegetation with scattered weeds. OR Mid-seral vegetation with few or no weeds. Good litter and/or microbiotic crust cover.
M Mid Seral	Little rough fescue, some bluebunch wheatgrass, junegrass, Sandberg's bluegrass and scattered forbs. 25-50% of climax plant community.	F Fair	Mid to late-seral vegetation with substantial weeds including spotted knapweed, sow thistle, cheatgrass. OR early seral vegetation but with few or no weeds, some litter and microbiotic crust.

Map Code	Name of Unit	Description of Non-Forested Ecosystems	
E Early Seral	Generally no visible rough fescue. Often dominated by spotted knapweed. 0-25% of climax vegetation	P Poor	Dominated by non-native species, particularly knapweed. Early seral. Exposed soil common.
Gg12wet	Rough Fescue – Yarrow – Old man's whiskers (Wet variant)	The Gg12w occurs in slight draws and areas with more snow accumulation or moisture run off than the Gg12. These sites would have been palatable longer in the season and were probably overgrazed as a result. These sites are now dominated almost exclusively by rhizomatous agronomic grasses such as smooth brome, quackgrass, and Kentucky bluegrass. At climax, these sites were likely dominated by rough fescue, abundant forbs (especially sticky geranium) and some scattered pasture sedge. ALWAYS EARLY SERAL/ POOR CONDITION	
OW	Shallow Open Water	A wetland composed of permanent shallow open water and lacking extensive emergent plant cover (<10%). The water is less than 2 m deep. There is one patch of shallow open water surrounded by cattail marsh (Wm05) near the entrance to the site.	
Ro01	Selaginella — Bluebunch wheatgrass – Sidewalk moss	This common rock outcrop unit is dominated by scattered bluebunch wheatgrass and patches of selaginella. Other common species include Sandberg's bluegrass, clad lichens, sidewalk moss and haircap mosses. There is extensive exposed bedrock.	
RZ	Road	An area cleared and compacted for the purpose of transporting goods and services by vehicles. Only mapped at the entrance to the site where the road is wider and there is a parking space.	

Map Code	Name of Unit	Description of Non-Forested Ecosystems
Wm03	Awned sedge Marsh	This marsh is occurs north of the cattail marsh and pond and is intermixed with the Wm07. This marsh is alkaline. The vegetation is dominated by awned sedge with few other species. There are some patches of beaked sedge intermixed with the awned sedge.
Wm04	Common spike-rush Marsh	This marsh occurs at one site intermixed with shallow open water. There is prolonged flooding. The vegetation is dominated by fairly low cover of spike-rush and few other species.
Wm05	Cattail marsh	This marsh occurs around the small pond at the entrance to the site with a trail and observation platform. Part of it used to be dominated by willows; many willow “skeletons” are visible in amongst the cattails. Changing water levels or possibly a willow borer may have killed off these willows. Soils are saturated most of the year but there is usually no surface water by late in the summer. The vegetation is dominated by cattail with low species diversity.
Wm07	Baltic rush marsh	This marsh is occurs north of the cattail marsh around the pond and in a narrow gully east of the main road in the northern half of the site. It occurs is dominated by Baltic rush with some field sedge; often there is Gg12w upslope of this wetland. Vegetation is patchy. This unit is often transitional between being a marsh and being a meadow. Condition varies with the amount of agronomic grasses present.

Table 7. Codes, names and descriptions of mapped forested ecosystems. Also includes descriptions of the seral stage conditions for the 112 aspen copse site series..

Map Code	Name	Description of Forested Ecosystems

Map Code	Name	Description of Forested Ecosystems
102	FdPy - Selaginella - Bluebunch wheatgrass	This unit occurs on small sites with very shallow soils and with pockets of exposed bedrock. It has a very open canopy of scattered Douglas-fir trees (some ponderosa pine snags). The shrub and herb layers are sparse and include species characteristic of rock outcrops including selaginella and shrubby penstemon, There is often scattered bluebunch wheatgrass.
103	FdPy - Bluebunch wheatgrass - Balsamroot	This unit occurs on steep, warm aspects. There is an open cover of Douglas-fir and ponderosa pine (mostly just snags in this area). The understory is dominated by bluebunch wheatgrass with scattered saskatoon, common juniper and birch-leaved spirea. Silky lupine and balsamroot are also common. Mosses and lichens are sparse.
101	FdPy - Pinegrass	This unit occurs on gently sloping sites. It is dominated by Douglas-fir, sometimes with scattered ponderosa pine. The understory is dominated by pinegrass with scattered saskatoon, birch-leaved spirea, rose and forbs such as heart-leaved arnica. Mosses and lichens are usually sparse. It was occasionally mapped as 101k where it occurred on a cool aspect. The area has been selectively logged
112	At - Snowberry - Rose	This unit occurs as patches in grassland-dominated areas. These are moist trembling aspen stands that have a shrubby understory dominated by snowberry and rose with only a few scattered grasses and forbs such as blue wildrye and mountain sweet-cicely. Shrub cover declines with grazing and is replaced by Kentucky bluegrass and other agronomic grasses. Scattered burdock and Canada thistle commonly occur on disturbed sites.
	G	Good Condition: good, nearly continuous cover of shrubs in the understory

Map Code	Name	Description of Forested Ecosystems
	F	Fair Condition: patch cover of shrubs mixed with patches of Kentucky bluegrass or other agronomic grasses
	P	Poor Condition: few shrubs, understory is dominated by agronomic grasses (usually predominantly Kentucky bluegrass).
113	At - Dogwood - Rose	This unit only occurs in grassland-dominated areas. These are moist to wet trembling aspen stands that occur in gullies and in depressions where soils remain wet for much of the year. It has a shrubby understory that includes red-osier dogwood together with snowberry, roses and gooseberries. On the site, this unit occurs in depressions and is surrounded by 112 on the slopes above it. Thick shrubs seem to deter cattle and this unit was generally in good condition in the few sites where it occurred.

Appendix 2 – Plant Species List for LGMGIS

The following list of plant species presents information showing the lifeform, (tree, shrub, herb, graminoid, moss, and lichens), a common name, scientific name and an indication of whether the species is and alien non native species. The full list of species is an indication of the species that could occur at the LGMGIS based upon observations for sites with similar ecological conditions on the broader landscape. Column 1 has a "y" for yes to indicate which species we observed while conducting field work at LGMGIS. This list is intended to form a check list that the public and naturalists can use while visiting the site. The intent is to update this list with observations but the mechanism to formally do this still needs to be worked out.

Species observed	Life form	Species	Common Name	Alien?
TREES				
y	Tree	Betula occidentalis	water birch	
	Tree	Picea engelmannii x glauca	hybrid white spruce	
y	Tree	Pinus ponderosa	ponderosa pine	
y	Tree	Populus tremuloides	trembling aspen	
	Tree	Populus trichocarpa	black cottonwood	
y	Tree	Pseudotsuga menziesii	Douglas-fir	
SHRUBS				
y	Shrub	Acer glabrum	Douglas maple	
	Shrub	Alnus incana	mountain alder	
y	Shrub	Amelanchier alnifolia	saskatoon	
y	Shrub	Clematis occidentalis	Columbia bower	
y	Shrub	Cornus stolonifera	red-osier dogwood	
	Shrub	Ericameria nauseosa	common rabbit-brush	
y	Shrub	Juniperus communis	Common juniper	
y	Shrub	Juniperus scopulorum	Rocky Mountain juniper	
y	Shrub	Lonicera involucrata	black twinberry	
y	Shrub	Mahonia aquifolium	tall Oregon-grape	
	Shrub	Paxistima myrsinites	falsebox	
	Shrub	Prunus virginiana	choke cherry	
y	Shrub	Ribes cereum	squaw currant	
	Shrub	Ribes glandulosum	skunk currant	
y	Shrub	Ribes lacustre	black gooseberry	
y	Shrub	Rosa acicularis	prickly rose	

Species observed	Life form	Species	Common Name	Alien?
y	Shrub	Rosa nutkana	Nootka rose	
y	Shrub	Rosa woodsii	prairie rose	
	Shrub	Rubus idaeus	red raspberry	
y	Shrub	Rubus parviflorus	thimbleberry	
y	Shrub	Salix barclayi	Barclay's willow	
y	Shrub	Salix bebbiana	Bebb's willow	
	Shrub	Sambucus racemosa	red elderberry	
y	Shrub	Shepherdia canadensis	soopolallie	
y	Shrub	Spiraea betulifolia	birch-leaved spirea	
y	Shrub	Symphoricarpos albus	common snowberry	
	Shrub	Viburnum edule	highbush-cranberry	
HERBS AND GRAMINOIDS				
y	Herb	Achillea millefolium	yarrow	
y	Graminoid	Achnatherum nelsonii	Columbia needlegrass	
y	Graminoid	Achnatherum richardsonii	spreading needlegrass	
y	Herb	Actaea rubra	baneberry	
y	Herb	Agoseris glauca	short-beaked agoseris	
y	Graminoid	Agropyron cristatum	crested wheatgrass	Alien
	Graminoid	Agrostis exarata	spike bentgrass	
y	Graminoid	Agrostis gigantea	redtop	Alien
y	Graminoid	Agrostis scabra	hair bentgrass	
y	Herb	Allium cernuum	nodding onion	
y	Graminoid	Alopecurus aequalis	little meadow-foxtail	
y	Herb	Alyssum alyssoides	pale alyssum	Alien
	Herb	Amphiscirpus nevadensis	Nevada bulrush	
y	Herb	Anaphalis margaritacea	pearly everlasting	
y	Herb	Androsace septentrionalis	northern fairy-candelabra	
y	Herb	Anemone multifida	cut-leaved anemone	
	Herb	Angelica arguta	sharptooth angelica	
y	Herb	Antennaria dimorpha	low pussytoes	
y	Herb	Antennaria microphylla	white pussytoes	
y	Herb	Antennaria neglecta	field pussytoes	
y	Herb	Antennaria parvifolia	Nuttall's pussytoes	
y	Herb	Antennaria pulcherrima	showy pussytoes	

