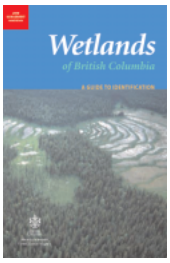

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Wetlands and related ecosystems are vital components of British Columbia's ecological diversity. This useful and beautiful guide presents descriptions of more than 100 wetland, floodplain, estuarine, shallow-water, and "transitional" site associations and their plants, wildlife, and soils. It provides a common language to describe wetland ecosystems and also provides an ecological basis for the management of wetlands. Colour photographs illustrate each of the associations in the fact-sheet summary that outlines essential environmental and biological attributes.

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52 LAND MANAGEMENT HANDBOOK

Wetlands of British Columbia

A GUIDE TO IDENTIFICATION

BRITISH COLUMBIA
Ministry of Forests
Forest Science Program

Wetlands of British Columbia A GUIDE TO IDENTIFICATION

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A GUIDE TO IDENTIFICATION

William H. MacKenzie
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BRITISH COLUMBIA

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Introduction 1

Wetlands are relatively uncommon ecosystems throughout most of British Columbia and yet play an integral role. Montane ponds and fens, such as this one near Alice Arm, support high-elevation wildlife populations and regulate headwater hydrology.

This guide presents a site classification and interpretative information for wetlands and related ecosystems of British Columbia. Site identification is based upon principles of Biogeoclimatic Ecosystem Classification (BEC) modified for wetland ecosystems.

The objectives of the classification are:

- to provide a framework for organizing ecological information and management experience about ecosystems;
- to promote a better understanding of wetlands and related ecosystems;
- to provide users with a common language to describe wetland ecosystems; and
- to provide an ecological basis for management of wetlands.

The Research Branch of British Columbia's Ministry of Forests initiated a program in 1994 to classify and describe the wetlands and riparian areas of British Columbia. Its central intent was to generate basic ecological information about these important ecosystems. This guide represents one aspect of the Wetland and Riparian Ecosystem Classification (WREC) initiative and has two principal goals:

- to assist users in describing and identifying wetland ecosystems; and
- to provide management interpretations to assist in conservation of wetlands ecosystems.

OTHER SOURCES OF INFORMATION

A more detailed description of the wetland classification framework can be found in *Classification of Wetlands and Related Ecosystems in British Columbia* (MacKenzie and Banner 2001). Explanations of the national wetland classification are presented in the *Wetlands of Canada* (NWWG 1988). *Biogeoclimatic Ecosystem Classification in British Columbia* (Pojar et al. 1987) outlines the methods and philosophy of BEC; descriptions of biogeoclimatic zones and representative ecosystems can be found in *Ecosystems of British Columbia* (Meidinger and Pojar 1991). For more detailed discussion of the standard methods used to describe ecosystems in British Columbia, refer to *Describing Ecosystems in the Field* (2nd edition) (Luttmerding et al. 1990), *Field Manual for Describing Terrestrial Ecosystems* (Province of British Columbia 1998), and *A Wetland Sampling Methodology: Draft* (MacKenzie and Shaw 1998).

Regional treatments of wetland Site Associations have been published for the Cariboo (Steen and Roberts 1988), south Coast (Klinka et al.

unpublished), and north Coast (Banner et al. 1986). Regional BEC field-guides (e.g., Banner et al. 1993) also contain descriptions for some forested swamp, bog, and flood ecosystems. For a comparison to wetland units described in other classifications, refer to Appendix 4.

For field identification of wetland plant species, refer to any of the Lone Pine series. For example, *Plants of Northern British Columbia* (MacKinnon et al. 1992) can be helpful for willow identification and *Plants of the Western Boreal Forest and Aspen Parkland* (Johnson et al. 1995) is good for sedges and mosses, especially *Sphagnum* species. The *Illustrated Flora of British Columbia* (Douglas et al. 1998–2002) provides formal botanical keys to vascular species identification.

GUIDE CONTENT AND LIMITATIONS

This guide describes common wetland ecosystems that occur in British Columbia. Related types of ecosystems that do not meet the strict definition for true wetlands are also presented. These include:

- **Flood** ecosystems, which occur on the floodplains of rivers and are inundated during the spring freshet but have well-drained and aerated soils;
- "**Transition**" ecosystems, which are often associated with wetlands and can have the vegetation structure similar to a wetland but have merely moist soils and few wetland indicator species; and
- tidal **Estuarine** ecosystems, which occur at the confluence of marine and fluvial environments.

Alpine wetlands are not described in this guide.

No guide can encompass all of the complexity and diversity of ecosystems that occur on the landscape. Although the described units include most of the common wetland and related ecosystems found in the province, users are likely to encounter sites that do not appear to "fit" the classification. Furthermore, wetlands are complex ecosystems that can change rapidly with hydrological modifications. This guide describes ecosystems that recur throughout the landscape and appear to be relatively stable in vegetation composition. An understanding of basic ecological factors and wetland processes is required to assess whether an equivocal site is in transition, represents a distinct ecological community not yet described, or is a variation of a described site association. This guide is just one tool to help describe and compare wetland and related

ecosystems and must be supplemented with practical knowledge, experience, and judgement.

The guide consists of the following major sections:

Chapter 2 provides an overview of the basic ecological features and environments of wetlands and related ecosystems and a summary of the classification systems underlying units in this guide.

Chapter 3 explains the taxonomic conventions, format, and coding used throughout the guide and the process of site identification.

Chapter 4 gives several tools for identifying the Site Class (broad functional groups of wetland ecosystems) including keys, tables of characteristics, and brief descriptive summaries.

Chapter 5 constitutes the main body of the guide. This chapter provides basic ecological information for the recognition of different wetland ecosystem types that occur in British Columbia. In standardized fact sheet format, information is provided for all wetland Site Classes and Site Associations. The chapter is divided into eight sections, one for each Site Class or Group described in this guide. A description of the major ecological characteristics for each recognized Association is presented in a one-page fact-sheet format outlining site, vegetation, and environmental characteristics. Short descriptions are included at the end of each section for infrequently sampled or poorly known ecosystems.

Chapter 6 summarizes conservation and management issues for wetlands and related ecosystems. This information will allow resource managers to make better-informed decisions on conservation and management of these ecosystems.

The **appendices** provide background information for the guide, including details about the multivariate analysis used to create the classification, a crosswalk to similar previously described units, a list of hydrophytes, a list of wetland-affiliated wildlife species, a glossary, and interpretive overlays of the wetland edatopic grid.

2 *Ecology and classification of wetland ecosystems*

The habitats surrounding wetlands are essential for a functioning wetland ecosystem. Most wildlife inhabiting this marsh near Lac La Hache will also use the adjacent grassland, aspen copse, or coniferous forest for some important part of their life cycle.

This section briefly describes the important ecological themes and principal concepts in ecosystem classification of wetland and related ecosystems.

CHARACTERISTICS OF WETLANDS AND RELATED ECOSYSTEMS

Wetland Ecosystems

Wetlands are:

> *areas where soils are water-saturated for a sufficient length of time such that excess water and resulting low soil oxygen levels are principal determinants of vegetation and soil development. Wetlands will have a relative abundance of hydrophytes in the vegetation community and/or soils featuring "hydric" characters.*

This wetland definition encompasses a wide range of ecosystems, from semi-terrestrial fens, bogs, and swamps to semi-aquatic marshes and shallow open water. Wetlands include a broad range of ecosystem types, from those permanently flooded by shallow water and dominated by aquatic organisms to forested sites with merely wet soils.

The water-saturated environment of wetlands supports a unique group of plants called **hydrophytes**. These plants are adapted to grow in waterlogged soils. Excessive water and the low rate at which oxygen diffuses under these conditions leads to a complex of critical conditions that require specialized adaptations (Daubenmire 1959). Adaptations, such as leathery leaves (to reduce nutrient requirements and combat physiological drought) or specialized internal air compartments (to transport oxygen to the roots) are required for wetland plants. **Obligate hydrophytes** (such as great bulrush) are restricted to wetlands and semi-aquatic sites. **Facultative hydrophytes** (such as Labrador tea and many other members of the Heather family) occur commonly in wetlands but also appear on some upland sites.

Wetland soils are subhydric or hydric and have one or more of the following features that reflect anaerobic soil conditions:

1. Peaty organic horizons greater than 40 cm thick.
2. Non-sandy soils with blue-grey gleying within 30 cm of the surface.
3. Sandy soils with prominent mottles within 30 cm of the surface or blue-grey matrix.
4. Hydrogen sulphide (rotten egg smell) in upper 30 cm.

From an ecological perspective, either an abundance of hydrophytes or hydric soil conditions is generally sufficient to indicate a wetland ecosystem. The boundary of the wetland is identified by changes in vegetation structure, loss of hydrophytes, and absence of wetland soil characteristics.

Environmental gradients in wetland ecosystems

The stability, mobility, and chemical composition of the watertable are the major environmental variables at the site level that differentiate wetland ecosystems.

The **acidity/alkalinity** of the watertable relates directly to base cation content and indirectly to nutrient availability in wetland ecosystems. Major floristic shifts occur over this gradient, particularly in peatlands (Vitt 1994). Ombrotrophic sites receive surface water from precipitation only and have few available base cations, high acidity, and very poor nutrient regime, and are dominated by *Sphagnum* mosses. Where the surface waters have been in contact with mineral materials, base cations in the surface water increase and the site becomes more alkaline, and peatlands become dominated by brown mosses (e.g., *Campylium*, *Tomenthypnum*, *Calliergon*, *Drepanocladus* species).

Alkali are mineral soils that contain an excess of exchangeable sodium and pH >8.5. Alkali soils will often have impermeable clay horizons and dry to a dark crust. **Saline soils** do not occur in peatlands but in saline meadows where evaporation concentrates salts. Saline sites have excess soluable salts (Na^{+}, Ca^{++}, Mg^{++}, Cl^{-}, SO_4^{--}) that impair site productivity, pH < 8.5, and dry to a white crust. **Saline-alkali** soils also occur. These sites have impermeable clay horizons, pH >8.5, and dry to a white crust (Richards 1969).

Regional bedrock and surface geology, and site drainage and discharge, influence the base cation content of the groundwater supply. For example, groundwater percolation in the Rocky Mountains generally has very high content of base cation (calcium) because of contact with limestone parent materials. Rich fens and swamps are common in this area. The outer Coast is dominated by nutrient-poor bogs largely due to the sterile nature of the granitic bedrock that underlies this region.

Water movement and seasonal water-level fluctuation (**hydrodynamics**) are as important as soil moisture regime in wetland ecosystems. Soil moisture regime can be difficult to assess in many wetland and flood

sites because the watertable changes significantly over the growing season. As a general rule, sites with greater waterflow are richer. Increasing lateral movement of water improves nutrient availability by bringing additional supplies of minerals and improving oxygenation. Vertical movements of the watertable alternately flood and expose the surface of the wetland, improving aeration and increasing decomposition rates.

Stable, high watertables (stagnant or sluggish hydrodynamics) promote peat formation and high bryophyte cover. Bogs and fens are ecosystems that form under these conditions. Peat accumulations on these sites can be very deep, are usually poorly decomposed, and are largely derived from mosses and sedges.

Sites with more dynamic watertables experience surface flooding followed by late-season drawdown. These types of sites usually have few bryophytes because most mosses are intolerant of prolonged submergence. Marshes, swamps, and shallow-water ecosystems may be underlain with peat but it is usually well-humified, non-bryophytic material derived from sedges or wood. On these sites and on flood ecosystems, the length and depth of flooding and the degree of waterflow are primary factors determining community composition. Species composition depends on species flood tolerance and life history requirements. Sites with large fluctuations in watertable, such as pothole marshes or tidal marshes, represent some of the most hydrologically dynamic and nutrient-rich ecosystems.

Regional climate is the broad environmental context for ecosystems. For wetlands, this influence is less pronounced than for upland ecosystems because of the overriding influence of wet site conditions. Still, climate is an important factor in wetland formation. In cool climates, where water inputs exceed evaporation rates, peatland formation is promoted. Small, water-collecting depressions and lake margins that would be marshes in regions with warm, dry climates are topogenous peatlands here. In these peatland regions, only the most hydrologically active areas adjacent to rivers and large lakes support marshes and shrub swamps. Peatlands occur even on sloping terrain in regions of cool climates with high summer precipitation, extensive groundwater seeps, or prolonged snowpack, where continual groundwater inputs maintain surface saturation. The dry and warm regions of the province typically have very limited peatland development because warm temperatures increase decomposition rates and high evaporation rates limit the extent of sites that have permanent saturation.

Estuarine ecosystems

Estuarine ecosystems are defined as:

> *coastal sites dominated by plants and other organisms tolerant of wet, brackish soils, found at the confluence of a freshwater source and the marine environment and affected by occasional or diurnal tidal inundation. Estuarine ecosystems occur specifically where:*
> - *at least periodically, the land supports predominantly hydrophytic plant species or benthic fauna adapted to brackish water.*
> - *the substrate is predominantly undrained hydric soil. Soils may be organic or inorganic. In mineral soils, gleying occurs within the top 30 cm, or the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season.*
> - *the site is tidally influenced and at least occasionally affected by brackish water.*

Estuarine ecosystems have similar characteristics to wetland ecosystems, with the additional influences of diurnal fluctuations in watertable and variable salinity. The gradients of most importance in this realm of ecosystems is the degree of tidal flooding, which is closely related to **height above the mean tide level**. Ecosystems that occur at the lowest level are flooded with every tide (excepting neap tides), while the highest may experience only occasional flooding during the highest high tides.

The **degree of freshwater influence** affects species distribution within an estuary independent of other factors. Particularly where high volumes of fresh water are delivered to estuarine environments, communities change along a gradient from where freshwater influences predominate (usually within the tidal reaches of the river) to where freshwater inputs are minimal.

Low-elevation coastal climates are more equable than interior and high-elevation climates, yet climate still plays a role in estuarine development. Estuaries of the Georgia Depression, where summers are warm and dry and where freshwater inflows are highest in the winter and lowest in the summer, have a flora that is related to estuaries farther south. Estuaries of the Coast and Mountains, where summers are cool and moist and rivers have peak flows in spring and summer, lack many of the "Californian" estuary species.

Terrestrial ecosystems

Terrestrial ecosystems occur on sites where water is not in surplus for extended periods of the growing season (actual moisture regime Very Dry

to Very Moist). These sites are characterized by the dominance of drought-tolerant vascular plants, bryophytes, and cryptogams. Decomposition is primarily aerobic by fungi, bacteria, and soil fauna.

Within a climatic region, differentiation of most terrestrial ecosystems can be explained primarily by soil moisture regime (SMR) and soil nutrient regime (SNR). However, the two groups of terrestrial ecosystems included in this guide, flood and "transition," have special environmental factors that override SMR and SNR influences.

The term "riparian" is defined or applied in the literature in several contradictory ways. In WREC, this term is used to describe sites that are adjacent to a waterbody. Thus, "riparian" does not imply any specific ecological feature of a site other than occurence next to a waterbody. By this definition, any type of ecosystem can be riparian. For those ecosystems that are ecologically distinct because of flooding, erosion/sedimentation, or subirrigation from an adjacent waterbody, this guide uses the term "Flood ecosystem."

Flood ecosystems are defined as:

> *sites flooded for a short time during the growing season, where soils are freely drained and anoxic conditions (if they occur) are quickly relieved after subsidence of floodwater. Vegetation tolerant of brief flooding events but not prolonged soil saturation is typical. Flood ecosystems occur specifically where:*
> - *waterbodies periodically flood their banks, depositing or eroding fluvial or lacustrine materials; and*
> - *watertables are within the rooting zone during part of the growing season, but not for sufficient duration to cause gleying within the top 30 cm of soil depth.*

The duration and power of flooding are the primary site determinants in these ecosystems.

"**Transition**" ecosystems are a loosely defined set of Associations that are included in this guide because they often occur adjacent to wetlands and have some structural and ecological similarities. Two Classes are described, the saline meadows of the Grassland Group and shrub-carrs from a Shrubland Group. Both of these Classes have Moist or Very Moist actual moisture regime and support non-forested climax communities. Because of a special site factor, these sites do not support forest or grassland ecosystem species groups that would normally occur under these soil moisture regimes.

Saline meadows have high soil salinity or alkalinity. They occur only in dry climates where early-season flooding prevents growth of trees or upland grasses, but where sufficient drawdown occurs to limit hydrophyte establishment. High content of salts in the soil is the driving variable for these meadows.

Shrub-carrs only occur in cold climates where cold-air drainage or ponding on some sites results in cold soils and mid-season frosts that preclude tree establishment. These areas are primarily in the Interior at high elevations or in boreal climates.

A SYNOPSIS OF THE CLASSIFICATION SYSTEM

Concepts

This guide applies a site unit classification model of a Wetland and Riparian Ecosystem Classification system (WREC) (MacKenzie and Banner 2001). This system has its basis in the Biogeoclimatic Ecosystem Classification (BEC) (Pojar et al. 1987) and Canadian Wetland Classification System (CWCS) (Warner and Rubec 1997).

Ecosystem

Ecosystems are interacting complexes of living organisms and their physical/chemical environments. For purposes of this guide, ecosystems are defined as portions of the physical landscape and the living systems that are on and in it. They are identified and characterized by a plant community and its associated environment. More specifically, ecosystems are areas of relatively uniform vegetation, topography, soils, and hydrology.

Microtopographic features are an important environmental factor in wetland ecosystems. Several distinct plant communities can occur on the hummocks and in the hollows of a single site. In this guide, these fine-scale variations are not treated as separate units but are considered to be a normal (and predictable) state for the ecosystem.

Climax, succession, and site potential

BEC integrates vegetation, climatic, site, and seral classifications into a system of regional, local, and chronological units. The basic approach in BEC is to use mature or climax vegetation communities to define site and climate classification units. "Climax" in ecology refers to a condition of dynamic equilibrium, a steady state rather than a static endpoint. For vegetation, this means that the species in the community replace themselves rather than being replaced by other species over time (the process of succession).

Mature communities are said to reflect site potential (or climatic potential in the restricted case of a zonal ecosystem) because they are relatively stable and are thought to integrate and reflect the sum of all the environmental conditions of the site. Site potential is a central concept in BEC but has been applied primarily to forested ecosystems, where the mature state is recognized through canopy structure and species composition. Applying this approach for wetlands and flood ecosystems is more difficult because they represent more dynamic systems where the site potential changes over time. Deviations from the concept of site potential occur in flood ecosystems, where deposition and erosion during flooding change soil texture, depth to watertable, and duration of flooding over time. These changes to site potential may occur gradually over decades or abruptly with the impacts of a significant flood. Similarly, the gradual accumulation of organic matter and establishment of *Sphagnum* mosses both affect the hydrological properties of peatlands, leading to long-term peatland succession and changes in site potential. Pothole marshes are characteristically variable in their interannual water regime; sites may be flooded in one year and dry in the next. Therefore, the concepts of climax and site potential in wetland and floodplain sites must be viewed as more fluid and temporary than in upland ecosystems.

Classification versus description

Site description and ecosystem classification are different but complementary processes. Site description produces a simple list of biotic and abiotic features for an ecosystem. No two ecosystems will have the exact same list of site characteristics and each site could be considered unique. However, to apply knowledge gained on one site more widely, groups of sites with similar ecological function must be recognized. Ecosystem classification distills the commonality among sites into recognizable groups based on a few ecologically important factors. These fundamental properties feature prominently within the formal classification; other descriptive attributes are used as supporting information.

Site units versus landscape units and mapping

The classification presented in this guide is a site classification; it describes the ecosystem as defined in the previous section—an area of relatively uniform vegetation, topography, soils, and hydrology. However, most wetlands and riparian areas are complexes of ecosystems, where mapping of site units would be difficult at commonly used scales (e.g., 1:20 000). For this reason, it is more likely that entire wetlands will be mapped as a single unit. WREC proposes a landscape-level unit called the

Ecocomplex to describe recurring complexes of Site Associations for use in mapping wetlands (MacKenzie and Banner 2001).

Classification units

WREC integrates several different classification models into a single hierarchical framework. The Site Association unit of BEC is grouped into broader units on the basis of more general ecological similarities (Figure 2.1). The Site Series and Site Association units of BEC describe site potential on ecologically homogeneous areas based on climate, soils, and mature vegetation communities. The "Class" concept of the Canadian Wetland Classification System is used as a broader description of site potential. Additional, even broader units (Group and Realm) formalize currently used, but imprecisely defined, terminology. These higher levels are defined by environmental states characterized by specific guilds of biota, rather than species groups. The units accentuate similarities in basic underlying processes and functions between ecosystems not reflected in vegetation. Such broad units allow wetlands to be placed in context with other non-wetland ecosystems.

Site Association

The Site Association defines all sites capable of supporting a similar plant association at climax.

Vegetation classification using a Braun-Blaunquet approach produces units with characteristic diagnostic species groups (Mueller-Dombois and Ellenberg 1974). When these species groups represent climax communities, they are said to reflect site potential and are used to define the Site Series within a given biogeoclimatic subzone/variant, or a Site Association across several BEC subzones/variants (Pojar et al. 1987). The Site Association is a collection of Site Series with similar plant species composition. For example, the **Wb01** (Black spruce – Lingonberry – Peatmoss) Site Association includes the Site Series BWBSdk1/10, BWBSdk2/07, BWBSmw1/08, and BWBSmw2/08.

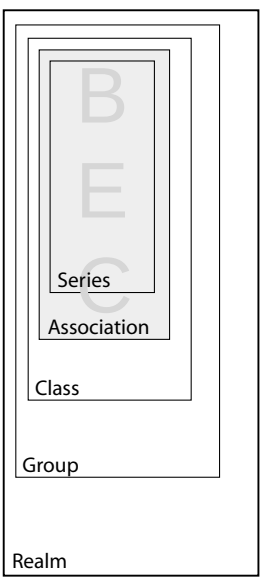


FIGURE 2.1 *Site unit hierarchy (from MacKenzie and Banner 2001).*

Site Class

The Site Class describes Associations with similar basic underlying environmental attributes that support similar characteristic species guilds at climax.

The Class concept is adapted from the Wetland Class of the Canadian Wetland Classification System (CWCS) (Warner and Rubec 1997). The Site Class, as applied here, is narrower than the original CWCS concept, where the Class could describe entire wetlands and with no requirement for "climax" plant communities. In this guide, the Class is an extension of the Site Association concept and the same restrictions apply: sites must be relatively homogeneous (rather than entire wetlands), mature, and undisturbed.

Site Group[1]

The Group describes functionally similar Classes based on a dominant, ecologically relevant environmental feature(s).

A single dominant environmental factor or site attribute, reflecting a constellation of environmental factors that influence ecosystem structure, is used to differentiate Groups. For example, within the Wetland Realm, the Peatland Group is distinguished from the Mineral Group based on the presence of deep fibric or mesic peat accumulations that indicate low decomposition rates, lower available nutrients, and near-permanent saturation. The Flood Group of the Terrestrial Realm includes those ecosystems that are strongly influenced by periodic/seasonal flooding events common in riparian situations.

Site Realm

The Realm delineates major biotic types that reflect gross differences in water abundance, quality, and source.

There are three primary Realms (Terrestrial, Freshwater, and Marine) and four secondary Realms where the primary Realms intersect (Wetland, Estuarine, Intertidal, and Wedge). The secondary Realms exhibit unique characteristics in addition to features that are common to the related primary Realms. This guide covers ecosystems of the wetland and estuarine ecosystem Realms and some terrestrial ecosystem groups that are related to true wetlands (Figure 2.2).

1 The Site Group term was previously used in BEC to define broad groupings of Site Associations based on species similarity. This BEC unit is now referred to as the Site Alliance to reflect its basis in vegetation classification.

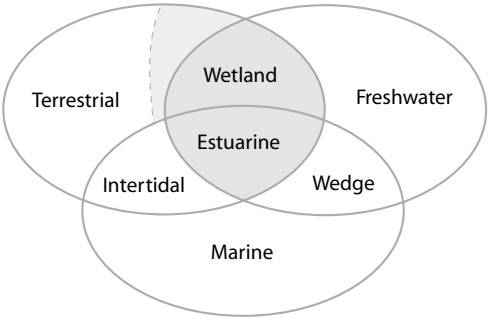


FIGURE 2.2 *Conceptual relationship between ecosystem Realms. Shaded section shows ecosystems covered in this guide (from MacKenzie and Banner 2001). The shaded portion of the Terrestrial Realm includes flood and "transition" ecosystems.*

Naming and numbering of Site Units

Classes and Associations are given a two-letter Class and two-number Association code (Figure 2.3). The Class code is a combination of the first letter of the Realm or Group in capital plus the first letter of the Class in small capitals. The number for the Site Association is always two digits. Interior Associations or those that occur on the Coast but are primarily of Interior distribution are numbered **01** to **49**. Site Associations that are exclusively or primarily Coastal are numbered **50** to **99**. Numbering of units loosely follows an approach of assigning the "01" number to an Association considered to represent the central concept for the Class. Units that most closely resemble this initial Association are then numbered sequentially.

Note that these Site Association codes are for application in a broader context, where the user intends to discuss ecosystems at a regional or provincial level. For discussion in a local context, the BEC Site Series code should be used if applicable (e.g., SBSdk/10). Refer to Appendix 4.

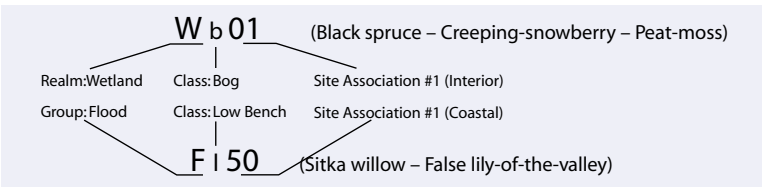


FIGURE 2.3 *Examples of coding for Site Associations.*

Full names of the Association follow the Site Series standards for BEC: no more than three species are used, species from the dominant layers appear first.

CLASSIFICATION OF WETLAND AND RIPARIAN SOILS

Soil types used in this guide are from the Canadian System of Soil Classification (CSSC) (Agriculture Canada Expert Committee on Soil Survey 1987). There are nine Soil Orders in the CSSC, of which two are found primarily in wetland environments: Gleysol Order and Organic Order.

Gleysols are defined by the presence of a gleyed soil horizon. Gleying occurs under waterlogged, anaerobic conditions. A gleyed horizon is indicated by a distinct dull blue-grey colour or prominent rust-coloured blotches called mottles. **Humic Gleysols** have an organically enriched surface horizon in addition to the above features. **Rego Gleysols** are very young and have limited profile development.

The soils of the **Organic Order** include **Fibrisols**, **Mesisols**, **Humisols**, and **Folisols** (upland organic soils); the first three are wetland soil Great Groups. These soils have accumulated more than 60 cm of organic materials derived from hydrophytic plants. Most organic soils are saturated with water for prolonged periods. They occur widely in poorly and very poorly drained depressions and level areas in regions of cool or wet climates.

Classification at the Great Group level (Fibrisol, Mesisol, or Humisol) is based primarily on the dominant horizon of the decomposition of the organic material in the middle tier (between 60 and 160 cm below the soil surface). Fibrisols are poorly decomposed, and peat constituents are easily recognizable. Mesisols are partially decomposed and Humisols are well decomposed. **Typic** organic soils have >160 cm or organic accumulations while **Terric** organic soils have 60–160 cm of organic matter over mineral substrates.

Several other Orders are described in this guide for non-wetland Site Associations.

Regosols are very young soils with little or no horizon development. They are common on active fluvial sites where flood events deposit sediment layers. On these sites, Regosols are **cumulic** with layers of sediments from different flood events. **Brunisols** are slightly older soils, with some chemical weathering, and can be **gleyed** from short periods of saturation.

Solonetzic soils have a prismatic soil structure resulting for the accumulation of salts. Saline meadows are classic locations for Solonetzic soils.

REGIONAL CLASSIFICATIONS

Two complementary regional classifications are used in Site Association descriptions in Chapter 5: the BEC zonal classification and the Ecoregion classification. The former is a climatic classification based on characteristic vegetation on average or zonal terrestrial sites that best reflect the influence of climate, independent of site conditions. Site Association occurrence by zone is outlined in table format at the beginning of each section of Chapter 5.

The Ecoregion classification takes a biophysical approach and is a combination of physiography and broad climatic classification. It provides a geographic context for describing Site Association provincial distribution and is used in the general descriptions for each Site Association.

Biogeoclimatic (BGC) zones

Fourteen BGC zones occur in British Columbia (Figure 2.4). For discussions of wetland ecosystem distribution, we have paired similar zones: the BG and PP, the SBS and SBSP, and the BWBS and SWB. The Alpine Tundra (AT) is not covered in this guide. More detailed descriptions of the zones can be found in Meidinger and Pojar (1991).

Bunchgrass / Ponderosa Pine (BG/PP)
The Bunchgrass and Ponderosa Pine zones are limited to low-elevation areas in the rainshadow of the southern mountains where dry, hot growing-season climates prevail. Grasslands, and ponderosa pine or Douglas-fir forest, are the dominant upland vegetation. Wetlands are primarily marshes.

Boreal White and Black Spruce / Spruce – Willow – Birch (BWBS/SWB)
The Boreal White and Black Spruce and Spruce – Willow – Birch zones occupy the northern quarter of the province at low to high elevations. These zones have short, cool summers and very long, very cold winters. Upland vegetation is primarily fire-initiated, white and black spruce forests. Peatland formation is favoured in these areas and extensive bogs and fens occur in low-relief landscapes.

Coastal Douglas-fir (CDF)
The Coastal Douglas-fir zone is restricted to low-elevation (<150 m) coastal areas in the rainshadow of Vancouver Island. This zone has a

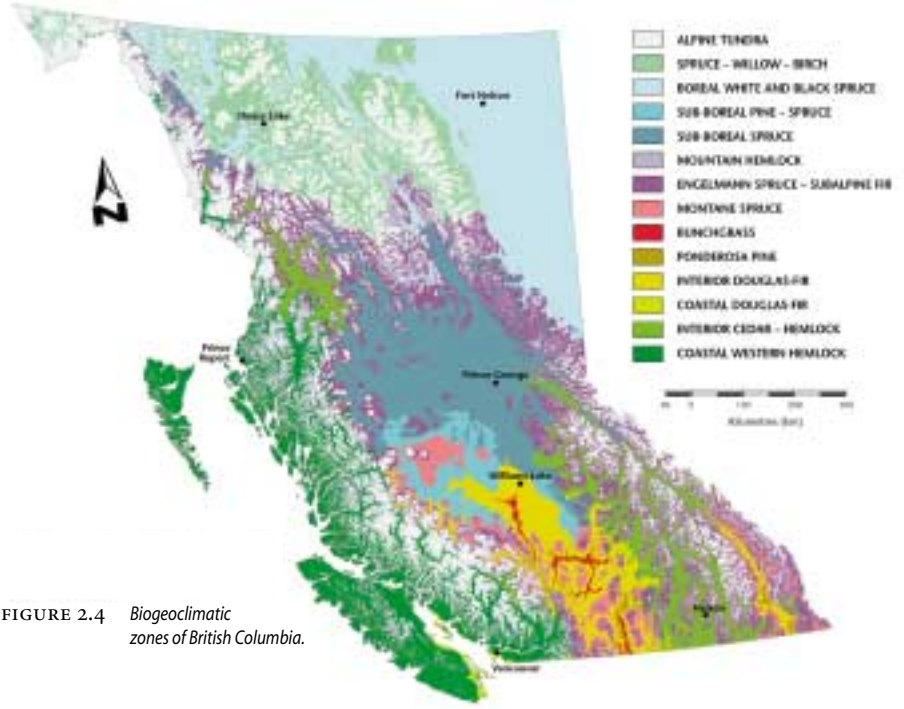


FIGURE 2.4 *Biogeoclimatic zones of British Columbia.*

Mediterranean climate characterized by warm, dry summers and mild, wet winters. Upland vegetation is primarily Douglas-fir, hemlock, and western redcedar forest. Both peatland and mineral wetlands are common.

Coastal Western Hemlock (CWH)

The Coastal Western Hemlock zone occurs at low to middle elevations west of the Coast Mountains. This zone has cool, wet summers and mild, wet winters. Natural upland vegetation is primarily old-growth western redcedar, western hemlock, and Sitka spruce forests. This climatic regime favours peatland formation.

Engelmann Spruce – Subalpine Fir (ESSF)
The Engelmann Spruce – Subalpine Fir is the uppermost forested zone in the southern three-quarters of the province. The zone has short, cool summers and long, cold, snowy winters. Upland vegetation is closed to patchy forest dominated by Engelmann spruce and subalpine fir. Wetlands are primarily peatlands.

Interior Douglas-fir (IDF)
The Interior Douglas-fir zone dominates low to mid elevations of the south-central Interior. This zone has warm, dry summers and cool, dry winters. Upland vegetation is fire-maintained Douglas-fir forest. Wetlands are diverse in this zone with a mix of peatland and mineral wetland.

Interior Cedar – Hemlock (ICH)
The Interior Cedar – Hemlock zone occurs on the windward Interior mountains and Coast transition valleys at low to middle elevations. This zone has mild, moist summers and cool, wet winters. Upland vegetation is forest dominated by western redcedar, western hemlock, and interior spruce. Peatlands are favoured but mineral wetlands also occur.

Mountain Hemlock (MH)
The Mountain Hemlock zone occurs at high elevations along the windward Coast Mountains. This zone has short, cool, wet summers and long, cool, snowy winters. Upland vegetation is open mountain hemlock forest. Wetlands are almost exclusively fens and swamps.

Montane Spruce (MS)
The Montane Spruce zone occurs at middle elevations in the southern Interior. This zone has short, warm summers and cold winters. Upland vegetation is fire-maintained forest of lodgepole pine and interior spruce. Wetlands are primarily peatlands but mineral wetlands are not uncommon.

Sub-Boreal Pine – Spruce / Sub-Boreal Spruce (SBPS/SBS)
The Sub-Boreal Pine – Spruce and Sub-Boreal Spruce zones occur in the central Interior at low to middle elevations. These zones have a continental climate with cool, dry to moist, short summers and cold winters. Upland vegetation is fire-maintained forest of interior spruce and lodgepole pine. Peatland formation is favoured in this climate.

Ecoprovinces

Ecoprovinces are used in this guide to describe general distribution of units in British Columbia (Figure 2.5).

Northern Boreal Mountains Ecoprovince (western BWBS, SWB)
The general character of this Ecoprovince is one of mountains and plateaus separated by wide valleys and lowlands. Short, cool growing seasons promote formation of peatlands in most wet depressions. Consequently, subdued terrain may be covered by large expanses of fen and shrub-carr ecosystems. Marshes and swamps are common in association with lake and river systems.

Taiga Plains Ecoprovince (eastern BWBS)
This Ecoprovince is a large lowland of poorly drained, glaciolacustrine deposits to the east of the northern Rocky Mountains. The climate is subarctic with very cold winters and short cloudy summers. This region has some of the highest concentrations of wetlands in the province (30%

FIGURE 2.5 *Ecoprovinces of British Columbia.*

areal extent). Bogs predominate, though fens and swamps occur along the sluggish streams that drain the region.

Boreal Plains Ecoprovince (eastern BWBS)
This Ecoprovince lies east of the Rocky Mountains and consists of low-relief plateaus, plains, prairies, and lowlands. The climate is typically continental since most of the moist Pacific air has dried crossing successive ranges of mountains before it reaches the area. Winters are cold. Bogs are common throughout.

Sub-Boreal Interior Ecoprovince (SBS, ESSF)
This Ecoprovince lies to the east of the Coast Mountains and consists of low-lying plateaus and several mountain ranges. Western areas are in the rainshadow of the Coast Mountains while eastern areas on the windward side of the Rocky Mountains are wet. Wetlands are primarily fens, with marshes and swamps associated with lakes and streams.

Central Interior Ecoprovince (IDF, SBPS, MS, dry ESSF)
This Ecoprovince lies in the rainshadow to the east of the Coast Mountains and is primarily rolling plateaus. The area has a typical continental climate: cold winters, warm summers, and a precipitation maximum in late spring or early summer. Extensive level terrain harbours a high concentration of wetlands, primarily fens.

Southern Interior Ecoprovince (BG, PP, IDF, MS)
This Ecoprovince lies in the rainshadow of the Coast and Cascade Mountains and contains some of the warmest and driest areas of the province in summer. Semi-arid conditions limit peat formation except at higher elevations; therefore, marshes and swamps are most common. Some potholes and shallow lakes may experience severe evaporation and drawdown during the summer months, resulting in the accumulation of salts and formation of distinctive ecosystems.