Species observed	Life form	Species	Common Name	Alien?
	Herb	Antennaria racemosa	racemose pussytoes	
y	Herb	Antennaria umbrinella	umber pussytoes	
	Herb	Aquilegia formosa	Sitka columbine	
y	Herb	Arabis holboellii	Holboell's rockcress	
	Herb	Arctium lappa	great burdock	Alien
y	Herb	Arctostaphylos uva-ursi	kinnikinnick	
y	Herb	Arenaria serpyllifolia	thyme-leaved sandwort	
y	Herb	Arnica cordifolia	heart-leaved arnica	
	Herb	Artemisia campestris	northern wormwood	
y	Herb	Artemisia dracunculus	tarragon	
y	Herb	Artemisia frigida	prairie sagewort	
	Herb	Artemisia ludoviciana	western mugwort	
	Herb	Astragalus agrestis	field milk-vetch	
	Herb	Astragalus collinus	hillside milk-vetch	
y	Herb	Astragalus miser	timber milk-vetch	
	Herb	Astragalus purshii	woollypod milk-vetch	
y	Herb	Balsamorhiza sagittata	arrowleaf balsamroot	
	Herb	Bassia hyssopifolia	five-hooked bassia	Alien
y	Graminoid	Beckmannia syzigachne	American sloughgrass	
	Herb	Boechera stricta	straight-up suncress	
y	Graminoid	Bromus inermis	smooth brome	Alien
	Graminoid	Bromus japonicus	Japanese brome	Alien
y	Graminoid	Bromus tectorum	cheatgrass	Alien
	Graminoid	Bromus vulgaris	Columbia brome	
y	Herb	Buglossoides arvensis (aka Lithospermum arvense)	corn gromwell	
y	Graminoid	Calamagrostis rubescens	pinegrass	
	Herb	Calochortus macrocarpus	sagebrush mariposa lily	
	Herb	Calypso bulbosa	fairy-slipper	
y	Herb	Camelina microcarpa	littlepod flax	Alien
	Herb	Campanula rotundifolia	common harebell	
y	Herb	Capsella bursa-pastoris	shepherd's purse	Alien
y	Graminoid	Carex atherodes	awned sedge	
y	Graminoid	Carex concinnoides	northwestern sedge	
	Graminoid	Carex disperma	soft-leaved sedge	

Species observed	Life form	Species	Common Name	Alien?
y	Graminoid	Carex pellita	woolly sedge	
	Graminoid	Carex petasata	pasture sedge	
y	Graminoid	Carex utriculata	beaked sedge	
	Herb	Castilleja miniata	scarlet paintbrush	
y	Herb	Cerastium arvense	field chickweed	
	Herb	Cerastium fontanum	mouse-ear chickweed	Alien
	Herb	Chenopodium sp.		
	Herb	Chimaphila umbellata	prince's pine	
y	Herb	Cirsium arvense	Canada thistle	Alien
y	Herb	Cirsium vulgare	bull thistle	Alien
	Herb	Claytonia cordifolia	heart-leaved springbeauty	
	Herb	Claytonia sibirica	Siberian miner's-lettuce	
y	Herb	Collinsia parviflora	small-flowered blue-eyed Mary	
y	Herb	Collomia linearis	narrow-leaved collomia	
y	Herb	Comandra umbellata		
	Herb	Corallorhiza maculata		
y	Herb	Crepis atribarba	slender hawksbeard	
	Herb	Cynoglossum officinale	common hound's-tongue	Alien
y	Graminoid	Dactylis glomerata	orchard-grass	Alien
	Graminoid	Danthonia californica	California oatgrass	
	Graminoid	Danthonia intermedia	timber oatgrass	
	Herb	Delphinium bicolor	Montana larkspur	
y	Herb	Delphinium nuttallianum	upland larkspur	
	Herb	Descurainia incana	Richardson's tansymustard	
y	Herb	Descurainia pinnata	short-fruited tansymustard	
	Herb	Descurainia sophia	flixweed	Alien
	Herb	Dodecatheon pulchellum	few-flowered shootingstar	
	Herb	Draba nemorosa	woods draba	
y	Herb	Drymocallis glandulosa var. glandulosa	sticky cinquefoil	

Species observed	Life form	Species	Common Name	Alien?
y	Graminoid	Eleocharis palustris	common spike-rush	
y	Graminoid	Elymus glaucus	blue wildrye	
y	Graminoid	Elymus repens	quackgrass	Alien
y	Graminoid	Elymus trachycaulus	slender wheatgrass	
y	Herb	Epilobium angustifolium	fireweed	
y	Herb	Epilobium brachycarpum	tall annual willowherb	
y	Herb	Epilobium ciliatum	purple-leaved willowherb	
y	Herb	Epilobium palustre	swamp willowherb	
y	Herb	Equisetum arvense	horsetail	
	Herb	Equisetum hyemale	scouring-rush	
	Herb	Eremogone capillaris	thread-leaved sandwort	
y	Herb	Erigeron compositus	cut-leaved daisy	
y	Herb	Erigeron corymbosus	long-leaved fleabane	
y	Herb	Erigeron divergens	diffuse fleabane	
	Herb	Erigeron filifolius	thread-leaved fleabane	
y	Herb	Erigeron linearis	linear-leaved daisy	
	Herb	Erigeron pumilus	shaggy fleabane	
y	Herb	Erigeron speciosus	showy daisy	
y	Herb	Eriogonum heracleoides	parsnip-flowered buckwheat	
	Herb	Eurybia conspicua	showy aster	
y	Graminoid	Festuca campestris	rough fescue	
y	Graminoid	Festuca idahoensis	Idaho fescue	
	Graminoid	Festuca occidentalis	western fescue	
y	Herb	Fragaria vesca	wood strawberry	
y	Herb	Fragaria virginiana	wild strawberry	
y	Herb	Fritillaria affinis	chocolate lily	
y	Herb	Fritillaria pudica	yellow bell	
y	Herb	Gaillardia aristata	brown-eyed Susan	
y	Herb	Galium boreale	northern bedstraw	
y	Herb	Galium trifidum	small bedstraw	
y	Herb	Galium triflorum	sweet-scented bedstraw	
	Herb	Geocaulon lividum	false toad-flax	
	Herb	Geranium bicknellii	Bicknell's geranium	
y	Herb	Geranium viscosissimum	sticky purple geranium	

Species observed	Life form	Species	Common Name	Alien?
y	Herb	Geum macrophyllum	large-leaved avens	
y	Herb	Geum triflorum	old man's whiskers	
	Graminoid	Glyceria striata	fowl mannagrass	
y	Herb	Goodyera oblongifolia	rattlesnake-plantain	
y	Herb	Hackelia deflexa	nodding stickseed	
	Graminoid	Hesperostipa comata ssp. comata	needle-and-thread grass	
	Herb	Heterotheca villosa	golden-aster	
	Herb	Heuchera chlorantha	meadow alumroot	
y	Herb	Heuchera cylindrica	round-leaved alumroot	
y	Herb	Hieracium albiflorum	white hawkweed	
	Herb	Hieracium gracile	slender hawkweed	
y	Herb	Hieracium scouleri	Scouler's hawkweed	
	Herb	Hieracium umbellatum	narrow-leaved hawkweed	
y	Herb	Hippuris vulgaris	common mare's-tail	
y	Graminoid	Hordeum jubatum	foxtail barley	
	Herb	Hydrophyllum capitatum	ballhead waterleaf	
y	Graminoid	Juncus balticus	Baltic rush	
y	Graminoid	Koeleria macrantha	junegrass	
	Herb	Lactuca serriola	prickly lettuce	alien
	Herb	Lappula occidentalis	western stickseed	
y	Herb	Lathyrus nevadensis	purple peavine	
	Herb	Lathyrus ochroleucus	creamy peavine	
y	Herb	Lemna minor	common duckweed	
	Herb	Lilium columbianum	tiger lily	
	Herb	Linaria genistifolia	Dalmatian toadflax	
	Herb	Linaria vulgaris	butter-and-eggs	
y	Herb	Linnaea borealis	twinflower	
y	Herb	Lithophragma parviflorum	small-flowered fringecup	
y	Herb	Lithospermum ruderale	lemonweed	
y	Herb	Lomatium dissectum	fern-leaved desert-parsley	
y	Herb	Lomatium macrocarpum	large-fruited desert-parsley	
	Herb	Lomatium triternatum	nine-leaved desert-	

Species observed	Life form	Species	Common Name	Alien?
			parsley	
y	Herb	Lupinus sericeus	silky lupine	
	Herb	Maianthemum racemosum	false Solomon's-seal	
y	Herb	Maianthemum stellatum	star-flowered false Solomon's-seal	
	Herb	Medicago lupulina	black medic	alien
	Herb	Medicago sativa	alfalfa	
y	Herb	Melilotus alba	white sweet-clover	alien
y	Herb	Mentha arvensis	field mint	
	Herb	Micranthes nidifica	meadow saxifrage	
	Herb	Mitella sp.	mitrewort	
	Herb	Moehringia lateriflora	blunt-leaved sandwort	
	Herb	Montia linearis	narrow-leaved montia	
	Herb	Mycelis muralis	wall lettuce	alien
	Herb	Myosotis stricta	blue forget-me-not	alien
y	Graminoid	Nassella viridula	green needlegrass	
	Herb	Opuntia fragilis	brittle prickly-pear cactus	
	Herb	Orobanche fasciculata	clustered broomrape	
y	Herb	Orthilia secunda	one-sided wintergreen	
	Graminoid	Oryzopsis asperifolia	rough-leaved ricegrass	
y	Herb	Osmorhiza berteroi	mountain sweet-cicely	
	Herb	Oxytropis campestris	field locoweed	
	Herb	Packera subnuda var. subnuda	alpine meadow butterweed	
	Graminoid	Pascopyrum smithii	western wheatgrass	
	Herb	Pedicularis racemosa	sickletop lousewort	
y	Herb	Penstemon fruticosus	shrubby penstemon	
	Herb	Penstemon procerus	small-flowered penstemon	
y	Herb	Persicaria amphibia	water smartweed	
	Herb	Petasites frigidus var. sagittatus	arrow-leaved coltsfoot	
y	Herb	Phacelia linearis	thread-leaved phacelia	
y	Graminoid	Phalaris arundinacea	reed canarygrass	
y	Graminoid	Phleum pratense	common timothy	alien

Species observed	Life form	Species	Common Name	Alien?
y	Herb	Phlox gracilis	pink twink	
	Herb	Phlox longifolia	long-leaved phlox	
y	Herb	Plantago major	common plantain	
y	Graminoid	Poa palustris	fowl bluegrass	
y	Graminoid	Poa pratensis	Kentucky bluegrass	alien
y	Graminoid	Poa secunda	Sandberg's bluegrass	
y	Herb	Polemonium pulcherrimum	showy Jacob's-ladder	
y	Herb	Polygonum douglasii	Douglas' knotweed	
y	Herb	Potentilla anserina	common silverweed	
y	Herb	Potentilla gracilis	graceful cinquefoil	
nearby	Herb	Potentilla recta	sulphur cinquefoil	alien
	Herb	Prosartes hookeri	Hooker's fairybells	
y	Herb	Prosartes trachycarpa	rough-fruited fairybells	
y	Herb	Prunella vulgaris	self-heal	
y	Graminoid	Pseudoroegneria spicata	bluebunch wheatgrass	
	Herb	Pterospora andromedea	pinedrops	
	Graminoid	Puccinellia nuttalliana	Nuttall's alkaligrass	
	Herb	Pyrola asarifolia	pink wintergreen	
	Herb	Pyrola chlorantha	green wintergreen	
	Herb	Ranunculus cymbalaria	shore buttercup	
	Herb	Ranunculus glaberrimus	sagebrush buttercup	
	Herb	Ranunculus uncinatus	little buttercup	
y	Herb	Rhinanthus minor	yellow rattle	
	Herb	Rorippa sylvestris	creeping yellowcress	alien
	Herb	Rumex sp.		
y	Herb	Rumex crispa	curled dock	alien
y	Herb	Rumex maritimus	golden dock	
	Herb	Salicornia sp.		
	Herb	Salsola tragus	Russian thistle	alien
	Herb	Sanicula marilandica	black sanicle	
	Herb	Saxifraga bronchialis		
	Herb	Scutellaria galericulata	marsh skullcap	
y	Herb	Sedum sp.		
	Herb	Selaginella densa	compact selaginella	
	Herb	Senecio sp.		

Species observed	Life form	Species	Common Name	Alien?
y	Herb	Silene menziesii	Menzies' campion	
	Herb	Silene parryi	Parry's campion	
y	Herb	Sisymbrium altissimum	tall tumble-mustard	alien
	Herb	Sisyrinchium idahoense	Idaho blue-eyed-grass	
	Herb	Sisyrinchium montanum	mountain blue-eyed-grass	
y	Herb	Sium suave	hemlock water-parsnip	
	Herb	Solidago canadensis	Canada goldenrod	
	Herb	Solidago simplex	spikelike goldenrod	
y	Herb	Sonchus arvensis	perennial sow-thistle	alien
y	Herb	Sonchus asper	prickly sow-thistle	alien
y	Herb	Stellaria nitens	shining starwort	
	Herb	Streptopus amplexifolius	clasping twistedstalk	
y	Herb	Symphyotrichum campestre	meadow aster	
y	Herb	Symphyotrichum ciliolatum	Lindley's aster	
	Herb	Symphyotrichum ericoides	tufted white prairie aster	
	Herb	Symphyotrichum falcatum	little gray aster	
y	Herb	Symphyotrichum foliaceum	leafy aster	
	Herb	Symphyotrichum spathulatum var. spathulatum	western mountain aster	
	Herb	Symphyotrichum subspicatum	Douglas' aster	
y	Herb	Taraxacum officinale	common dandelion	alien
y	Herb	Thalictrum occidentale	western meadowrue	
	Herb	Toxicoscordion venenosum	meadow death-camas	
y	Herb	Tragopogon dubius	yellow salsify	alien
y	Herb	Trifolium pratense	red clover	alien
y	Herb	Trifolium repens	white clover	alien
y	Herb	Utricularia macrorhiza	greater bladderwort	
y	Herb	Verbascum thapsus	great mullein	alien
y	Herb	Veronica beccabunga	American speedwell	
y	Herb	Vicia americana	American vetch	
	Herb	Viola adunca	early blue violet	
y	Herb	Viola canadensis	Canada violet	
y	Herb	Viola glabella	stream violet	

Species observed	Life form	Species	Common Name	Alien?
	Herb	Viola vallicola	yellow sagebrush violet	
	Herb	Woodsia sp.		
	Herb	Zigadenus elegans	mountain death-camas	
MOSSES AND LICHENS				
	Moss	Abietinella abietina	wiry fern-moss	
y	Moss	Aulacomnium palustre	glow moss	
	Moss	Barbilophozia barbata		
y	Moss	Brachythecium sp.	ragged-moss	
	Moss	Bryum argenteum	silver-moss	
	Moss	Bryum caespiticium	tufted thread-moss	
	Moss	Calocedrus decurrens	incense-cedar	
	Moss	Ceratodon purpureus	fire-moss	
	Moss	Cetraria islandica	icelandmoss	
	Lichen	Cetraria nivalis	ragged paperdoll	
y	Lichen	Cladina sp.	reindeer lichens	
y	Lichen	Cladonia cariosa	lesser ribbed pixie	
	Lichen	Cladonia cervicornis	laddered pixie-cup	
	Lichen	Cladonia chlorophaea	mealy pixie-cup	
	Lichen	Cladonia macilenta	lipstick powderhorn	
	Lichen	Cladonia macrophyllodes	stepladdered pixie-cup	
	Lichen	Cladonia pocillum	rosetted pixie-cup	
y	Lichen	Cladonia pyxidata	pebbled pixie-cup	
	Lichen	Cladonia subfurcata	rosegarden clad	
	Lichen	Cladonia symphycarpia	thatch soldiers	
	Lichen	Cladonia verruculosa	greater pebblehorn	
	Lichen	Cornicularia sp.	bootstrap lichen	
y	Moss	Dicranum polysetum	wavy-leaved moss	
	Moss	Dicranum tauricum	broken-leaf moss	
y	Lichen	Diploschistes muscorum	cow pie	
	Lichen	Diploschistes scruposus		
	Moss	Drepanocladus sp.	hook-moss	
	Moss	Eurhynchium pulchellum	elegant beaked-moss	
	Moss	Funaria hygrometrica	common cord-moss	
y	Moss	Grimmia sp.	grimmia	
y	Moss	Homalothecium sp.	curl-moss	

Species observed	Life form	Species	Common Name	Alien?
y	Moss	Hylocomium splendens	step moss	
y	Moss	Hypnum revolutum	rusty claw-moss	
	Moss	Hypnum sp.	claw-moss	
	Moss	Lecidea lurida		
	Lichen	Marchantia polymorpha	green-tongue liverwort	
	Lichen	Melanelia elegantula	elegant brown	
	Lichen	Melanelia infumata	elegant brown	
	Lichen	Melanelia sp.	brown lichens	
	Moss	Mnium sp.	leafy moss	
y	Moss	Mnium spinulosum	red-mouthed leafy moss	
	Lichen	Parmelia saxatilis	salted shield	
y	Lichen	Peltigera canina	dog pelt	
	Lichen	Peltigera didactyla	temporary pelt	
	Lichen	Peltigera lepidophora	butterfly pelt	
	Lichen	Peltigera malacea	apple pelt	
y	Lichen	Peltigera rufescens	felt pelt	
	Moss	Plagiomnium sp.	leafy moss	
y	Moss	Pleurozium schreberi	red-stemmed feathermoss	
	Moss	Pohlia nutans	nodding thread-moss	
	Moss	Polytrichum juniperinum	juniper haircap moss	
	Moss	Pterigynandrum filiforme	capillary wing-moss	
	Moss	Pterygoneurum ovatum		
	Liverwort	Ptilidium ciliare	northern naugahyde liverwort	
y	Moss	Ptilium crista-castrensis	knight's plume	
y	Moss	Racomitrium sp.	rock-moss	
	Moss	Rhizomnium glabrescens	large leafy moss	
	Moss	Rhizomnium sp.	leafy moss	
y	Moss	Rhytidiadelphus triquetrus	electrified cat's-tail moss	
	Moss	Rhytidiopsis robusta	pipecleaner moss	
	Moss	Roellia roellii	mountain moss	
	Moss	Sanionia uncinata	sickle-moss	
	Lichen	Stereocaulon spp.	foam lichens	
y	Moss	Timmia austriaca	false-polytrichum	

Species observed	Life form	Species	Common Name	Alien?
y	Moss	Tortula ruralis	sidewalk moss	
y	Lichen	Umbilicaria spp.	rocktripe lichens	
	Lichen	Xanthoria polycarpa	pincushion orange	

Appendix 3 – Noxious Weed List for LGMGIS

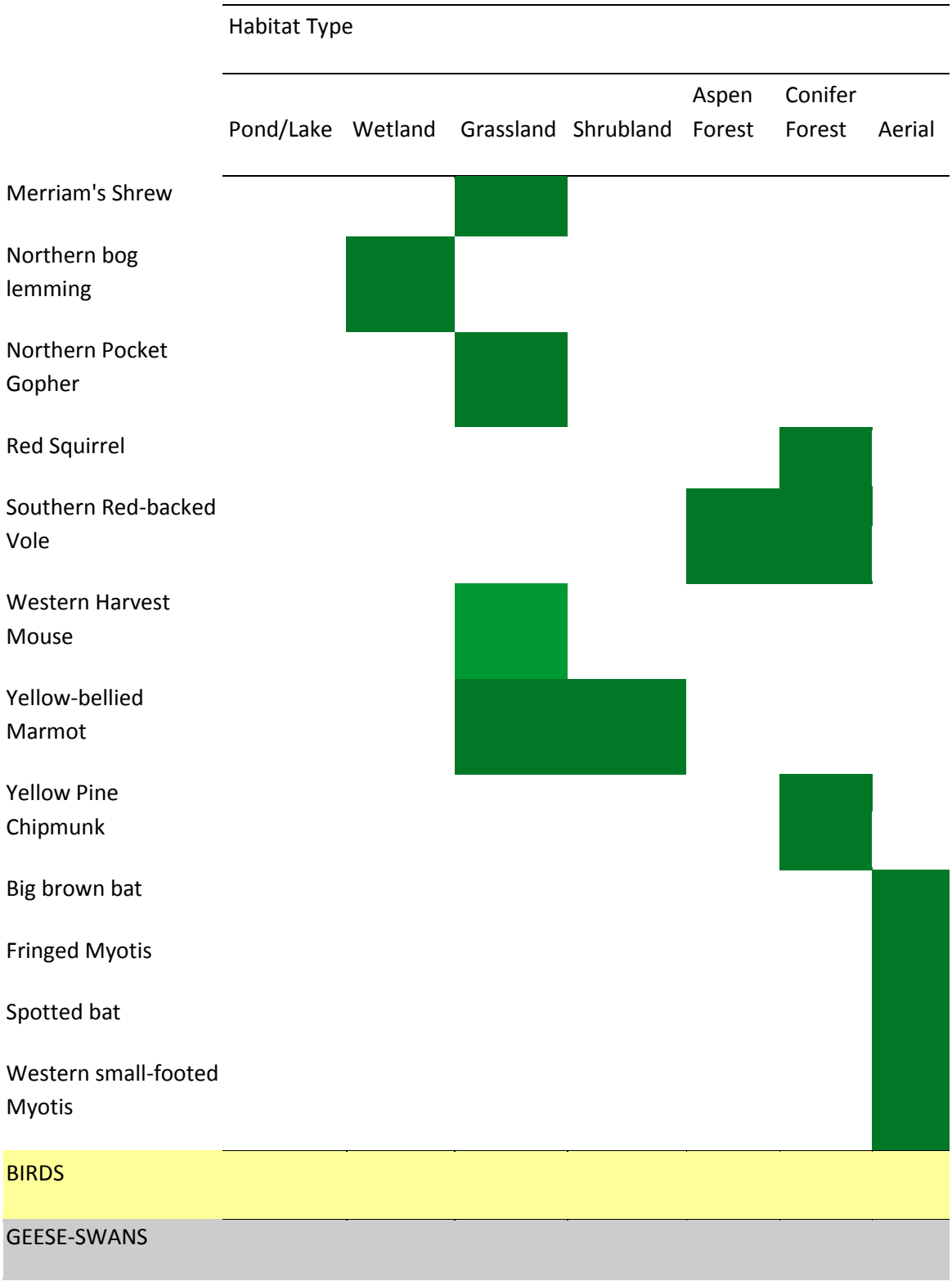
A list of noxious weeds (regulated invasive plants) and unregulated invasive plants of concern for LGMGIS.