Southern Interior Mountains Ecoprovince (ICH, ESSF, BG/PP)
This Ecoprovince is the highlands and mountains east of the southern Interior plateaus. There are two distinct climate regimes—wet in the mountains and dry in southern Rocky Mountain Trench. Wetlands are not common in this region, occupying mainly the valley bottoms where many have been altered by development.

Coast and Mountains Ecoprovince (CWH, MH)
Encompassing the coastal mountain ranges, this Ecoprovince experiences a maritime climate characterized by abundant precipitation and mild summer and winter temperatures The geology is predominantly

granites poor in minerals, with little or no glacial till. Consequently, wetlands are primarily bogs even though most sites receive groundwater seepage. These bogs are extensive on gently to steeply sloping terrain of the outer Coast.

Georgia Depression Ecoprovince (CDF, dry CWH)
The southeast corner of Vancouver Island, the Gulf Islands, and part of the adjacent mainland experience mild winters, warm summers, and moderate precipitation. Wetlands are not uncommon in this landscape (6% of the area), but most have been modified by human activities; some have been lost completely. The northern range limit of many plant and animal species is within this region and this, combined with the mild climate, produces ecosystems not found elsewhere in British Columbia.

SUMMARY OF SAMPLING AND ANALYSIS METHODS

The Site Associations presented here were developed using vegetation and environmental data from approximately 2600 plots located throughout British Columbia. The principal data sources include wetland classification projects (900 plots), Biogeoclimatic Ecosystem Classification program (1000 plots), ecosystem mapping projects (400 plots), and thesis data (300 plots) (Beil 1969; Revel 1972; Annas 1974; Ceska 1978; Banner 1983). Most plot sampling before 1998 used standard methods outlined in *Describing Ecosystems in the Field* (Luttmerding et al. 1990). Sampling after 1998 followed the *Field Manual for Describing Terrestrial Ecosystems* (Province of British Columbia 1998).

Sites sampled specifically for this guide were selected using available resource information such as topographic maps, air photos, and forest cover maps. Ecosystem plots were located on suitable sites that were homogeneous and relatively undisturbed and the position fixed by GPS. A sample plot size of 20 by 20 m (400 m^2) was used for most sites but was reduced or skewed to fit smaller areas such as pocket wetlands or elongated zones within larger complexes. In each plot, vegetation and environmental data were collected on the FS882 ecosystem field form according to standard procedures outlined in the *Field Manual for Describing Terrestrial Ecosystems* (Province of British Columbia 1998). Plant species on each site were listed by layer, with an estimate of species percent cover for each layer and for total cover. Unknown specimens were collected and identified.

One soil pit (for mineral soils) or peat core (for organic soils) was established in each plot. Texture, decomposition, depth, and other descriptors where noted for each soil horizon, and the soil type classified according to the *Canadian System of Soil Classification* (Canada Soil Survey Committee 1998). Humus forms were classified using Green et al. (1993). Peat cores were taken using a modified Hiller peat sampler.

We used a combination of ordination and tabular analysis to classify ecosystem plots into Site Associations. We initially subjected the plots for each biogeoclimatic subzone to tabular analysis using Braun-Blanquet methods (Mueller-Dombois and Ellenberg 1974), with the assistance of an ecological database program, VPRO97 ver. 2.0 (MacKenzie and Klassen 1999). Ordination by Detrended Correspondence Analysis (DCA) using PC-ORD ver. 4.0 (McCune and Mefford 1999) was performed and combined with an overlay of the initial tabular classification to aid in assigning plots and differentiating units. Subzone units (Site Series) were combined into the Site Associations appearing in this guide using tabular analysis and ordination of summary values from each subzone unit. Environmental descriptions for each Site Association were produced from summary environmental tables generated from VPRO97 ver. 2.0.

Ordinations diagrams of the final classification are presented in Appendix 1.

Procedures for site description and identification

3

Site description is the first step in the process of classification and an understanding of ecosystem function. The measurement and recording of basic attributes of this coastal bog in the Ecstall River valley will give insight into its controlling environmental factors and habitat values.

Site unit identification requires:
1) accurate description of site, soil, and vegetation characteristics
2) use of the various aids and descriptive materials in this guide to determine the site unit that best matches these characteristics.

It should not be expected that sites will perfectly match all details in the description of site units in this guide. The descriptions presented here represent a range of conditions around a central concept for a population of more variable individual sites that are part of the Association. It is also important to note that the classification is based on relatively undisturbed wetlands and that identification of highly disturbed or heavily managed wetlands is problematic.

This guide describes ecosystems that recur throughout the landscape and appear to be relatively stable in vegetation composition. Although this guide represents the majority of wetland sites in the province it is likely that users will find units that do not match any of the units described. This can be for one of four reasons:
1) the plot location was placed in a transitional area between two ecosystems
2) the site is a hybrid of two types
3) the site is disturbed or in transition from one type to another
4) the site represents a new ecosystem not previously recognized. If the user feels that this is the case, data and information on the site should be forwarded to the Research Branch.

This guide is just one tool to help describe and compare wetland and related ecosystems and must be supplemented with practical knowledge, experience, and judgement.

Describing sites

The following steps are the suggested approach to describe a wetland or wetland-related ecosystem:
1) **Select sample area**. Plots should be placed in homogeneous areas within wetlands; sites that cross community lines and are heterogeneous are not useful for ecosystem classification. A standard 20 × 20 m plot is ideal; however, wetland communities often occur as narrow bands within a larger wetland. Plots should be made-to-fit in these community types. Microtopographic variation in site and vegetation characteristics is permissible but sites should not include pronounced differences in site, soil, or vegetation.

2) **Determine and record site and soil features**. The methodology outlined in Province of British Columbia (1998) should be followed. Site features should represent the entire sample area. Soils should be recorded from a soil pit of at least 60 cm depth. A peat core to >160 cm is preferred on peatland sites. For sites with strong microtopographic features, descriptions of hummock and hollow soils are important. Table 3.1 lists some important site and soil attributes that should be described.
3) **Determine and record vegetation features**. Identify and record percent ground cover of as many plant species as possible. Unknown species, especially those that form a large component of the ground cover, should be collected and preserved for proper identification. Species are recorded by layer.
   - trees: woody plants >10 m
   - tall shrubs: woody plants >2 m and <10 m
   - low shrubs: woody plants <2 m
   - herbaceous species and dwarf shrubs: non-woody species, aquatics, and dwarf shrubs (woody species that are largely <10 cm at maturity)
   - mosses and lichens: all mosses, liverworts, and lichens
4) **Estimate** hydrodynamic index, pH, absolute soil moisture, and nutrient regime using tools outlined in Section 5.0.

TABLE 3.1 *Important site and soil features for identifying site units*

Feature	Definition and description
BGC unit	From BGC maps
Position in wetland	Relationship to other ecosystems
Soil texture	Soil texture or von Post decomposition of rooting zone
Surficial material	Mode of deposition of soil parent materials
Watertable depth	Depth to watertable
Humus form	Humus form order of the surface soil organic layers
Hydrogeomorphic system	Hydrological system of site
Microtopography	Type and strength of surface microtopography

Identifying site units

Once the site, soil, and vegetation information has been recorded and soil moisture, nutrient, and hydrodynamic index have been determined, the Site Class and Association can be determined.

1) Determine the Class by using the Class key, the summary table of characteristics, and/or the descriptions of Classes presented in Chapter 4. The key is dichotomous and presents a series of choices between two alternatives until the name of the appropriate Class is reached. Review the brief Class descriptions following or the one-page descriptions at the start of each Class section.
2) Go to the appropriate Class section of Chapter 5 and review the species importance table for the Associations of the identified Class. Compare the vegetation of the site under consideration with that of the table and select the closest match. Confirm the correct identification by comparing species and site descriptions for the Site Association.

Sites intermediate between bogs and fens, fens and swamps, marshes and fens, and swamps and low-bench flood ecosystems should be expected to occur. The user may have to review the Site Associations for more than one Class to correctly identify equivocal sites.

Site classes

4

The Class level of classification is useful where site information is not readily available or the scale of application is broad. The ecosystem Classes of this location along the Torpy River, McGregor Mountains, have distinct visual signatures that are readily identifiable from the air.

This chapter provides descriptions and tools for the identification of wetland and related ecosystem Site Classes. Three tools can be used to determine Site Class: the key to Site Classes, the summary table of characteristics, or summary descriptions. More detailed descriptions of Classes are found at the beginning of each section in Chapter 5 along with a species importance table of Associations in the Class. The user can use one or all of these tools to identify the Site Class. A suggested approach follows three steps:

1) Use the key to tentatively identify a Class.
2) Review the summary characteristics table (Table 4.1) and short descriptions to substantiate the results from the key.
3) Proceed to the relevant section of Chapter 5 and review Association descriptions.

KEY TO SITE CLASSES

Figure 4.1 is dichotomous key for determination of Site Class. It uses a combination of simple vegetation and site features to tentatively identify the Site Class.

BRIEF DESCRIPTIONS OF SITE CLASSES

The following descriptions outline the essential characteristics of the Site Classes described in this guide. Figure 4.2 shows the distribution of each of the Classes on the modified edatopic grid.

Bog Wetland Class (Wb)
Bogs are shrubby or treed, nutrient-poor peatlands with distinctive communities of ericaceous shrubs and hummock-forming *Sphagnum* species adapted to highly acid and oxygen-poor soil conditions. Bogs develop in basins where peat accumulation has raised the wetland surface above groundwater flow, or, less commonly, where groundwater is very low in dissolved nutrients (e.g., flows from granitic parent material).

Fen Wetland Class (Wf)
Fens are peatlands where groundwater inflow maintains relatively high mineral content within the rooting zone. These sites are characterized by non-ericaceous shrubs, sedges, grasses, reeds, and brown mosses. Fens develop in basins, lake margins, river floodplains, and seepage slopes, where the watertable is usually at or just below the peat surface for most of the growing season.

TABLE 4.1 *Summary of characteristics for wetland and related ecosystem Site Classes*

Site Realm/ Group	Site Class	Environmental features	Cover types	Species groups
Wetland Realm		***Wet or Very Wet SMR***		
	Bogs	+/- ombrotrophic pH < 5.5 > 40 cm fibric/mesic peat	Conifer treed or low shrub	Sphagnum mosses, ericaceous shrubs, and conifers
	Fens	Groundwater-fed pH > 5.0 > 40 cm fibric/mesic peat	Graminoid or low shrub	Deciduous shrubs, sedges, and brown mosses
	Marshes	Mineral soils or well-humified peat Protracted shallow flooding (0.1–2.0 m)	Graminoid or forb	Large emergent sedge, grass, forb, or horse-tail species
	Swamps	Mineral soils or well-humified peat Temporary shallow flooding (0.1–1.0 m) Significant water flow	Tall shrub or forested	Conifers, willows, alders, forbs, grasses leafy mosses
	Shallow waters	Permanent deep flooding (0.5–2 m)	Aquatic	Aquatic species Emergent vegetation < 10% cover
Estuarine Realm		***Tidal, brackish water***		
	Estuarine meadow Class	High intertidal and supratidal zones Brief semi-diurnal tidal flooding by brackish water	Graminoid	Grasses, sedges, and forbs tolerant of di-urnal flooding and brackish water
	Estuarine marsh Class	Intertidal Diurnal tidal flooding by salt water	Graminoid or forb	Salt-tolerant emergent graminoids and suc-culents
Flood Group of Terrestrial Realm		***Riparian flood zone***		
	High bench	Benches above normal waterflow Brief flood period	Coniferous forested	Upland species of seepage sites
	Mid bench	Elevated benches flooded most years for < 21 days Areas of sedimentation	Deciduous treed or forested	Flood-tolerant decid-uous trees and shrubs
	Low bench	Site directly adjacent to watercourse Annual flood >21 days Significant annual erosion and deposition	Tall deciduous shrub	Flood-tolerant shrubs
Transition Classes from Terrestrial Realm		***"Special" factor***		
	Shrub-carr	Frost-prone depressions with fine- to medium-textured moist soils	Low shrub	Deciduous low shrubs, grasses, and forbs
	Saline meadow	Semi-arid climate Slightly to highly saline soils Brief periods of inundation	Graminoid	Flood and salt-tolerant graminoids and forbs

1	Sites tidal and influenced by salt water	**Estuarine (Section 5.6)**
1a	Sites non-tidal or in freshwater tidal reaches of river	**go to 2**
2	Wet or Very Wet sites. Soils Gleysols or Organics.	**go to 3**
2a	Soil moisture regime hygric or drier. Soil types variable	**go to 8**
Wetland Ecosystems		
3	Sites permanently flooded and with < 10% emergent vegetation	**go to 4**
3a	Sites with >10% emergent cover	**go to 5**
4	Sites with > 10% cover of rooted aquatic plants	**Shallow-waters (Section 5.5)**
4a	Sites with < 10% cover of rooted aquatic plants	**Unclassified aquatic ecosystem**
5	Sites with mineral soil or a surface tier of humic peat (von Post 7 or greater)	**go to 6**
5a	Sites with organic soils and surface tier dominated by fibric or mesic sedge or moss peat	**go to 7**
Mineral Group		
6	Sites dominated by tall shrubs or trees (> 10% cover)	**Swamps (Section 5.4)**
6a	Sites dominated by emergent grass-like species. Shrub and tree cover < 10%	**Marshes (Section 5.3)**
Peatland Group		
7	Sphagnum Groups I & III dominate moss layer. Ericaceous spp. common. Peat pH < 5.5.	**Bogs (Section 5.1)**
7a	Bryophyte layer not dominated by Sphagnum. Graminoids dominant. Peat pH > 5.0	**Fens (Section 5.2)**
Terrestrial Ecosystems		
8	Sites not inundated by floodwaters. Soils non-cumulic	**go to 9**
8a	Sites periodically flooded by adjacent rivers or lakes. Soils commonly layered (cumulic)	**go to 10**
9	Sites not affected by special site factors such as severe cold-air ponding, or soil salinity. "Normal" forest or grassland communities	**Sites described by BEC**
9a	Sites affected by special site factors such as severe cold-air ponding, or soil salinity	**go to 13**
Flood Group		
10	Tree cover < 10%. Always immediately adjacent to and not much elevated above waterbodies	**go to 11**
10a	Tree cover > 10%. May be adjacent to active channel or at some distance from open water on elevated benches and terraces. Soils with some horizon development	**go to 12**
11	Sites with continuous shrub cover; flooded for moderate periods	**Low benches (Section 5.7)**
11a	Sites with sparse shrub cover (< 10%). Flooded for prolonged periods	**Active channel (not described)**
12	Coniferous trees usually predominate. Understorey vegetation resembles upland seepage sites	**High benches (BEC units)**
12a	Deciduous trees predominate; conifers limited to elevated microsites	**Middle benches (Section 5.7)**
Other Terrestrial Classes		
13	Sites with > 10% low shrubs in frost hollows or gradual slopes experiencing cold-air drainage	**Shrub-carrs (Section 5.8)**
13a	Sites dominated by graminoids and salt-tolerant forbs. In drawdown zone of ephemeral ponds or shallow lakes. Mainly in subzones with extensive natural grasslands (e.g., IDF, SBPS, BG, PP)	**Saline meadows (Section 5.8)**

FIGURE 4.1 *Dichotomous key for the identification of Site Class.*

Marsh Wetland Class (Wm)
A marsh is a shallowly flooded mineral wetland dominated by emergent grass-like vegetation. A fluctuating watertable is typical in marshes, with early-season high watertables dropping through the growing season. Exposure of the substrate in late season or during dry years is common. The substrate is usually mineral, but may have a well-decomposed organic veneer derived primarily from marsh emergents. Nutrient availability is high (eutrophic to hyper-eutrophic) due to circumneutral pH, water movement, and aeration of the substrate.

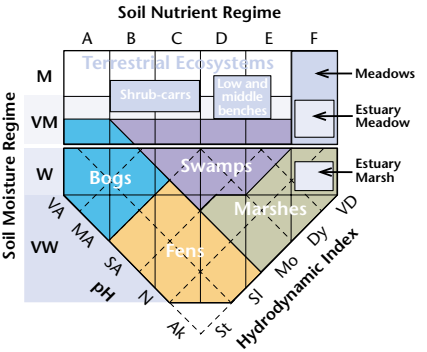


FIGURE 4.2 *Site Class distribution on the modified edatopic grid. Shallow-water wetlands do not fit this conceptual model and are not indicated. The wetland edatopic grid is described in detail in Chapter 5.0.*

Swamp Wetland Class (Ws)
A swamp is a forested, treed, or tall-shrub, mineral wetland dominated by trees and broadleaf shrubs on sites with a flowing or fluctuating, semipermanent, near-surface watertable. Tall-shrub swamps are dense thickets, while forested swamps have large trees occurring on elevated microsites and lower cover of tall deciduous shrubs. Both types of swamps have abundant available nutrients from groundwater and often have surface standing water. Swamps may be underlain with peat but this is well decomposed, woody, and dark.

Shallow-water (Aquatic) Wetland Class (Wa)
Aquatic wetlands are shallow waters dominated by rooted, submerged and floating aquatic plants. These communities are always associated with permanent still or slow-moving waterbodies such as shallow potholes or deeper ponds and lakes. Shallow-water sites are usually permanently flooded; rarely they may become exposed during extreme drought years. Shallow-water communities most commonly occur where standing water is less than 2 m deep in midsummer. Aquatic plants may root in mineral soils or in well-humified sedimentary peat.

Saline meadow Transition Class (Gs)
Saline meadows are grass-, rush-, or halophyte-dominated sites that occur on periodically saturated and occasionally inundated sites, where

watertable decline is caused mainly by evaporation and where salts accumulate. These conditions occur only in dry climates. After a brief period of inundation, the watertable drops below the rooting zone during most of the growing season, resulting in a well-aerated rooting medium. These ecosystems are part of a Grassland Group of terrestrial ecosystems.

Shrub-carr Transition Class (Sc)
A shrub-carr is a shrub-dominated ecosystem that develops on frost-prone sites with moist or very moist soils. These sites are seasonally saturated but rarely inundated (see flood ecosystems) and may have watertables perched at depth. Shrub-carrs frequently border wetlands or occur in frost-prone hollows in cold and dry climatic regions. A strongly mounded soil surface is typical, and shrubs of 1–2 m occur mainly on these elevated microsites. These ecosystems are part of a Shrubland Group of terrestrial ecosystems.

Low bench Flood Class (Fl)
Low bench ecosystems occur on sites that are flooded for moderate periods (< 40 days) of the growing season, conditions that limit the canopy to tall shrubs, especially willows and alders. Annual erosion and deposition of sediment generally limit understorey and humus development.

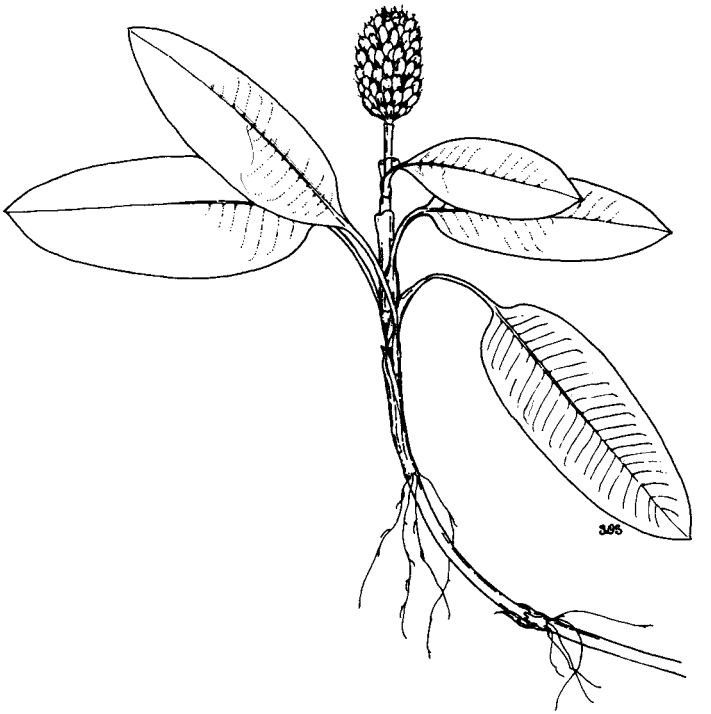
Middle bench Flood Class (Fm)
Middle bench ecosystems occur on sites briefly flooded (10–25 days) during freshet, allowing tree growth but limiting tree species to only flood-tolerant broadleaf species such as black cottonwood and red alder.

High bench Flood Class (Fh)
High bench ecosystems occur where flooding rivers produce lengthy subsurface flow in the rooting zone but only periodic, brief inundation. Surface flooding may occur from as frequently as several times annually to only during extreme flood years. These periods of flooding are generally not restrictive of plant species; plant communities are similar to adjacent upland forests on seepage sites. High bench Site Series are described in BEC field guides and are not presented in this guide.

Estuarine Marsh Class (Em)
An estuarine marsh is an intertidal ecosystem that is flooded diurnally and has simple communities dominated by salt-tolerant emergent graminoids and succulents. These marshes occur in the middle to upper tidal zones of estuaries where saltwater influences predominate.

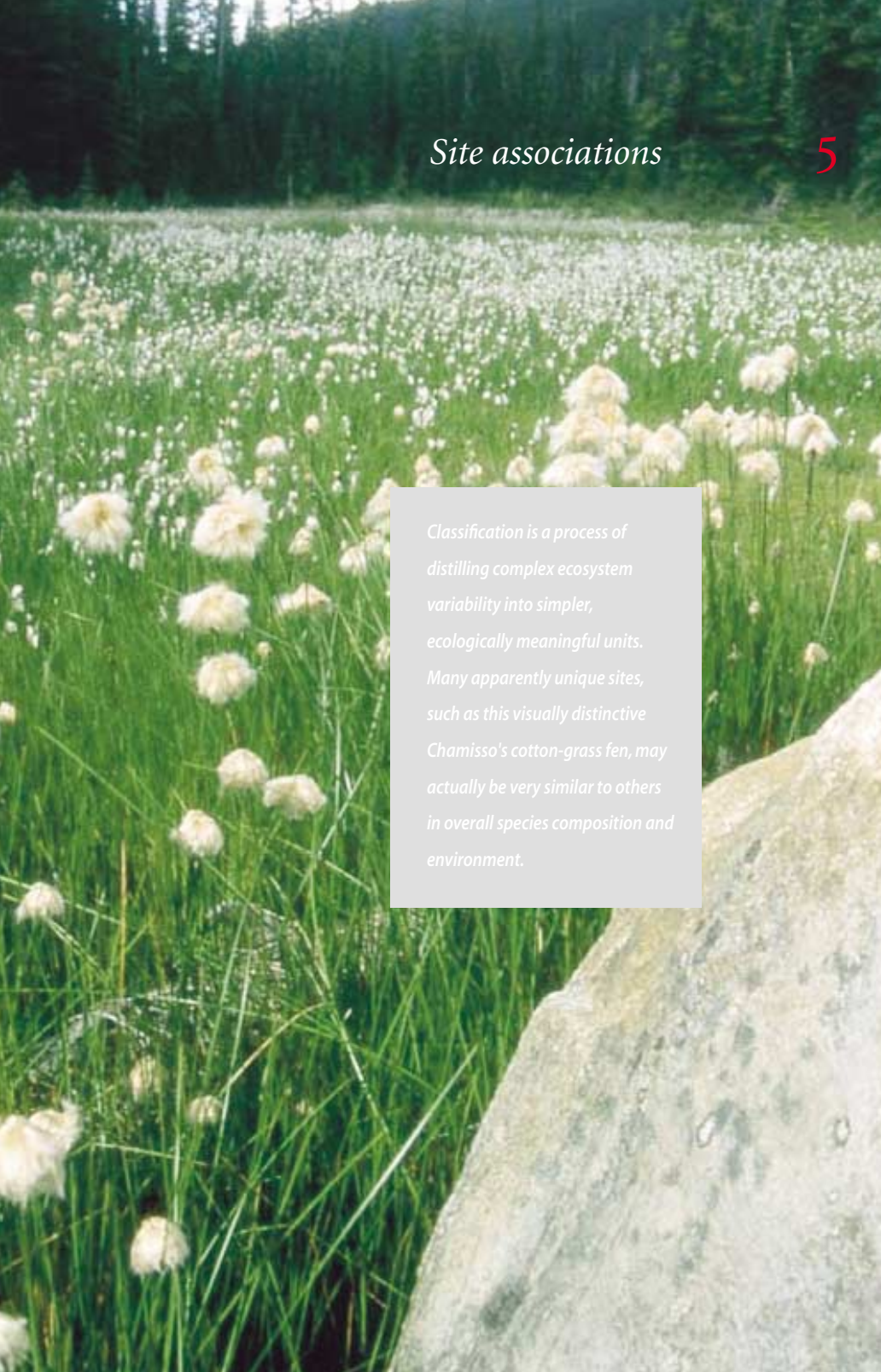
Estuarine meadow Class (Ed)

Estuarine meadows occur in the high intertidal and supratidal zones of estuaries, where tidal flooding occurs less frequently than daily and is tempered by freshwater mixing. Species composition is relatively diverse, typically with a mix of graminoids and forbs.



Polygonum amphibium, water smartweed

Site associations 5



Classification is a process of distilling complex ecosystem variability into simpler, ecologically meaningful units. Many apparently unique sites, such as this visually distinctive Chamisso's cotton-grass fen, may actually be very similar to others in overall species composition and environment.

This chapter presents detailed Site Class and Association descriptions in standardized format. The chapter has eight sections, one for each Class or Group. Each section includes a four-page Class description followed by one-page Site Association fact sheets. Associations for which there is little current information or that are similar to more common Associations are given a single paragraph outlining the characteristics of such units at the end of each Class section.

LAYOUT AND CONVENTIONS FOR SITE CLASS DESCRIPTIONS

A standard-format, four-page Class description precedes one-page fact sheets for each of the Site Associations in the Class.

Definition: A concise definition of the Class.

Edatopic Grid: General location of the Class on the edatopic grid.

Vegetation: A description of the vegetation structure and composition typical and characteristic of the Class.

Landscape: Provincial distribution and locations in the landscape where the Class is found.

Hydrology and Soils: Soil types and hydrological characteristics that are typical for the Class.

Other Comments: Additional information.

Conservation Issues: Common Class characteristics of importance to management and conservation of ecological function.

Distribution of Site Associations by BGC Zone: This presents a list of Associations described in the guide and their distribution by biogeoclimatic zone. The abundance of the type relative to other wetland types in the zone is given a ranking:

- **x** = **incidental/rare**: occurs infrequently in the zone, <5% of wetland occurences.
- **xx** = **minor/uncommon**: 5–25% of wetland occurences.
- **xxx** = **major/common**: >25% of wetland occurrences, often occupies extensive areas.

In some cases, a superscript letter is used to indicate a specific part of the zone where the unit occurs.

Species importance table

Species that are distinctive for at least one of the Associations are included in the species importance table and indicated by relative importance:

	Infrequent: occurs very sporadically in the unit. Usually <30% of plots.
▮	Uncommon: occurs on a minority of sites (<30%) and with low cover.
▮▮	Common: occurs on many sites (30–60%), often low cover but occasionally with appreciable cover (to 10%).
▮▮▮	Abundant: occurs on most sites (>60%), occasionally prominent on some sites (± 10%).
▮▮▮▮	Very abundant: occurs on nearly all sites (>80%); prominent species (± 10%).
▮▮▮▮▮	Dominant: occurs on all sites (>95%); the most abundant species on most sites (>25% cover).

SITE ASSOCIATION FACT SHEET

Site Association fact sheets (Figure 5.0.1) describe each unit as a range or a summary of average conditions. Fact sheets seldom describe the precise conditions of a given plot, but provide the "central concept" for the unit and give insights into the typical conditions that can be expected within a Site Association.

Name (1): Name of Site Association defined by diagnostic or leading plant species. Common names are placed in the header and scientific names below.

General Description (2): Brief description of distribution, landscape position, hydrology, soils, and vegetation.

Characteristic Vegetation (3): Plant species commonly found in the Site Association, grouped by cover layer. Species importance is coded by font:

- ***Dominant species appear as italicized, bold, and underlined***
- ***Abundant and very abundant species as italicized and bold***
- *Common species as italics*

Comments (4): Additional information on the Association including successional relationships, associated ecosystems, and similar previously described units.

Photograph (5): Photo of a typical example of the Site Association.

Wetland Edatopic Grid (6): The edatopic grid depicts the location of the

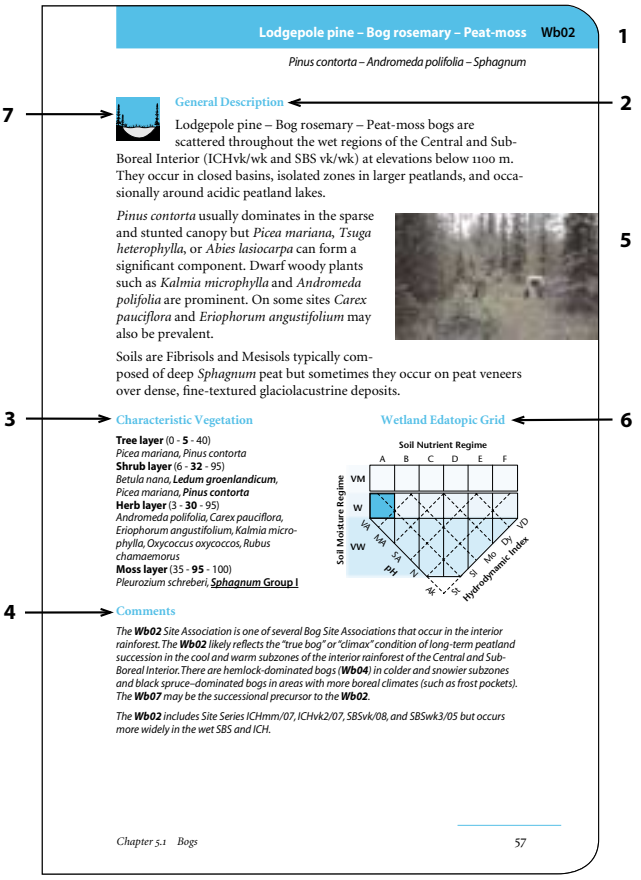


FIGURE 5.0.1 *Example Site Association fact sheet.*

Site Association in relation to important environmental features. The shaded area represents the estimated environmental range of the Site Association in relation to actual soil moisture and nutrient regime, acidity/alkalinity, and hydrodynamic index. A description of the wetland edatopic grid is found below.

Hydrogeomorphic Icon (7): Symbol(s) indicating in which hydrogeomorphic group the unit commonly occurs. The hydrogeomorphic classification describes the topographic position and hydrology of sites (MacKenzie and Banner 2001).

	**Estuarine System:**	Sites at the confluence of fluvial and marine environments affected by tides
	**Fluvial System:**	Sites associated with flowing water and subject to flooding, erosion, and sedimentation
	**Lacustrine System:**	Sites at lakeside, directly affected by lake hydrological processes (e.g., wave action, flooding, and sedimentation)
	**Palustrine System, Basins and Hollows:**	Sites in depressions and other topographic low points with the watertable near or at the surface; receive water mainly from groundwater and precipitation
	**Palustrine System, Ponds and Potholes:**	Sites associated with small waterbodies
	**Palustrine System, Seepage slopes:**	Sloping sites with near-surface groundwater seepage

The Wetland Edatopic Grid

The edatopic grid used in this guide is a modification of the model used in BEC. The BEC grid uses soil moisture and nutrient regimes as major site descriptors for comparing forested ecosystems. However, additional factors are important in wetland and riparian ecosystems, including acidity/alkalinity (as a correlate to availability of base cations) and magnitude of lateral flow or vertical fluctuation (hydrodynamics). In the Wet and Very Wet portions of the edatopic grid, two tangent environmental axes have been added to accommodate these important site factors, based on concepts presented in Vitt (1994). The grid should be viewed as a conceptual model; it has not been rigorously tested with field data.

Several edatopic grid overlays of vegetation characteristics to assist in interpreting the grid are presented in **Appendix 2.**

The four axes of the grid (Figure 5.0.2) describe specific site characteristics and are defined as follows:

Actual Soil Moisture Regime (ASMR) is the average amount of soil water annually available for evapotranspiration by vascular plants over

several years (Pojar et al. 1987). There are nine moisture categories from Very Dry to Very Wet. Wetlands are found only on Wet to Very Wet sites. Related ecosystem classes are also found on Moist and Very Moist sites. The wetland edatopic grid is therefore limited to this range. The definitions for soil moisture categories used in the guide are defined as:

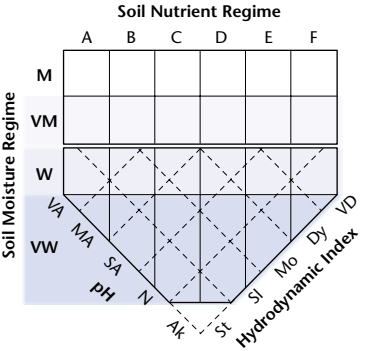


FIGURE 5.0.2 *A modified edatopic grid showing pH and hydrodynamic index axes for Wet and Very Wet sites.*

Moist (M): No water deficit occurs. Current need for water does not exceed supply; temporary groundwater table may be present. Unless otherwise limited, supports forest.

Very Moist (VM): Rooting-zone groundwater present during the growing season (water supply exceeds demand). Groundwater table > 30 cm below the surface. Unless otherwise limited, supports forest.

Wet (W): Rooting-zone groundwater present during the growing season (water supply exceeds demand). Groundwater table between 0 and 30 cm below the surface. Can support tall shrubs and trees.

Very Wet (VW): Groundwater table at or above the ground surface during the growing season. Will not support tall shrubs or trees but can support low shrubs.

Soil Nutrient Regime (SNR) is the essential soil nutrients available to vascular plants over a period of several years (Pojar et al. 1987). Six SNR classes are recognized from Very Poor to Alkaline/Saline. Wetland and wetland-related ecosystems can occur throughout the range. Some indicators of SNR in wetlands are presented in Figure 5.0.3.

pH (acidity/alkalinity) is a correlate measure of base cation availability. This is primarily of importance for peatlands and less important for hydrologically dynamic systems. Five categories are recognized from Very Acid to Alkaline. Generally, as acidity increases, available base cations decrease, resulting in reduced site productivity.

Very Acid (VA): (<4.5 pH) sites are true bogs with high cover of *Sphagnum* Group I or III mosses and few minerotrophic indicators.

FIGURE 5.0.3 *Environmental characteristics useful for determining nutrient status in wetlands.*

SNR	A Very Poor	B Poor	C Medium	D Rich	E Very Rich	F Hyper
Available nutrients	very low	low	average	plentiful	abundant	excess alkali or salt accumulation
Water pH	<5.0	4.5 – 6.0	5.0 – 6.5	6.0 – 7.4	6.5 – 8.0	8.0+
vonPost of surface tier	1 – 3	3 – 6	4 – 7	7 – 10	8 – 10	
Ground - water flow through site	stagnant		seasonal seepage		continuous seepage	
C:N ratio	High		Medium		Low	
Surface tier material	Fibrimor		Mesimor	Saprimoder	Marl	
				Mineral		
Water colour	tea colored; yellowish-deep brown and turbid		green-brown and clear	green-brown and turbid		blue-green and very clear (alkaline)
Colour of surface peat	pale		dark			
Surface tier saturation	always saturated		seasonal exposure of substrate		diurnal exposure of substrate	

Moderately Acid (MA): (4.5–5.5 pH) sites still have high *Sphagnum* cover but minerotrophic indicators also occur. Peatland sites are considered bogs in this guide but would be poor fens or poor swamps using a "classic" definition.

Slightly Acid (SA): (5.5–6.5 pH) sites are fens or swamps. *Tomenthypnum*, *Warnstorfii*, and *Drepanocladus* brown mosses are typical for sites with a stagnant or sluggish hydrodynamic index.

Neutral (N): (6.5–7.4 pH) sites are fens, swamps, or marshes. Species are often a combination of species found on slightly acid and alkali sites.

Alkaline (Ak): (>7.4 pH) sites are dominated by minerophilic bryophytes such as *Scorpidium* or *Campylium* mosses on peatland sites. Alkali-tolerant species occur in marshes.