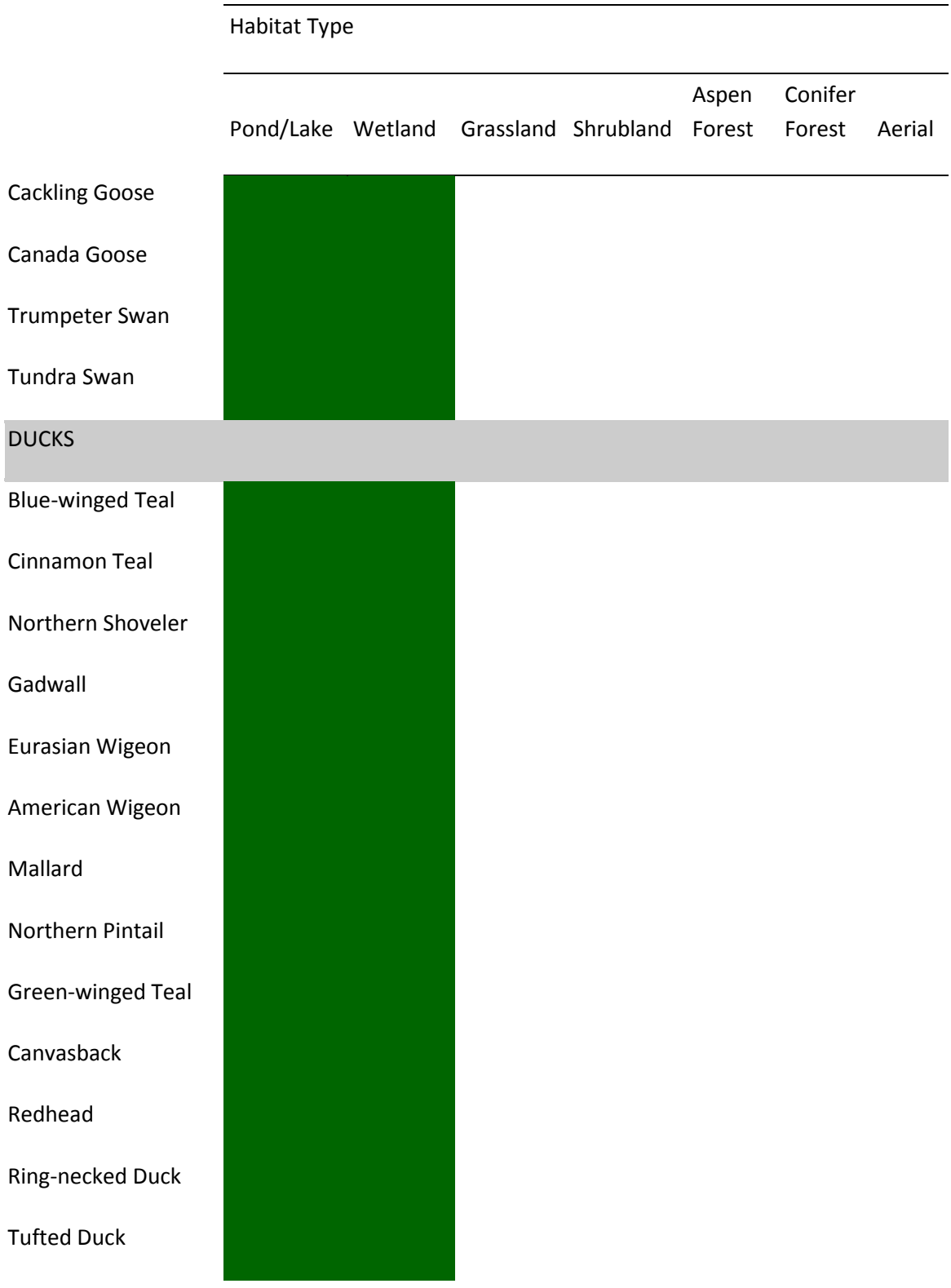
Common Name	Scientific Name	Distribution	List
Bull thistle	Cirsium vulgare	Occasionally in disturbed coniferous forest	Unregulated invasive plants of concern in B.C.
Canada thistle	Cirsium arvense	Aspen copses, drier parts of wetlands	Provincially noxious
Hound's tongue	Cynoglossum officinale	Disturbed parts of aspen copses	Provincially noxious
Perennial sow-thistle	Sonchus arvensis	Disturbed areas in grasslands	Provincially noxious
Spotted knapweed	Centaurea stoebe	Widespread in grasslands, only scattered plants in other habitats	Provincially noxious
Sulphur Cinquefoil	Potentilla recta	Presently known from near the property (but not on it)	Regionally noxious

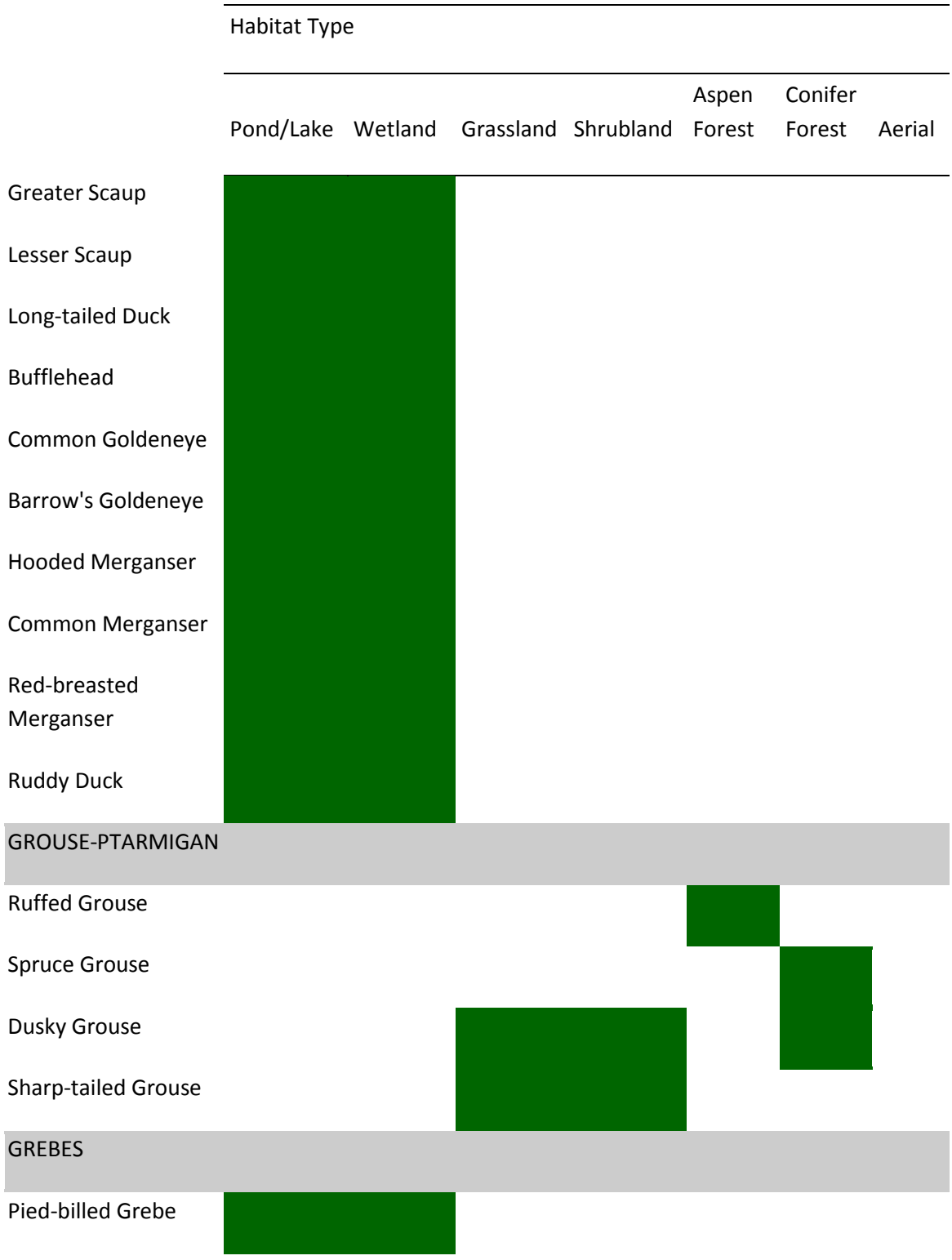
Appendix 4 – Wildlife Species List for LGMGIS

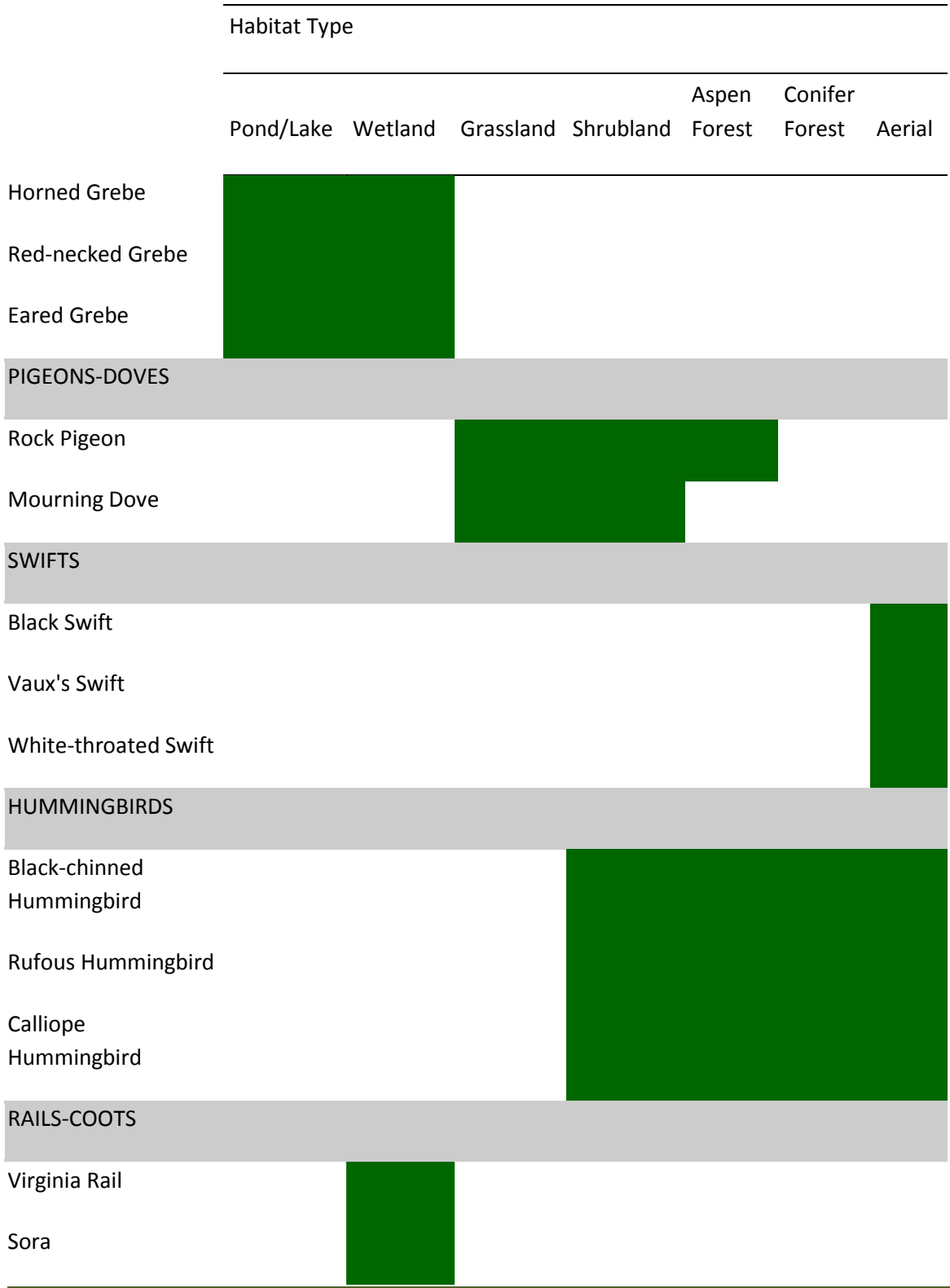
The following table lists potential wildlife species that we anticipate could occur at the LGMGIS based upon historic work in similar ecosystems. The habitats listed below correspond to the broad ecological types described and mapped at LGMGIS as indicated by the green highlighting.

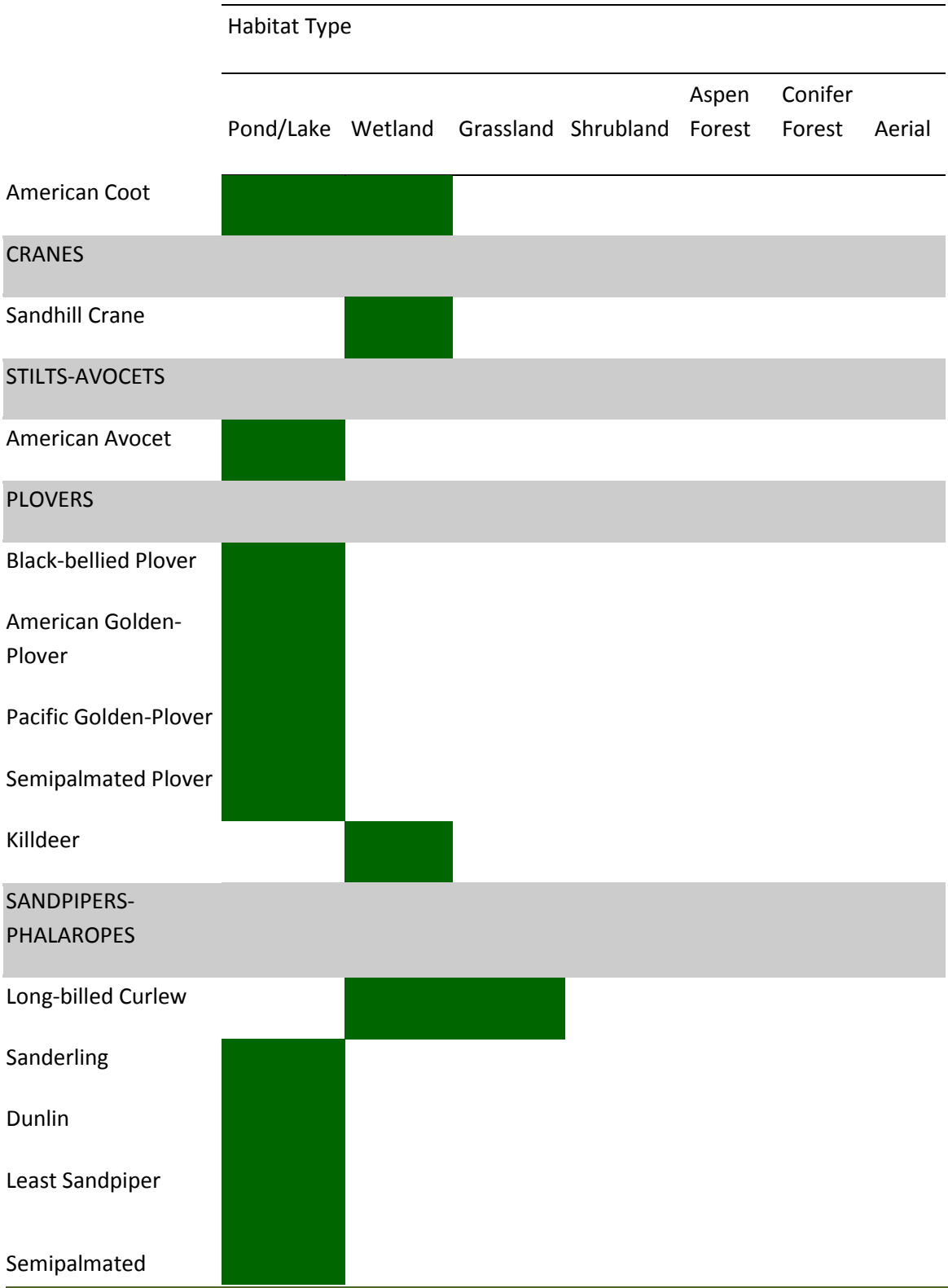
	Habitat Type						
	Pond/Lake	Wetland	Grassland	Shrubland	Aspen Forest	Conifer Forest	Aerial
MAMMALS							
Mule Deer							
White-tailed Deer							
Moose							
Elk							
Black Bear							
American Badger							
Bobcat							
Cougar							
Coyote							
Lynx							
Snowshoe or Varying Hare							
Deer mouse							
Montane Vole							

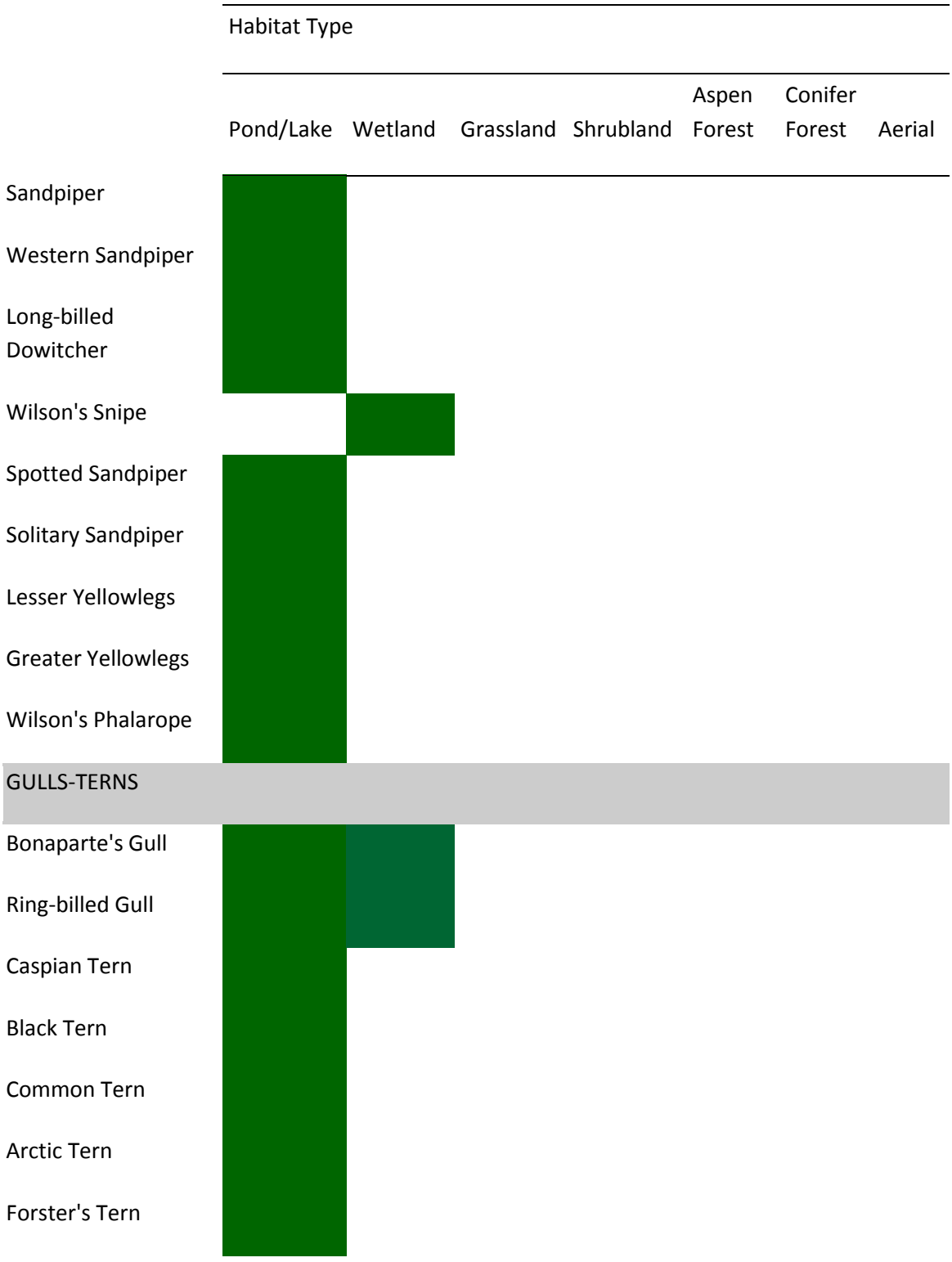

Habitat Type
Pond/Lake
Wetland
Grassland
Shrubland
Aspen Forest
Conifer Forest
Aerial
Merriam's Shrew
Northern bog lemming
Northern Pocket Gopher
Red Squirrel
Southern Red-backed Vole
Western Harvest Mouse
Yellow-bellied Marmot
Yellow Pine Chipmunk
Big brown bat
Fringed Myotis
Spotted bat
Western small-footed Myotis
BIRDS
GEESE-SWANS


Habitat Type
Pond/Lake
Wetland
Grassland
Shrubland
Aspen Forest
Conifer Forest
Aerial
Cackling Goose
Canada Goose
Trumpeter Swan
Tundra Swan
DUCKS
Blue-winged Teal
Cinnamon Teal
Northern Shoveler
Gadwall
Eurasian Wigeon
American Wigeon
Mallard
Northern Pintail
Green-winged Teal
Canvasback
Redhead
Ring-necked Duck
Tufted Duck