The Hydrodynamic Index (HI) has five categories that describe the magnitude of vertical and lateral water movements in the soil on Wet and Very Wet sites.

Stagnant (St): Stagnant to very gradually moving soil water. Vertical fluctuations minimal. Permanent surface saturation but minimal or no surface flooding. Basins or hollows with stable water regimes. Abundant organic matter accumulation and high bryophyte cover.

Sluggish (Sl): Gradual groundwater movement through peat or fine-textured mineral soils along a hydrological gradient. Minor vertical watertable fluctuations. Semipermanent soil saturation with some elevated microsites or brief periods of surface aeration. Hollows, slopes, and water tracks in basins or lake flats not directly influenced by the waterbody. Abundant peat accumulation and bryophyte cover.

Mobile (Mo): Distinct flooding and drawdown or pronounced lateral water movements. Peripheral areas of peatlands, sites adjacent to open water tracks, small rivulets or ponds, small potholes with relatively stable water regimes, protected lake embayments, or backmarshes in estuaries. Can have deep but well-decomposed accumulations of peat. Patchy bryophyte cover.

Dynamic (Dy): Significant lateral flow and/or strong vertical watertable fluctuations through mineral soils. Potholes in arid climates that experience significant drawdown, wave-exposed shores, floodplain back channels, and protected estuary sites. Little organic accumulation, few bryophytes.

Very Dynamic (VD): Highly dynamic surface water regime. Exposed tidal sites, shallow potholes in arid climates that experience significant drawdown, wave-exposed shores, and sites directly adjacent to and influenced by river flow. No organic accumulation or bryophytes.

Estuarine tidal diagram

Estuarine ecosystems occur within the intertidal zone, which is defined as the area between chart datum (zero tide on marine charts) and the limit of higher high tides. These ecosystems have Wet or Very Wet soil moisture regimes but the modified edatopic grid used for wetlands does not describe these estuarine ecosystems well. The salinity of floodwaters and the duration of daily tidal flooding are of primary importance for these systems. Therefore, for the Site Associations in Section 5.5, a simple diagram of salinity and relative height above chart datum replaces the wetland edatopic grid (Figure 5.0.4).

Salinity of estuarine sites is variable depending on season and magnitude of tide. The highest salinity that these ecosystems experience during the growing season is likely to be the important attribute rather than the average annual or daily salinity. The highest growing-season salinity is described in a six-category system (from Cowardin et al. 1978).

Fresh: <0.5 parts per thousand (ppt) salts

Oligosaline: Weakly brackish; 0.5–5 ppt salts

Mesosaline: Moderately brackish; 5–18 ppt salts

Polysaline: Strongly brackish 18–30 ppt salts

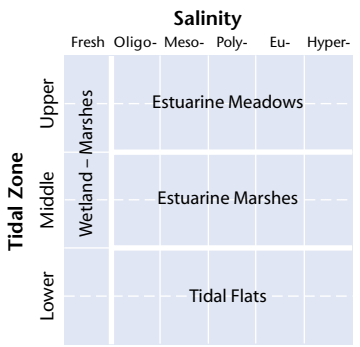


FIGURE 5.0.4 *Distribution of Site Classes relative to intertidal zone and salinity.*

Eusaline: Normal seawater; 30–40 ppt salts

Hypersaline: >40 ppt salts

Elevation above chart datum is a corollary for duration of flooding but is dependent on the magnitude of tides in a particular area. The definitions below are from Howes et al. (1999).

The **Upper Intertidal** describes the upper third of the elevation range between the highest high tide and zero tide for a particular area

(e.g., 4.07–6.1 m near Prince Rupert but 2.15–3.2 m at Fulford Harbour). These sites are flooded for 5–50% of each tidal cycle.

The **Middle Intertidal** describes the middle third of the elevation range between highest high tide and zero tide (e.g., 2.03–4.07 m for Prince Rupert and 1.07–2.15 m for Fulford Harbour). The lower edge of this zone roughly corresponds to the lower vegetation limit. Sites are flooded for 50–90% of the tidal cycle.

The **Lower Intertidal** describes the lower third of the elevation range between highest high tide and zero tide (e.g., 0–2.03 m for Prince Rupert and 0–1.07 m for Fulford Harbour). Sites are flooded for over 90% of the tidal cycle. Sites are primarily unvegetated tidal flats.

TAXONOMIC CONSIDERATIONS

Taxonomy for vascular plants follows the *Illustrated Flora for British Columbia* (Douglas et al. 1998a, b, 1999a, b, 2000, 2001a, b). Moss taxonomy follows Anderson (1990) and Anderson et al. (1990). Hepatic scientific names and authorities are based on Stotler and Crandall-Stotler (1977). Lichen scientific names and authorities are consistent with Esslinger and Egan (1995).

Species equivalents

In some cases, a genus or species name is used to represent more than one species or genus. This has been done where taxa have similar ecological requirements, are difficult to distinguish and are likely to be confused by many field workers, or have a contentious taxonomy.

Betula nana includes *B. pumila*

Carex limosa includes *C. magellanica*

Equisetum arvense includes *E. pratense*

Equisetum fluviatile includes *E. palustre*

Picea X includes *P. glauca*, *P. engelmannii*, and all hybrids

Populus balsamifera includes *P. balsamifera* ssp. *balsamifera*, and *P. balsamifera* ssp. *trichocarpa*

Salix barclayi includes *S. pseudomonticola*

Schoenoplectus acutus includes *S. tabernaemontani*

Sphagnum **Group I** are widespread peat-mosses of poor sites and include *S. angustifolium*, *S. capillifolium*, *S. fuscum*, and *S. magellanicum*

Sphagnum **Group II** are primarily peat-mosses of interior intermediate sites and include *S. centrale*, *S. squarrosum*, *S. subnitens*, *S. subsecundum*, *S. teres*, and *S. warnstorfii*

Sphagnum **Group III** are primarily coastal peat-mosses of raised sites and includes *S. austinii*, *S. papillosum*, and *S. rubellum*.

Sphagnum **Group IV** are primarily peat-mosses in water or saturated lawns and include *S. cuspidatum*, *S. lindbergii*, *S. mendocinum*, and *S. tenellum*

Peat-moss groups are based on several sources (Sims and Baldwin 1996; Gignac et al. 1991; Vitt 1994; Belland and Vitt unpublished).

Recent taxonomic changes

There have been a number of recent taxonomic name changes to common species in the flora of British Columbia. The species and genera following have been changed in this guide to reflect current standands (Meidinger 2002).

Alnus tenuifolia and *A. viridis* have reverted to *A. incana* and *A. crispa*, respectively

Betula glandulosa is now *B. nana*

The moss genus *Drepanocladus* has been divided into *Drepanocladus*, *Homatocaulis*, *Sanionia*, *Scorpidium*, and *Warnstorfia* genera

Potentilla palustris is now *Comarum palustris*

The genus *Scirpus* has been divided into four genera: *Scirpus*, *Bolboshoenus*, *Schoenoplectus*, and *Amphiscirpus*

Scirpus acutus and *S. validus* are now *Schoenoplectus acutus* and *S. tabernaemontani*, respectively

Scirpus maritimus is now *Bolboshoenus maritimus*

Tofieldia is now *Triantha*

Utricularia vulgaris is now *U. macrorhiza*

1 *Classic boreal black spruce bog, Alaska Highway, Boreal Plains (BWBSmw1)* **2** *A Shore sedge – Peat-moss floating bog, White River near Meziadin Junction (ICHvc)* **3** *Blanket mire complex, near Prince Rupert (CWHvh2)*

Definition

A bog is a nutrient-poor, *Sphagnum*-dominated peatland ecosystem in which the rooting zone is isolated from mineral-enriched groundwater, soils are acidic, and few minerotrophic plant species occur.

General Description

Vegetation

Table 5.1.2 lists the species that are common in Bog Site Associations described in this guide. Bogs are characterized by an abundance of *Sphagnum* mosses and evergreen woody vegetation (conifers and ericaceous shrubs) adapted to nutrient-poor site conditions. *Sphagnum* mosses generally drive these systems because they trap base cations, causing the organic soils to acidify and to retain moisture, thus slowing the decomposition rate and promoting peat accumulation. Bogs commonly support stunted coniferous trees that, on true bogs, rarely reach 7 m in height but can reach 15 m on more productive sites. Sparse shrub and herb layers are common. In wetter bogs, where the watertable is at the surface, tree species do not survive and dwarf shrubs are prominent.

Interior bog vegetation is similar to that found throughout boreal regions worldwide. However, bogs of the outer Coast have distinctive, globally unusual vegetation. A hypermaritime climate (with moderate annual temperatures, high precipitation, and high ambient humidity) combined with mineral-poor bedrock promotes widespread bog formation on level and sloping terrain. This blanket mire complex is a combination of open, shrubby, and woodland bog types.

Landscape Position and Distribution

Bogs occur primarily in closed basins, on the periphery of larger peatlands, or occasionally as raised domes in fens. They are common in climatic regions with cool summer temperatures where evapotranspiration rates are low and saturated conditions are maintained throughout the growing season (Table 5.1.1). Extensive bogs occur in the outer coastal lowlands, where precipitation is high and nutrient-poor parent material is common, and in the Taiga Plains, where there is extensive low-relief terrain on impermeable glaciolacustrine deposits. Topogenous bogs are also common in subdued terrain of the sub-boreal and boreal forests.

Hydrology and Soils

Bogs develop in basins where peat accumulation has raised the surface peat above the watertable, or, less commonly, where groundwater is near the surface but is very low in dissolved minerals and nutrients (Figure 5.1.1). While the groundwater table can be well below the soil surface, the upper tier remains saturated throughout the growing season through the capillary action of living and dead *Sphagnum* mosses. Bogs are never flooded.

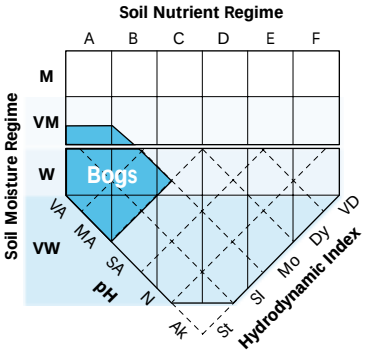


FIGURE 5.1.1 *Position of bogs on the edatopic grid.*

Soils are usually deep peat deposits with at least the upper layers poorly decomposed and derived from *Sphagnum* moss.

Other Comments

The traditional definition of bog describes peatland ecosystems that are ombrotrophic (i.e., isolated from groundwater). However, many peatland ecosystems in British Columbia with bog-like vegetation and abundant *Sphagnum* experience some groundwater contact, especially in microtopographic hollows. This guide includes these ecosystems (variously referred to as poor fens or poor swamps) in the bog wetland class (see Bridgham et al. 1996).

Conservation Issues

Many typical bog species are not tolerant of flooding and are outcompeted by minerotrophic species when nutrient availability is even merely moderate. Therefore, land uses that increase water inputs to these sites can convert bogs to swamp or fen communities. Road construction that diverts runoff into or blocks drainage from bogs is the most common anthropogenic disturbance in non-urban areas. Additions of nitrogen-rich water (such as from sewage or cattle yard runoff) can quickly degrade bog ecosystems by increasing peat decomposition and facilitating invasion of marsh species such as cattail. Removal of water from bogs will lead to an increase in tree growth and cover of upland species and a loss of obligate hydrophytes, but, because of the moisture-holding capacity of *Sphagnum* peat, many bog species can persist.

However, *Sphagnum* is not tolerant of shading, so continued increase in tree or shrub cover generally leads to a decline in peat-mosses.

Bog vegetation is generally very slow growing and therefore provides few forage values for larger wildlife. However, the unique combination of plant species and habitat structure supports distinctive arthropod communities. Bogs in the boreal forest and outer Coast are important Sandhill Crane nesting areas.

Timber and range values in bogs are essentially nil. More productive bogs have some sizeable trees but regeneration issues are considerable. Peat cutting has occurred in some regions of the province but is not widespread, in part because peat composition in most regions is of poor quality for horticultural uses or fuel.

Empetrum nigrum, crowberry

TABLE 5.1.1 *Distribution of Bog Site Associations by biogeoclimatic zone*

		BG PP	BWBS SWB	ESSF	ICH	IDF	MS	SBPS SBS	CDF	CWH	MH
Wb01	Black spruce – Creeping-snowberry – Peat-moss							x			
Wb02	Lodgepole pine – Bog rosemary – Peat-moss				x			x[w]			
Wb03	Black spruce – Lingonberry – Peat-moss		xxx								
Wb04	Western hemlock – Cloudberry – Peat-moss				x[n]						
Wb05	Black spruce – Water sedge – Peat-moss		xx		x		x	xxx			
Wb06	Tamarack – Water sedge – Fen moss		xxx					x			
Wb07	Lodgepole pine – Water sedge – Peat-moss			x	x	x	x				
Wb08	Black spruce – Soft-leaved sedge – Peat-moss				x	x	x	xx			
Wb09	Black spruce – Common horsetail – Peat-moss		xx					x			
Wb10	Lodgepole pine – Few-flowered sedge – Peat-moss			x	x			x			
Wb11	Black spruce – Buckbean – Peat-moss				x			x[w]			
Wb12	Scheuchzeria – Peat-moss		x		x			x			
Wb13	Shore sedge – Buckbean – Peat-moss			x	x			x			
Wb50	Labrador tea – Bog-laurel – Peat-moss								x	x[s]	
Wb51	Shore pine – Crowberry – Tough peat-moss									xx	
Wb52	Common juniper – Tufted clubrush – Rock moss									xxx[oc]	
Wb53	Shore pine – Yellow-cedar – Tufted clubrush									xxx[oc]	

x = incidental; < 5% of wetlands
xx = minor; 5–25% of wetlands
xxx = major; >25% of wetlands
w = wet/very wet subzones only
n = northern subzones only
oc = outer coast (hypermaritime) only
s = southern subzones only

TABLE 5.1.2 *Bog Species Importance Table*

	Species	Wb01	Wb02	Wb03	Wb04	Wb05	Wb06	Wb07	Wb08
Trees	*Picea mariana*	▮▮▮▮	▮▮▮	▮▮▮▮▮	▮	▮▮▮▮	▮▮▮	▮	▮▮▮▮
	Larix laricina			▮▮			▮▮▮▮		▮
	Tsuga heterophylla		▮		▮▮▮▮			▮	
	Pinus contorta var. *latifolia*	▮	▮▮▮		▮	▮	▮	▮▮▮	▮
	Picea X	▮	▮	▮	▮▮	▮	▮	▮▮▮	▮▮
	Thuja plicata		▮		▮			▮	
	Pinus contorta var. *contorta*								
	Chamaecyparis nootkatensis								
Shrubs	*Ledum groenlandicum*	▮▮▮▮▮	▮▮▮▮	▮▮▮▮	▮▮	▮▮▮	▮▮▮	▮▮▮	▮▮▮
	Betula nana	▮	▮▮	▮	▮	▮▮▮▮	▮▮▮▮	▮▮▮	▮▮▮
	Salix myrtillifolia			▮		▮	▮▮		▮
	Lonicera involucrata	▮	▮	▮		▮		▮▮	▮
	Salix pedicellaris	▮	▮			▮	▮▮	▮	▮
	Myrica gale								
	Vaccinium uliginosum			▮					
	Juniperus communis								
Herbs and Dwarf Shrubs	*Oxycoccus oxycoccos*	▮▮	▮▮	▮	▮▮	▮▮	▮	▮▮	▮
	Gaultheria hispidula	▮▮▮	▮	▮	▮	▮	▮	▮	▮
	Vaccinium vitis-idaea			▮▮▮		▮	▮▮	▮	
	Rubus chamaemorus	▮	▮▮	▮▮	▮▮▮▮	▮	▮	▮	▮
	Carex aquatilis/sitchensis	▮	▮	▮	▮	▮▮▮	▮▮▮▮	▮▮▮▮	▮▮
	Carex disperma	▮	▮	▮	▮	▮	▮	▮	▮▮▮▮
	Carex tenuiflora					▮		▮	▮▮
	Comarum palustre	▮	▮		▮	▮▮	▮	▮	▮▮▮
	Equisetum arvense	▮	▮	▮▮		▮	▮	▮▮	▮▮
	Carex pauciflora	▮	▮▮		▮	▮	▮	▮	▮
	Andromeda polifolia		▮▮	▮		▮	▮		
	Empetrum nigrum	▮		▮	▮▮	▮	▮	▮▮	▮
	Carex limosa	▮	▮		▮	▮	▮	▮	▮
	Menyanthes trifoliata		▮		▮	▮	▮	▮	▮
	Eriophorum angustifolium		▮▮		▮▮	▮		▮	▮
	Kalmia microphylla		▮▮		▮▮	▮		▮	
	Scheuchzeria palustris		▮						
	Drosera anglica								
	Drosera rotundifolia		▮	▮	▮	▮		▮	
	Coptis trifolia				▮			▮	
	Carex pluriflora		▮						
	Fauria crista-galli								
	Carex livida				▮				
	Sanguisorba officinalis								
	Triantha glutinosa		▮					▮	
	Trichophorum cespitosum		▮					▮	
	Rhynchospora alba								
	Agrostis aequivalvis								
Lichens and Mosses	*Sphagnum* Group I	▮▮▮▮▮	▮▮▮▮▮	▮▮▮	▮▮▮▮▮	▮▮▮▮	▮▮▮▮	▮▮▮▮▮	▮▮▮
	Pleurozium schreberi	▮▮▮	▮▮	▮▮▮▮	▮▮▮▮	▮▮	▮	▮▮	▮▮
	Hylocomium splendens	▮		▮▮▮▮		▮	▮		▮▮
	Aulacomnium palustre	▮▮	▮	▮	▮	▮▮	▮▮▮▮	▮▮▮	▮▮
	Tomentypnum nitens	▮		▮		▮▮▮	▮▮▮▮	▮▮	▮▮▮
	Sphagnum Group III	▮	▮	▮	▮	▮			▮
	Cladina spp.	▮	▮	▮▮	▮	▮	▮		
	Cladonia spp.	▮	▮	▮		▮		▮	
	Sphagnum Group IV								
	Racomitrium lanuginosum								
	Siphula ceratites								
	Campylopus atrovirens								

Wb09	Wb10	Wb11	Wb12	Wb13	Wb50	Wb51	Wb52	Wb53	Common Name
▮▮▮▮	▮	▮▮▮▮	▮						black spruce
		▮							tamarack
		▮		▮	▮▮	▮▮	▮	▮	western hemlock
	▮▮▮	▮▮	▮▮						lodgepole pine
▮▮	▮▮	▮	▮						spruce
		▮		▮	▮	▮▮	▮▮	▮▮	western redcedar
					▮▮	▮▮▮	▮▮▮	▮▮▮▮	shore pine
						▮▮	▮▮	▮▮▮▮▮	yellow-cedar
▮▮▮	▮▮	▮▮▮	▮▮	▮	▮▮▮▮	▮▮▮	▮▮	▮▮▮	Labrador tea
▮▮	▮▮	▮▮▮	▮▮						scrub birch
▮▮		▮							bilberry willow
▮▮		▮							black twinberry
▮	▮	▮▮	▮▮	▮					bog willow
				▮	▮▮▮	▮▮	▮▮▮	▮	sweet gale
▮						▮▮	▮▮	▮▮	bog blueberry
						▮▮	▮▮▮▮	▮▮	common juniper
▮▮	▮▮	▮▮▮	▮▮	▮▮	▮▮▮	▮▮	▮▮	▮	bog cranberry
▮▮	▮	▮▮							creeping-snowberry
▮▮						▮	▮	▮	lingonberry
▮	▮	▮	▮	▮	▮	▮▮▮	▮	▮	cloudberry
▮▮	▮▮	▮▮	▮	▮▮	▮▮	▮▮	▮		water sedge/Sitka sedge
▮▮		▮							soft-leaved sedge
▮	▮	▮▮	▮						sparse-leaved sedge
▮	▮	▮▮	▮▮	▮▮					marsh cinquefoil
▮▮▮▮▮	▮	▮							common horsetail
	▮▮▮▮	▮▮	▮	▮	▮	▮		▮	few-flowered sedge
▮		▮▮	▮▮▮	▮	▮	▮▮	▮▮▮	▮	bog-rosemary
▮▮	▮▮				▮▮	▮▮▮	▮▮	▮▮▮	crowberry
▮	▮▮	▮▮	▮▮▮	▮▮▮▮					shore sedge
		▮▮▮▮	▮▮	▮▮▮	▮	▮		▮	buckbean
	▮▮▮	▮▮	▮▮	▮▮▮		▮▮▮	▮▮▮	▮▮	narrow-leaved cotton-grass
	▮▮▮	▮▮	▮▮	▮▮	▮▮▮	▮▮	▮▮	▮▮▮	western bog-laurel
			▮▮▮▮	▮					scheuchzeria
			▮▮	▮▮		▮	▮▮		great sundew
	▮	▮▮	▮	▮	▮▮	▮▮	▮▮▮	▮▮	round-leaved sundew
				▮	▮	▮▮	▮▮	▮▮	three-leaved goldthread
						▮▮	▮	▮	many-flowered sedge
					▮	▮	▮▮	▮▮	deer-cabbage
						▮▮	▮▮	▮▮	pale sedge
					▮	▮▮▮	▮▮▮▮	▮▮	great burnet
		▮		▮▮	▮	▮▮	▮▮	▮▮	sticky false-asphodel
				▮		▮▮	▮▮▮▮▮	▮▮▮▮▮	tufted clubrush
					▮▮	▮▮	▮▮▮	▮▮	white beak-rush
				▮		▮	▮▮	▮▮	Alaska bentgrass
▮▮▮▮	▮▮▮▮▮	▮▮▮▮	▮▮▮▮	▮▮▮▮▮	▮▮▮▮▮	▮▮▮▮▮	▮▮▮	▮▮	peat-moss Group I
▮▮▮	▮▮	▮▮		▮	▮▮	▮▮	▮	▮▮	red-stemmed feathermoss
▮▮▮		▮			▮	▮		▮	step moss
▮▮▮	▮▮	▮▮	▮▮	▮	▮▮			▮	glow moss
▮▮		▮▮	▮▮	▮					golden fuzzy fen moss
▮	▮	▮▮	▮▮	▮▮	▮▮	▮▮▮▮▮	▮▮▮▮	▮▮▮	peat-moss Group III
▮	▮	▮	▮		▮	▮▮	▮▮▮▮	▮▮	reindeer lichens
▮	▮					▮	▮▮▮	▮▮	clad lichens
				▮	▮	▮▮	▮▮▮	▮	peat-moss Group IV
						▮▮	▮▮▮▮	▮▮▮	hoary rock-moss
						▮	▮▮▮	▮	northern waterfingers
							▮▮	▮	bristly swan-neck moss

Picea mariana – Gaultheria hispidula – Sphagnum

General Description

Black spruce – Creeping-snowberry – Peat-moss bogs are uncommon in the dry and moist SBS and SBPS of the Central and Sub-Boreal Interior at elevations between 500 and 1000 m. Typically, they occur in closed basins or peripheral areas of larger peatlands where there is little groundwater influence.

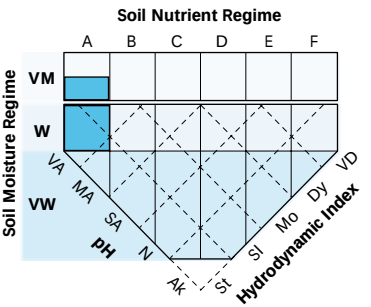
Picea mariana and *Ledum groenlandicum* are always present and generally occupy raised microsites. Dwarf woody plants are common and few minerotrophic species are present. *Gaultheria hispidula* is characteristic and is often prominent. The hummock-forming peat-mosses *Sphagnum fuscum* and *S. capillifolium* are dominant in the moss layer but a diversity of other mosses also occurs. On sites with high tree cover, feathermosses can replace *Sphagnum* as the dominant component of the moss layer.

Soils are Mesisols and Fibrisols with a poorly decomposed, acidic, *Sphagnum* surface tier. Deep sedge and wood peat frequently underlies the surface tier and comprises the bulk of the peat profile.

Characteristic Vegetation

Tree layer (0 - **9** - 50)
Picea mariana
Shrub layer (5 - **35** - 90)
Ledum groenlandicum, ***Picea mariana***
Herb layer (2 - **17** - 50)
Gaultheria hispidula, *Oxycoccus oxycoccos*
Moss layer (70 - **95** - 100)
Aulacomnium palustre, ***Pleurozium schreberi***, ***Sphagnum* Group I**

Wetland Edatopic Grid



Comments

*The **Wb01** represents the "true bog" or "climax" condition of long-term peatland succession in the sub-boreal forests. A peatland successional sequence in infilling basins appears to follow: **Wm01** >> **Wf01** >> **Wb05** >> **Wb01**. The related and more common **Wb05** occurs where* Sphagnum *peat accumulation has not yet raised the soil surface well above the groundwater table, and where minerotrophic indicators occur in abundance. Regional climatic conditions likely limit widespread development of **Wb01**.*

*In small closed basins, **Wb01** communities can dominate an entire wetland. However, more commonly, they occur in locations peripheral to **Wf02**, **Wb05**, or **Wb08**.*

*The **Wb01** includes only Site Series SBSdk/09 but also occurs elsewhere in the dry/moist SBS and SBPS.*

General Description

Lodgepole pine – Bog rosemary – Peat-moss bogs are scattered throughout the wet regions of the Central and Sub-Boreal Interior (ICHvk/wk and SBSvk/wk) at elevations below 1100 m. They occur in closed basins, isolated zones in larger peatlands, and occasionally around acidic peatland lakes.

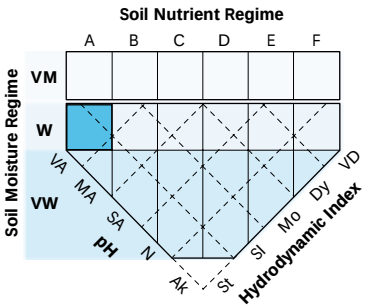
Pinus contorta usually dominates in the sparse and stunted canopy but *Picea mariana*, *Tsuga heterophylla*, or *Abies lasiocarpa* can form a significant component. Dwarf woody plants such as *Kalmia microphylla* and *Andromeda polifolia* are prominent. On some sites *Carex pauciflora* and *Eriophorum angustifolium* may also be prevalent.

Soils are Fibrisols and Mesisols typically composed of deep *Sphagnum* peat but sometimes they occur on peat veneers over dense, fine-textured glaciolacustrine deposits.

Characteristic Vegetation

Tree layer (0 - **5** - 40)
Picea mariana, Pinus contorta
Shrub layer (6 - **32** - 95)
*Betula nana, **Ledum groenlandicum**, Picea mariana, **Pinus contorta***
Herb layer (3 - **30** - 95)
Andromeda polifolia, Carex pauciflora, Eriophorum angustifolium, Kalmia microphylla, Oxycoccus oxycoccos, Rubus chamaemorus
Moss layer (35 - **95** - 100)
*Pleurozium schreberi, **Sphagnum** Group I*

Wetland Edatopic Grid



Comments

*The **Wb02** Site Association is one of several Bog Site Associations that occur in the interior rainforest. The **Wb02** likely reflects the "true bog" or "climax" condition of long-term peatland succession in the cool and warm subzones of the interior rainforest of the Central and Sub-Boreal Interior. There are hemlock-dominated bogs (**Wb04**) in colder and snowier subzones and black spruce–dominated bogs in areas with more boreal climates (such as frost pockets). The **Wb07** may be the successional precursor to the **Wb02**.*

*The **Wb02** includes Site Series ICHmm/07, ICHvk2/07, SBSvk/08, and SBSwk3/05 but occurs more widely in the wet SBS and ICH.*

Picea mariana – Vaccinium vitis-idaea – Sphagnum

General Description

Black spruce – Lingonberry – Peat-moss bogs are widespread in the Taiga and Boreal Plains and uncommon in the Northern Boreal Mountains in topographic depressions with little groundwater influence.

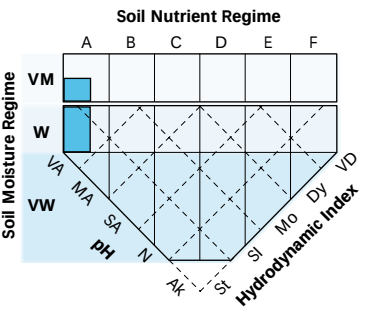
Stunted *Picea mariana*, usually less than 10 m tall, is always present over an open herb layer and a continuous *Sphagnum* blanket. *Ledum groenlandicum*, *Rubus chamaemorus*, and *Vaccinium vitis-idaea* are the most abundant understorey species. Sites are hummocky, but because of luxuriant *Sphagnum* growth, hollows are generally no wetter than hummocks and support few minerotrophic indicators. High tree cover on some sites shades out *Sphagnum*, and feathermosses become dominant. Surface peat on elevated hummocks or domes may dry out and become dominated by *Cladonia* and *Cladina* lichens on some sites.

Many **Wb03** sites are underlain with permafrost and have a domed surface shape. Deep blankets of acidic *Sphagnum* peat are typical and there is little or no surface water present. Soil types are Fibrisols or Organic Cryosols.

Characteristic Vegetation

Tree layer (0 - **20** - 70)
Larix laricina, ***Picea mariana***
Shrub layer (1 - **35** - 90)
Ledum groenlandicum, ***Picea mariana***
Herb layer (1 - **20** - 99)
Equisetum arvense, *Rubus chamaemorus*, ***Vaccinium vitis-idaea***
Moss layer (48 - **91** - 100)
Cladina spp., ***Hylocomium splendens***, ***Pleurozium schreberi***, ***Sphagnum* Group I**

Wetland Edatopic Grid



Comments

*The **Wb03** represents the climax condition of long-term peatland succession in boreal climates. Climatic conditions in much of this region are favourable to true bog formation and therefore the **Wb03** is widespread in suitable terrain. Northern black spruce bogs can occur as simple landscape units in small closed basins, extensive domed bog landscapes, or as zones within larger fen peatlands. Extensive peatlands in the Taiga Plains are primarily the **Wb03**, with **Wb06** occurring along sluggish peatland streams where some water movement is maintained.*

*The **Wb03** includes Site Series BWBSdk1/10, BWBSdk2/07, BWBSmw1/08, and BWBSmw2/08.*

General Description

Western hemlock – Cloudberry – Peat-moss bogs are rare in the cold, snowy subzones of the ICH of the Nass Basin, east of the Coast Mountains at elevations below 750 m. These bogs occur in small, closed basins with little or no groundwater influence.

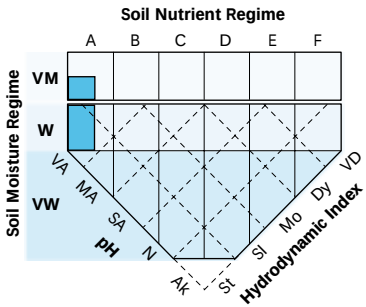
Stunted *Tsuga heterophylla* is always prominent, but other conifers often occur with low cover. Dwarf woody plant species, especially *Rubus chamaemorus* and *Kalmia microphylla* are the dominant component of the open herb layer. *Sphagnum* growth is strong, elevating most of the soil surface above the watertable; therefore, few minerotrophic species occur.

Fibrisols or Mesisols of poorly decomposed *Sphagnum* peat underlain by deep sedge or woody peat are typical.

Characteristic Vegetation

Tree layer (0 - **3** - 11)
Tsuga heterophylla
Shrub layer (6 - **25** - 60)
Ledum groenlandicum, *Picea* X, ***Tsuga heterophylla***
Herb layer (17 - **25** - 90)
Cornus canadensis, *Empetrum nigrum*, *Eriophorum angustifolium*, *Kalmia microphylla*, *Oxycoccus oxycoccos*, ***Rubus chamaemorus***
Moss layer (90 - **90** - 100)
Pleurozium schreberi, ***Sphagnum* Group I**, *Cladina* spp.

Wetland Edatopic Grid



Comments

*The **Wb04** represents the "climax" peatland community in the northern interior rainforest of the Nass Basin. This area, though low in elevation, has extremely high snowfall and relatively cool summers. These conditions limit the black spruce or lodgepole pine that would typically occur under similar site conditions. Most **Wb04** sites are small in extent. They occur alone or with **Wb13** ecosystems.*

*The **Wb04** has not been previously described. Further sampling may indicate that the **Wb04** also occurs in the wetter subzones of the SBS.*

Picea mariana – Carex aquatilis – Sphagnum

General Description

The Black spruce – Water sedge – Peat-moss Bog/Poor Fen Site Association is common throughout the Sub-Boreal and Central Interior (ICH, SBPS, SBS) at elevations below 1300 m. It is found in small closed basins and peripheral areas of larger peatlands where there is a small amount of lateral and groundwater movement and watertable depression.

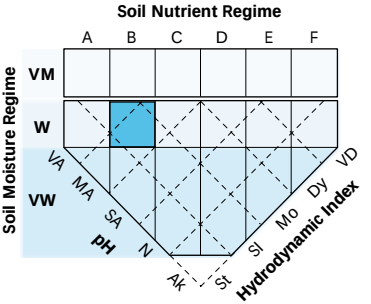
Sites are strongly hummocky with trees and other common bog species rooting on elevated *Sphagnum* and *Tomentypnum nitens* mounds, and minerotrophic indicators such as *Carex aquatilis*, *Equisetum* spp., and *Comarum palustre* rooting in the wetter swales. *Betula nana* is a common and often dominant low shrub in the **Wb05**. Stunted *Picea mariana* is normally the predominant tree species but a component of *Pinus contorta* occurs on some sites.

Soils are typically Mesisols of deep (to 4 m) sedge and wood peat. A surface tier of poorly decomposed *Sphagnum* moss occurs discontinuously, mainly under the raised hummocks.

Characteristic Vegetation

Tree layer (0 - **8** - 55)
Picea mariana
Shrub layer (4 - **40** - 85)
Betula nana*, *Ledum groenlandicum*, *Picea mariana
Herb layer (20 - **52** - 98)
Carex aquatilis, *Comarum palustre, Gaultheria hispidula, Oxycoccus oxycoccos*
Moss layer (25 - **90** - 100)
Aulacomnium palustre, Pleurozium schreberi, ***Sphagnum* Group I, *Sphagnum* Group II, *Tomentypnum nitens***

Wetland Edatopic Grid



Comments

*The **Wb05** Site Association is transitional to the **Wb01**. It has hummock vegetation similar to the **Wb01** and **Wf01**- or **Wf02**-like vegetation in wetter swales. This suggests that the **Wb05** represents the successional state intermediate between sedge fen and "true" bog. A simple peatland successional sequence to the **Wb01** is represented the following progression: **Wm01** >> **Wf01**>> **Wf02** >>**Wb05**>>**Wb01**. The **Wb05** is far more abundant than the **Wb01** in the sub-boreal, suggesting that regional climatic conditions limit peatland succession. **Wb05** communties are often adjacent to the **Wf02**.*

*The **Wb05** includes several Site Series from the ICH, SBPS, and SBS (see Appendix 4).*

General Description

The Tamarack – Water sedge – Fen moss is a common Bog/Poor Fen Site Association of the eastern BWBS. It occurs adjacent to domed bogs along peatland streams, water tracks, or groundwater inflow seeps.

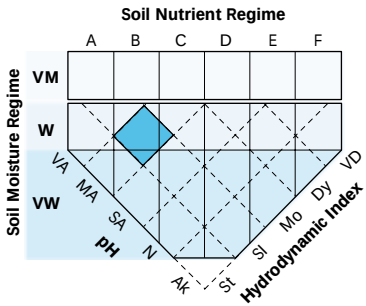
Sites are hummocky, with tamarack and black spruce growing on elevated sites and sedges rooting in the wet hollows. The watertable remains high throughout the growing season. *Larix laricina*, up to 15 m in height, dominates the canopy, with *Picea mariana* also present on many sites. A mixed low-shrub understorey dominated by *Betula nana* can be well developed. Forbs, dwarf shrubs, and smaller sedges root on the elevated hummocks under the tamarack or black spruce trees.

Soils are Mesisols of deep sedge and woody peat. Unlike black spruce bogs (**Wb03**) that occur in the same region, the **Wb06** is rarely underlain by permafrost.