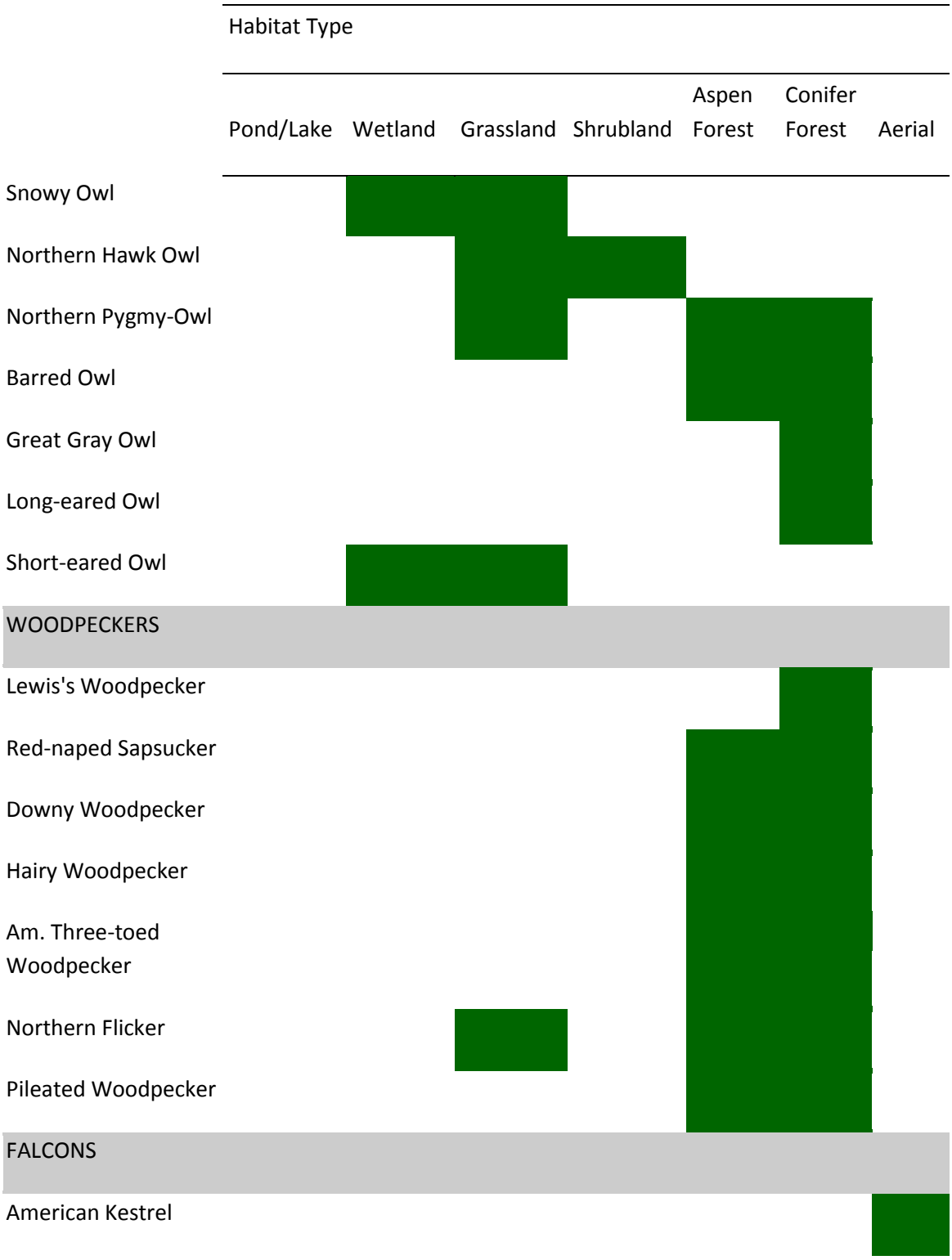

Habitat Type
Pond/Lake
Wetland
Grassland
Shrubland
Aspen Forest
Conifer Forest
Aerial
Greater Scaup
Lesser Scaup
Long-tailed Duck
Bufflehead
Common Goldeneye
Barrow's Goldeneye
Hooded Merganser
Common Merganser
Red-breasted Merganser
Ruddy Duck
GROUSE-PTARMIGAN
Ruffed Grouse
Spruce Grouse
Dusky Grouse
Sharp-tailed Grouse
GREBES
Pied-billed Grebe


Habitat Type
Pond/Lake
Wetland
Grassland
Shrubland
Aspen Forest
Conifer Forest
Aerial
Horned Grebe
Red-necked Grebe
Eared Grebe
PIGEONS-DOVES
Rock Pigeon
Mourning Dove
SWIFTS
Black Swift
Vaux's Swift
White-throated Swift
HUMMINGBIRDS
Black-chinned Hummingbird
Rufous Hummingbird
Calliope Hummingbird
RAILS-COOTS
Virginia Rail
Sora

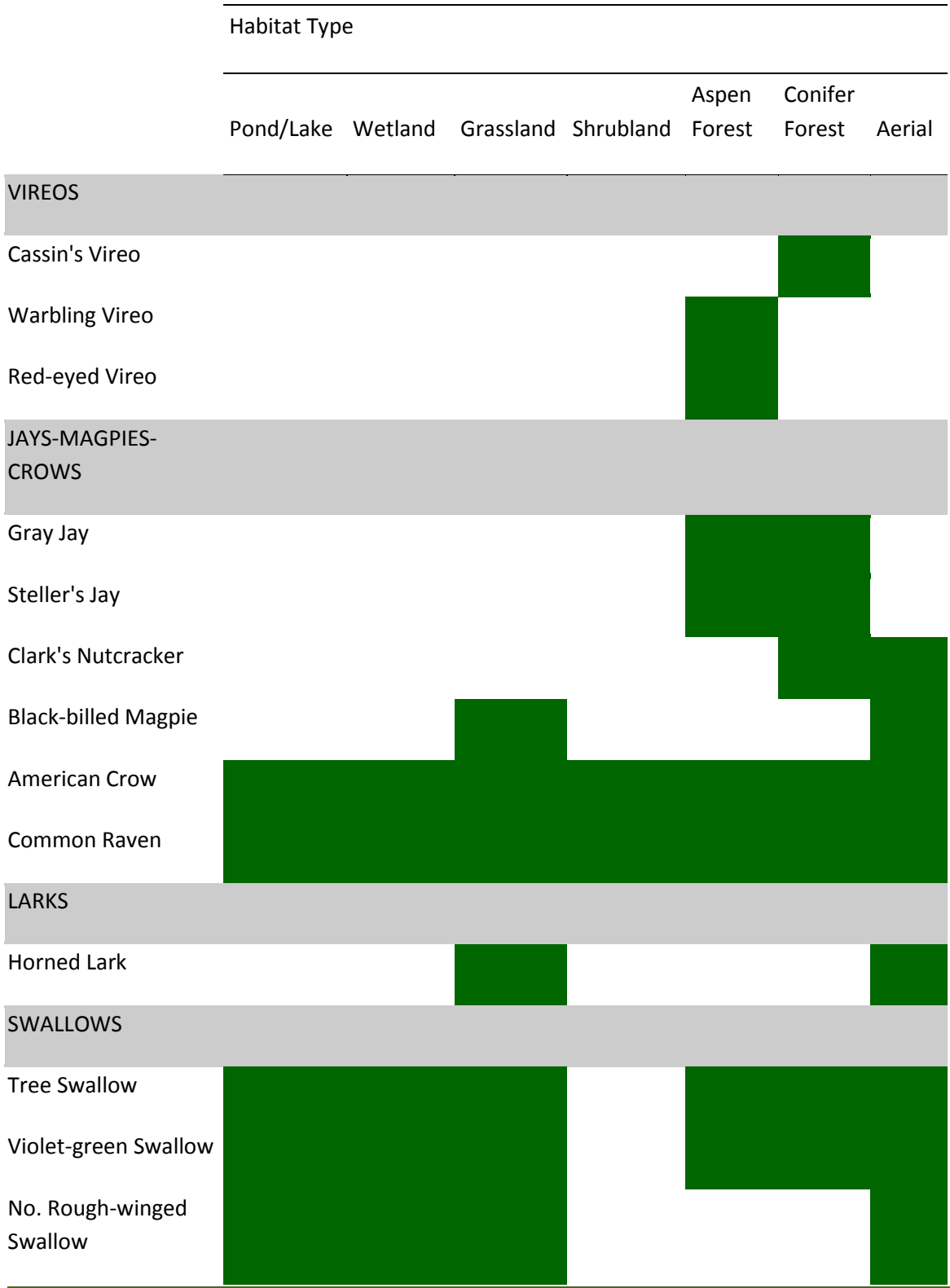

Habitat Type
Pond/Lake
Wetland
Grassland
Shrubland
Aspen Forest
Conifer Forest
Aerial
American Coot
CRANES
Sandhill Crane
STILTS-AVOCETS
American Avocet
PLOVERS
Black-bellied Plover
American Golden-Plover
Pacific Golden-Plover
Semipalmated Plover
Killdeer
SANDPIPERS-PHALAROPES
Long-billed Curlew
Sanderling
Dunlin
Least Sandpiper
Semipalmated


Habitat Type
Pond/Lake
Wetland
Grassland
Shrubland
Aspen Forest
Conifer Forest
Aerial
Sandpiper
Western Sandpiper
Long-billed Dowitcher
Wilson's Snipe
Spotted Sandpiper
Solitary Sandpiper
Lesser Yellowlegs
Greater Yellowlegs
Wilson's Phalarope
GULLS-TERNS
Bonaparte's Gull
Ring-billed Gull
Caspian Tern
Black Tern
Common Tern
Arctic Tern
Forster's Tern

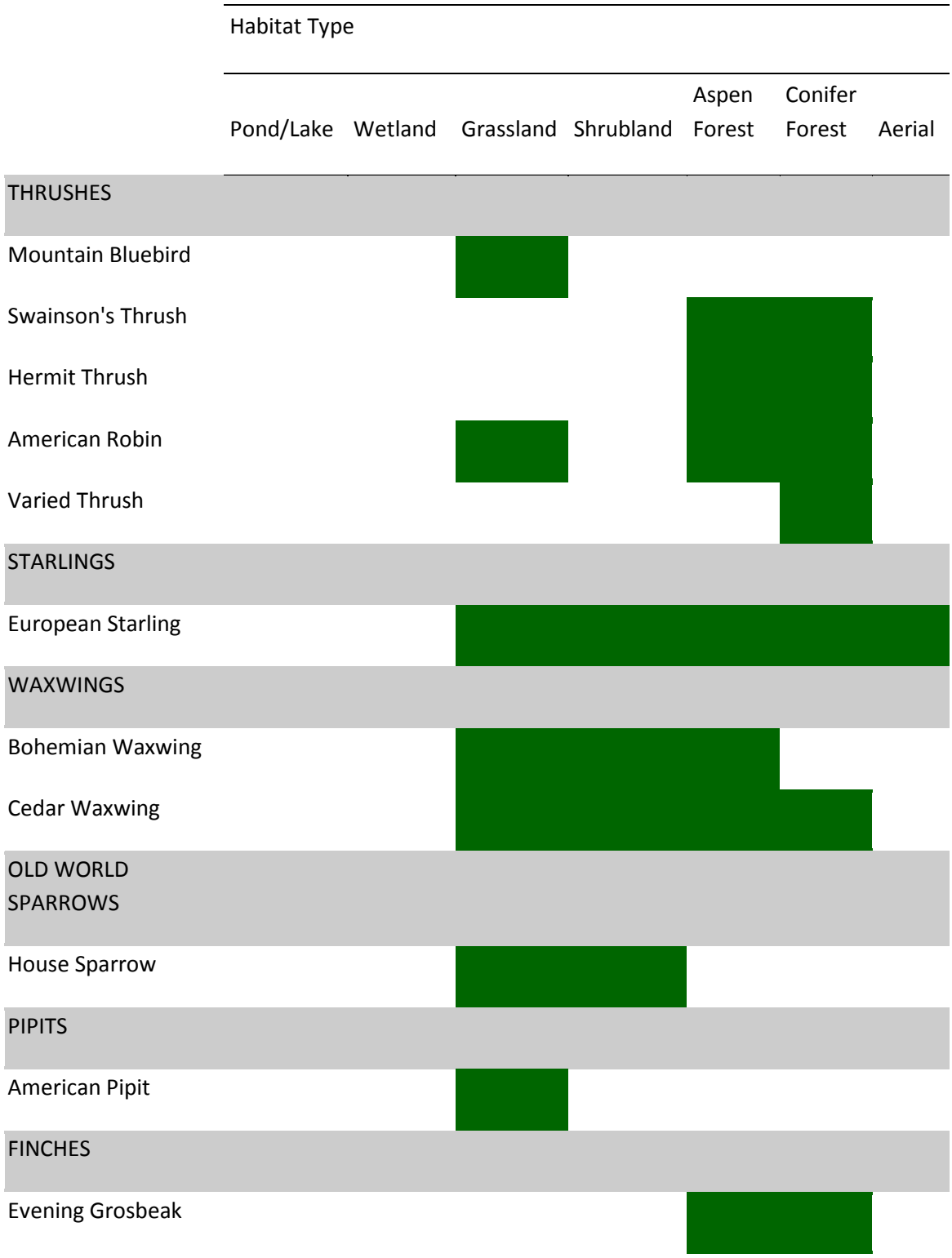

Habitat Type
Pond/Lake
Wetland
Grassland
Shrubland
Aspen Forest
Conifer Forest
Aerial
EGRETS-HERONS
Great Blue Heron
VULTURES
Turkey Vulture
OSPREY-EAGLES-HAWKS
Osprey
Bald Eagle
Northern Harrier
Sharp-shinned Hawk
Cooper's Hawk
Northern Goshawk
Red-tailed Hawk
Rough-legged Hawk
Golden Eagle
OWLS
Flammulated Owl
Great Horned Owl

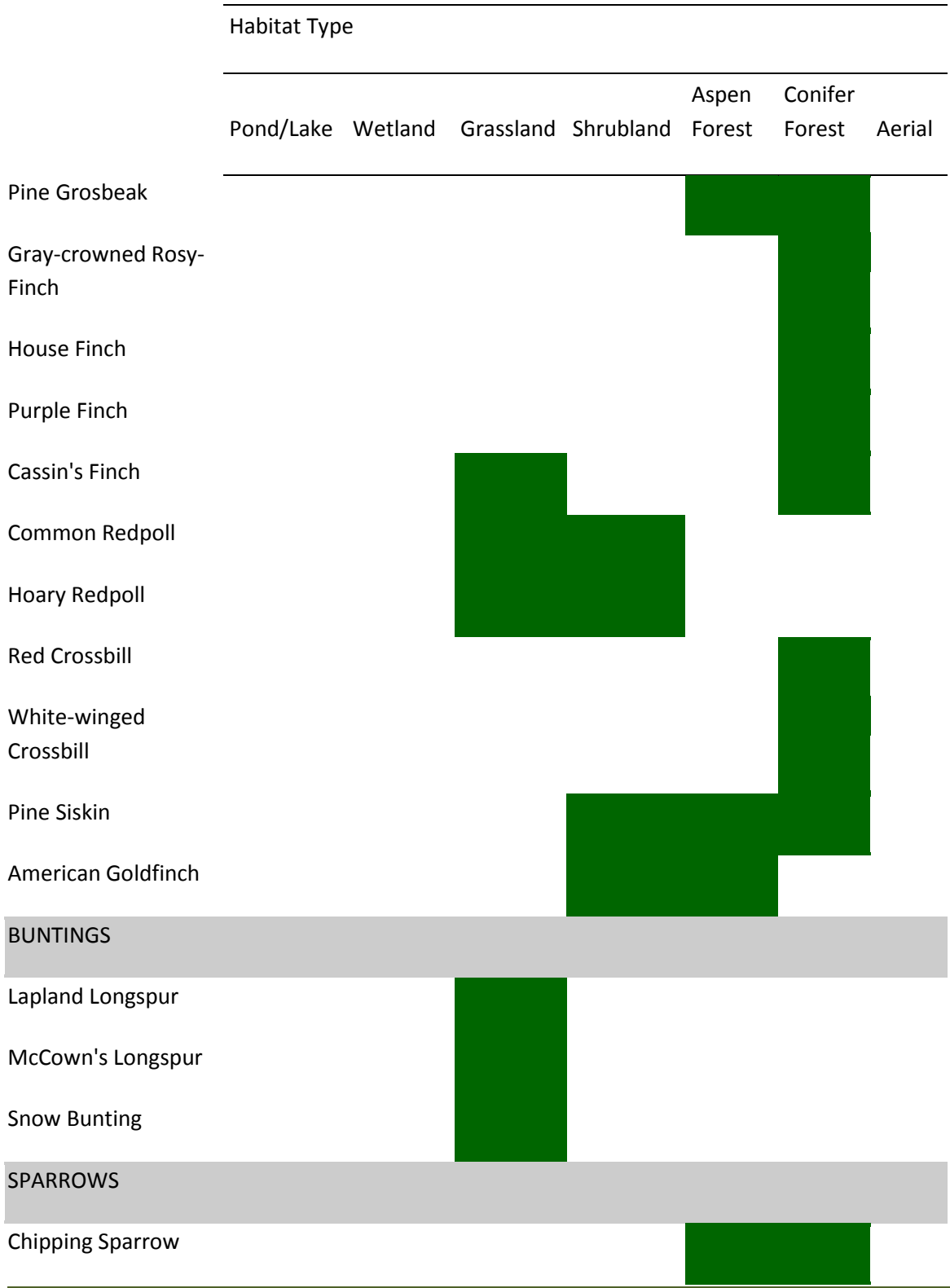

Habitat Type
Pond/Lake
Wetland
Grassland
Shrubland
Aspen Forest
Conifer Forest
Aerial
Snowy Owl
Northern Hawk Owl
Northern Pygmy-Owl
Barred Owl
Great Gray Owl
Long-eared Owl
Short-eared Owl
WOODPECKERS
Lewis's Woodpecker
Red-naped Sapsucker
Downy Woodpecker
Hairy Woodpecker
Am. Three-toed Woodpecker
Northern Flicker
Pileated Woodpecker
FALCONS
American Kestrel

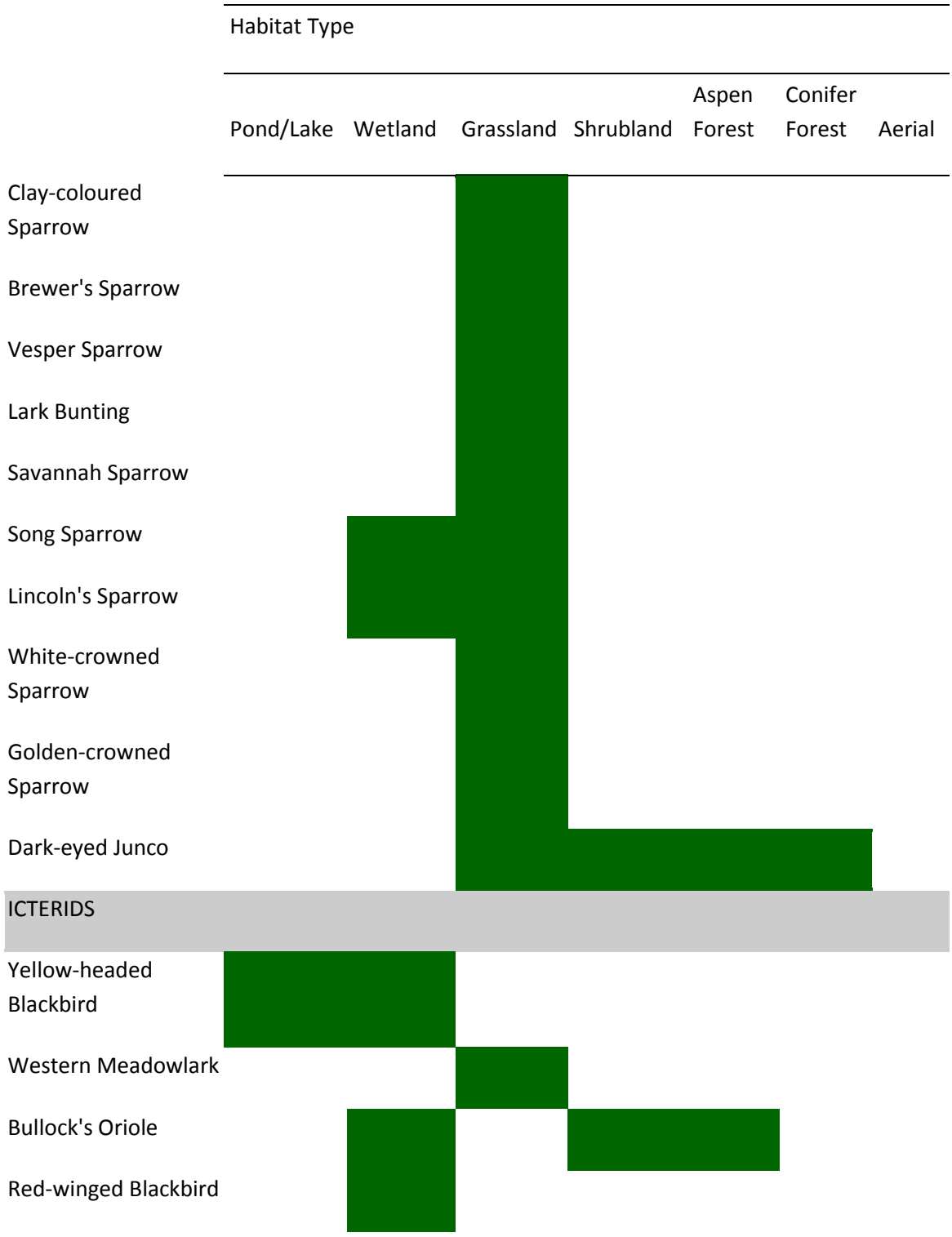

Habitat Type
Pond/Lake
Wetland
Grassland
Shrubland
Aspen Forest
Conifer Forest
Aerial
Merlin
Gyrfalcon
Peregrine Falcon
Prairie Falcon
FLYCATCHERS
Olive-sided Flycatcher
Western Wood-Peewee
Alder Flycatcher
Willow Flycatcher
Least Flycatcher
Hammond's Flycatcher
Dusky Flycatcher
Pacific-slope Flycatcher
SHRIKES
Northern Shrike