Characteristic Vegetation

Tree layer (0 - **0** - 25)
Larix laricina
Shrub layer (10 - **30** - 67)
Betula nana, ***Larix laricina***, ***Ledum groenlandicum***, ***Picea mariana***, *Salix myrtillifolia, S. pedicellaris*
Herb layer (20 - **52** - 90)
Carex sitchensis, *Maianthemum trifolium, Vaccinium vitis-idaea*
Moss layer (60 - **90** - 95)
Aulacomnium palustre, ***Sphagnum* Group I**, ***Tomentypnum nitens***

Wetland Edatopic Grid



Comments

*The **Wb06** occurs in a climatic region that favours the development of classic black spruce bogs (**Wb03**). The **Wb06** occurs only where some watertable flow is maintained. In subdued terrain, this is mainly along sluggish peatland streams and in mountainous terrain at peatland margins adjacent to slopes.*

*The **Wb06** is transitional to fens and would be considered a fen under some definitions of wetland classes. However, there are many floristic similarities to true bogs, and the high cover of* Sphagnum *suggests placement of this unit within the bog class as defined by this guide.*

*The **Wb06** includes only Site Series BWBSdk2/08 but is also common throughout the Boreal and Taiga Plains. A Tamarack – Scrub birch – Buckbean Site Series (BWBSmw2/10) has been described for this region (Delong et al. 1990), but it is based on limited plots at a single location and likely represents a recently flooded **Wb06** site.*

Pinus contorta – Carex aquatilis – Sphagnum

General Description

Lodgepole pine – Water sedge – Peat-moss bogs/poor fens are uncommon in the interior rainforest climates at elevations to 1600 m. They most commonly occur in closed basins or in peripheral areas of larger peatlands where there is some groundwater influence.

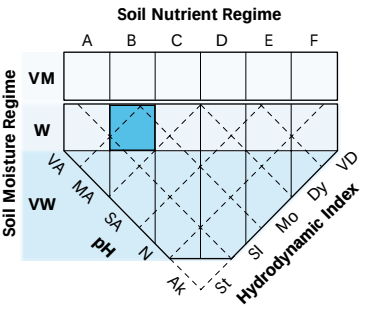
Pinus contorta, *Picea* X, and *Abies lasiocarpa* are all common in the low canopy. *Betula nana* and *Ledum groenlandicum* are generally present and often abundant. Abundant *Carex aquatilis* is characteristic but a diversity of bog-affiliated species occurs on hummocks. *Sphagnum capillifolium* and *S. angustifolium* form a nearly continuous moss layer.

Soils are deep (to 4 m), fibric or mesic peat blankets with a poorly decomposed, acidic, *Sphagnum* surface tier. Typic Mesisols and Fibrisols are common soil types. Microtopography is often strongly mounded with hummocks of *Sphagnum fuscum* and *S. capillifolium*.

Characteristic Vegetation

Tree layer (0 - **5** - 12)
Picea X, *Pinus contorta*
Shrub layer (15 - **37** - 85)
Abies lasiocarpa, ***Betula nana***, ***Ledum groenlandicum***, *Lonicera involucrata*, ***Picea* X**, ***Pinus contorta***
Herb layer (46 - **80** - 95)
Carex aquatilis, *Cornus canadensis, Empetrum nigrum, Equisetum arvense, Oxycoccus oxycoccos*
Moss layer (40 - **78** - 100)
Aulacomnium palustre, *Pleurozium schreberi*, ***Sphagnum* Group I**, *Tomentypnum nitens*

Wetland Edatopic Grid



Comments

*The **Wb07** is the southern and wet-climate equivalent of the **Wb05** that occurs widely in the SBS and BWBS. The distrbution of **Wb07** sites coincides with regions where* Picea mariana *does not occur.*

General Description

Spruce – Soft-leaved sedge – Peat-moss bogs/poor swamps are uncommon throughout the Interior below 1700 m in palustrine depressions fed by slow-moving groundwater. These sites are often strongly hummocky; trees and upland species occur on mounds. Standing water is often present between hummocks, but sites are not fully flooded.

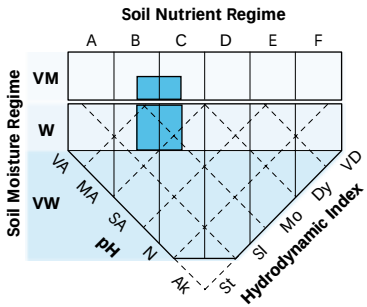
The coniferous canopy of spruce and black spruce is open. The trees grow poorly because of saturated soils, though there may be large individual stems on some sites. *Carex disperma* and *Equisetum* spp. co-dominate on many sites. The moss layer is diverse; peat-mosses, leafy mosses, and feathermosses can all be prominent. On wetter sites, with deep standing water in depressions, *Equisetum fluviatile* or *E. palustre* can be abundant.

Soils are usually deep (1–4 m) Typic Mesisols or Humisols derived from woody peat but are occasionally thin organic veneers over limnic deposits or fine-textured lacustrine materials.

Characteristic Vegetation

Tree layer (0 - **25** - 55)
Picea mariana, *Picea* X
Shrub layer (6 - **30** - 80)
Betula nana, ***Ledum groenlandicum***, *Picea mariana*, *Picea* X
Herb layer (10 - **64** - 99)
Carex aquatilis, ***C. disperma***, *C. tenuiflora*, ***Comarum palustre***, *Equisetum arvense*, ***E. fluviatile***
Moss layer (2 - **76** - 100)
Aulacomnium palustre, *Hylocomium splendens*, ***Mnium* spp.**, ***Pleurozium schreberi***, ***Sphagnum* Group I**, ***Tomentypnum nitens***

Wetland Edatopic Grid



Comments

*The **Wb08** occupies sites intermediate between the **Wb05** and the more productive **Ws07**. These sites are transitional bogs to swamps, with bog communities occurring on elevated mounds and more minerotrophic species occurring in wet swales. The closely related **Wb09** has a more northerly distribution, less standing water, and lower productivity. These ecosystems often occur in peripheral areas of larger peatlands or wet depressions adjacent to shrub swamps.*

*The **Wb08** includes many Site Series from the SBS (see Appendix 4) but is now recognized as being more widespread.*

Picea mariana – Equisetum arvense – Sphagnum

General Description

The Black spruce – Common horsetail – Peat-moss Bog/Poor Swamp Site Association is uncommon in the Central Interior and Northern Boreal Mountains (BWBS, SBS) in small palustrine basins and at the periphery of larger peatlands. This Site Association is transitional to forested swamps but has, in contrast, abundant bog-affiliated species, very poor tree growth, and more stagnant hydrology.

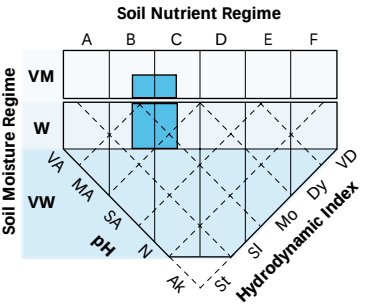
Sites are often strongly hummocky, with conifers and typical bog species occurring on elevated sites and minerotrophic indicators in hollows. Hummock species include stunted *Picea mariana*, *Ledum groenlandicum*, and *Sphagnum* spp. *Equisetum arvense* is always present between hummocks.

Soils can be deep *Sphagnum* peat (to 3 m) or shallow veneers over fine-textured mineral materials. Mesisols and Gleysols are equally common. Standing water can persist between hummocks, but elevated sites are never flooded.

Characteristic Vegetation

Tree layer (0 - **17** - 77)
Picea mariana
Shrub layer (10 - **37** - 95)
Betula nana, ***Ledum groenlandicum***, ***Picea mariana***
Herb layer (18 - **58** - 95)
Calamagrostis canadensis, *Cornus canadensis*, ***Equisetum arvense***
Moss layer (18 - **58** - 95)
Aulacomnium palustre, ***Hylocomnium palustre***, *Mnium* spp., ***Pleurozium schreberi***, ***Sphagnum* Group I**, *Tomentypnum nitens*

Wetland Edatopic Grid



Comments

*The **Wb09** is the northern equivalent of the **Wb08** and represents sites transitional between the **Wb03** and **Ws07**.*

*The **Wb09** includes Site Series BWBSdk1/09, wk1/07, and wk2/07 also occurs elsewhere in the BWBS and northern SBS.*

General Description

Lodgepole pine – Few-flowered sedge – Peat-moss bogs/poor fens are rare at montane elevations in the Sub-Boreal Interior and Southern Interior Mountains. These ecosystems occur as small stands in frost-prone basins or on gradual slopes.

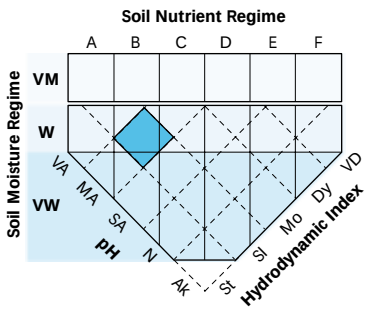
Pinus contorta is always present as a sparse canopy. Trees are small but well formed and are not rooted on elevated microsites. The shrub layer consists almost entirely of stunted conifers, giving these sites an open, park-like character. *Carex pauciflora* usually dominates the herb layer but there is a diversity of other graminoids and typical bog dwarf shrubs. The moss layer is most often a continuous lawn of *Sphagnum angustifolium* with scattered other species.

This Site Association usually has a smooth microtopography and is saturated at the surface from seepage. Soil water is moderately acid, suggesting that groundwater inputs are poor in minerals. Soils are Typic Humisols and Mesisols with a surface tier of poorly decomposed *Sphagnum* peat.

Characteristic Vegetation

Tree layer (0 - **1** - 22)
Pinus contorta
Shrub layer (3 - **20** - 45)
Betula nana, Ledum groenlandicum, Pinus contorta
Herb layer (15 - **44** - 75)
Carex aquatilis, ***C. pauciflora***, ***Eriophorum angustifolium***, ***Kalmia microphylla***, *Oxycoccus oxycoccos*
Moss layer (30 - **85** - 100)
Pleurozium schreberi, ***Sphagnum*** **Group I**

Wetland Edatopic Grid



Comments

Few ***Wb10*** *sites have been sampled; the site conditions that support this Site Association are not well understood and appear to be uncommon. A high watertable and limited microtopography would suggest limited potential for tree growth but many of these sites have trees to 15 m.*

This ecosystem has been found most often as a pure stand type not associated with other wetland ecosystems, but may border ***Wf01*** *or* ***Wf12*** *sites.*

Picea mariana – Menyanthes trifoliata – Sphagnum

General Description

The Black spruce – Buckbean – Peat-moss Bog Site Association is uncommon in the wet climates of the Sub-Boreal Interior and the Nass Basin at elevations below 1200 m. These sites are found in small infilled basins or on edges of larger peatlands where the watertable is stagnant.

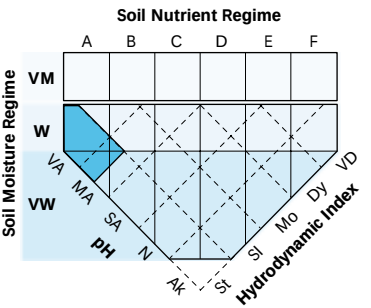
Picea mariana and/or *Pinus contorta* are always present. Tree cover and growth are very sparse and stunted (< 2 m) on wetter sites but cover and growth increase with declining watertable. A diverse assemblage of graminoids and shrubs is typical, with *Menyanthes trifoliata* always prominent. Sites can be hummocky with some standing water in depressions, or with a dense, continuous *Sphagnum* lawn.

Soils are commonly deep moss- and sedge-derived peat. Typic Mesisols and Fibrisols are the most common soil types but Terric subgroups or Humisols derived from limnic materials also occur.

Characteristic Vegetation

Tree layer (0 - **8** - 60)
Picea mariana, *Pinus contorta*
Shrub layer (5 - **28** - 85)
Betula nana, ***Ledum groenlandicum***, ***Picea mariana***, *Pinus contorta*
Herb layer (8 - **53** - 90)
Carex aquatilis, C. limosa, Comarum palustre, Equisetum fluviatile, ***Menyanthes trifoliata***, ***Oxycoccus oxycoccos***
Moss layer (20 - **95** - 100)
Aulacomnium palustre, Pleurozium schreberi, ***Sphagnum* Group I**, *Sphagnum* Group II, *Tomentypnum nitens*

Wetland Edatopic Grid



Comments

Wb11 *develops from* ***Wf07*** *or* ***Wb13*** *ecosystems where* Menyanthes trifoliata *is a prominent species. It is likely that* M. trifoliata *is a persistent species that initially establishes during the early phases of basin-infilling and continues to grow apace of peat accumulation.*

General Description

Scheuchzeria – Peat-moss bogs are uncommon in the sub-boreal and boreal forests at elevations below 1000 m. They usually occur as small inclusions in larger peatlands on floating mats with continually saturated peat and restricted water movements.

Vegetation is characterized by species tolerant of permanent saturation but intolerant of deep flooding. A low shrub layer of *Salix pedicellaris* occurs on some sites but dwarf shrubs such as *Andromeda polifolia*, *Kalmia microphylla*, and *Oxycoccus oxycoccos* are more prevalent. *Scheuchzeria palustris* is always prominent and *Carex limosa* occurs on most sites. The moss layer is dominated by *Sphagnum* Group I species.

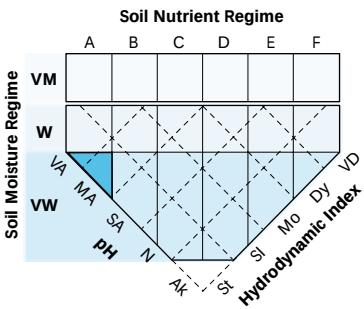
Soils are mostly fibric *Sphagnum* peat and can be floating mats. The watertable is at the surface but does not flood more than several centimetres above the soils surface. The water is very stagnant and low in dissolved oxygen.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **8** - 20)
Salix pedicellaris
Herb layer (20 - **37** - 90)
Andromeda polifolia, ***Carex limosa***, *Eriophorum chamissonis, Kalmia microphylla, Oxycoccus oxycoccos,* ***Scheuchzeria palustris***.

Moss layer (60 - **67** - 100)
***Sphagnum* Group I**

Wetland Edatopic Grid



Comments

*The **Wb12** Site Association requires permanent saturation with acidic waters in combination with no flooding. It therefore occurs in wetlands where water regimes are relatively stable and on sites with ungrounded peat that can rise and fall with changes in watertable. On sites with higher pH, the **Wb12** is replaced by the **Wf07** or **Wf08**.*

*In the eastern boreal areas, ecosystems that are very similar to **Wb12** but have* Sarracenia purpurea *and* Chamaedaphne calyculata *occur (see additional units).*

Carex limosa – Menyanthes trifoliata – Sphagnum

General Description

Shore sedge – Buckbean – Peat-moss bogs are uncommon in the interior rainforest and coastal transition regions at elevations below 1600 m. They occur as components of larger acidic peatlands, occupying the central, wettest portions of the peatland: either grounded, highly saturated peat blankets, or floating mats.

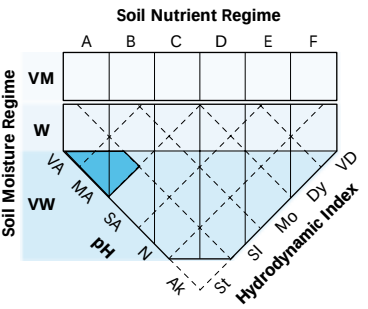
Species tolerant of acidic, continually saturated conditions and concurrent lack of oxygen are prominent. The most consistent of these is *Carex limosa*. *Drosera anglica*, *Menyanthes trifoliata*, *Kalmia microphylla*, and other species can be abundant, sparse, or absent on **Wb13** sites. *Sphagnum angustifolium*, *S. magellanicum*, or *S. fuscum* often form a continuous lawn or there may be a mix of species in hummock-hollow patterns.

Soils are deep (to > 5 m) sedge-derived Mesisols with a surface tier of poorly decomposed *Sphagnum* peat. The watertable is typically at or near the surface but there is little standing water.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **.5** - 10)
Herb layer (15 - **73** - 100)
Carex limosa, *Drosera anglica*, ***Eriophorum angustifolium***, *Kalmia microphylla*, ***Menyanthes trifoliata***, *Trientalis europaea* ssp. *arctica*
Moss layer (30 - **90** - 100)
***Sphagnum* Group I**

Wetland Edatopic Grid



Comments

*The **Wf08** is a similar unit that occurs in drier interior climates on saturated sites.*

*This unit most frequently occurs in wetter locations adjacent to the **Wb11** or **Wb02**, and beside peatland ponds or lakes.*

General Description

Labrador tea – Bog laurel – Peat-moss bogs occur uncommonly in the drier subzones of the south Coast at low to montane elevations. They are raised bogs in closed basins with a high, stagnant watertable or adjacent to peatland lakes. Some locations may be on floating mats.

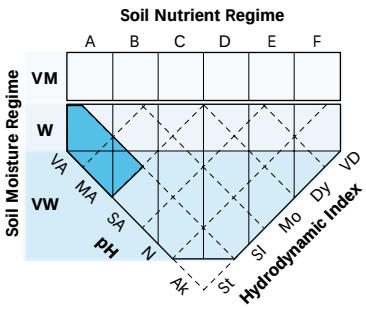
The vegetation is low in stature and dominated by *Ledum groenlandicum* with an abundance of *Kalmia microphylla* and *Oxycoccus oxycoccos*. *Myrica gale* or dwarfed *Pinus contorta* var. *contorta* can be prominent on some, usually drier, sites. Herb cover is variable, low-lying areas can have a high cover of *Rhynchospora alba* while raised sites can have *Rubus chamaemorus* in abundance. Group I *Sphagnum* spp. are most common (*S. fuscum*, *S. capillifolium*) but coastal species also occur (*S. papillosum*), mostly in wetter hollows.

Soils are Typic Fibrisols or Mesisols with surface tier of poorly decomposed *Sphagnum* peat.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **20** - 85)
Ledum groenlandicum, ***Myrica gale***, *Pinus contorta*
Herb layer (10 - **30** - 50)
Drosera rotundifolia, ***Kalmia microphylla***, ***Oxycoccus oxycoccos***, *Rhynchospora alba*
Moss layer (50 - **90** - 91)
***Sphagnum* Group I**

Wetland Edatopic Grid



Comments

*The **Wb50** is widespread but generally of small extent except for several notably extensive bogs in subdued terrain (e.g., Burns Bog). It occurs in open, unshaded locations adjacent to other low-stature peatland types or open water.*

The microtopography of this unit is often broken by peat degradation hollows caused by dieback of Sphagnum *and increased localized decomposition. Shallow pools caused by peat degradation are frequent and are occupied by species such as* Menyanthes trifoliata, Scheuchzeria palustris, *or* Nuphar lutea.

Pinus contorta var. *contorta* – *Empetrum nigrum* – *Sphagnum austinii*

General Description

Shore pine – Black crowberry – Tough peat-moss are raised bogs that occur on level terrain or topographic depressions in the Coast and Mountains at elevations below 100 m.

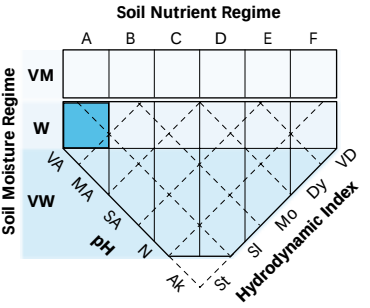
"Bonsai" *Pinus contorta* are scattered with other low shrubs such as *Chamaecyparis nootkatensis*, *Myrica gale*, and *Juniperus communis*. *Empetrum nigrum*, *Kalmia microphylla*, and *Rubus chamaemorus* are typical prominent dwarf shrubs. Several *Sphagnum* species occur in these bogs but the distinctive *Sphagnum austinii*, which forms dense tough mounds, is very common, especially in northern sites.

Soils are commonly Mesisols of *Sphagnum* peat, fibric at the surface and mesic or humic at depth. Sites are slightly domed and raised above surrounding sites through the active growth of *Sphagnum*. Peat depths range from 0.5 m to > 4 m.

Characteristic Vegetation

Tree layer (0 - **0** - 5)
Shrub layer (7 - **30** - 65)
Chamaecyparis nootkatensis, *Juniperus communis*, ***Ledum groenlandicum***, *Myrica gale*, ***Pinus contorta***, *Thuja plicata*
Herb layer (13 - **35** - 50)
Carex livida, *C. pluriflora*, ***Empetrum nigrum***, ***Eriophorum angustifolium***, *Kalmia microphylla*, ***Rubus chamaemorus***, ***Sanguisorba officinalis***, *Triantha glutinosa*, *Trichophorum cespitosum*
Moss layer (90 - **95** - 100)
Racomitrium lanuginosum,
***Sphagnum* Group I**, ***Sphagnum* Group III**

Wetland Edatopic Grid



Comments

*The **Wb51** represents actively growing bogs that show few signs of the stagnation in peat accumulation (such as high abundance of ground lichens and peat degradation pools) common in other bogs of the outer Coast. Extensive areas of the **Wb51** can be found in and around Naikoon Provincial Park on the Queen Charlotte Islands where large tracts of domed bog have developed over marine or glacial outwash sediments. Elsewhere, this community type occurs as smaller areas in the blanket mire complex or in small topogenous bogs.*

*The **Wb51** includes Site Series CWHvh2/31 and CWHwh1/11.*

General Description

Common juniper – Tufted clubrush – Hoary rock-moss bogs are a very common component of the "blanket mire complex" of the outer Coast at elevations below 800 m.

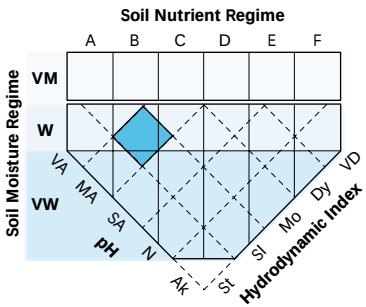
Scattered, "bonsai" shore pine are always present but the shrub layer is characterized more by *Juniperus communis* and *Myrica gale*. *Trichophorum cespitosum* is always dominant but there is a diversity of dwarf shrubs and herbs. On sites with deeper peat, *Sphagnum* spp. are co-dominant with *Racomitrium lanuginosum*, *Cladina* spp., and *Siphula ceratites*. On sites with shallow peat, moss layer cover is lower, *Sphagnum* is greatly reduced, and *Siphula ceratites* and *Campylopus atrovirens* become more prominent.

Deposits of dark mesic peat to 1.5 m, underlain by bedrock, are typical, but peat depth varies considerably. Some sites on the extreme outer Coast have a complex of poorly drained mineral soils derived from bedrock and discontinuous organic accumulations 5–50 cm deep.

Characteristic Vegetation

Shrub layer (0 - **27** - 90)
Chamaecyparis nootkatensis, ***Juniper communis***, *Ledum groenlandicum*, ***Myrica gale***, ***Pinus contorta***, *Vaccinium uliginosum*
Herb layer (8 - **70** - 99)
Agrostis aequivalvis, ***Andromeda polifolia***, *Carex livida*, *Coptis trifolia*, *Drosera rotundifolia*, *Empetrum nigrum*, ***Eriophorum angustifolium***, *Fauria crista-galli*, *Kalmia microphylla*, ***Rhynchospora alba***, ***Sanguisorba officinalis***, ***Trichophorum cespitosum***
Moss layer (5 - **75** - 99)
Campylopus atrovirens, ***Cladina* spp.**, ***Racomitrium lanuginosum***, ***Siphula ceratites***, ***Sphagnum* Group I**, ***Sphagnum* Group III**, ***Sphagnum* Group IV**

Wetland Edatopic Grid



Comments

*The **Wb52** probably represents "over-mature" bogs where* Sphagnum *mosses are limited and peat is no longer accumulating. This is reflected in the prevalence of* Racomitrium lanuginosum *and ground lichens, which would not normally be able to compete with* Sphagnum. *Furthermore, on most sites there are circular to teardrop-shaped shallow pools that are created by peat degradation. These pools are 1–4 m^2 in area and 10–50 cm deep, ringed by dams of* Sphagnum *and* Trichophorum cespitosum *growing in strongly tenacious peat.*

*The **Wb52** includes Site Series CWHvh2/32.*

Pinus contorta – Chamaecyparis nootkatensis – Trichophorum cespitosum

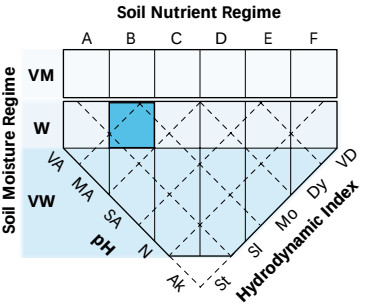
General Description

The Shore pine – Yellow-cedar – Tufted clubrush Site Association is a very common component of the "blanket mire complex" of the outer Coast. The **Wb53** occurs on gently to steeply sloping terrain on slightly shedding sites such as hillocks and slope breaks, or simply along drainageways. There is rarely standing water on these sites.

Stunted yellow-cedar and shore pine to 10 m is characteristic and differentiates this association from the **Wb52**. *Trichophorum cespitosum* is prominent in the understorey but there is a diversity of other herbs and dwarf shrubs. The moss layer is moderately well developed with a mix of upland species on elevated sites and *Sphagnum* spp. in wetter hollows.

Soils are variable, ranging from deep fibric sedge and wood peat deposits (> 2 m) to thin peat veneers over granitic bedrock. Hummocky microtopography provides drier sites for tree establishment.

Wetland Edatopic Grid



Characteristic Vegetation

Tree layer (0 - **0** - 10)
Pinus contorta
Shrub layer (10 - **55** - 95)
Chamaecyparis nootkatensis, ***Gaultheria shallon***, ***Ledum groenlandicum***, ***Pinus contorta***, *Thuja plicata*
Herb layer (25 - **70** - 95)
Cornus canadensis, Drosera rotundifolia, ***Empetrum nigrum***, *Eriophorum angustifolium, Fauria crista-galli,* ***Kalmia microphylla***, *Sanguisorba officinalis,* ***Trichophorum cespitosum***, *Vaccinium uliginosum*
Moss layer (5 - **50** - 90)
Cladina* spp.**, *Pleurozium schreberi,* ***Racomitrium lanuginosum, *Sphagnum* Group I, ***Sphagnum* Group III**

Comments

*The **Wb53** has been refered to as "bog woodland" and is a major component of the blanket mire complex of the outer Coast. It typically occurs with the related **Wb52** on sloping terrain. The **Wb53** includes Site Series CWHvh2/12.*

This section briefly describes some uncommon Bog Site Associations that have been sampled in British Columbia.

Western redcedar – White pine – Bristle-stalked sedge
Thuja plicata – Pinus monticola – Carex leptalea

Western redcedar – White pine – Bristle-stalked sedge stands are uncommon in the Georgia Depression in regions underlain with basic bedrock. They occur in small depressions and around peatland lakes on raised peat deposits.

A diverse mixture of conifers forms an open, tall-shrub layer. Western redcedar and white pine are common but western hemlock, Sitka spruce, and shore pine also occur. Labrador tea and sweet gale are common in the shrub layer. Bristle-stalked sedge is always prominent in the herb layer but other sedges can be common. Peat-mosses predominate; sites with bog-like vegetation but with brown mosses instead of peat-mosses have been observed.

Leatherleaf – Pitcher plant – Peat-moss
Chamaedaphne calyculata – Sarracenia purpurea – Sphagnum

Leatherleaf – Pitcher plant – Peat-moss sites have been observed but infrequently sampled in the Taiga Plains Ecoprovince. They occur on floating mats or other peatland locations where the watertable is maintained at, but not above, the peat surface.

These communities are very similar in species composition and structure to the **Wb12** of the western boreal and sub-boreal regions. However, leatherleaf (*Chamaedaphne calyculata*) replaces bog willow (*Salix pedicellaris*), and pitcher plant (*Sarracenia purpurea*) occurs. The Taiga Plains Ecoprovince represents the western limit of pitcher plant in the Canadian boreal forest.

Shore pine – Labrador tea – Salal
Pinus contorta var. *contorta – Ledum groenlandicum – Gaultheria shallon*

Shore pine – Labrador tea – Salal stands are uncommon in the Georgia Depression in small topographic depressions and around the edge of domed bogs.

Shore pine is often the only tree species in an open and stunted (< 10 m) canopy. *Ledum groenlandicum* and *Gaultheria shallon* typically form a dense, low-shrub layer. *Kalmia polifolia*, *Oxycoccus oxycoccos*, *Pteridium aquilinium*, and *Cornus canadensis* are common in the typically sparse

herb layer. *Sphagnum capillifolium* is often a small component of the moss layer, with feathermosses, such as *Hylocomium splendens*, dominating on most sites.

Soils have a surface horizon of feathermoss and litter-derived humus over deep peat deposits composed of *Sphagnum* remains.

1 *Sphagnum* spp., peat moss **2** *Ledum groenlandicum*, Labrador tea **3** *Oxycoccus oxycoccos*, bog cranberry

1 *A patterned fen near Williston Reservoir, northern Rocky Mountains (SBSmk2)* **2** *A basin fen near Babine Lake, Sub-Boreal Interior (SBSmc2)* **3** *Sloping fens, Harold Price Plateau near Smithers (ESSFwv)*

Definition

A fen is a nutrient-medium peatland ecosystem dominated by sedges and brown mosses, where mineral-bearing groundwater is within the rooting zone and minerotrophic plant species are common.

General Description

Vegetation

Table 5.2.2 lists species common to Fen Site Associations described in this guide. Fens are characterized by high cover of sedges and bryophytes of the brown moss group, such as *Campylium*, *Drepanocladus*, *Scorpidium*, *Tomentypnum*, and *Warnstorfia.* These species reflect relatively mineral-rich site conditions in fens compared to bogs. Some sites may have high cover of minerotrophic non–hummock-forming *Sphagnum* species (see Group II *Sphagnum* definition page 47). Low shrub or graminoid physiognomy is typical: a high watertable precludes tall shrubs and trees. Shrub species are typically deciduous, most commonly willows and scrub birch. On very saturated sites some evergreen dwarf shrubs such as bog cranberry and bog rosemary may be prominent. The moss layer is usually well developed.

Landscape Position and Distribution

Fens develop where permanently saturated soil conditions are maintained. Common locations for fens are groundwater-fed basins, gradual seepage slopes, and protected lake or pond margins where there is little wave action or drawdown.

Fens are the most common wetland class in the province and occur in all but the warmest and driest climates (Table 5.2.1). Regions with cool summer temperatures are optimal for fen formation.

Hydrology and Soils

Fens occur where peat accumulates but where groundwater flows maintain relatively high mineral content in the rooting zone. The watertable is usually at or near the soil surface with little late season drawdown. The degree of lateral flow, stability of the watertable, and availability of base cations differentiate most fen ecosystems (Figure 5.2.1).

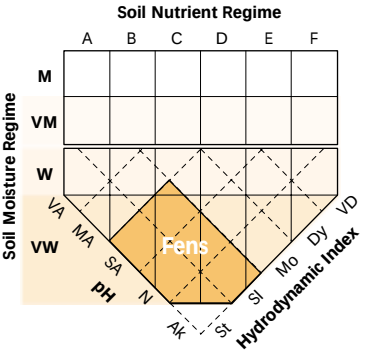


FIGURE 5.2.1 *Position of fens on the edatopic grid.*

Soils are of the Organic order, most frequently Mesisols, derived from sedges and mosses. Soil nutrient regime ranges from poor to rich.

Other Comments

In long-term peatland development, fens are classically represented as an intermediate stage between marsh (with mineral rooting substrate) and bog ecosystems (semi-terrestrial peatlands). The peat profile and vegetation of some peatland ecosystems in British Columbia do reflect this model; the lowest tier of peat indicates marsh conditions, the middle tier is sedge-dominated, and the upper tier is *Sphagnum*-derived. However, many fens occur in climatic areas that are not conducive to bog development and therefore may be long-lived. In addition, some fens have peat profiles with consistent peat composition throughout, suggesting that they have been stable ecosystems since peatland initiation and are not undergoing long-term peatland succession.

Conservation Issues

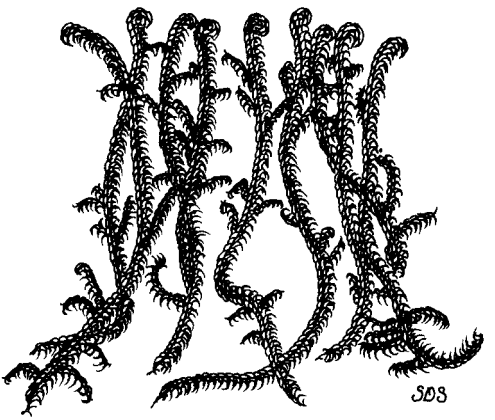
Fens are the most common wetland class throughout most of British Columbia. Site Associations dominated by water, beaked, or Sitka sedges and narrow-leaved cotton-grass (**Wf01–03, 11, 12**) are the most common of the fen types in the province in part because these species tolerate a wide range of hydrologic conditions. These large sedge–dominated Site Associations persist despite beaver flooding, beaver dam removal, haying, extreme flooding, sedimentation, or burning. However, fundamental changes to the water regime such as permanent watertable elevation or draining will convert communities to other types.

Fen Site Associations with high stable water regimes (**Wf05 – Wf11**) are less common and more sensitive to lowered watertables. They are resilient to moderate increases in watertable since peat blankets will often swell or float in response, thereby preventing deep flooding.

Fens have moderate wildlife habitat values. Forage availability is moderate for ungulates and very low for bear in most fens. Fens with standing water will support moderate aquatic insect populations, which in turn support avian and mammalian insectivores. Shrew and some rodents such as jumping mice and voles will use fens extensively. Fens with relatively stable water regimes and well-developed bryophyte layers support unique peatland arthropod communities.

Waterfowl use of fens is often limited because of low prey abundance. Other waterbirds such as Common Snipe and Black Tern use fens for nesting.

Agricultural uses of fens are primarily for grazing and the production of "swamp hay." The **Wf01** is the most commonly used Site Association for this purpose. Wetter fens are generally of low value because of trafficability problems associated with saturated peat soils.



Drepanocladus aduncus, common hook-moss

TABLE 5.2.1 *Distribution of Fen Site Associations by biogeoclimatic zone*

		BG PP	BWBS SWB	ESSF	ICH	IDF	MS	SBPS SBS	CDF	CWH	MH
Wf01	Water sedge – Beaked sedge		xx	x	xx	xxx	xxx	xxx		x[i]	
Wf02	Scrub birch – Water sedge		xxx	x	xx	xx	xx	xx			
Wf03	Water sedge – Peat-moss			xx				x			
Wf04	Barclay's willow – Water sedge – Glow mosss		x	xxx			x	x			
Wf05	Slender sedge – Common hook-moss		x		xx	xx	xx	xx			
Wf06	Slender sedge – Buckbean		x		x	x		x			
Wf07	Scrub birch – Buckbean – Shore sedge		x		x	x		x			
Wf08	Shore sedge – Buckbean – Hook-moss		x	x		x	x	x			
Wf09	Few-flowered spike-rush – Hook-moss			x			x	x			
Wf10	Hudson Bay clubrush – Red hook-moss							x			
Wf11	Tufted clubrush – Star moss		x	x	x		x	x			
Wf12	Narrow-leaved cotton-grass – Marsh-marigold			xxx							
Wf13	Narrow-leaved cotton-grass – Shore sedge			xx			x				
Wf50	Narrow-leaved cotton-grass – Peat-moss									x	xxx
Wf51	Sitka sedge – Peat-moss				x				xx	xx	
Wf52	Sweet gale – Sitka sedge								xx	xx[s]	
Wf53	Slender sedge – White beak-rush								x	xx[s]	

x = incidental; < 5% of wetlands xx = minor; 5–25% of wetlands xxx = major; >25% of wetlands
i = inland areas only s = southern subzones only

TABLE 5.2.2 *Fen Species Importance Table*

	Species	Wf01	Wf02	Wf03	Wf04	Wf05	Wf06	Wf07	Wf08
Shrubs	*Betula nana*								
	Salix barclayi								
	Salix pedicellaris								
	Spiraea douglasii								
	Myrica gale								
Herbs and Dwarf Shrubs	*Carex utriculata*								
	Carex aquatilis								
	Comarum palustre								
	Calamagrostis canadensis								
	Carex lasiocarpa								
	Menyanthes trifoliata								
	Carex limosa								
	Carex chordorrhiza								
	Eleocharis quinqueflora								
	Trichophorum alpinum								
	Trichophorum cespitosum								
	Eriophorum angustifolium								
	Caltha leptosepala								
	Carex anthoxanthea								
	Equisetum fluviatile								
	Carex magellanica								
	Carex sitchensis								
	Rhynchospora alba								
	Carex livida								
	Eriophorum chamissonis								
	Vahlodea atropurpurea								
	Drosera anglica								
	Hypericum anagalloides								
	Triantha glutinosa								
	Schoenoplectus tabernaemontani								
	Fauria crista-galli								
	Senecio triangularis								
	Andromeda polifolia								
	Kalmia microphylla								
	Oxycoccus oxycoccos								
	Triglochin maritima								
	Drosera rotundifolia								
	Leptarrhena pyrolifolia								
	Platanthera dilatata								
	Sanguisorba canadensis								
	Utricularia intermedia								
	Viola palustris								
Lichens and Mosses	*Sphagnum* Group I								
	Aulacomnium palustre								
	Drepanocladus spp.								
	Sphagnum Group II								
	Tomentypnum nitens								
	Philonotis fontana								
	Calliergon stramineum								
	Scorpidium spp.								
	Campylium stellatum								
	Warnstorfia spp.								
	Meesia triquetra								

Wf09	Wf10	Wf11	Wf12	Wf13	Wf50	Wf51	Wf52	Wf53	Common Name
									scrub birch
									Barclay's willow
									bog willow
									pink spirea
									sweet gale
									beaked sedge
									water sedge
									marsh cinquefoil
									bluejoint reedgrass
									slender sedge
									buckbean
									shore sedge
									cordroot sedge
									few-flowered spike-rush
									Hudson Bay clubrush
									tufted clubrush
									narrow-leaved cotton-grass
									white mtn. marsh-marigold
									yellow-flowered sedge
									swamp horsetail
									poor sedge
									Sitka sedge
									white beak-rush
									pale sedge
									Chamisso's cotton-grass
									mountain hairgrass
									great sundew
									bog St. John's-wort
									sticky asphodel
									great bulrush
									deer-cabbage
									arrow-leaved groundsel
									bog-rosemary
									western bog-laurel
									bog cranberry
									seaside arrow-grass
									round-leaved sundew
									leatherleaf saxifrage
									fragrant white rein orchid
									Sitka burnet
									flat-leaved bladderwort
									marsh violet
									peat-moss Group I
									glow moss
									hook-mosses
									peat-moss Group II
									golden fuzzy fen moss
									spring moss
									straw spear-moss
									sausage-moss
									yellow star-moss
									hook-mosses
									three-ranked hump-moss

Carex aquatilis – Carex utriculata

General Description

The Water sedge – Beaked sedge Fen Site Association is the most common and widespread Fen Site Association in the province. It occurs in all but the warmest and driest subzones from low to subalpine elevations on sites that are annually inundated by shallow, low-energy flood waters and that experience some late-season drawdown. **Wf01** fens are found in a wide variety of landscape positions but most commonly palustrine basins.They occupy wetter zones in larger peatland complexes but also form extensive pure "meadows."

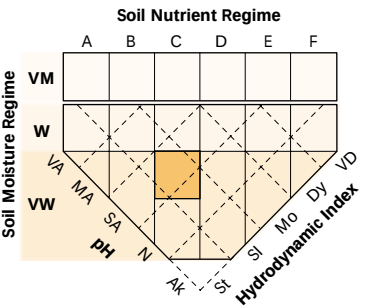
Species diversity is low; *Carex aquatilis* and *Carex utriculata* cover is often continuous, with scattered forbs, aquatics, and mosses in the understorey. On sites that dry out at the surface, *Calamagrostis canadensis* or *C. stricta* can become prominent, species diversity increases, and sites become more meadow-like.

Peat depths range from 30 to > 300 cm. Common soil types include typic and terric Fibrisols and Mesisols. This Site Association tolerates variable hydrology.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 10)
Herb layer (13 - **80** - 100)
Carex aquatilis*, *C. utriculata
Moss layer (0 - **5** - 100)
Drepanocladus aduncus

Wetland Edatopic Grid



Comments

Sites dominated by C. utriculata *and* C. aquatilis *but with mineral or humic soils are described by the* ***Wm01****. Because* ***Wf01*** *and* ***Wm01*** *sites are species-poor and the two dominant sedge species have a wide ecological amplitude, the plant community poorly differentiates between sites on peat (****Wf01****) and those on mineral soil (****Wm01****).* ***Wf01*** *sites typically have less* C. utriculata *and fewer aquatics than* ***Wm01*** *sites. The* ***Wf01*** *develops from the* ***Wm01*** *in most circumstances.*

Sites that are drier or at least have more pronounced microtopography than the ***Wf01*** *are usually occupied by communities with low shrubs and high moss cover (most commonly, the* ***Wf02****). However, at higher elevations few shrubs occur and only moss cover increases (****Wf03****). Sites with greater waterflow are characterized by tall-shrub swamps dominated by willows or alders, and water sedges, and have mineral or humic peat soils.*

General Description

The Scrub birch – Water sedge Fen Site Association is one of the most common peatland Site Associations throughout the Interior and is absent only from PP/BG and wet ESSF subzones. It is frequently a major component of large peatlands where there is some watertable fluctuation and the surface becomes aerated by mid-season. These sites are often hummocked, with shrubs rooting on elevated microsites.

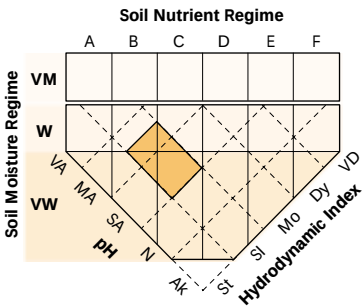
Betula nana and *Carex aquatilis* are the characteristic species but *Salix pedicellaris* and *Carex utriculata* dominate on wetter sites. The moss layer is variable and can be diverse, absent, or dominated by *Tomentypnum nitens*, *Sphagnum*, or *Drepanocladus*. Some drier sites will have scattered, stunted trees (spruce or black spruce most commonly).

Common soil types are terric and typic Mesisols and Fibrisols. Peat depths are frequently between 1 and 2 m but deep sedge-derived peat to 4 m occurs; this Site Association can occassionally occur on thin organic veneers.

Characteristic Vegetation

Tree layer (0 - **0** - 10)
Shrub layer (10 - **35** - 100)
Betula nana, *Salix pedicellaris*
Herb layer (5 - **60** - 100)
Carex aquatilis, ***C. utriculata***, *Comarum palustre*
Moss layer (0 - **70** - 100)
Aulacomnium palustre, Drepanocladus aduncus, Sphagnum Group I, ***Tomentypnum nitens***

Wetland Edatopic Grid



Comments

*The **Wf02** Site Association often occurs around the periphery of the wetter **Wf01** or adjacent to the drier **Wb05**. These three Site Associations may represent a sequence of long-term peatland succession. Many sites have a moss layer with rich and poor site indicators, suggesting that they are in transition from fen to bog conditions.*

*The **Wf02** is one of the most common Interior peatland community types at low to subalpine elevations. It is probably only absent from the AT, BG, and PP zones. In coastal areas, similar sites are occupied by the **Wf52**.*

Carex aquatilis – Sphagnum

General Description

Water sedge – Peat-moss fens occur mainly at elevations above 1100 m in the Interior (ESSF zone), where they are the counterpart to the **Wf02** of lower elevations. These communities appear to be relatively common but have not been extensively sampled. Small pocket depressions or gradual seepage slopes where there is no flooding are typical locations.

Carex aquatilis is the dominant species, though there can be significant occurrence of subalpine forbs such as *Caltha leptosepala*, *Sanguisorba canadensis*, or *Senecio triangularis* on some sites. Peat-mosses are usually dominant in the **Wf03**, though there may be a diversity of other mosses such as *Aulacomnium palustre*, *Tomentypnum nitens*, and others.

Mesisols derived from sedge peat up to 2 m (rarely to 4 m) in depth are common.

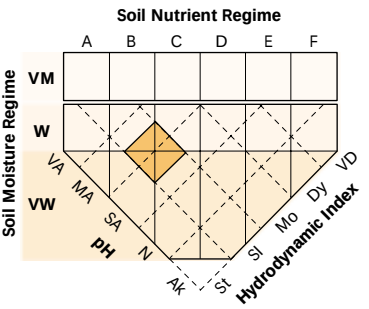
Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **3** - 10)
Herb layer (25 - **70** - 100)
Carex aquatilis, *C. sitchensis, Senecio triangularis*
Moss layer (30 - **85** - 100)
Aulacomnium palustre, ***Sphagnum* Group I**, *Tomentypnum nitens*

Comments

*The **Wf11** and **Wf12** occur only at higher elevations but require greater surface waterflow and replace the **Wf03** on active seeps and more saturated sites. Frost and cold soils rather than a high watertable probably limit shrub establishment on **Wf03** sites.*

Wetland Edatopic Grid



General Description

Barclay's willow – Water sedge – Glow moss fen/swamps are common at subalpine elevations of the Sub-Boreal Interior, Southern Interior Mountains, and Northern Boreal Mountains. They occur on subalpine seepage slopes, along glacier-fed creeks, and in frost-prone basins.

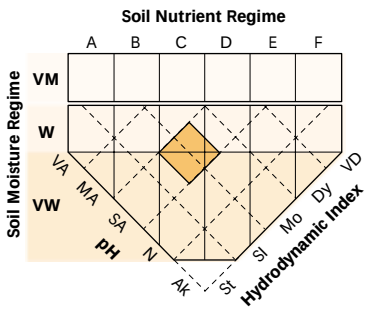
Salix barclayi dominates the shrub layer with a scattering of other low shrub species. *Carex aquatilis* dominates the herb layer but is often accompanied by scattered high-elevation species such as *Caltha leptosepala*, *Eriophorum angustifolium*, and *Leptarrhena pyrolifolia*. The moss layer can be absent or moderately well developed.

Continuous (often copious) groundwater or snowmelt seepage is typical, and soils are cold. Peat is often shallow because of low biomass production but occasionally deep sedge peat deposits are encountered. Common soil types include terric Mesisols, Humisols, and Fibrisols

Characteristic Vegetation

Tree layer (0 - **.5** - 3)
Shrub layer (10 - **35** - 95)
Salix barclayi
Herb layer (26 - **65** - 99)
Calamagrostis canadensis, ***Carex aquatilis***, *C. sitchensis*
Moss layer (0 - **15** - 95)
Aulacomnium palustre, *Mnium* spp., *Philonotis fontana*

Wetland Edatopic Grid



Comments

Wf04 *can occur alone or surrounding sedge or cotton-grass fens (**Wf03** or **Wf12**), or in wet depressions within forb-rich subalpine meadows or carrs. The similar **Sc03** is also common at high elevations in the Interior. However, the **Sc03**'s low shrub physiognomy is the result of cold-air drainage not wet soils, and it is characterized by subalpine forbs with few hydrophytes.*

Carex lasiocarpa – Drepanocladus aduncus

General Description

Slender sedge – Common hook-moss fens are common throughout the Interior at elevations below 1400 m. These fens occur on peat flats surrounding small lakes and ponds or in infilled palustrine basins. Prolonged shallow surface flooding and continual surface peat saturation are typical.

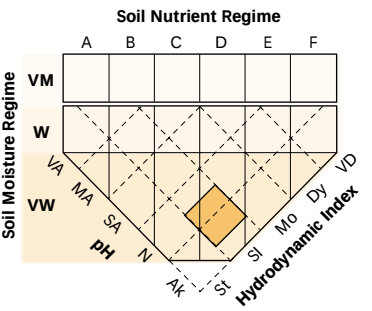
Carex lasiocarpa and *Drepanocladus aduncus* are constant dominants. Other large water sedges, such as *C. aquatilis* and *C. utriculata*, are also common. There can be a very sparse shrub cover of *Salix pedicellaris*, *S. candida*, or *Betula nana*. The moss layer is usually well developed but is occasionally absent. Hook-mosses usually dominate with occasional inclusions of other brown mosses.

Deep peat deposits are common but some sites may occur on thin organic veneers. Mesisols are the most common soil type but Humisols and Fibrisols also occur.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **3** - 10)
Herb layer (13 - **60** - 100)
Carex aquatilis, ***C. lasiocarpa***, *C. utriculata*
Moss layer (0 - **55** - 100)
Drepanocladus aduncus

Wetland Edatopic Grid



Comments

*Some **Wf05** sites are marsh-like with deep flooding, low diversity, and virtually no moss layer. The related **Wf06** occurs on floating mats with a more equable water regime and hummock/hollow topography. Slender-sedge fens (**Wf05**, **Wf06**) occur in locations similar to the **Wf01** but seem to represent sites with longer surface saturation and more basic soil water. Similar sites in coastal areas are described by the **Wf53**.*

General Description

Slender sedge – Buckbean fens are uncommon in the Central and Sub-Boreal Interior at elevations below 1300 m. They occur on floating mats adjacent to small lakes and peatland ponds, or in flarks of patterned fens where there is permanent surface saturation and shallow inundation.

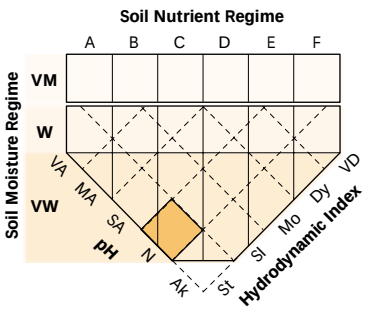
Sites are often slightly hummocked, with *Menyanthes trifoliata* occurring in the wet depressions and *Carex lasiocarpa* and *Drepanocladus* spp. and other mosses occurring on mounds. A sparse shrub layer can occur and the moss layer is always well developed. Hook-mosses are the most common component of the moss layer but *Sphagnum* spp. or *Campylium stellatum* may dominate on some sites.

Sites have sedge peat to 2.5 m, often with a subsurface water lens or supersaturated horizon. Fibrisols and Mesisols are typical soil types.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **3** - 10)
Herb layer (20 - **65** - 85)
Carex lasiocarpa, ***Menyanthes trifoliata***
Moss layer (30 - **55** - 100)
Drepanocladus aduncus, *Warnstorfia* spp.

Wetland Edatopic Grid



Comments

Wf06 *site conditions are intermediate between the* ***Wf05*** *and the* ***Wf08****. The* ***Wf06*** *has a more equable water regime with less flooding, less water flow, and greater peat saturation than the related* ***Wf05****, but has deeper and more dynamic surface water than the* ***Wf08****. Slender-sedge fens (****Wf05****,* ***Wf06****) occur in locations similar to the* ***Wf01*** *but seem to represent sites with longer surface saturation and more basic soil water. The* ***Wf06*** *almost always occurs as a floating mat adjacent to a waterbody.*

Similar sites in coastal areas are described by the ***Wf53****.*

Betula nana – Menyanthes trifoliata – Carex limosa

General Description

Scrub birch – Buckbean – Shore sedge fens occur throughout the Central and Sub-Boreal Interior at middle elevations below 1400 m, in palustrine basins or patterned fens with permanently high watertables. Most sites are prominently hummocked or ribbed with elevated sites and permanent shallow-water hollows.

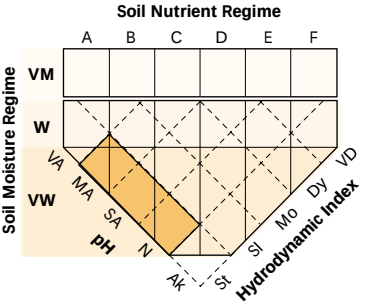
An open cover of *Betula nana* or *Salix pedicellaris* rooted on elevated microsites is distinctive. Low sedges such as *Carex chordorrhiza* and *C. limosa* are prominent throughout most sites, while *Comarum palustre* and *Menyanthes trifoliata* occupy inundated depressions. The composition of the well-developed bryophyte layer is variable. Mixed-species *Sphagnum* cover is common on some sites (not necessarily the most acidic), brown mosses are common on others, while true calciphiles such as *Scorpidium scorpioides* occur only on the most basic sites.

Mesisols and Fibrisols derived from sedge/moss peat are typical. Peat is often >1 m in depth but, less commonly, sites occur on peat veneers.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (10 - **26** - 55)
Betula nana*, *Salix pedicellaris
Herb layer (20 - **60** - 80)
Carex aquatilis, *C. chordorrhiza*, ***C. limosa***, ***Comarum palustre***, ***Menyanthes trifoliata***
Moss layer (20 - **95** - 100)
Drepanocladus aduncus, *Scorpidium* spp., *Sphagnum* Group I, *Sphagnum* Group II, *Tomentypnum nitens*

Wetland Edatopic Grid



Comments

*The **Wf07** covers much of the acidity/alkalinity gradient, with little change in the vascular flora but a marked difference in the bryophyte composition. Some sites have more* Sphagnum *and are generally more bog-like, while others are more clearly rich fens. These sites are similar to the **Wb13** but have a well developed shrub layer. However, there is a high degree of intergradation with few clear environmental criteria to separate most sites (except at the extremes of the spectrum). Hence, the variation has been grouped into a single Site Association.*

*The open shrub cover of the the **Wf07** distinguishes it from the wetter **Wf08** or **Wb13**. The **Wf07** may represent the middle stage of a peatland succession sequence: **Wf08** >> **Wf07** >> **Wb11** in some regions .*

General Description

The Shore sedge – Buckbean – Hook-moss is an uncommon, rich Fen Site Association that occurs mainly at higher elevations throughout the Interior (700–1800 m) in colder subzones. These fens occur on pond-side floating mats or in flarks of patterned fens where there is prolonged shallow flooding to no more than several centimetres.

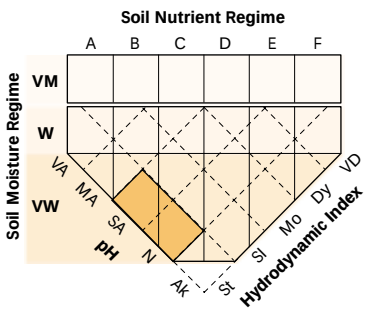
Carex limosa rooted in shallow water is the constant dominant on these sites. *Menyanthes trifoliata* occurs on most sites but can be very sparse or absent on some. A diversity of species tolerant of permanent saturation such as *Carex chordorrhiza*, *Equisetum fluviatile*, and *Andromeda polifolia* commonly occur with low cover.

Peat deposits are shallow (0.5 m) to very deep (> 6 m), fibric or mesic, and derived from fine sedges and brown mosses. Fibrisols are the most common soil type.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **.5** - 10)
Herb layer (14 - **35** - 100)
C. limosa*, *Menyanthes trifoliata
Moss layer (1 - **85** - 100)
Drepanocladus spp.

Wetland Edatopic Grid



Comments

*This is the most common and dominant Site Association in patterned fens. In weakly patterned fens, the **Wf08** occurs over ribs and flarks. Where there is a more pronounced rib/flark pattern, the **Wf08** will typically occur in flarks and the floristically similar, shrubby **Wf07** on elevated ribs.*

*The **Wf06** occurs on wetter and more hydrologically dynamic sites than the **Wf08**. Similarly stagnant sites with acidic soil water are occupied by the **Wb13**. The **Wf08** has similar hydrology to the **Wf09** and **Wf10**, but with more mobile groundwater and greater degree of surface flooding. **Wf08** sites may become **Wb13** sites in some circumstances.*
Peat deposits are often consistent throughout the profile, and peat core contents of fine sedge and brown mosses are readily identifiable. This suggests that these ecosystems can be stable and long-lived.

Eleocharis quinqueflora – Drepanocladus

General Description

The Few-flowered spike-rush – Hook-moss Fen Site Association occurs on small sloping peatlands at high elevations (mostly above 1200 m) throughout the Sub-Boreal, Central, and Southern Interior. It is rare throughout most of its range, occurring only in slope positions with continual slow surface seepage.

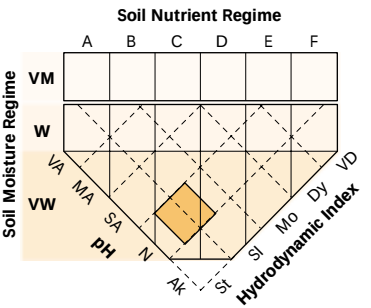
Plant diversity is low; *Eleocharis quinqueflora* is the site dominant, with lesser amounts of *Carex limosa*, *Eriophorum angustifolium*, and other forbs occasionally occurring. Hook-mosses such as *Homatocaulis vernicosus*, *Scorpidium revolvens*, and *Drepanocladus aduncus* usually comprise the moss layer but other brown mosses such as *Meesia triquetra* and *Tomentypnum nitens* can occur in high abundance.

Peat forms as a characteristically dense and tenacious mesic peat. Peat depths are frequently shallow but can be up to 2 m. Terric Mesisols and Humisols are common soil types.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **.5** - 10)
Herb layer (30 - **60** - 100)
Carex limosa, ***Eleocharis quinqueflora***, *Eriophorum angustifolium*
Moss layer (1 - **50** - 95)
***Drepanocladus* spp.**, *Tomentypnum nitens*

Wetland Edatopic Grid



Comments

*The **Wf09** unit is similar in structure and hydroedatopic position to the **Wf11** of lower elevations. **Wf09** commonly occurs without adjacent wetland Site Associations or in complex with cotton-grass fens (**Wf12** or **Wf13**).*
The tenacious peat of this unit is typically of similar composition throughout the profile, suggesting that this ecosystem can be stable and long-lived.

*Peat is sufficiently dense on **Wf09** sites that soil water movements are impeded and most waterflow is at the surface as sheet flow. The specific conditions that give rise to the **Wf09** rather than other high-elevation fens are not well understood but may be partly initiated and maintained by the dense stems and roots of* Eleocharis quinqueflora.

General Description

The Hudson Bay clubrush – Red hook-moss Site Association is rare and seems to occur only in the moist subzones of the SBS. It is floristically related to the **Wf11** but occurs where the watertable is more stagnant and at or slightly above the peat surface for much of the growing season. Common locations are around small peatland lakes and ponds, and in flarks.

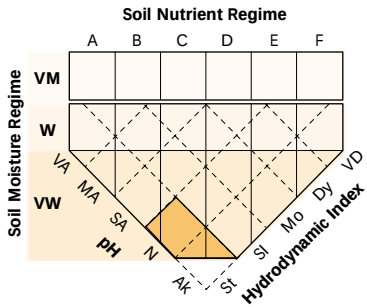
Trichophorum alpinum dominates but there is usually a diverse array of other species typical of base-rich and saturated peatland habitats such as *Carex chordorrhiza*, *C. lasiocarpa*, *C. limosa*, *Menyanthes trifoliata*, and *Triglochin maritima*. The moss flora is dominated by brown mosses and strong calciphiles: *Campylium stellatum*, *Scorpidium revolvens*, and *S. scorpioides*.

Many sites are underlain by calcareous marl, and peat water is usually neutral to alkaline. Peat decomposition is apparently retarded under these conditions because the entire peat profile often has few signs of decomposition. Typic Fibrisols are common. Peat is usually deep (> 3 m).

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 0.5)
Herb layer (37 - **90** - 95)
Andromeda polifolia, *Carex aquatilis*, ***C. chordorrhiza***, *C. lasiocarpa*, ***C. limosa***, ***Drosera anglica***, ***Menyanthes trifoliata***, *Oxycoccus oxycoccos*, *Triantha glutinosa*, ***Trichophorum alpinum***, *Triglochin maritima*
Moss layer (25 - **95** - 100)
Calliergon stramineum, ***Campylium stellatum***, ***Scorpidium revolvens***, ***S. scorpioides***, *Sphagnum* Group II, *Tomentypnum nitens*

Wetland Edatopic Grid



Comments

Wf10 *sites are usually small inclusions in larger complexes of rich fen peatland but are conspicuous when* Trichophorum alpinum *is in flower. Most site conditions are similar to the* ***Wf08*** *but the* ***Wf10*** *occurs where soil water is alkaline and (apparently) occurs over a much more restricted climatic range.*

Trichophorum cespitosum – Campylium stellatum

General Description

The Tufted clubrush – Star moss Fen Site Association is scattered throughout the Interior at middle to subalpine elevations, most commonly in regions underlain with base-rich parent materials. These fens occur on level and gently sloping, groundwater-fed peatlands that are permanently saturated but rarely inundated. Sites have smooth, ribbed, or slightly hummocked topography and any depressions are water-filled.

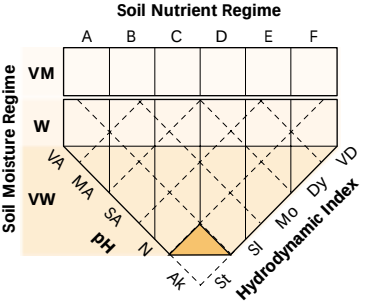
Trichophorum cespitosum and *Campylium stellatum* are constant dominants and occur mainly on drier microsites. *Menyanthes trifoliata* and calcium-encrusted *Scorpidium scorpioides* and *Scorpidium revolvens* are commonly found in very shallow pools.

Most sites have a distinct dense and tenacious turfy peat. Deep peat is typical (to 5 m) but occasionally thin peat veneers occur. Fibrisols and Mesisols are typical soil types.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **1** - 10)
Herb layer (20 - **75** - 97)
Carex limosa, Eriophorum angustifolium, Menyanthes trifoliata, ***Trichophorum cespitosum***
Moss layer (0 - **70** - 95)
Campylium stellatum, *Sphagnum* Group II

Wetland Edatopic Grid



Comments

The ***Wf11*** *occurs where extremely high pH limits the availability of phosphorous, making these sites nutrient-poor even though they have an abundance of cations. Tufted clubrush–dominated wetlands are also found in regions underlain by base-poor granitic parent material, such as coastal British Columbia, where phosphorus is also limited. These communities lack minerotrophic site indicators and have a* Sphagnum*-dominated moss layer. Tufted clubrush – Peat-moss ecosystems (****Wb52****) are very common in coastal British Columbia but several sites have been observed in interior locations where the local geology is of igneous intrusive origin (e.g., Monashee Ranges).*

General Description

The Narrow-leaved cotton-grass – Marsh-marigold Site Association is common at subalpine elevations (above 1200 m) throughout the Sub-Boreal and Central Interior. It occurs on gently sloping peatlands where there is continual seepage from snowmelt and groundwater.

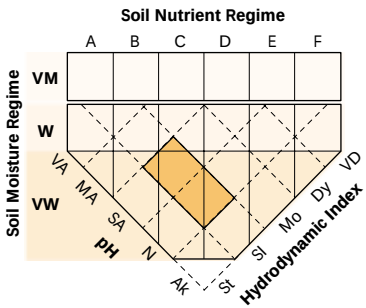
Eriophorum angustifolium occurs on most sites with high cover. Sites with abundant surface seepage will also have a high cover of *Caltha leptosepala* and/or *Leptarrhena pyrolifolia*. Other graminoids such as *C. anthoxanthea*, *C. aquatilis*, or *C. nigricans* may also occur with high cover on some sites. The moss layer is usually well developed but compositionally variable.

Soils are usually deep, mushy sedge peat. Typic Mesisols and Fibrisols are the most common soil types.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **1** - 10)
Herb layer (12 - **80** - 100)
Caltha leptosepala*, *Eriophorum angustifolium
Moss layer (0 - **75** - 95)
Aulacomnium palustre

Wetland Edatopic Grid



Comments

*The **Wf12** occurs on sites with more active seepage than the related **Wf13** Site Association. It also has similar site characteristics to the **Wf08**, but that unit is fed by groundwater with high levels of base cations and has dense peat deposits.*

*The **Wf12** occurs alone or in complex with the **Wf03**, on microsites with more active seepage.*

*Some **Wf12** sites in the upper Skeena drainage have high cover of* Carex anthoxanthea, *which is a common species of bog forests on the north Coast. The Interior distribution of this species is greatly restricted and could be limited to these high-elevation wetland ecosystems.*

Eriophorum angustifolium – Carex limosa

General Description

Narrow-leaved cotton-grass – Shore sedge fens occur at higher elevations (1200–1800 m) of the ESSF zone in depressions or gradual seepage slopes where standing water persists for most of the short growing season. The **Wf13** appears to be relatively common (at least locally) but has not been extensively sampled.

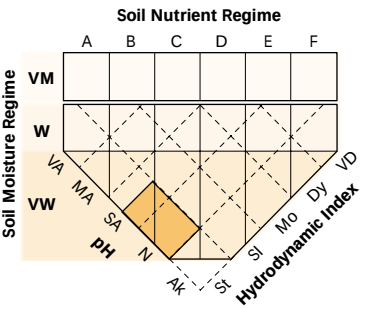
A community dominated by *Eriophorum angustifolium* with *Carex limosa* is typical but some sites may have poor sedge (*Carex magellanica*) instead of *C. limosa*. Grasses such as *Calamagrostis canadensis* and *Vahlodea atropurpurea* and the forb *Caltha leptosepala* are commonly abundant. The moss layer is well developed and is often diverse, with no one species dominating.

Soils are deep peat deposits of fibric or mesic cotton-grass remains. Typic Mesisols and Fibrisols are common soil types.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **2** - 10)
Herb layer (20 - **80** - 100)
Caltha leptosepala, Carex aquatilis, ***C. limosa, Eriophorum angustifolium***
Moss layer (0 - **40** - 99)
Aulacomnium palustre, Philonotis fontana, ***Sphagnum*** **Group I**

Wetland Edatopic Grid



Comments

The ***Wf13*** *is wetter than the closely related* ***Wf12*** *and tends to be found more commonly in depressional areas where water ponds. The high-elevation fen units* ***Wf03***, ***Wf04***, ***Wf11***, ***Wf12***, *and* ***Wf13*** *often occur together in complex in extensive subalpine peatlands, each occurring in habitats differing in water flow and ponding (****Wf03*** *driest to* ***Wf13*** *wettest).*

General Description

The Narrow-leaved cotton-grass – Peat-moss Fen/Bog Site Association describes a wide range of ecosystems of montane and subalpine areas of the Coast where there is some surface seepage. Many sites are sloping but the **Wf 50** also occurs on level sites with a permanent, high watertable.

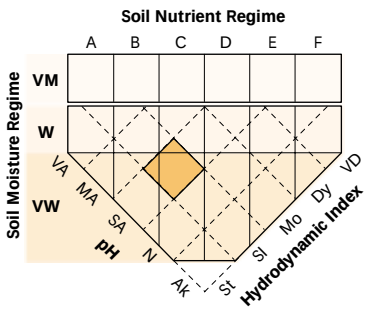
As with many sloping peatlands, sites are microtopographically heterogeneous and therefore a mosaic of vegetation is common. *Eriophorum angustifolium* is always prominent but other species can be very abundant on some sites or in specific locations within the peatland. Tree and shrub species, if they occur, are on raised sites. Groundwater seepage pools or surface drainage channels are common.

Peat deposits are generally < 2 m deep. Mesic sedge peat throughout the profile is common. Terric and Typic Mesisols are common soil types.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **3** - 10)
Herb layer (39 - **75** - 98)
Eriophorum angustifolium, *Fauria crista-galli, Kalmia microphylla, Trichophorum cespitosum*
Moss layer (20 - **75** - 99)
Sphagnum **Group I**

Wetland Edatopic Grid



Comments

*The **Wf50** is analogous to the interior **Wf11** and **Wf12** of subalpine sloping seeps but has many coastal species and is generally more heterogeneous. The complex nature of hydrological flow in these sites means that large tracts of homogeneous vegetation are uncommon. Several more specific classification units based on the presence of additional dominants are likely possible with sufficient data. Sites with high cover of* Carex pauciflora, Sanguisorba *spp.,* Fauria crista-galli, Dodecatheon jeffreyi, *or* Rubus chamaemorus *have all been observed.*

Carex sitchensis – Sphagnum

General Description

Sitka sedge – Peat-moss fens occur at low elevations along the Coast, in wet drainage channels or hollows in sloping peatlands where there is gradually flowing surface water. These sites are uncommon and often of small areal extent relative to other ecosystems of the Coast.

Carex sitchensis grows in dense swards with *Sphagnum* species in carpets or floating in shallow water. A diversity of other species occurs with low cover on most sites.

Peat accumulations in the **Wf51** range from thin veneers to deep blankets of poorly to well-decomposed peat. Organic layers are often intermixed with mineral materials. Fibrisols are the most common soil type but Mesisols and Humisols also occur.

Characteristic Vegetation

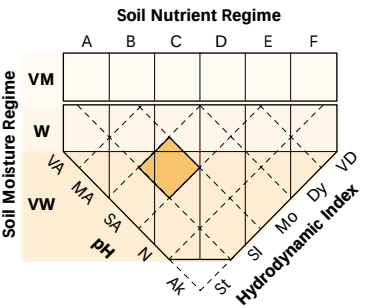
Tree layer (0 - **0** - 0)
Shrub layer (0 - **.5** - 5)
Herb layer (15 - **82** - 100)
Carex sitchensis, *Comarum palustre*
Moss layer (0 - **40** - 100)
***Sphagnum* spp**.

Comments

*The **Wf51** is similar to the **Wf01** in most respects but has a coastal distribution;* Carex sitchensis *replaces* Carex aquatilis *on the Coast. The presence of* Sphagnum *on these sites reflects the wider tolerance to variable hydrology of* Sphagnum *species that occur in this climate and not to ombrotrophic conditions, which is typical in the Interior.*

*The **Wm50** occurs on more hydrologically active sites than the **Wf51**.*

Wetland Edatopic Grid



General Description

Sweet gale – Sitka sedge fens are uncommon at low elevations in the Georgia Depression and Coast and Mountains in a wide variety of landscape positions. Sites can be shallowly flooded in the early season but will drop just below the surface for most of the growing season.

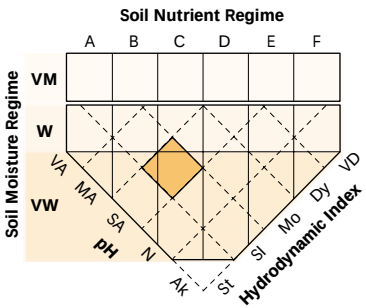
Myrica gale and *Spiraea douglasii* form a closed and sometimes dense thicket mostly < 1.5 m in height. *Carex sitchensis* dominates the herb layer but there is a scattering of other species on most sites. Because of flooding, the bryophyte layer is generally sparse but on some sites cover of *Sphagnum* or other moss species may be high.

Peat deposits are mostly shallow, moderately to well decomposed sedge and wood peat. Terric Humisols and Mesisols are common soil types.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (30 - **60** - 85)
Myrica gale, *Spiraea douglasii*
Herb layer (20 - **35** - 100)
Carex sitchensis
Moss layer (0 - **14** - 60)
Sphagnum spp.

Wetland Edatopic Grid



Comments

*The **Wf52** Site Association is common as a component of many peatlands in the south Coast. It is most often found in complex with the **Wm50** in more peripheral (and drier) locations but occurs around other Site Associations as well, including estuarine marshes.*

Shrub thickets dominated by Spiraea douglasii *with sparse* Myrica gale *and* Carex *spp. are common in the region where the **Wf52** occurs. These communities are usually on mineral soil and described by the **Ws50** Site Association.*

Carex lasiocarpa – Rhynchospora alba

General Description

Slender sedge – White beak-rush fens occur in the Georgia Depression at elevations below 600 m. The **Wf 53** requires permanently saturated soils and is tolerant of prolonged shallow inundation. Lake margins are the most common location but some isolated basins may also have suitable conditions.

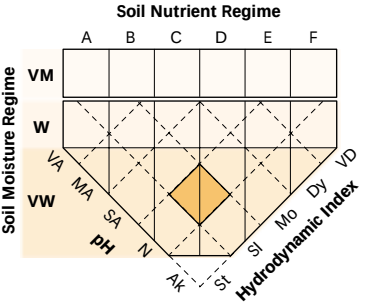
Carex lasiocarpa is always abundant and dominant. *Rhynchospora alba* and scattered low-growing *Myrica gale* occur on most sites. However, wetter sites often lack these species and have aquatic species such as *Nuphar lutea*, *Brasenia schreberi*, or *Menyanthes trifoliata* instead. *Schoenoplectus acutus* grows in more alkaline examples of the **Wf 53**.