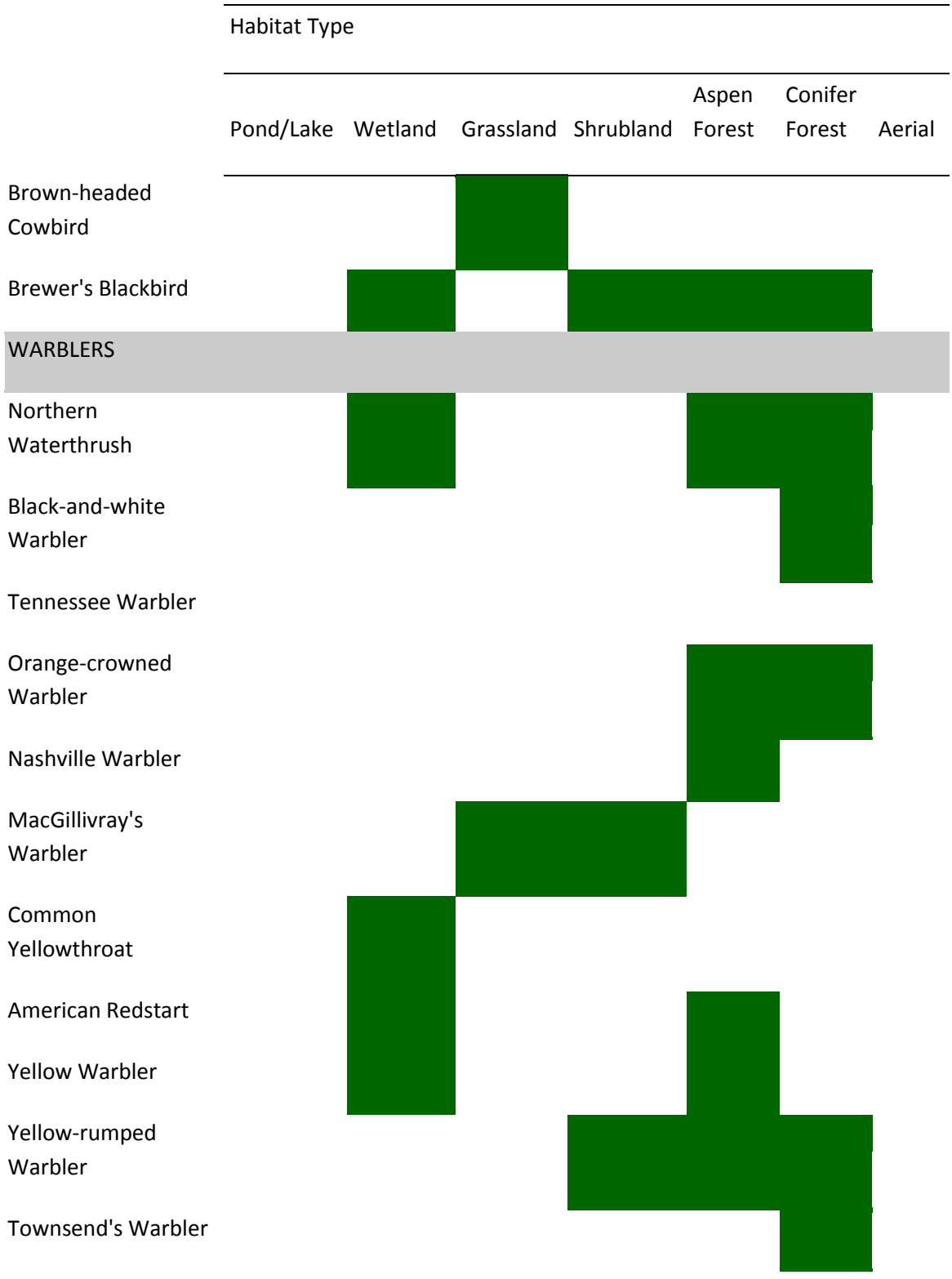

Habitat Type
Pond/Lake
Wetland
Grassland
Shrubland
Aspen Forest
Conifer Forest
Aerial
VIREOS
Cassin's Vireo
Warbling Vireo
Red-eyed Vireo
JAYS-MAGPIES-CROWS
Gray Jay
Steller's Jay
Clark's Nutcracker
Black-billed Magpie
American Crow
Common Raven
LARKS
Horned Lark
SWALLOWS
Tree Swallow
Violet-green Swallow
No. Rough-winged Swallow


Habitat Type
Pond/Lake
Wetland
Grassland
Shrubland
Aspen Forest
Conifer Forest
Aerial
Bank Swallow
Cliff Swallow
Barn Swallow
CHICKADEES
Black-capped Chickadee
Mountain Chickadee
NUTHATCHES
Red-breasted Nuthatch
CREEPERS
Brown Creeper
WRENS-DIPPER-KINGLETS
Marsh Wren
Golden-crowned Kinglet
Ruby-crowned Kinglet
BLUEBIRDS-


Habitat Type
Pond/Lake
Wetland
Grassland
Shrubland
Aspen Forest
Conifer Forest
Aerial
THRUSHES
Mountain Bluebird
Swainson's Thrush
Hermit Thrush
American Robin
Varied Thrush
STARLINGS
European Starling
WAXWINGS
Bohemian Waxwing
Cedar Waxwing
OLD WORLD SPARROWS
House Sparrow
PIPITS
American Pipit
FINCHES
Evening Grosbeak


Habitat Type
Pond/Lake
Wetland
Grassland
Shrubland
Aspen Forest
Conifer Forest
Aerial
Pine Grosbeak
Gray-crowned Rosy-Finch
House Finch
Purple Finch
Cassin's Finch
Common Redpoll
Hoary Redpoll
Red Crossbill
White-winged Crossbill
Pine Siskin
American Goldfinch
BUNTINGS
Lapland Longspur
McCown's Longspur
Snow Bunting
SPARROWS
Chipping Sparrow


Habitat Type
Pond/Lake
Wetland
Grassland
Shrubland
Aspen Forest
Conifer Forest
Aerial
Clay-coloured Sparrow
Brewer's Sparrow
Vesper Sparrow
Lark Bunting
Savannah Sparrow
Song Sparrow
Lincoln's Sparrow
White-crowned Sparrow
Golden-crowned Sparrow
Dark-eyed Junco
ICTERIDS
Yellow-headed Blackbird
Western Meadowlark
Bullock's Oriole
Red-winged Blackbird


Habitat Type
Pond/Lake
Wetland
Grassland
Shrubland
Aspen Forest
Conifer Forest
Aerial
Brown-headed Cowbird
Brewer's Blackbird
WARBLERS
Northern Waterthrush
Black-and-white Warbler
Tennessee Warbler
Orange-crowned Warbler
Nashville Warbler
MacGillivray's Warbler
Common Yellowthroat
American Redstart
Yellow Warbler
Yellow-rumped Warbler
Townsend's Warbler


Habitat Type
Pond/Lake
Wetland
Grassland
Shrubland
Aspen Forest
Conifer Forest
Aerial
CARDINALS
Western Tanager
Lazuli Bunting
REPTILES
Great Basin Gopher Snake
North American racer
Northern Rubber Boa
Painted Turtle
AMPHIBIANS
Western Toad
Great Basin Spadefoot

Appendix 5. List of potential red- and blue-listed vertebrate species for LGMGIS.

Species	Status	Included	Rationale
White-throated Swift	Blue	No	no suitable nesting habitat on LGMGIS
Great Blue Heron, herodias subspecies	Blue	no	difficult to assign habitat suitability and capability ratings
Short-eared Owl	Blue	yes	
Burrowing Owl	Red	no	unlikely to occur in study area
Swainson's Hawk	Red	no	unlikely to occur in study area
Canyon Wren	Blue	no	no suitable nesting habitat on LGMGIS
Lark Sparrow	Blue	no	unlikely to occur in study area
Painted Turtle	Blue	no	unlikely to occur in study area
North American Racer	Blue	no	unlikely to occur in study area
Olive-sided Flycatcher	Blue	yes	
Townsend's Big-eared Bat	Blue	no	unlikely to den/roost in study area
Western Rattlesnake	Blue	no	unlikely to occur in study area
Black Swift	Blue	no	no suitable nesting habitat on LGMGIS
Bobolink	Blue	no	no suitable nesting habitat on LGMGIS
Horned Lark, merrilli	Blue	no	unlikely to occur in study area

Species	Status	Included	Rationale
subspecies			
Spotted Bat	Blue	no	unlikely to den/roost in study area
Rusty Blackbird	Blue	yes	
Prairie Falcon	Red	no	no suitable nesting habitat on LGMGIS
Peregrine Falcon, anatum subspecies	Red	no	no suitable nesting habitat on LGMGIS
Wolverine, luscus subspecies	Blue	no	unlikely to occur in study area
Barn Swallow	Blue	no	no suitable nesting habitat on LGMGIS
Western Screech-Owl, macfarlanei subspecies	Blue	no	no suitable nesting habitat on LGMGIS
Lewis's Woodpecker	Blue	yes	
Western Small-footed Myotis	Blue	no	unlikely to den/roost in study area
Fringed Myotis	Blue	no	unlikely to den/roost in study area
Long-billed Curlew	Blue	no	unlikely to breed in study area
Sage Thrasher	Red	no	no suitable nesting habitat on LGMGIS
Bighorn Sheep	Blue	no	unlikely to occur in study area
Fisher	Blue	no	unlikely to occur in study area

Species	Status	Included	Rationale
Columbia Plateau Pocket Mouse	Blue	no	unlikely to occur in study area
Gopher Snake, deserticola subspecies	Blue	no	unlikely to den/roost in study area
Eared Grebe	Blue	no	unlikely to nest/ in study area
Flammulated Owl	Blue	yes	
American Avocet	Blue	no	unlikely to occur in study area
Great Basin Spadefoot	Blue	yes	
Williamson's Sapsucker	Blue	no	unlikely to occur in study area
American Badger	Red	yes	
Sharp-tailed Grouse, columbianus subspecies	Blue	yes	
Grizzly Bear	Blue	no	unlikely to occur in study area