Soils are shallow mesic or humic peat of sedge or limnic origin. Terric Mesisols and Humisols are common soil types.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **3** - 10)
Myrica gale
Herb layer (60 - **80** - 85)
Carex lasiocarpa, *Rhynchospora alba*
Moss layer (0 - **2** - 8)

Wetland Edatopic Grid



Comments

Coastal Carex lasiocarpa *stands occur on a range of ecological conditions from semi-terrestrial to shallowly flooded and marsh-like peatlands. Ceska (1978) observed variants of this unit: a typic with* Rhynchospora alba, *a limose variant with* Nuphar lutea, *a mineric variant with* Dulichium arundinaceum *and* Schoenoplectus acutus, *and a higher-elevation variant with* Carex limosa. *With sufficient additional data, several more specific classification units based on the presence of additional dominants might be indicated.* Carex lasiocarpa *communities with abundant* Spiraea douglasii *and* Myrica gale *occur on drier and hummocky sites (see additional units).*

*The **Wf52** is similar but grows on drier and more acidic sites than the **Wf53**. The **Wf53** is analogous to the **Wf05** of the Interior but has little or no moss cover and includes coastal species.*

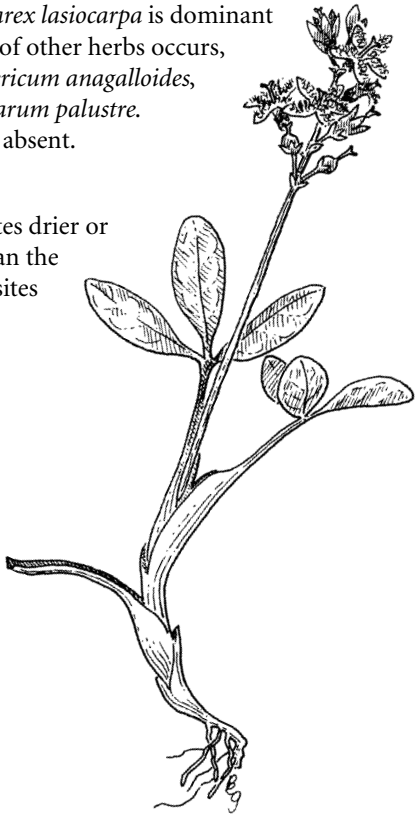
Sweet gale – Pink spirea – Slender sedge
Myrica gale – Spiraea douglasii – Carex lasiocarpa

Sweet gale – Pink spirea – Slender sedge fens are uncommon in the Georgia Depression in basins and lake margins.

The shrub layer is well developed and composed of *Myrica gale* and/or *Spireae douglasii. Carex lasiocarpa* is dominant in the herb layer but a diversity of other herbs occurs, including *Carex sitchensis*, *Hypericum anagalloides*, *Menyanthes trifoliata*, and *Comarum palustre*. The moss layer is very sparse or absent.

Soils are primarily Mesisols.

These communities occur on sites drier or with more microtopography than the **Wf 53**. Similar but more acidic sites support the **Wf 52**.



Menyanthes trifoliata, buckbean

1 *Carex chordorrhiza*, cordroot sedge **2** *Carex lasiocarpa*, slender sedge
3 *Eriophorum angustifolium*, narrow-leaved cotton-grass

1 *A pothole marsh dominated by the rare grass* Scolochloa festucacea, *the Wineglass Ranch near Riske Creek (IDFdk4)* **2** *A coastal Beaked sedge marsh on Minerva Lake near Prince Rupert (CWHvh2)* **3** *Cattail thicket, Nicola Lake (BGxw1)*

MARSH WETLAND CLASS

Definition

A marsh is a permanently to seasonally flooded non-tidal mineral wetland dominated by emergent grass-like vegetation.

General Description

Vegetation

Table 5.3.2 lists species common in the Marsh Site Associations described in this guide. Marshes are floristically simple plant communities with low species diversity and strong dominance by one or two species. The high nutrient availability in marshes favours "aggressive" species that spread vegetatively. This results in communities with one or two dominant species that effectively limit establishment and spread of other species. Dominance can result from optimal environmental conditions for mature plants, favourable conditions for initial establishment of one species over another, or simply chance initial establishment of one species. Marshes have > 10% cover of emergent grasses, rushes, sedges, or (occasionally) forbs or horsetails. The tree, shrub, and bryophyte layers in marshes are usually absent or very sparse (< 10%). Aquatic plants are common, especially in marshes that retain standing water for most or all of the year.

Landscape Position and Distribution

Marshes are favoured by dynamic hydrological regimes, high nutrient status, and warm growing-season climates. In cool, wet climates, marshes are restricted to wave-washed lakeshores, stream floodplains, and back-levees where waterflow prevents peat accumulation and keeps nutrient availability high. In these climates, peatlands occupy most small basins. In warm and dry climates, however, marshes are the most common wetland class and occur in most hydrogeomorphic types including small potholes and depressions. In these areas, high evapotranspiration rates result in watertable fluctuations that expose the soil surface in late season and promote decomposition of organic materials. Large variation in pothole water levels between years is common in semi-arid climates. The Site Associations and their extent often varies considerably in response to these hydrological changes.

Hydrology and Soils

Marshes are always flooded in the early season to depths up to 3 m. Some remain flooded throughout the year and have circulating waters that maintain a high nutrient availability (Figure 5.3.1). However, many have pronounced drawdown and substrate exposure by mid to late summer. Soils are usually mineral, but they can also have a well-decomposed organic surface tier of humic or limnic peat. Nutrient availability is high due to circum-neutral pH, abundant waterflow, and periodic exposure and aeration of the substrate.

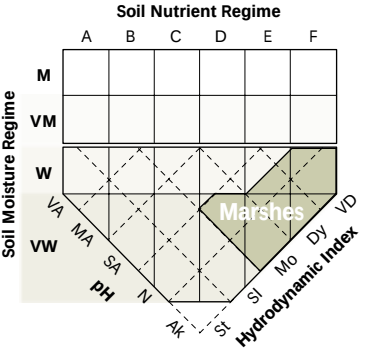


FIGURE 5.3.1 *Position of marshes on the edatopic grid.*

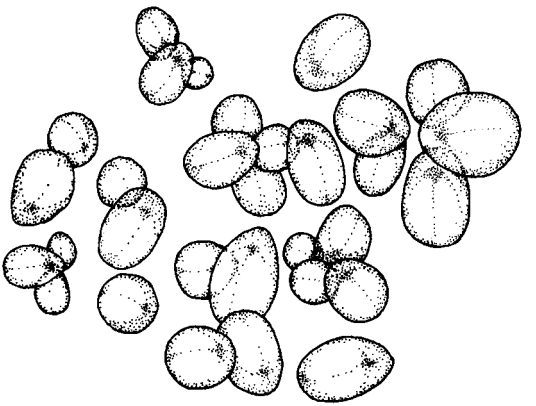
Conservation Issues

Marshes are critically important wetland ecosystems. They are the most heavily used wetland type for most wetland-using wildlife species because they support a large standing crop of palatable vegetation, plankton, and aquatic invertebrates—organisms that form a food base for larger animals. Marshes are the favoured wetland class for most waterfowl, amphibians, and semi-aquatic mammals because they provide good cover, open water, and a food source for young animals. They are the most common wetland type in the dry and warm climates where wetlands in general are uncommon and this is where many of British Columbia's rare wetland-dependent vertebrates occur (e.g., Great Basin Spadefoot, Tiger Salamander).

Marshes are early-seral ecosystems in wetland succession. Marshes are the easiest wetland class to create artificially because they will form naturally in recently created wetland environments (e.g., roadside ditches, sewage lagoons). Most marshes are tolerant of hydrological modifications that are not outside the natural, broad range for the Site Association. Maintaining wetland habitats by stabilizing watertables is a common practice in the prairie pothole region of Canada, where many wetlands dry up during drought years. However, throughout most of British Columbia, this method is inappropriate and will reduce the productivity of existing marshes. Most marshes will recover from even severe mechanical or grazing disturbance if hydrological regime is maintained.

Phragmites australis (common reed), *Lythrum salicaria* (purple loosestrife), and *Iris pseudacorus* (yellow-flag) are invasive wetland species in British Columbia. Like other marsh dominants, these require nutrient-rich site conditions and warm growing-season temperatures. However, these species require more growing degree days than occur in most of the province, thereby restricting them to warmer climates. It is unclear how profound the impact of invasive species is upon the rest of the ecosystem because they merely replace one near monoculture with another (Farnsworth and Ellis 2001; Gardner et al. 2001).

Waste-water treatment wetlands will be marshes. High inputs of nitrogenous waste will drive any wetland towards marsh-like conditions.



Lemna minor, duckweed

TABLE 5.3.1 *Distribution of Marsh Site Associations by biogeoclimatic zone*

	BG PP	BWBS SWB	ESSF	ICH	IDF	MS	SBPS SBS	CDF	CWH	MH
Wm01 Beaked sedge – Water sedge	x	xx	x	xxx	xxx	xx	xx		x	
Wm02 Swamp horsetail – Beaked sedge		x		x	x	x	xx			
Wm03 Awned sedge	x				x					
Wm04 Common spike-rush	x	x		xx	x	x	xx		x	
Wm05 Cattail	xxx	x		xx	xx	x	xx	xx	x[s]	
Wm06 Great bulrush	xxx	x		x	xx	xx	x	x	x	
Wm07 Baltic rush	x				xx					
Wm50 Sitka sedge – Hemlock-parsley								xx	xx	
Wm51 Three-way sedge				x				x	x	

x = incidental; < 5% of wetlands xx = minor; 5–25% of wetlands xxx = major; >25% of wetlands
s = southern subzones only

TABLE 5.3.2 *Marsh Species Importance Table*

	Species	Wm01	Wm02	Wm03	Wm04	Wm05
Herbs and Dwarf Shrubs	*Carex utriculata*	▮▮▮▮	▮▮▮▮	▮		▮▮
	Carex aquatilis	▮▮▮	▮▮	▮		
	Equisetum fluviatile	▮	▮▮▮▮▮		▮	
	Comarum palustre	▮▮	▮▮			▮
	Sium suave	▮	▮▮			
	Carex exsiccata			▮		
	Carex atherodes			▮▮▮▮▮		
	Polygonum amphibium	▮	▮	▮▮	▮	▮
	Eleocharis palustris		▮		▮▮▮▮▮	▮
	Potamogeton richardsonii				▮▮▮	
	Typha latifolia		▮			▮▮▮▮▮
	Schoenoplectus acutus					▮
	Menyanthes trifoliata					
	Utricularia macrorhiza	▮	▮	▮	▮	▮
	Juncus balticus	▮		▮		
	Hordeum jubatum				▮	
	Potentilla anserina			▮		
	Calamagrostis canadensis	▮▮	▮	▮▮	▮	
	Cicuta douglasii		▮			▮
	Lysichiton americanus					▮
	Oenanthe sarmentosa					▮
	Galium trifidum	▮				
	Spiraea douglasii					▮
	Carex sitchensis					
	Nuphar lutea ssp. *polysepala*				▮	▮
	Dulichium arundinaceum					
Mosses	*Drepanocladus* spp.	▮▮	▮▮	▮▮	▮	▮
	Warnstorfia spp.	▮	▮	▮	▮	▮

Wm06	Wm07	Wm50	Wm51	Common Name
				beaked sedge
				water sedge
				swamp horsetail
				marsh cinquefoil
				hemlock water-parsnip
				inflated sedge
				awned sedge
				water smartweed
				common spike-rush
				Richardson's pondweed
				common cattail
				great bulrush
				buckbean
				greater bladderwort
				Baltic rush
				foxtail barley
				common silverweed
				bluejoint
				Douglas' water-hemlock
				skunk cabbage
				Pacific water-parsley
				small bedstraw
				pink spirea
				Sitka sedge
				yellow pond-lily
				three-way sedge
				hook-mosses: intermediate
				hook-mosses: poor

Carex utriculata – Carex aquatilis

General Description

Beaked sedge – Water sedge marshes constitute the most common and widespread Marsh Site Association in the province. The **Wm01** occurs in all subzones from low to sub-alpine elevations on sites that are inundated by shallow, low-energy floodwaters and that experience some late-season drawdown. These marshes are found in a wide variety of landscape positions including flooded beaver ponds, lake margins, floodplains, and palustrine basins.

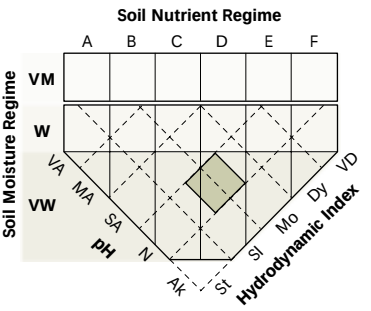
Species diversity is low and plant cover is strongly dominated by *Carex utriculata* and *C. aquatilis* with scattered forbs, aquatics, and mosses. On sites experiencing significant surface drying, species diversity increases and sites become more meadow-like. Species such as *Calamagrostis canadensis*, *Geum macrophyllum*, or *Deschampsia cespitosa* can become prominent.

The **Wm01** occurs over a wide range of site conditions on mineral substrates with thin peat veneers. Common soil types include Gleysols and Terric Humisols.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 5)
Herb layer (13 - **80** - 100)
Carex aquatilis*, *C. utriculata
Moss layer (0 - **5** - 100)

Wetland Edatopic Grid



Comments

*The **Wf01** and **Wm01** have similar plant communities, but, because these units are species-poor and the two dominant sedge species have a wide ecological amplitude, the plant community poorly differentiates between sites on peat (**Wf01**) and those on mineral soil (**Wm01**). In general, the **Wm01** is more deeply flooded, has more dynamic hydrology, and has a higher cover of* C. utriculata.

*The **Wm02** is another similar community that occurs on more hydrologically dynamic locations such as lake margins or floodplains. In cooler climates the **Wm01** frequently develops into **Wf01** on sites with less dynamic hydrology.*

*Some **Wm01** sites have scattered tall shrubs; those sites supporting > 10% shrub cover are described by Swamp Site Associations (Section 5.4).*

General Description

The Swamp horsetail – Beaked sedge Marsh Site Association is uncommon at lower elevations throughout the Interior. Common locations are in back-levee depressions along sediment-laden, low-gradient streams, protected bays of large lakes, or hydrologically modified (flooded) fens. The **Wm02** also occurs along the Coast in tidal reaches of large rivers above saltwater influence.

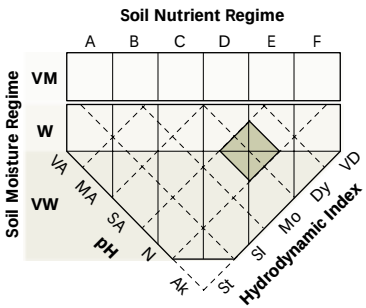
Plant diversity is low. Sites are dominated by *Equisetum fluviatile* with *Carex utriculata* sometimes co-dominating; often there are scattered aquatics such as *Potamogeton* and *Myriophyllum* spp. The **Wm02** is similar to the **Wm01** but is distinguished by its higher hydrodynamic index and by the dominance of *E. fluviatile*.

Soils are derived from silty or fine-sandy fluvium, deep limnic deposits at open margins of lakes, or recently flooded peat. Rego Gleysols and Terric Humisols are common soil types.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 4)
Herb layer (18 - **85** - 100)
C. utriculata*, *Equisetum fluviatile
Moss layer (0 - **0** - 90)

Wetland Edatopic Grid



Comments

E. fluviatile *is tolerant of extreme variations in water depth and high rates of sedimentation and can colonize exposed mineral or peat soils. It has been used to revegetate the extreme environment of the drawdown zone in reservoirs.*

*On fluvial sites, the **Wm02** is usually adjacent to tall-willow swamps or low bench communities. In lake systems, **Wm02** commonly adjoins open water and other marsh communities.*

Carex atherodes

General Description

The Awned sedge Marsh Site Association is uncommon and restricted to dry climates of the Central Interior at low to middle elevations. These marshes are generally small and occur most commonly in small potholes surrounded by forest, where water levels are shallow and relatively constant.

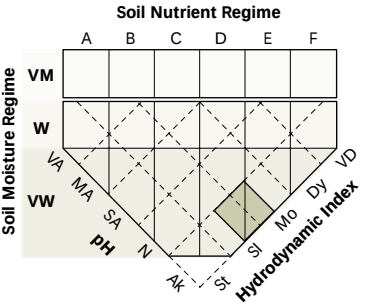
Sites are always dominated by *Carex atherodes*, but infrequently other species, such as *Drepanocladus aduncus*, *Myriophyllum verticillatum*, *Alopecurus aequalis*, or *Carex utriculata*, occur in abundance.

Standing water is slightly alkaline; rooting substrates are fine-textured mineral or shallow sedge-derived peat. Common soil types are Humisols and Humic Gleysols.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 4)
Herb layer (55 - **90** - 100)
Carex atherodes
Moss layer (0 - **0** - 95)
Drepanocladus aduncus

Wetland Edatopic Grid



Comments

*This unit is similar to the **Wm01** but is much more limited in distribution and seems to be favoured by more alkaline waters. In the BG zone, Woolly sedge marshes occur on sites similar to the **Wm03** (see additional units).*

***Wm03** sites often occupy entire basins but they are also found in small patches within some larger **Wm01** or **Wm08** marshes.*

*The distribution of **Wm03** is primarily within rangelands and* C. atherodes *is palatable; many sites experience some level of grazing pressure.*

General Description

Common spike-rush marshes are widely distributed throughout the Interior at elevations below 1300 m. They occur along lakeshores, and as a zone in larger potholes, oxbows, and slow-moving rivers, where there is some weak waterflow or wave action. Sites are shallowly flooded in the early season in all locations; the watertable often drops to the surface in palustrine locations but is permanent in lacustrine or fluvial systems. **Wm04** sites also occur in freshwater and brackish tidal reaches of large coastal rivers and estuaries.

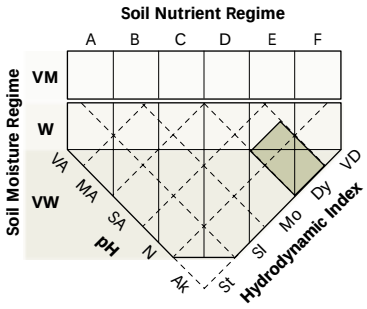
Plant diversity is low; *Eleocharis palustris* is often the only emergent species with significant cover. In interior sites, submerged and floating aquatics can be common; in estuarine sites *Carex lyngbyei* is often present.

Soils are typically sandy or gravelly with or without a thin organic veneer.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 0)
Herb layer (10 - **70** - 100)
Eleocharis palustris,
Potamogeton richardsonii
Moss layer (0 - **0** - 10)

Wetland Edatopic Grid



Comments

Eleocharis palustris *occurs commonly in a wide variety of wetland habitats, including alkaline and weakly saline marshes, rich fens, and estuarine marshes. However, the* ***Wm04*** *describes only those sites where* E. palustris *dominates.* ***Wm04*** *sites are generally more shallowly flooded than* ***Wm06*** *sites and better aerated than* ***Wm05*** *sites.*

The ***Wm04*** *commonly occurs adjacent to* ***Wm05***, ***Wm06***, *and* ***Wm07*** *Site Associations or shallow-water ecosystems.*

Typha latifolia

General Description

Cattail marshes are common throughout the Coast and Interior at low elevations in subzones with warm summers. They occur most commonly in protected lake embayments and potholes or even roadside ditches, where the surface substrate remains saturated for most of the growing season.

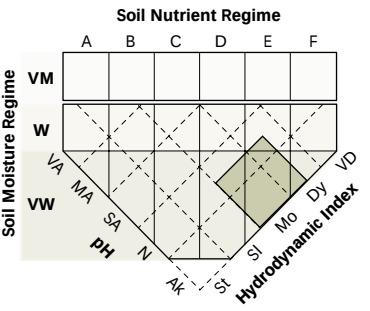
Typha latifolia dominates, often with few other rooted plants present, especially where nutrient levels are high and *T. latifolia* growth profuse. Occasionally there is significant cover of *Carex utriculata*, *Schoenoplectus acutus*, or *Lemna* spp.

These sites often have organic veneers of well-decomposed, odiferous muck. Soil types can be Humisols or Humic Gleysols. Water depths may be up to 1 m in the spring but recede in late summer, sometimes to the surface.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 10)
Herb layer (40 - **80** - 100)
Typha latifolia
Moss layer (0 - **0** - 90)

Wetland Edatopic Grid



Comments

Typha latifolia *effectively turns high nutrient levels (N and P) into biomass and often dominates wetlands experiencing nutrient loading. Addition of agricultural or human waste to most wetlands will lead to an increase and eventual dominance by* T. latifolia *if climatic conditions are favourable. Initial* T. latifolia *establishment requires substrate exposure for seedling establishment and germination, though once established it spreads extensively by rhizomes so that large stands may consist of only a few individual plants.*

Similar sites with more dynamic hydrology or lower N and P are usually occupied by ***Wm06****. Patches of* S. acutus *in* ***Wm05*** *marshes can be a result of intensive grazing by Muskrat.* S. acutus *stores nutrients in the root mass and can more rapidly recover from removal of its stem than can* T. latifolia*.*

General Description

Great bulrush marshes occur widely in subzones with warm and dry summers. Wave-exposed lake embayments with significant water movements, and grassland potholes with occasional substrate exposure (conditions that provide abundant aeration and limit organic accumulations), are the most common locations for this Site Association.

Plant diversity is low; typically, *Schoenoplectus acutus* is the only species with significant cover. Bulrush marshes are usually adjacent to open water in wetland mosaics and can sometimes be found in complex with the **Wm05**.

Floodwaters to 1.5 m depth in the spring are typical, with significant growing-season drawdown occurring in potholes. Great bulrush is tolerant of alkali soils and often dominates in brackish potholes. Soils are mostly Gleysols and Humic Gleysols, though Terric Humisols occasionally occur.

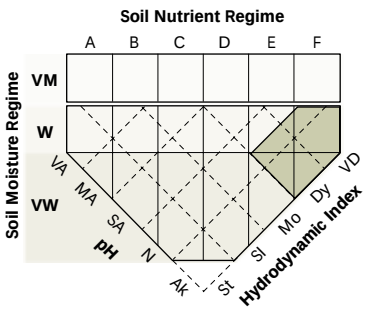
Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 5)
Herb layer (10 - **70** - 100)
Schoenoplectus acutus
Moss layer (0 - **0** - 60)

Comments

*The **Wm06** includes marshes dominated by* S. tabernaemontani *(soft-stemmed bulrush). On wave-exposed lake shorelines or where sites are more brackish,* S. acutus *is more frequent, while in protected waters and potholes with mucky substrates,* S. tabernaemontani *is typical.*

Wetland Edatopic Grid



*Site conditions for **Wm05** and **Wm06** overlap.* S. acutus *dominates on sites with alkaline mineral soils, greater wave exposure, or pronounced surface drying. Where marshes are heavily grazed by Muskrat,* S. acutus *is often favoured over* Typha latifolia *because it stores nutrients in the root mass and recovers more rapidly from grazing.*

Juncus balticus

General Description

Baltic rush saline meadows/marshes are common in the Chilcotin Plateau and uncommon in the dry climates of the Southern Interior and Southern Interior Mountains. The **Wm07** occurs in alkaline or saline potholes, primarily closed basins, where there is early-season inundation followed by gradual watertable drop to below the surface.

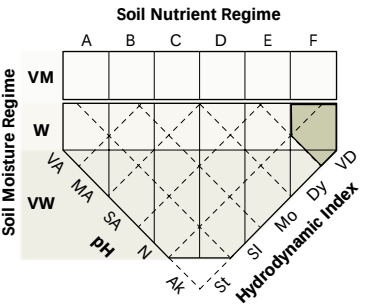
Juncus balticus is always dominant on **Wm07** sites. Other saline-tolerant species such as *Carex praegracilis*, *Potentilla anserina*, and *Puccinellia nuttalliana* may occur, especially on drier sites.

Soils are fine textured, and poorly to imperfectly drained, with up to 10 cm of surface organic accumulation. The upper horizons remain wet throughout most of the growing season. When these sites dry out, a salt or alkali crust is often evident.

Characteristic Vegetation

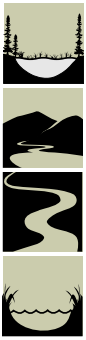
Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 2)
Herb layer (15 - **70** - 100)
Hordeum jubatum, ***Juncus balticus***, *Potentilla anserina*
Moss layer (0 - **5** - 20)

Wetland Edatopic Grid



Comments

*The **Wm07**, along with other communities of saline or alkaline soils conditions, requires site conditions that concentrate salts. These conditions are found in closed basins of semi-arid climates, where high evaporation rates and limited freshwater inflow lead to salt concentration. These same conditions also result in variable watertables within and between years, reflecting a changing balance of inflows and evaporation. Under these variable conditions the optimum environment for Site Associations changes location within the basin between years.* Juncus balticus *occupies those zones where flooding is shallow but soils do not completely dry out in the summer. **Wm07** can form extensive stands in seasonally flooded depressions or as peripheral communities in the drawdown zone around permanent ponds and **Wm06** marshes. Drier sites are **Gs03** or **Gs02**.*



General Description

Sitka sedge – Hemlock-parsley marshes are common in the Georgia Depression and Coast and Mountains at low elevations in basins, and along slow-moving streams, ponds, and lakeshores.

A monoculture of *Carex sitchensis* occurs on many sites, but occasionally other species are also prominent. Sites with flowing floodwaters often have abundant *Oenanthe sarmentosa* or *Glyceria elata*. Drier sites have a mix of forbs such as *Veronica scutellata*, *Hypericum anagalloides*, and *Galium trifidum*.

The **Wm50** tolerates variable hydrology and disturbance and occurs on mineral substrates or shallow (occasionally deep) peat veneers.

Characteristic Vegetation

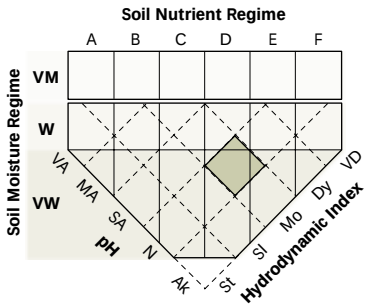
Tree layer (0 - **0** - 0)
Shrub layer (0 - **1** - 4)
Herb layer (70 - **80** - 100)
Carex sitchensis, *Galium trifidum*, ***Oenanthe sarmentosa***
Moss layer (0 - **0.1** - 0.5)

Comments

*The **Wm50** is the coastal equivalent of the **Wm01** of the Interior.*

*Ceska (1978) describes several variants of the **Wm50**, including* Carex sitchensis *with* C. obnupta, Cicuta douglasii, *and* Aster subspicatus *occurring adjacent to alder forests, with* Deschampsia cespitosa, Gentiana sceptrum, *and* Hypericum anagalloides *on drier sites, or with* Glyceria elata *and* Calamagrostis canadensis *in shaded areas with waterflow.*

Wetland Edatopic Grid



Dulichium arundinaceum

General Description

Three-way sedge marshes/fens are uncommon and often of limited extent on the south Coast and rare in wet regions of the Southern Interior Mountains at elevations below 600 m. The **Wm51** occurs along the protected margins of shallow lakes or sluggish streams on mucky substrates.

Dulichium arundinaceum is always dominant. There is often a minor component of emergent sedges or rushes. Other species that grow well on flooded, degrading peaty soils, such as *Nuphar lutea*, *Menyanthes trifoliata*, and *Comarum palustre* occur on some sites.

The **Wm51** prefers permanently flooded conditions on degrading peat or soft muck (mix of fine mineral material and organics).

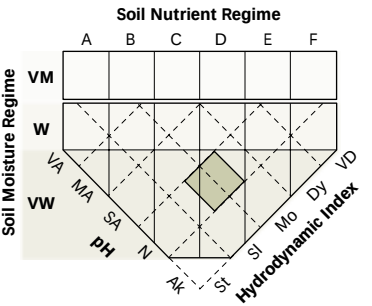
Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **2** - 5)
Herb layer (40 - **80** - 100)
Carex sitchensis, ***Dulichium arundinaceum***, *Nuphar lutea*
Moss layer (0 - **5** - 10)

Comments

*The **Wm51** often occurs at the interface between peatland ecosystems such as the **Wf52** and shallow-water ecosystems dominated by pond-lily or water shield.*

Wetland Edatopic Grid



This section briefly describes some uncommon Marsh Site Associations that have been sampled in British Columbia.

Sharp bulrush *Schoenoplectus pungens*

The Sharp bulrush Marsh Site Association is uncommon and restricted to the warm, dry subzones of the Southern Interior (BG, PP, and warmer IDF) at low elevations. These marshes are generally small and occur most commonly around small alkaline potholes or seepages where water levels are shallow and relatively constant. Rooting substrates are fine-textured mineral soil and can be saline/alkaline. Sites are always dominated by *Schoenoplectus pungens* with a scattering of other alkali-tolerant species such as *Eleocharis palustris*, *Hordeum jubatum*, *Juncus balticus*, and *Triglochin maritima*. Sharp bulrush marshes can occur adjacent to **Wm06**, **Wm04**, or **Gs01** communities.

Common reed *Phragmites australis*

The Common reed Site Association is very uncommon and restricted to regions with warm summers such as the PP, BG, and hot IDF subzones of the Southern Interior and Southern Interior Mountains. *Phragmites australis* is a native rhizomatous grass that is more common in eastern Canada. It forms monocultures of tall stems (to 3 m) in shallow water of lakes, ponds, and slow-moving streams on mineral soils. Extreme watertable fluctuations are common, with deep flooding in spring to watertables well below the surface by the end of the growing season. Adjacent sites with more permanent soil saturation are occupied by **Wm05** or **Wm06**.

Inflated sedge *Carex exsiccata*

Inflated sedge marshes occur widely but rarely throughout the southern two-thirds of the province at low to montane elevations. *Carex exsiccata* stands occur in conditions similar to those of *C. utriculata*. Sites have prolonged shallow flooding of mineral soils. Inflated sedge marshes have been sampled adjacent to small lakes, streams, and potholes.

Northern mannagrass *Glyceria borealis*

The Northern mannagrass Marsh Site Association is uncommon throughout the Interior at lower elevations. These marshes are often small and occur in shallow standing water at the margins of lakes, ponds, and slow-moving streams. Bottom substrates may be fine-textured mineral soils or well humified organic deposits. *Glyceria borealis* is the dominant species and may form a virtual monoculture. Such communities can be adjacent to **Wm01** marshes, which occupy drier sites. (Described by Steen and Roberts 1988.)

Reed canarygrass *Phalaris arundinacea*

Reed canarygrass communities are common throughout the southern two-thirds of the province in areas with warm and relatively dry summers. They represent a disclimax community that establishes or is seeded on cleared willow swamps and low-bench sites. Typical sites are the floodplains of low-gradient streams or lake flats that are flooded in the spring and have prolonged soil saturation. Soils are commonly Gleysolic and fine-textured. *Phalaris arundinacea* is strongly rhizotomous and produces a dense sod and full canopy that excludes most other species; most stands are monotypic.

Seacoast bulrush *Bolboschoenus maritimus*

The Seacoast bulrush Marsh Site Association is uncommon and restricted to the dry subzones of the Southern Interior at low to middle elevations. These marshes are generally small and occur most commonly around alkaline potholes. Soil reaction is generally > 8.5 pH and may also be saline. Soils are fine-textured and continually saturated. *Bolboschoenus maritimus* usually forms moderately dense monocultures. The **Wm06** or shallow-water ecosystems may occur in adjacent more deeply flooded habitats. Seacoast bulrush communities also occur in southern estuaries (see Chapter 5.6).

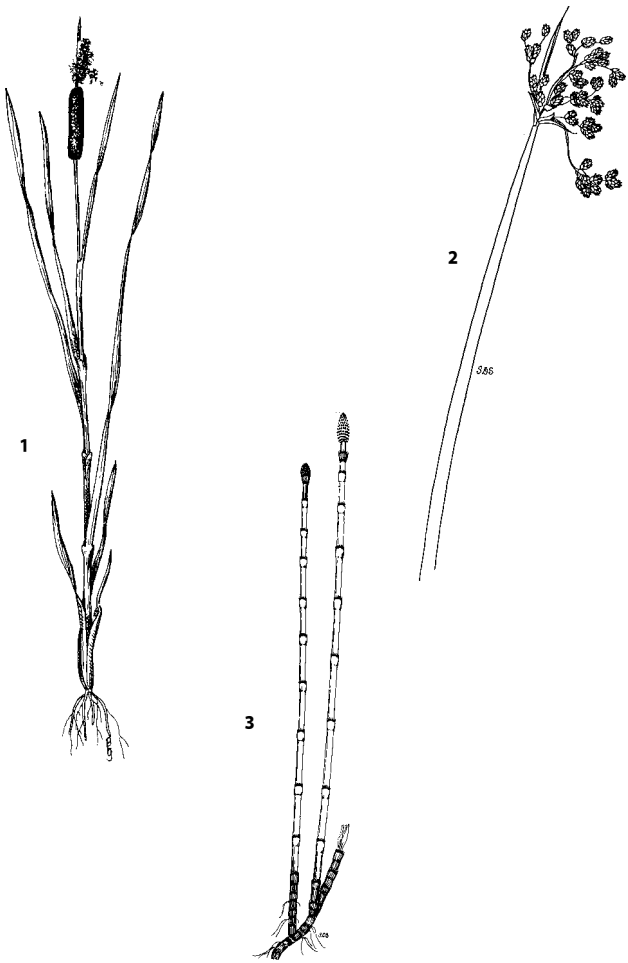
Seaside arrow-grass *Triglochin maritima*

The Seaside arrow-grass Marsh Site Association is uncommon and restricted to the dry subzones of the Central Interior at low elevations. These marshes are generally very small and occur most commonly around small saline potholes. Sites are seasonally inundated, though standing water can persist until late in the season. Soils are fine-textured Gleysols with thin, well-humified organic layers. Sites have very low species diversity; frequently only *Triglochin maritima* occurs. This ecosystem may represent a short-lived successional community that establishes on saline flats experiencing "improved" water regime. (Described by Steen and Roberts 1988.)

Woolly sedge *Carex lanuginosa*

The Woolly sedge Marsh Site Association is uncommon and restricted to the warm, dry subzones of the Central and Southern Interior (BG, PP, and warmer IDF) at low elevations. These marshes are generally small and occur in small freshwater, grassland-surrounded potholes where water levels are shallow and relatively constant. They are also found in small patches within some larger **Wm01** or **Wm06** marshes. Standing

water is slightly alkaline; rooting substrates are fine-textured mineral soil. Sites are always dominated by *Carex lanuginosa* but infrequently have other species, such as *Drepanocladus aduncus*, *Myriophyllum verticillatum*, *Alopecurus aequalis*, *Carex atherodes*, or *C. utriculata*, occurring with significant cover. **Wm03** marshes occur in similar hydrological conditions but are more common in the forested zones.



1 *Typha latifolia*, common cattail **2** *Schoenoplectus acutus*, great bulrush
3 *Equisetum fluviatile*, swamp horsetail

1 *Red alder - Skunk cabbage swamp, Vancouver Island (CWHxm1)* **2** *A Spruce – Horsetail swamp at Mount Savona near Kamloops (MSxk)* **3** *MacCalla's willow – Beaked sedge swamp near Uncha Lake, Sub-Boreal Interior (SBSdk)*

Definition

A swamp is a nutrient-rich wetland ecosystem where significant groundwater inflow, periodic surface aeration, and/or elevated microsites allows growth of large trees or tall shrubs under subhydric conditions.

General Description

Vegetation

Table 5.4.2 lists common species of Swamp Site Associations described in this guide. Swamps are characterized by a high cover of tall shrubs and/or trees plus a well-developed herb layer. Richer swamps have a herb layer with a high component of ferns and forbs. Nutrient-medium sites have a sedge-dominated understorey.

There are two distinct groups of swamps: one characterized by a tall-shrub physiognomy and the other forested. The former are often floristically related to fen ecosystems but distinguished by vigorous shrub growth. The moss layer is typically poorly developed because shade and abundant litterfall limit bryophyte establishment and growth.

Forested swamps are transitional to uplands and often have a mix of terrestrial and wetland microhabitats. Elevated microsites under conifers are favourable for terrestrial species, and depressions support hydrophytes.

Landscape Position and Distribution

Swamps occur where there is an abundant flow of near-surface groundwater, and on slope breaks, peatland margins, inactive floodplain back-channels, back-levee depressions, lake margins, and gullies.

Swamps are common throughout the province, but usually not extensive in most landscapes (Table 5.4.1). Most frequently, they occur as small components of larger wetland systems.

Hydrology and Soils

Swamps occur on sites with pronounced microtopography. Trees and shrubs root on microsites elevated above a high semipermanent watertable or where there is pronounced lateral groundwater flow and surface aeration in otherwise saturated soils (Figure 5.4.1).

Soils are usually distinctly gleyed. A surface horizon of well-decomposed woody peat smelling strongly of hydrogen sulfide is common. Occasionally, swamps occur on deeper peat deposits but this is the exception; these are either peatlands that have undergone hydrological change or are sites fed by well-aerated water that provides enough oxygen for growth of larger plants. Swamps have abundant available nutrients supplied by groundwater flow.

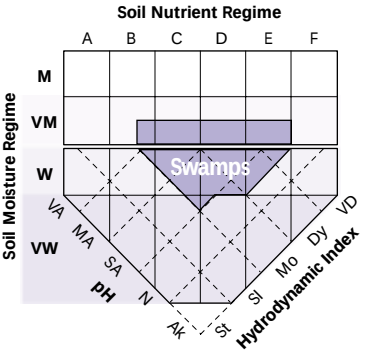


FIGURE 5.4.1 *Position of swamps on the edatopic grid.*

Other Comments

Most of the forested Swamp Site Associations presented in this section are transitional to upland ecosystems and have been previously described in BEC field guides (e.g., Banner et al. 1993). The plant communities on these sites do not have an abundance of obligate hydrophytes and do not clearly distinguish sites that are on wetland soils from those on merely very moist upland soils at this ecotone. Therefore, such Site Associations include some productive upland sites and also non-productive sites. "Poor swamps," those sites with trees, stagnant hydrology, relatively few minerotrophic indicators, and abundant bog-affiliated species, are included in the Bog Class.

Conservation Issues

Swamps are important habitats for wildlife. They have more vertical structure than other wetland classes and therefore support a more diverse avifauna. Species that use seral stands for nesting and feeding also use shrub swamps. Forested swamps have a characteristically open or patchy canopy that appears to be favoured by many bird and bat species. Several important bear foods, such as *Lysichiton americanus* and *Equisetum arvense*, are common in swamps. Willow and other shrubs are important browse for ungulates.

Livestock and wildlife use swamps for browse, shade, and cover, especially where they occur adjacent to open grassland or sources of drinking water. Excessive grazing will affect these sites, and rest rotation methods are recommended. In many areas where shrub swamps are cleared for

pasture, dense and persistent stands of reed canarygrass (*Phalaris arundinacea*) become established.

Forested swamps are productive relative to other wetland ecosystems but are still marginal for timber production. The forested ecosystems described in this guide occur at the limits of operability. Some sites are dry enough and productive enough to be successfully regenerated but these are in the minority. Sites with large trees on wetland soils are especially risky for timber harvest since watertables rise post-harvest, microtopography (which allows large tree growth) is easily destroyed, and brush competition is high. Operable and inoperable sites share essentially the same indicator species groups, however, and so are not separated at the Site Association level.

Spiraea douglasii,
hardhack or pink spirea

TABLE 5.4.1 *Distribution of Swamp Site Associations by biogeoclimatic zone*

		BG PP	BWBS SWB	ESSF	ICH	IDF	MS	SBPS SBS	CDF	CWH	MH
Ws01	Mountain alder – Skunk cabbage – Lady fern				xx			xx^{w}			
Ws02	Mountain alder – Pink spirea – Sitka sedge		x	x	xx	x	x	x^{w}		x	
Ws03	Bebb's willow – Bluejoint	x	xx			xx	x	xx			
Ws04	Drummond's willow – Beaked sedge				x	x	x	xx			
Ws05	MacCalla's willow – Beaked sedge					x		x			
Ws06	Sitka willow – Sitka sedge				xx			x^{w}			
Ws07	Spruce – Common horsetail – Leafy moss		xx	x	xx	xx	xx	xxx			
Ws08	Subalpine fir – Sitka valerian – Common horsetail			xx							
Ws09	Black spruce – Skunk cabbage – Peat-moss				xx			x^{w}			
Ws10	Western redcedar – Spruce – Skunk cabbage				xx						
Ws11	Spruce – Subalpine fir – Skunk cabbage							x^{w}			
Ws50	Pink spirea – Sitka sedge				x			x^{w}	xxx	xx	
Ws51	Sitka willow – Pacific willow – Skunk cabbage				x				x	x	
Ws52	Red alder – Skunk cabbage								xx	xx	
Ws53	Western redcedar – Sword fern – Skunk cabbage								x	x^{x}	
Ws54	Western redcedar – Western hemlock – Skunk cabbage								x	xx	
Ws55	Yellow-cedar – Mountain hemlock – Skunk cabbage										xx

x = incidental; < 5% of wetlands xx = minor; 5–25% of wetlands xxx = major; >25% of wetlands
w = wet subzones only x = very dry subzones only

TABLE 5.4.2 *Swamp Species Importance Table*

	Species	Ws03	Ws04	Ws05	Ws02	Ws06	Ws07	Ws08	Ws01
Trees	*Picea* X								
	Picea mariana								
	Abies lasiocarpa								
	Tsuga heterophylla								
	Thuja plicata								
	Picea sitchensis								
	Alnus rubra								
	Acer macrophyllum								
	Chamaecyparis nootkatensis								
	Tsuga mertensiana								
	Abies amabilis								
Shrubs	*Salix bebbiana*								
	Salix drummondiana								
	Salix maccalliana								
	Alnus incana								
	Lonicera involucrata								
	Spiraea douglasii								
	Cornus stolonifera								
	Vaccinium alaskaense/ovalifolium								
	Salix sitchensis								
	Salix lucida								
	Rubus spectabilis								
	Sambucus racemosa								
	Gaultheria shallon								
	Ribes bracteosum								
	Elliottia pyroliflorus								
Herbs and Dwarf Shrubs	*Calamagrostis canadensis*								
	Carex aquatilis/sitchensis								
	Carex utriculata								
	Gymnocarpium dryopteris								
	Valeriana sitchensis								
	Scirpus microcarpus								
	Equisetum arvense								
	Lysichiton americanus								
	Athyrium filix-femina								
	Tiarella trifoliata								
	Streptopus lanceolatus								
	Maianthemum dilatatum								
	Oenanthe sarmentosa								
	Polystichum munitum								
	Equisetum telmateia								
	Blechnum spicant								
	Veratrum viride								
	Fauria crista-galli								
Mosses and Lichens	*Drepanocladus* spp.								
	Mnium spp.								
	Aulacomnium palustre								
	Sphagnum spp.								
	Hylocomium splendens								
	Pleurozium schreberi								
	Eurhynchium praelongum								
	Rhytidiadelphus loreus								

Ws09	Ws10	Ws11	Ws50	Ws51	Ws52	Ws53	Ws54	Ws55	Common Name
▮▮	▮▮▮	▮▮▮							spruce
▮▮▮	▮	▮							black spruce
▮▮▮▮	▮▮▮	▮▮▮▮▮							subalpine fir
▮	▮▮▮▮				▮	▮▮▮	▮▮▮▮▮	▮▮▮▮▮	western hemlock
▮	▮▮▮▮▮			▮	▮▮	▮▮▮▮▮	▮▮▮▮	▮	western redcedar
				▮	▮	▮▮	▮▮▮	▮	Sitka spruce
			▮	▮	▮▮▮▮▮	▮▮▮▮	▮	▮	red alder
					▮▮	▮▮▮			bigleaf maple
							▮	▮▮▮▮▮	yellow-cedar
							▮	▮▮▮▮▮	mountain hemlock
							▮▮	▮▮▮▮	amabilis fir
		▮							Bebb's willow
				▮					Drummond's willow
									MacCalla's willow
▮▮▮	▮	▮▮▮▮		▮					mountain alder
▮	▮	▮▮▮	▮	▮▮	▮	▮	▮		black twinberry
▮▮▮	▮	▮▮	▮▮▮▮▮	▮▮	▮		▮		pink spirea
▮	▮	▮	▮	▮▮	▮	▮	▮		red-osier dogwood
▮▮	▮▮▮	▮▮		▮			▮▮▮▮	▮▮▮▮▮	Alaska/oval-leaved blueberry
▮				▮▮▮▮▮					Sitka willow
			▮	▮▮▮▮▮					Pacific willow
		▮	▮	▮▮▮	▮▮▮▮▮	▮▮▮▮	▮▮▮	▮▮	salmonberry
	▮			▮	▮▮▮▮	▮▮▮	▮		red elderberry
			▮	▮		▮	▮▮▮	▮	salal
				▮	▮▮▮	▮	▮		stink currant
								▮▮	copperbush
▮▮	▮	▮	▮	▮			▮	▮	bluejoint
▮			▮▮▮	▮				▮	water/Sitka sedge
			▮						beaked sedge
▮	▮▮▮	▮▮▮		▮	▮		▮	▮	oak fern
									Sitka valerian
▮	▮			▮▮		▮	▮		small-flowered bulrush
▮▮▮	▮▮▮	▮▮▮	▮	▮▮	▮	▮	▮		common horsetail
▮▮▮▮▮	▮▮▮▮	▮▮▮▮▮	▮	▮▮▮▮▮	▮▮▮▮▮	▮▮▮▮	▮▮▮▮	▮▮▮▮	skunk cabbage
▮▮	▮▮▮▮	▮▮▮▮	▮	▮▮▮	▮▮▮▮	▮▮▮▮	▮▮▮	▮▮	lady fern
▮	▮▮	▮▮▮		▮	▮▮	▮▮	▮▮	▮	foamflower
▮	▮▮	▮▮		▮	▮		▮	▮	rosy twistedstalk
				▮	▮▮▮	▮▮▮	▮	▮	false lily-of-the-valley
			▮	▮▮▮	▮	▮	▮		Pacific water-parsley
					▮▮	▮▮▮	▮	▮	sword fern
				▮	▮	▮▮▮	▮		giant horsetail
				▮	▮	▮	▮▮▮	▮▮	deer fern
	▮	▮			▮		▮	▮▮	Indian hellebore
							▮	▮▮	deer-cabbage
								▮	hook-mosses
▮▮	▮▮▮▮	▮▮▮▮	▮	▮▮	▮▮▮	▮▮▮	▮▮▮	▮▮▮	leafy mosses
▮	▮		▮	▮					glow moss
▮▮▮▮	▮▮▮	▮▮	▮	▮	▮		▮▮	▮▮▮	peat-mosses
▮	▮▮	▮		▮		▮	▮▮▮	▮▮	step moss
▮▮▮	▮▮	▮							red-stemmed feather-moss
				▮	▮▮▮▮	▮▮▮▮	▮	▮	beak moss
	▮			▮	▮	▮	▮▮▮	▮▮▮	lanky moss

Alnus incana – Lysichiton americanus – Athyrium filix-femina

General Description

Mountain alder – Skunk cabbage – Lady fern swamps are common in wet regions of the Sub-Boreal Interior and Southern Interior Mountains, particularly in areas underlain by glaciolacustrine deposits. The **Ws01** frequently occurs in wet gullies or along small creeks where there is continuous seepage near the surface and poor drainage. It also occurs in the lagg of peatlands, where seepage from upslope enriches peat deposits.

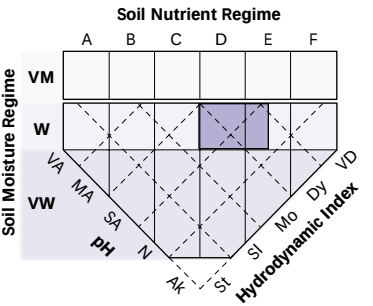
Alnus incana dominates these sites, which have a lush and diverse understorey where *Athyrium filix-femina* and *Lysichiton americanus* are prominent. Scattered spruce is common. The moss layer is often sparse because of shading and high rates of litterfall.

Soils are usually poorly drained, fine-textured mineral deposits with a veneer of well-humified woody peat. Occasionally this unit will occur on deeper peat deposits.

Characteristic Vegetation

Tree layer (0 - **5** - 8)
Picea X
Shrub layer (20 - **53** - 99)
Alnus incana, *Lonicera involucrata*, *Picea* X, ***Spiraea douglasii***
Herb layer (35 - **68** - 95)
Athyrium filix-femina, *Calamagrostis canadensis*, *Equisetum arvense*, ***Lysichiton americanus***
Moss layer (0 - **24** - 87)
***Mnium* spp**.

Wetland Edatopic Grid



Comments

*Several other mountain alder–dominated Site Associations occur. The **Fl01** and **Fl02** occur on well-drained soils adjacent to streams and rivers; these sites lack skunk cabbage. On wetter sites,* Carex sitchensis *is dominant in the understorey and described by the **Ws02**.*

*The **Ws01** often fully occupies small depressions and gullies in upland forest. It also occurs between sedge fens and upland forest.*

General Description

The Mountain alder – Pink spirea – Sitka sedge Swamp Site Association is common in wet climates of the Sub-Boreal Interior, Southern Interior Mountains, and interior transition areas of the Coast and Mountains. The **Ws02** occurs on beaver-flooded flats of small creeks, peripheral zones of wetlands, and lakeshores, where there is early season flooding, continuous seepage near the surface, and poor drainage.

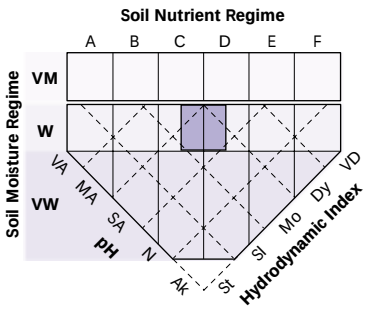
Alnus incana forms an open to sparse canopy. *Spiraea douglasii* can be scattered or prominent. *Carex aquatilis* or *C. sitchensis* is usually the dominant species of the herb layer, but *Scirpus microcarpus* dominates on some sites. Significant cover of *Calamagrostis canadensis* is common.

Soils are derived from fluvial or lacustrine material and often have a veneer or blanket of sedge peat. Organic horizons have silty or sandy lenses throughout, indicating periodic significant flood events.

Characteristic Vegetation

Tree layer (0 - **0** - 2)
Shrub layer (12 - **44** - 99)
Alnus incana*, *Spiraea douglasii
Herb layer (20 - **72** - 100)
Calamagrostis canadensis*, *Carex aquatilis/sitchensis*, *Comarum palustre*, *Scirpus microcarpus
Moss layer (0 - **10** - 85)
***Mnium* spp.**

Wetland Edatopic Grid



Comments

*The **Ws02** is similar to Willow – Sedge Site Associations but occurs on sites with more dynamic water flow; willow-dominated sites (**Ws04–06**) tend to be more stagnant.*

Salix bebbiana – Calamagrostis canadensis

General Description

Bebb's willow – Bluejoint swamps are uncommon but widespread throughout the drier climates of the Interior at elevations below 1200 m. They occur on lake flats, pond margins, fluvial terraces, seasonal creeks, and palustrine basins where early-season shallow standing water draws down to very moist conditions by late growing season.

Salix bebbiana forms an open canopy, often with a significant component of *Alnus incana*. Scattered spruce trees can occur. Various other shrub species are common in the understorey. *Calamagrostis canadensis* is a constant dominant but usually occurs only on raised microsites. *Equisetum arvense* and other horsetails can also be prominent. A diversity of other forbs with low cover is typical. Sites often have distinct mounds created by fallen trees, interspersed with sparsely vegetated pools of water; however, some stands are drier and have a more continuous herbaceous understorey.

Soils are fine-textured Gleysols, often with veneers of woody peat.

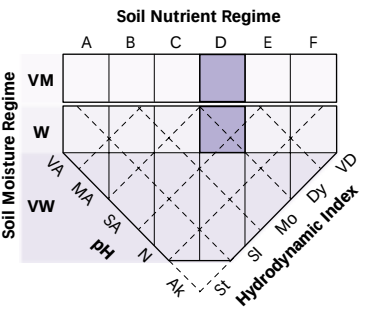
Characteristic Vegetation

Tree layer (0 - **2** - 5)
Shrub layer (20 - **46** - 99)
Alnus incana, *Cornus stolonifera, Lonicera involucrata,* ***Salix bebbiana***
Herb layer (6 - **56** - 90)
Calamagrostis canadensis, *Carex utriculata,* ***Equisetum arvense***
Moss layer (0 - **19** - 75)
Mnium spp.

Comments

The ***Ws03*** *has soils and hydrology characteristic of wetland ecosystems but typically has low cover of obligate hydrophytes.*

Wetland Edatopic Grid



General Description

Drummond's willow – Beaked sedge swamps/fens are common in the Central and Sub-Boreal Interior in back-levee depressions of low-gradient creeks or channel margins in peatland streams. **Ws04** sites can be deeply flooded during the spring freshet and after drawdown maintain a high watertable due to fine-textured soils or low-lying position relative to the watertable.

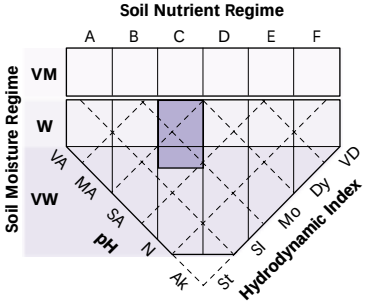
Salix drummondiana dominates these sites, with other shrubs such as *Lonicera involucrata* and *Spiraea douglasii* common in the low-shrub layer. The herb layer is moderately well developed and predominantly *Carex aquatilis* and *C. utriculata*.

Sedge peat veneers or blankets over fine- to medium-textured fluvial or lacustrine materials are typical. Flooding can result in buried organic layers, peat and mineral mixing, or reduced surface organic accumulation.

Characteristic Vegetation

Tree layer (0 - **.5** - 10)
Shrub layer (10 - **52** - 100)
Lonicera involucrata, ***Salix drummondiana***, *Spiraea douglasii*
Herb layer (2 - **53** - 90)
Calamagrostis canadensis, ***Carex aquatilis/sitchensis***, ***C. utriculata***
Moss layer (0 - **14** - 80)
Mnium spp.

Wetland Edatopic Grid



Comments

*In wetter climates of the Interior, the **Ws04** is replaced by the **Ws06**.*

*The **Ws04** occurs along open water channels adjacent to **Wf01** and **Wm01** units. It also occurs in low sites along sluggish streams adjacent to the **Fl05**.*

Drummond's willow is well adapted to fluvial sites; twigs and branches have brittle bases that readily break during flood events. These whips will readily root in mineral soils.

Salix maccalliana – Carex utriculata

General Description

MacCalla's willow – Beaked sedge swamps/fens occur in scattered locations in drier climates of the Central and Sub-Boreal Interior in basins, hollows, and streamside areas that are shallowly flooded in the early season by slowly flowing waters.

Sites often have complex microtopography with tall willows rooting on elevated hummocks, and with depressions with standing water.

Tall *Salix maccalliana* dominates these sites but a diversity of other shrubs is common. *Carex utriculata* or *C. aquatilis* are usually dominant in the understorey but because of the pronounced microtopography a diversity of species often occurs. The moss layer is often moderately developed.

Soils are variable, ranging from deep mesic peat to thin layers of humic muck. Peat accumulations from 20 to 400 cm with well-humified surface tiers are typical.

Characteristic Vegetation

Tree layer (0 - **.1** - 2)
Shrub layer (25 - **60** - 85)
Betula nana, Salix glauca, ***S. maccalliana***
Herb layer (13 - **54** - 95)
Calamagrostis canadensis, ***Carex aquatilis***, ***C. utriculata***
Moss layer (0 - **40** - 100)
Aulocomnium palustre, ***Drepanocladus* spp.**, *Mnium* spp.

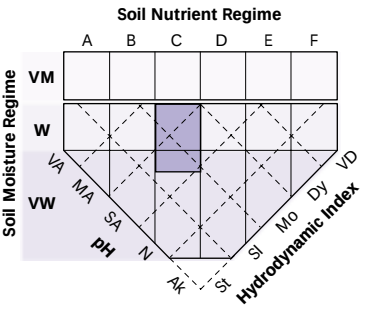
Comments

Pronounced lateral water flow in ***Ws05*** *sites allow the robust growth of* Salix maccalliana *on peaty soils.*

Sites occasionally occur on deep deposits of sedge peat with a humic surface tier, suggesting that these sites have developed on hydrologically modified fens.

Sites with more active flooding are occupied by the ***Ws04****.*

Wetland Edatopic Grid



General Description

Sitka willow – Sitka sedge swamps are uncommon at low elevations in the Coast and Mountains, Nass Basin, and wet subzones of the Southern Interior Mountains and Sub-Boreal Interior. These sites are usually associated with fluvial systems or linked basins and experience prolonged saturation and brief early-season flooding.

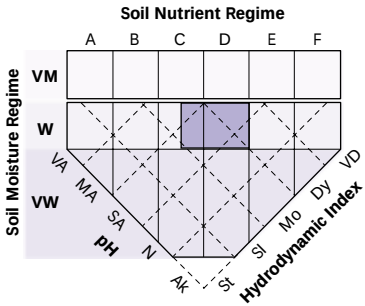
Salix sitchensis dominates **Ws06** sites. The herb layer is primarily *Carex sitchensis* and *Equisetum arvense*. Other large sedges and forbs are also common. On some sites, particularly those under shade, *Scirpus microcarpus* replaces *C. sitchensis* as the site dominant. The moss layer is poorly developed.

Gleysols derived from fluvial materials are the most common soil type. On some sites, sedge peat is layered in fluvial deposits.

Characteristic Vegetation

Tree layer (0 - **.2** - 2)
Shrub layer (15 - **50** - 90)
Alnus incana, ***Salix sitchensis***
Herb layer (30 - **74** - 99)
Calamagrostis canadensis, ***Carex sitchensis***, *C. utriculata*, ***Equisetum arvense***, *Scirpus microcarpus*
Moss layer (2 - **8** - 35)
Mnium spp.

Wetland Edatopic Grid



Comments

*Adjacent communities are often **Wm01** or **Wm02** marshes or low bench flood communities. This Site Association is similar to the **Ws04** and **Ws02**; the former occurs in drier subzones and the latter on more active floodplain sites.*

Sitka willow is well adapted to fluvial sites; twigs and branches have brittle bases that readily break during flood events. These whips will readily root in mineral soils.

General Description

The Spruce – Common horsetail – Leafy moss Swamp Site Association is common in the Northen Boreal Mountains and Central and Sub-Boreal Interior from low to subalpine elevations. It occurs on lower and toe slopes and margins of wetlands, where there is significant flow of mineral-rich groundwater.

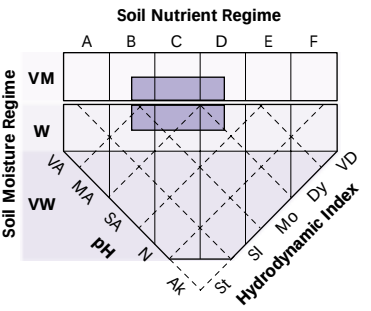
These can be moderately productive sites with spruce to 25 m tall rooting on elevated mounds. The shrub layer may be well developed or sparse with *Lonicera involucrata* the most prominent species. *Equisetum arvense* is always abundant but a diversity of other upland and wetland species is common. The moss layer can be diverse, with leafy mosses (*Mnium* spp.) and *Aulacomnium palustre* usually prominent in depressions and *Pleurozium schreberi* and other feathermosses on raised mounds.

Soils most often have a thin, dark, well-humified, woody peat veneer over fine-textured mineral soils but occasionally deeper peat deposits are encountered.

Characteristic Vegetation

Tree layer (10 - **25** - 50)
***Picea* X**
Shrub layer (25 - **30** - 70)
Alnus incana, ***Lonicera involucrata***, *Picea* X
Herb layer (6 - **70** - 90)
Equisetum arvense
Moss layer (5 - **70** - 99)
Aulacomnium palustre, ***Hylocomium splendens***, ***Mnium* spp.**, *Pleurozium schreberi*

Wetland Edatopic Grid



Comments

*Spruce – Horsetail units have been described for many interior biogeoclimatic subzones in regional field guides (see Appendix 4). Most of these Site Series include sites with freely drained soils supporting productive forests, as well as stands with wetland soils and poor tree productivity. Plant community composition does not clearly reflect these separate conditions because most species are facultative wetland indicators, and pronounced microtopography allows upland species to occur on wetland sites. The **Ws07** therefore includes wetland and non-wetland sites. Wetland sites will have poor tree productivity and hydric soils.*

*A similar site with more stagnant hydrology and greater peat development is the **Wb08**. **Ws08** ecosystems are generally similar to the **Ws07** but occur at high elevations and have abundant subalpine indicators.*

General Description

Subalpine fir – Sitka valerian – Common horsetail swamps are common at elevations above 1100 m throughout the Interior. The **Ws08** occurs on lower and toe slopes and margins of wetlands, where there is significant flow of mineral-rich groundwater.

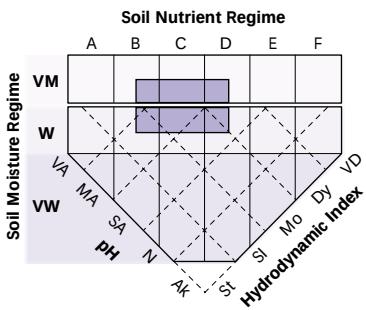
The canopy is open and patchy with groups of interior spruce and subalpine fir separated by forb-rich openings. The shrub layer may be well developed or sparse. The herb layer is generally well developed; an abundance of *Equisetum arvense* and subalpine forbs is typical. Leafy mosses (*Mnium* spp.) and *Aulacomnium palustre* are usually prominent in depressions and *Barbilophozia* and feathermoss species are prominent on raised mounds.

Gleysolic soils have a thin, dark, well-humified, woody peat veneer over fine-textured mineral soil, but occasionally deeper peat deposits are encountered.

Characteristic Vegetation

Tree layer (6 - **40** - 80)
***Abies lasiocarpa*, *Picea* X**
Shrub layer (10 - **40** - 80)
Abies lasiocarpa, *Picea X, Vaccinium membranaceum*
Herb layer (25 - **70** - 99)
Equisetum arvense, *Rubus pedatus, Senecio triangularis, Streptopus amplexifolius,* ***Valeriana sitchensis***
Moss layer (5 - **70** - 90)
Aulacomnium palustre, *Barbilophozia lycopodioides, Brachythecium* spp., ***Mnium* spp.**, *Pleurozium schreberi*

Wetland Edatopic Grid



Comments

Subalpine fir – Horsetail units have been described for many ESSF subzones in regional field guides (see Appendix 4). Many subzones have two Subalpine fir – Horsetail site series described; one for poor sites and one for rich sites. Rich sites have abundant ferns, only occur at lower elevations of the ESSF, and more closely resemble Spruce – Horsetail sites. The ***Ws08*** *does not include these sites.*

The ***Ws08*** *is the high-elevation equivalent of the* ***Ws07****. Tree growth is disproportionately slow at higher elevations because of cold conditions in wet soils and persistent snowpack. With increasing elevation, open patches with abundant subalpine forbs become larger and trees become more restricted to elevated sites.*

Picea mariana – Lysichiton americanus – Sphagnum

General Description

Black spruce – Skunk cabbage – Peat-moss poor swamps/bogs are uncommon in the "rainforest" climate areas of the Central Interior (wet SBS and northern ICH), in palustrine basins and back-levee depressions with high watertables. These sites are strongly mounded, with conifers on elevated microsites and standing water in between.

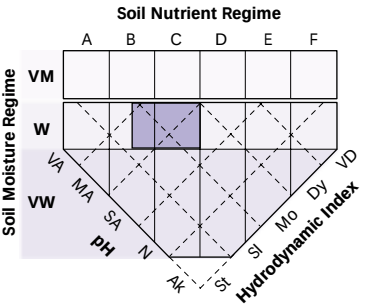
Canopy composition is diverse with *Picea mariana*, *Abies lasiocarpa*, *Pinus contorta*, and *Tsuga heterophylla* often all present. Pronounced microtopography can result in diverse, well-developed shrub, herb, and moss layers. *Lysichiton americanus* is always present in damp hollows and *Sphagnum* species dominate the moss layer.

Organic veneers of dark woody humic or mesic peat over fine-textured lacustrine material are typical. However, peat depths vary from 20 to 150 cm on different sites. Soils are Terric Humisols/Mesisols or Humic Gleysols with peaty veneers.

Characteristic Vegetation

Tree layer (0 - **18** - 35)
Abies lasiocarpa, *Picea* X, ***P. mariana***
Shrub layer (25 - **49** - 70)
Abies lasiocarpa, ***Alnus incana***, *Ledum groenlandicum*, *Picea mariana*, ***Spiraea douglasii***, *Vaccinium ovalifolium*
Herb layer (6 - **56** - 90)
Athyrium filix-femina, *Calamagrostis canadensis*, *Carex disperma*, ***Equisetum arvense***, ***Lysichiton americanus***
Moss layer (2 - **46** - 98)
Mnium spp., ***Pleurozium schreberi***, *Ptilium crista-castrensis*, ***Sphagnum* Group I**, ***Sphagnum* Group II**

Wetland Edatopic Grid



Comments

Ws09 *swamps occur in regions where* ***Ws10*** *and* ***Ws11*** *swamps also occur; however, this unit occurs on wetter sites and usually in locations with cold-air ponding. These sites are transitional to bogs but have some rich site indicators and have swamp-like soils and tree growth potential. The* ***Wb08*** *is the equivalent Site Association of drier climates.*

The ***Ws09*** *has not been previously described in regional BEC field guides, where it is lumped with the richer and more productive skunk cabbage forests of the ICH (****Ws10****) or SBS (****Ws11****).*

General Description

Western redcedar – Spruce – Skunk cabbage swamps are uncommon in ICH zones of the Central Interior and Southern Interior Mountains. They occur on toe slopes, peatland margins, and low-lying areas in floodplains.

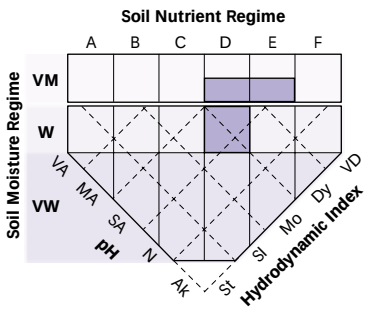
Canopy composition is typically a mix of *Picea* X, *Thuja plicata*, and *Tsuga heterophylla*, with *Abies lasiocarpa* occurring in cold-air ponding sites. Pronounced microtopography can result in diverse, well-developed shrub, herb, and moss layers. *Lysichiton americanus* is always present in damp hollows, and rich-site indicators such as *Gymnocarpium dryopteris*, *Athyrium filix-femina*, and *Equisetum arvense* are abundant. Leafy mosses are prominent in a diverse moss layer.

Organic veneers of dark woody humic or mesic peat over fine-textured lacustrine material are typical. However, peat depths are variable, ranging from 10 to 200 cm. Soils are Gleysols/Humic Gleysols with peaty humus forms or Terric Humisols/Mesisols.

Characteristic Vegetation

Tree layer (0 - **52** - 99)
Abies lasiocarpa*, *Picea* X, *Thuja plicata*, *Tsuga heterophylla
Shrub layer (5 - **55** - 99)
Oplopanax horridus, ***Thuja plicata*, *Tsuga heterophylla*, *Vaccinium ovalifolium***
Herb layer (6 - **59** - 90)
Athyrium filix-femina*, *Cornus canadensis*, *Equisetum arvense*, *Gymnocarpium dryopteris*, *Lysichiton americanus, *Streptopus lanceolatus*, *Tiarella trifoliata*
Moss layer (5 - **63** - 98) ***Mnium* spp.**, ***Pleurozium schreberi*, *Ptilium crista-castrensis*, *Rhytidiadelphus triquetrus***, *Sphagnum* Group II

Wetland Edatopic Grid



Comments

*The **Ws10** is the most common forested skunk cabbage Site Association in the Interior. Soils indicate a wetland environment but plant community composition does not clearly reflect this because pronounced microtopography allows upland species to occur. Most species in **Ws10** sites are facultative wetland indicators.*

*The **Ws10** describes rich, wet skunk cabbage forests of the ICH; similar forests in the SBS are described by the **Ws11**. The **Ws09** is similar but has more stagnant hydrology, greater peat development, and few rich-site indicators.*

*The **Ws10** includes several BEC Sites Series (see Appendix 4).*

Picea X – *Abies lasiocarpa* – *Lysichiton americanus*

General Description

Spruce – Subalpine fir – Skunk cabbage swamps are uncommon in the wet SBS subzones of the Sub-Boreal Interior on toe slopes, peatland margins, and low-lying areas in floodplains.

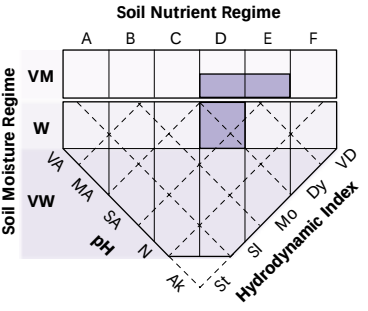
Canopy composition is typically a mix of *Picea* X and *Abies lasiocarpa*. Pronounced microtopography can result in diverse, well-developed shrub, herb, and moss layers. *Lysichiton americanus* is always present in damp hollows, and rich-site indicators such as *Gymnocarpium dryopteris*, *Athyrium filix-femina*, and *Equisetum arvense* are abundant.

Organic veneers of dark woody humic or mesic peat over fine-textured lacustrine material are typical. However, peat depths are variable from 5 to 80 cm on different sites. Soils are Gleysols/Humic Gleysols with peaty humus forms or Terric Humisols.

Characteristic Vegetation

Tree layer (0 - **15** - 25)
Abies lasiocarpa, ***Picea* X**
Shrub layer (30 - **41** - 60)
Abies lasiocarpa, ***Alnus incana***, ***Lonicera involucrata***, *Oplopanax horridus*, *Picea* X, *Spiraea douglasii*, *Vaccinium ovalifolium*
Herb layer (40 - **59** - 95)
Athyrium filix-femina, ***Cornus canadensis***, *Drypopteris expansa*, ***Equisetum arvense***, ***Gymnocarpium dryopteris***, ***Lysichiton americanus***, ***Streptopus lanceolatus***, ***Tiarella trifoliata***
Moss layer (2 - **23** - 40)
***Brachythecium* spp.**, ***Mnium* spp.**, *Sphagnum* spp.

Wetland Edatopic Grid



Comments

*The **Ws11** is similar to the **Ws10** but occurs in climatic areas where redcedar and hemlock are not present. Soils indicate a wetland environment but plant community composition does not clearly reflect this because pronounced microtopography allows upland species to occur. Most species in **Ws11** sites are facultative wetland indicators.*

*The **Ws11** describes rich, wet, skunk cabbage forests of the SBS; similar forests in the ICH are described by the **Ws10**. The **Ws09** is similar but has more stagnant hydrology, greater peat development, and few rich-site indicators.*

*The **Ws11** includes Site Series SBSvk/10.*

General Description

Pink spirea – Sitka sedge swamps are common at low elevations of the Georgia Depression in basins, gullies, and margins of waterbodies and peatlands. These sites experience prolonged saturation and brief early-season flooding.

Species diversity is low in this Site Association. *Spiraea douglasii* always dominates **Ws50** sites; few other shrub species occur. The sedge-dominated understorey is sparse or well developed. Few species other than *Carex sitchensis* are common. The moss layer is often minimal but *Aulacomnium palustre* or *Sphagnum* spp. occur with high abundance on some sites.

Humisols and Gleysols are the most common soil types.

Characteristic Vegetation

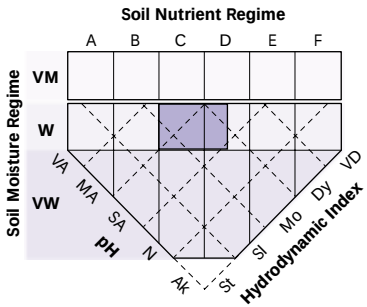
Tree layer (0 - **0** - 2)
Shrub layer (15 - **70** - 99)
Spiraea douglasii
Herb layer (2 - **35** - 85)
Carex sitchensis
Moss layer (0 - **34** - 90)
Aulacomnium palustre, Sphagnum Group I

Comments

*The **Ws50** Site Association is common as a component of many peatlands along the southern Coast. It can be the dominant Site Association in small basins or surrounding **Wm50** marshes.* S. douglasii *increases with disturbance and many spirea thickets actually represent disturbance communities that have developed after hydrological change. Understoreys in these successional communities vary from completely absent to bog-like.*

Shrub thickets dominated by Myrica gale *with sedge are common in the region where the **Ws50** occurs. These communities are usually on peat and are described by the **Wf52** Site Association.*

Wetland Edatopic Grid



Salix sitchensis – Salix lucida – Lysichiton americanus

General Description

Sitka willow – Pacific willow – Skunk cabbage swamps occur sporadically at low elevations throughout the Coast and Mountains, Georgia Depression, and coastal transition areas of the Interior at peatland margins and in floodplain depressions.

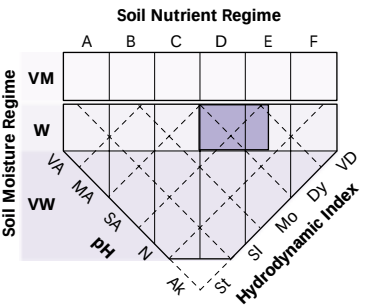
Salix sitchensis and *S. lucida* often co-dominate a closed canopy of tall shrubs and low trees. The understorey is lush and dominated by *Lysichiton americanus* and *Athyrium filix-femina*. Wetter microsites have *Scirpus microcarpus*, *Oenanthe sarmentosa*, and *Equisetum* spp. The moss layer is typically sparse.

Soils are mostly Gleysols with dark peat veneers. In palustrine locations, deeper humic organic deposits are common.

Characteristic Vegetation

Tree Layer (0 - **10** - 85)
Alnus rubra, ***Salix lucida***, *S. sitchensis*
Shrub layer (3 - **65** - 99)
Cornus stolonifera, Lonicera involucrata, ***Rubus spectabilis***, ***Salix lucida***, ***S. sitchensis***, *Spiraea douglasii*
Herb Layer (30 - **60** - 99)
Athyrium filix-femina, *Equisetum arvense,* ***Lysichiton americanus***, ***Oenanthe sarmentosa***, *Scirpus microcarpus*
Moss Layer (0 - **7** - 50)
Mnium spp.

Wetland Edatopic Grid



Comments

Ws51 *swamps often occur between floodplain forests and marshes or shallow-water habitats in flood-scar depressions of larger rivers.*

Sites are flooded and saturated longer than in the related ***Ws52***

General Description

Red alder – Skunk cabbage swamps are uncommon in the Georgia Depression and the Coast Mountains at low elevations in small creek draws, floodplain depressions, and peatland margins.

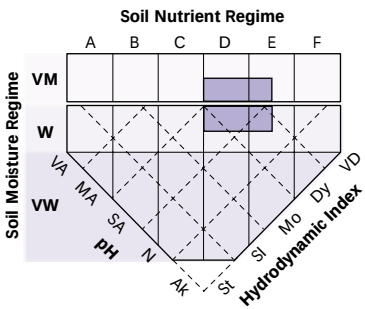
Alnus rubra dominates the canopy. Tall *Salix lucida*, *S. sitchensis*, and *Thuja plicata* are common but of low cover. *Rubus spectabilis* is usually abundant, and some sites also have abundant *Ribes bracteosum* or *Cornus stolonifera*. *Lysichiton americanus* and *Athyrium filix-femina* are prominent in the herb layer; however, some sites have a dominance of *Carex obnupta*. The moss layer is usually poorly developed because of high litterfall and shading.

Humisols or Gleysols with peaty humus forms are most common.

Characteristic Vegetation

Tree Layer (0 - **.2** - 2)
Acer macrophyllum, ***Alnus rubra***, *Thuja plicata*
Shrub Layer (15 - **50** - 90)
Alnus rubra, *Cornus stolonifera*, ***Ribes bracteosum***, ***Rubus spectabilis***, *Salix lucida, S. sitchensis*, ***Sambucus racemosa***
Herb Layer (30 - **74** - 99)
Athyrium filix-femina, *Carex obnupta*, ***Lysichiton americanus***, ***Maianthemum dilatatum***, ***Tiarella trifoliata***, *Polystichum munitum*
Moss Layer (2 - **8** - 35)
Eurynchium praelongum, ***Mnium* spp.**

Wetland Edatopic Grid



Comments

Alnus rubra *is a seral species in coastal environments and is also tolerant of lengthy flooding. Cleared* ***Ws53*** *and* ***Ws54*** *forests often regenerate to red alder. In these cases, red alder – skunk cabbage forests represent a community successional to conifer forest.* ***Ws52*** *sites have high watertables and lack elevated microsites that would allow them to succeed to conifer-forested skunk cabbage swamps.*

Thuja plicata – Polystichum munitum – Lysichiton americanus

General Description

Western redcedar – Sword fern – Skunk cabbage swamps are uncommon in the Georgia Depression. They occur in receiving sites in topographic depressions, toe slopes, and peatland margins in areas where wet conditions are maintained in hollows, but better-drained sites exist on raised mounds.

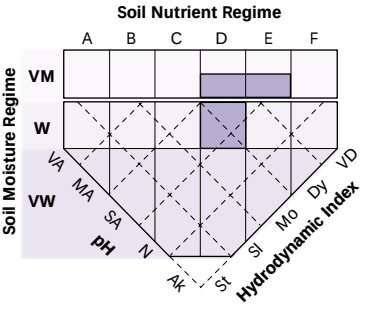
Thuja plicata dominates the open canopy with *Tsuga heterophylla*, *Acer macrophyllum*, and *Picea sitchensis*. *Alnus rubra* is also common in natural openings and where clearing has occurred. The shrub layer is moderately developed: *Oemleria cerasiformis*, *Rubus spectabilis*, and *Sambus racemosa* are the most common species. *Lysichiton americanus* is very prominent in the herb layer along with other rich-site indicators.

Gleysol and Humisols are common soil types. Most sites have at least a veneer of dark, woody peat.

Characteristic Vegetation

Tree layer (30 - **70** - 95)
Acer macrophyllum, ***Alnus rubra***, *Picea sitchensis*, ***Thuja plicata***, ***Tsuga heterophylla***
Shrub layer (10 - **52** - 99)
Oemleria cerasiformis, ***Rhamnus purshiana***, ***Rubus spectabilis***, ***Sambucus racemosa***
Herb layer (5 - **61** - 95)
Athyrium filix-femina, *Dryopteris expansa*, ***Equisetum telmatiea***, ***Lysichiton americanus***, ***Maianthemum dilatatum***, ***Polystichum munitum***, *Stachys chamissonis*, *Tiarella trifoliata*
Moss layer (0 - **38** - 80)
Eurhynchium praelongum, *Leucolepis acanthoneuron*, ***Mnium* spp.**

Wetland Edatopic Grid



Comments

*The **Ws53** supports moderately productive forest. Soils indicate a wetland environment but plant community composition does not clearly reflect this because pronounced microtopography allows upland species to occur. Most species in **Ws53** sites are facultative wetland indicators.*

*The **Ws53** describes rich, wet skunk cabbage forests of the CDF and very dry CWH; similar site conditions in the rest of the CWH are described by the **Ws54**.*

*The **Ws53** includes site series CDFmm/11 and CWHxm/12.*

General Description

Western redcedar – Western hemlock – Skunk cabbage swamps are common in the Coast and Mountains at low elevations. They occur in low-lying areas on floodplains and receiving sites at toe slopes and wetland margins. These sites are strongly mounded, with conifers on elevated microsites.

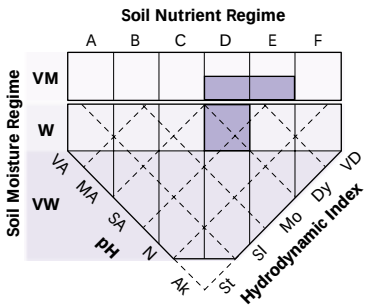
The canopy is open and consists primarily of *Thuja plicata* and *Tsuga heterophylla*. Shrubs root mainly on mounds: *Gaultheria shallon*, *Rubus spectabilis*, and *Vaccinium* species are prominent. *Lysichiton americanus* is always present in damp hollows, accompanied by a diversity of rich-site indicators.

Organic veneers of dark, woody humic or mesic peat over fine-textured lacustrine material are typical. However, peat depths are variable, ranging from 0 to 130 cm. Terric Humisols/ Mesisols or Humic Gleysols with peaty humus forms are the most common soil types, but gleyed Podzols also occur.

Characteristic Vegetation

Tree layer (0 - **51** - 100) *Abies amabilis*, ***Picea sitchensis***, ***Thuja plicata***, ***Tsuga heterophylla***
Shrub layer (4 - **55** - 99)
Gaultheria shallon, *Menziesia ferruginea*, ***Rubus spectabilis***, *Thuja plicata*, ***Tsuga heterophylla***, ***Vaccinium alaskaense***, *V. ovalifolium*, ***V. parvifolium***
Herb layer (5 - **59** - 99)
Athyrium filix-femina, ***Blechnum spicant***, *Cornus canadensis*, ***Lysichiton americanus***, *Rubus pedatus*, *Tiarella trifoliata*
Moss layer (5 - **63** - 98)
Hylocomium splendens, ***Mnium*** *spp.*, *Pellia neesiana*, ***Rhytidiadelphus loreus***, *Sphagnum* Group II

Wetland Edatopic Grid



Comments

*The **Ws54** supports poor to moderately productive forest. Soils indicate a wetland environment but plant community composition does not clearly reflect this because pronounced microtopography allows upland species to occur. Most species in **Ws54** sites are facultative wetland indicators. On degrading floodplain sites, forests are dominated by Sitka spruce (see additional units).*

*The **Ws54** describes rich, wet skunk cabbage forests of the CWH; similar forests in the CDF and very dry CWH are described by the **Ws53**. At higher elevations in the MH, forested skunk cabbage ecosystems are described by the **Ws55**.*

*The **Ws54** includes numerous BEC Site Series (see Appendix 4).*

Chamaecyparis nootkatensis – Tsuga mertensiana – Lysichiton americanus

General Description

Yellow-cedar – Mountain hemlock – Skunk cabbage swamps are common at high elevations in the Coast and Mountains. They occur on toe slopes or depressions with permanent seepage and impeded drainage.

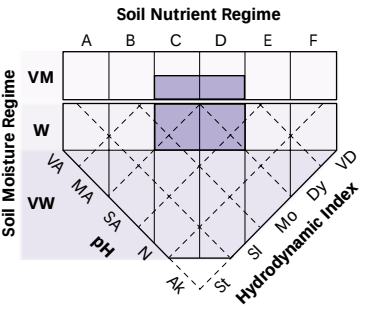
The diverse canopy is open and consists of (in descending order of abundance) *Chamaecyparis nootkatensis*, *Tsuga mertensiana*, *T. heterophylla*, and *Abies amabilis*. The shrub layer is commonly dense with a mix of tree species, *Vaccinium* spp., *Menziesia ferruginea*, and *Elliottia pyroliflorus*. *Lysichiton americanus* is always present in damp hollows, often with abundant *Fauria crista-galli*. Other herbs common on wet sites frequently occur. The moss layer is a well developed mix of upland and wetland species.

Organic veneers of dark, woody humic or mesic peat are typical. However, peat depths are variable, ranging from 10 to 60 cm. Common soil types include Terric Humisols/ Mesisols or Gleysols with peaty humus forms.

Characteristic Vegetation

Tree layer (5 - **38** - 80)
Abies amabilis*, *Chamaecyparis nootkatensis*, *Tsuga heterophylla*, *T. mertensiana
Shrub layer (5 - **57** - 95)
A. amabilis*, *C. nootkatensis*, *Elliottia pyroliflorus*, *Menziesia ferruginea*, *Rubus spectabilis*, *T. heterophylla*, *Vaccinium alaskaense*, *V. ovalifolium
Herb layer (12 - **62** - 95)
*Blechnum spicant, Coptis asplenifolia, Fauria crista-galli, **Lysichiton americanus**, Veratrum viride*
Moss layer (10 - **73** - 95)
Hylocomium splendens, ***Mnium* spp.**, ***Rhytidiadelphus loreus*, *Sphagnum* Group II**

Wetland Edatopic Grid



Comments

*The **Ws55** supports only poor-productivity forest. Soils indicate a wetland environment but plant community composition does not clearly reflect this because pronounced microtopography allows upland species to occur. Most species in **Ws55** sites are facultative wetland indicators.*

*The **Ws55** describes wet skunk cabbage forests of the MH; similar forests at lower elevations in the CWH are described by the **Ws54**.*

*The **Ws55** includes BEC Site Series MHmm1/09, MHmm2/09, MHwh1/09, and MHwh2/09.*

Willow – Sedge

Salix spp. – *Carex* spp.

Several of the most common Willow – Sedge ecosystems in British Columbia are given full descriptions in this chapter. However, communities dominated by other willow species have been observed in various localities. Some other types observed include those dominated by *Salix lucida*, *S. prolixa*, *S. glauca*, *S. planifolia*, *S. bebbiana*, or *S. commutata*.

The reasons for dominance by these other willow species may be the result of several factors:

- climatic influences (e.g., *S. commutata* at high elevations, *S. planifolia* and *S. glauca* in cold climates);
- special site conditions (e.g., *S. lucida* and *S. prolixa* where there is abundant lateral groundwater flow);
- willow persistence after hydrological changes (e.g., *S. bebbiana*); or
- stochastic willow establishment.

Additional sampling may formalize these communities as distinct Site Associations.

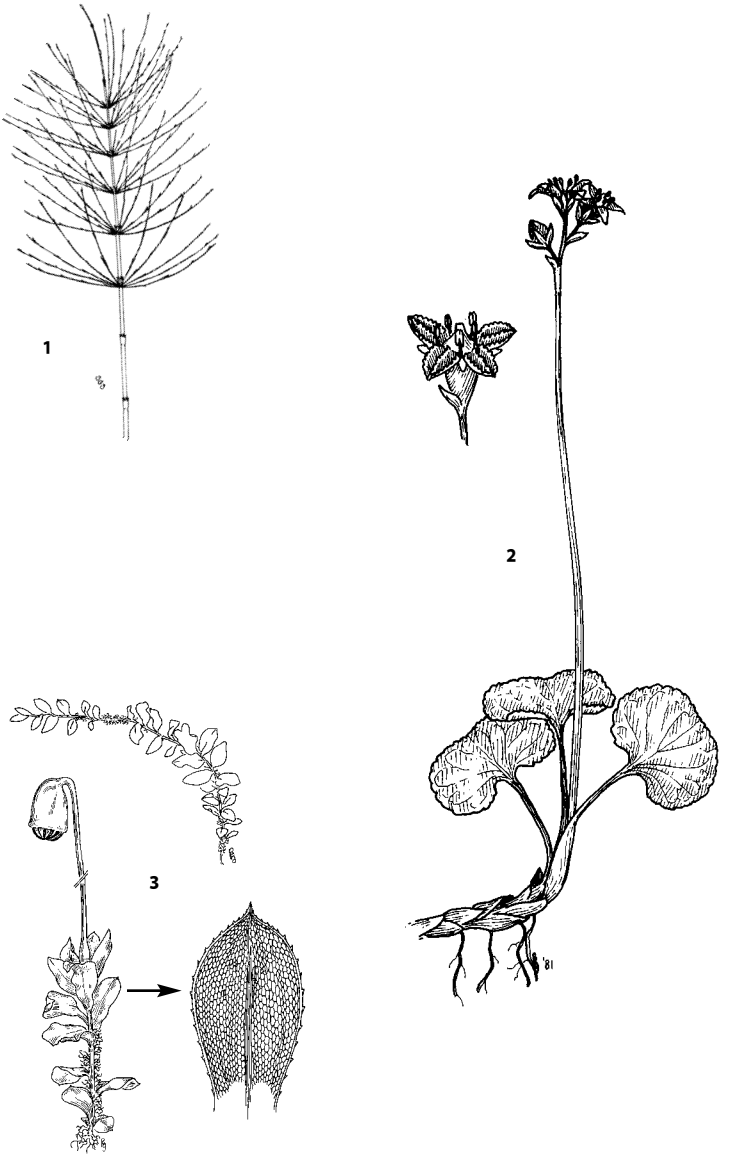
Sitka spruce – Skunk cabbage

Picea sitchensis – Lysichiton americanus

Sitka spruce – Skunk cabbage forests are common in the northern CWH near the edge of the range of western redcedar and uncommon elsewhere along the Coast. They occur on inactive floodplains where drainage is poor and the watertable remains high because of impermeable horizons within the soil profile. However, significant subirrigation and mounded microtophography allow high growth rates of Sitka spruce.

The plant community is similar in composition to the **Ws54** except that the canopy has little western redcedar and the trees are much larger. Red alder may also occur in the canopy openings. *Lysichiton americanus*, *Rubus spectabilis*, *Vaccinium* spp., *Oplopanax horridus*, and *Athyrium filix-femina* are the most common understorey species. In contrast to **Ws54** stands, these sites have low cover of *Gaultheria shallon*, *Menziesia ferruginea*, and *Blechnum spicant*.

Sitka spruce – Skunk cabbage stands are more productive than the **Ws54** swamps that occur more commonly along the Coast. They initiate on active floodplains (high-bench sites) that subsequently become less active and wetter from the formation of restricting layers (duric, placic, ortstein, or clay horizons). Harvesting of Sitka spruce – Skunk cabbage will lead to the site becoming wetter still and sites will likely regenerate as **Ws54** in southern areas.



1 *Equisetum arvense*, common horsetail **2** *Fauria crista-galli*, deer-cabbage **3** *Mnium* sp., leafy moss

1 *Water shield mixed with yellow pond-lily in a flooded bog near Parksville, Vancouver Island (CWHxm)*
2 *A yellow pond-lily community in a lake bay near Meziadin Junction (ICHvc)* **3** *An alkali pond with* Stuckenia pectinata *at Lac du Bois grasslands near Kamloops (IDFxh2a)*

Definition

Shallow-waters are aquatic wetlands permanently flooded by still or slow-moving water and dominated by rooted submerged and floating-leaved aquatic plants.

General Description

Vegetation

Shallow-waters are dominated by rooted floating-leaved and submerged aquatic plant species and have less than 10% emergent cover. Like marshes, shallow-waters are often simple communities dominated by one to several species.

Aquatic environments require adaptations in plants. Anaerobic sediments, light limitations, low carbon dioxide availability, and water currents require specialized structures and metabolic processes. However, in general, these habitats have benign site conditions and are relatively uniform over large climatic regions. Many aquatic plant species in British Columbia occur widely throughout North America.

Aquatics typically lack rigid structural components because these are unnecessary for support. Ribbon-like or highly dissected leaves are common in submerged aquatics because they facilitate light penetration and diffusion of dissolved gases. In addition, this leaf arrangement offers little resistance to potentially damaging water movements. Thin leaf cuticles facilitate uptake of dissolved gases but this also make species very susceptible to desiccation. Floating-leaved aquatics often have spongy tissue with well-developed air-filled chambers. These "aerhynchema" help transport gases between roots and leaves. Leaves are almost always ovoid and entire to facilitate floating. Pressurized ventilation, a process that moves air from young leaves to roots and back to the atmosphere through older leaves, occurs in many floating-leaved species.

Rooted aquatics acquire most of their nutrients from sediments. However, rootless species such as *Utricularia* spp. and *Ceratophyllum* spp. absorb nutrients directly from the water.

Carbon dioxide diffuses slowly in water and can be limiting for submerged aquatics. Particularly in non-acidic waters, carbon dioxide is converted to bicarbonate. Some species, such as *Chara* spp., *Schoenoplectus subterminalis*, *Elodea canadensis*, and *Potamogeton* spp., are capable of using

bicarbonate for photosynthesis and often become dominant in stagnant waters where carbon dioxide concentrations are very low.

Landscape Position and Distribution

Shallow-water ecosystems are always associated with still or slow-moving waterbodies. These sites are widespread and common throughout the province in all climatic regimes. The most common shallow-water habitats occur in the littoral zone of lakes, particularly in protected waters where fine sediments collect, and in potholes. Less commonly, shallow-water ecosystems occur in small peatland ponds, peat degradation hollows, and very sluggish streams.

Hydrology and Soils

Shallow-water wetlands are affected by factors not well described by the modified edatopic grid. Factors that affect the distribution of aquatic plant species include water chemistry (acidity and salinity gradients), substrate quality, water depth, turbidity, and waterflow.

The single most important factor limiting the occurrence of aquatic plants is lack of light. Light levels diminish with increased water depth and turbidity. Turbidity of still waters is largely related to nutrient status of water (Table 5.5.1). The depth to which rooted aquatics occur largely depends on the clarity of the water and can reach as much as 5 m of water where water is very clear. In highly turbid water, light penetration can be limited to several centimetres and only floating-leaved species can occur.

Aquatic substrates are generally classified as non-soil because they are permanently flooded at depths greater than 60 cm and do not undergo profile development (Agriculture Canada Expert Committee on Soil

TABLE 5.5.1 *Characteristics of water with different nutrient status (Ellenberg 1986 in Klinka unpublished)*

	Attribute			
Nutrient Status	**Water colour**	**Clarity**	**pH**	**N and mineral availability**
Dystrophic	Yellowish–deep brown	Very turbid	<4.5	Very low
Oligotrophic Ca-poor	Greenish–brownish	Clear	4.5–7	Low
Oligotrophic Ca-rich	Blue–greenish	Very clear	>7	Medium
Eutrophic	Greenish–brownish	Turbid	>7	High–Very high

Survey 1987). Substrates can be sands, silts, clays, muck (a mix of silt, clay, and organic matter), degraded peat sediments, marl, or limnic sediments (gyttja or "loonshit").

Conservation Issues

Shallow-water wetlands are among the most important habitats for wildlife and fish. The plants that grow in shallow water are often highly palatable, in part because they lack tough, indigestible structural material. Permanent water and abundant structure encourage use by aquatic macroinvertebrates. Excellent cover and high prey densities attract juvenile and adult fish. Yellow pond-lily is an important forage for Beaver, Muskrat, and Moose.

Nutrient loading is potentially one of the biggest impacts on shallow-water ecosystems. High nutrient levels cause blooms of phytoplankton and other algae that reduce water clarity, light penetration, and available oxygen. Many aquatic macrophytes do not tolerate turbid water and will decline. In addition, species that are capable of fast growth under nutrient-loaded conditions, such as *Myriophyllum* spp., will choke out other species.

Sedimentation can affect plant communities by increasing turbidity and decreasing light penetration.

Shallow-water Ecosystem Types

Shallow-water wetland plant communities have not been well sampled in British Columbia. The descriptions below are based on local classifications, descriptive accounts, and observations. While these summaries provide a scope for discussion and future work, the units presented here should be viewed as preliminary only.

YELLOW POND-LILY TYPES

Yellow pond-lily ecosystems are widespread throughout British Columbia. They occur in a wide variety of aquatic sites from deep (5 m), clear lakes with gravel substrates to shallow, acidic peat-degradation pools in coastal bogs. Several types have been previously described for British Columbia.

Yellow pond-lily - Bladderwort
Nuphar lutea – Utricularia macrorhiza

This community is widespread on the Coast and in the Interior. It occurs in dystrophic and oligotrophic waters 20–200 cm deep on gyttja and peat

sediments. Sites are relatively species-poor. *Nuphar lutea* forms an open canopy, with *Utricularia macrorhiza* and *Chara* spp. common in the understorey. These communities persist during basin infilling and small patches can be found in bogs.

Yellow pond-lily – Water clubrush
Nuphar lutea – Schoenoplectus subterminalis

This community is widespread in the Georgia Depression in dystrophic and oligotrophic lakes on gyttja and peat sediments. *Schoenoplectus subterminalis* co-dominates with *N. lutea. Utricularia macrorhiza*, *Najas flexilis*, *Sparganium natans*, and *Potamogeton pusillus* commonly occur. This community typically occurs in the shallowest shallow-water locations adjacent to bogs or fens. (Described by Ceska 1978.)

Yellow pond-lily – Robbin's pondweed
Nuphar lutea – Potamogeton robbinsii

This community occurs in the Georgia Depression in 30–120 cm of water on wave-washed shores with gravel bottoms. Vegetation cover is typically low (< 30%). *N. lutea* forms an open canopy, with *Isoetes echinospora*, *Chara* spp., *Utricularia macrorhiza*, and *Najas flexilis* in the understorey. (Described by Ceska 1978.)

Yellow pond-lily – Richardson's pondweed
Nuphar lutea – Potamogeton richardsonii

This community is described by Revel (1972) for the Sub-Boreal Interior. It occurs on mineral sediments with some water movement. *N. lutea* forms a dense canopy with scattered *Potamogeton natans* and *Polygonum amphibium. Potamogeton richardsonii* dominates the understorey; scattered *Myriophyllum spicatum* also occurs.

PONDWEED TYPES

Common pondweed *Potamogeton natans*

Common pondweed communities are widespread in the Interior and the Georgia Depression. They occur in quiet waters on peat sediment in oligotrophic and mesotrophic lakes. They often occur in deeper waters adjacent to yellow pond-lily communities.

Potamogeton natans forms a dense canopy. The understorey is frequently sparse; *Utricularia* spp. and *Myriophyllum* spp. commonly occur.

Large-leaved pondweed *Potamogeton amplifolius*

Large-leaved pondweed occurs in the Georgia Depression, Southern Interior, and Southern Interior Mountains. It occurs in similar conditions to common pondweed but at greater water depths. Light conditions are very limited because of water depth and dense submerged foliage of *P. amplifolius*; therefore, few other species occur. (Described by Ceska 1978.)

Long-stalked pondweed *Potamogeton praelongus*

Long-stalked pondweed occurs throughout the Coast and Interior in deep waters (2.5–4 m) with sandy bottoms. *P. praelongus* dominates and few other species occur. (Described by Ceska 1978.)

Fennel-leaved pondweed – Widgeon-grass
Stuckenia pectinata – Ruppia maritima

Fennel-leaved pondweed – Widgeon-grass communities occur in saline and alkaline waters of the Central Interior, Southern Interior, and Southern Interior Mountains. Substrates are mineral materials and water depths are 0.5–2.5 m in depth.

Ruppia maritima and *Stuckenia pectinata* both commonly occur in weakly to moderately saline conditions. However, *R. maritima* is more tolerant of high salinity and will dominate where salinity is above 30 parts per thousand (normal salinity of sea water).

Both *R. maritima* and *S. pectinata* have very high forage values for waterfowl.

OTHER TYPES

Water shield – Bladderwort
Brasenia schreberi – Utricularia spp.

Water shield ecosystems are common in the Georgia Depression and southwestern Vancouver Island. Conditions are similar to yellow pond-lily sites but water shield usually occurs in deeper waters. Sites are in waters 1–2.5 m in depth with gyttja or peat substrates. Common locations are on the windward site of peatland lakes where sediments and winterbuds accumulate.

A dense canopy of *Brasenia schreberi* is common. *Nuphar lutea* can occur on some sites, especially in shallower locations. Submerged aquatics include *Utricularia gibba*, *Utricularia macrorhiza*, and *Ceratophyllum demersum*. (Described by Ceska 1978.)

Water smartweed *Polygonum amphibium*

These communties occur in larger lakes in 0.5 –1.5 m deep water on sandy substrates where currents limit accumulation of organic matter and fines. *Polygonum amphibium* can form a dense floating cover with scattered *Potamogeton natans*. Submerged species such as *Myriophyllum spicatum* and *Potamogeton foliosus* are common. Sites are nitrogen-poor. (Described by Revel 1972.)

Water lobelia – Bristle-like quillwort
Lobelia dortmanna – Isoetes echinospora

Water lobelia – Bristle-like quillwort communities occur in the Georgia Depression and Queen Charlotte Islands in shallow (20–70 cm), oligotrophic waters on sandy- or gyttja-bottomed flats.

Vegetation cover is often low (< 30%). *Lobelia dortmanna* is the dominant species but *Isoetes echinospora*, *Potamogeton gramineus*, *Ranunculus flammula*, and *Subularia aquatica* are also common. (Described by Ceska 1978.)

Muskgrass *Chara* spp.

Muskgrass is a macroalga that occurs in stagnant, alkali waters that have not been over-fertilized or polluted. *Chara* spp. are efficient at using bicarbonate for photosynthesis and this precipitates large quantities of calcium carbonate (marl).

Waterfowl use muskgrass communities extensively. *Chara* spp. are valuable forage that does not die back in winter and they harbour abundant macroinvertebrates.

Wavy water-nymph – Robbin's pondweed
Najas flexilis – Potamogeton robbinsii

Wavy water-nymph – Robbin's pondweed occurs in the Georgia Depression, Southern Interior, and Southern Interior Mountains in clear, fresh to brackish waters, 50–150 cm in depth. *Najas flexilis* dominates and often has very high cover. Ceska's (1978) characterization of coastal water-nymph communities includes a high presence of *P. robbinsii*, *P. pusillus*, and *Utricularia macrorhiza*.

N. flexilis is an important waterfowl forage species. All parts of the plant are consumed.

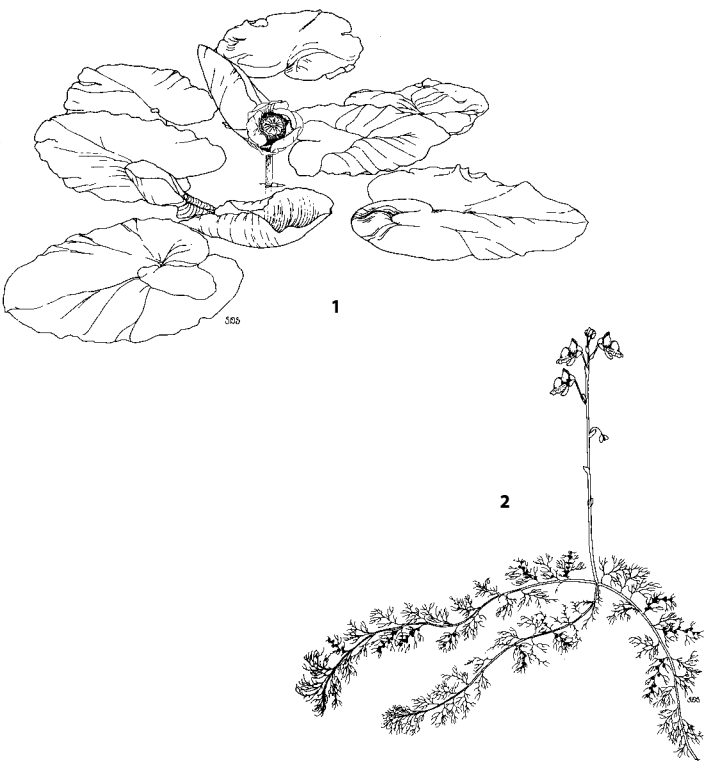
White water-buttercup *Ranunculus aquatilis*

White water-buttercup occurs throughout the province in mesotrophic to eutrophic waters on firm to soft mineral substrates and often where there is some current. Water depths can be shallow to moderately deep (1.5 m).

Narrow-leaved bur-reed *Sparganium angustifolium*

Narrow-leaved bur-reed occurs throughout the province in small ponds and protected embayments. It prefers cold waters 20–100 cm in depth with soft mucky bottoms and non-acid waters.

Fruits are eaten by ducks and all parts are grazed by deer and Muskrat.



1 *Nuphar lutea*, yellow pond-lily **2** *Utricularia macrorhiza*, greater bladderwort

1 *Khutzeymateen Estuary, northern Coast and Mountains (CWHvm1)* **2** *Complex of Lyngbye's sedge and Arctic rush communities on the Bella Coola estuary (CWHms2)* **3** *Gilttoyees Estuary, near Kitimat, Coast and Mountains (CWHvh2)*

Definition

An estuarine ecosystem is an intertidal community, occurring at the confluence of a freshwater source and the marine environment, and is regularly flooded by brackish tidal waters.

General Description

Vegetation

Table 5.6.2 lists species common in Estuarine Site Associations described in this guide. Estuarine Site Associations are characterized by an abundance of species tolerant of repeated (diurnal) flooding and brackish water. Species at the marine edge have specialized morphology to tolerate the desiccating effect of salt water. Succulents and other halophytes with salt-excreting organs are common. Species at the freshwater interface are more typical of wetland habitats but still must be tolerant of at least occasional brackish conditions. In addition, species occurring close to the river course must be tolerant of high sedimentation rates.

Low-elevation coastal climates are more equable than interior and high-elevation climates, yet climate still plays a role in estuarine development. Estuaries of the Georgia Depression have "California" species missing from estuaries of the Coast and Mountains ecoregion.

Landscape Position and Distribution

Estuaries form at the confluence of streams and rivers with the open ocean. The degree of estuarine development depends largely on the size of the river and its sediment load. Larger systems with high sediment loads tend to have extensive estuarine habitat development and diversity. Smaller streams can have substantial estuaries if they are glacier-fed but those systems fed by lakes or peatlands generally have very limited estuarine ecosystem development.

Hydrology and Soils

Tidal flooding is a characteristic feature of estuarine ecosystems. The lowest vegetated communities (marshes) are flooded and exposed twice daily with each tide. Flood duration is usually several hours per tide cycle. Higher communities are less regularly flooded and flood duration is generally more brief when it does occur (meadows).

Soil development is very limited in most estuarine marsh communities. Continual erosion and sedimentation keep soils juvenile. Cumulic

Regosols in communities along the river course are typical. Buried vegetation layered between annual spring flood deposits is a common soil feature. Meadows can have some soil development and shallow peat has been observed on some sites.

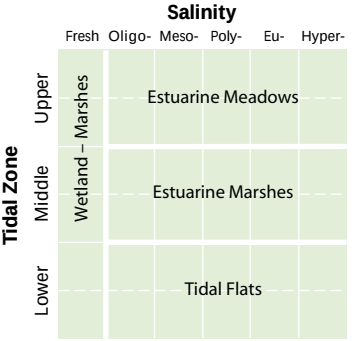


FIGURE 5.6.1 *Distribution of ecosystem classes of estuaries by elevation and salinity.*

Estuarine ecosystems have similar characteristics to wetland ecosystems with the additional influences of diurnal fluctuations in watertable and variable salinity (Figure 5.6.1). The gradient of most importance is the degree of tidal flooding, which is closely related to **height above the mean tide level**. Ecosystems that occur at the lowest level are flooded with every tide (except neap tides) while the highest may experience only occasional flooding during the highest high tides.

The **degree of fresh water influence** affects species distribution within an estuary independent of other factors. Particularly where high volumes of freshwater flow into estuarine environments, communities change along a gradient from where freshwater influences predominate (usually within the tidal reaches of the river) to where freshwater inputs are minimal.

Conservation Issues

Estuaries provide critical habitat for many wildlife species but comprise much less than 1% of the coastal landscape. These ecosystems have very high values for waterfowl and shorebirds, which use estuaries to maintain fat stores during migration to the nesting grounds. In addition, estuarine ecosystems are critical for coastal bear populations, providing early-season and mid-season forage, and cover while fishing during the salmon run.

Estuaries are critically important fish habitat. Freshwater inputs of nutrients and organic debris into the marine environment fuel highly productive ecosystems. Many saltwater, freshwater, and anadromous fish will selectively use estuaries during some portion of their lifecycle, particularly for juvenile rearing.

However, river mouths and estuaries are often the only practical access points to resources located farther up the watershed and are a convenient location for log booms and camps. Most Estuarine Site Associations are adapted to disturbance and will, therefore, recover from most human-caused physical disturbance except infilling. Damming of the parent river has profound impacts on estuarine ecosystems. Even without changes in water regime, reservoirs settle out fluvial sediments that feed and maintain estuaries. The result is a major reduction in extent of estuarine ecosystems.

Deschampsia cespitosa,
tufted hairgrass

TABLE 5.6.1 *Distribution of Estuarine Site Associations by biogeoclimatic zone*

		BG PP	BWBS SWB	ESSF	ICH	IDF	MS	SBPS SBS	CDF	CWH	MH
Em01	Widgeon-grass								xx	xx	
Em02	Glasswort – Sea-milkwort								xx	x^{sq}	
Em03	Seashore saltgrass								xx		
Em04	Seaside plantain – Dwarf alkaligrass									xx	
Em05	Lyngbye's sedge								xx	xxx	
Em06	Lyngbye's sedge – Douglas' water-hemlock									xx	
Ed01	Tufted hairgrass – Meadow barley								xx	xxx	
Ed02	Tufted hairgrass – Douglas' aster								x	xx	
Ed03	Arctic rush – Alaska plantain								xx	x^{s}	

x = incidental; < 5% of estuarine xx = minor; 5–25% of estuarine xxx = major; >25% of estuarine
s = southern subzones only q = Queen Charlotte Islands

TABLE 5.6.2 *Estuarine Species Importance Table*

	Species	Em01	Em02	Em03	Em04	Em05
Herbs	*Ruppia maritima*	▮▮▮▮▮				
	Eleocharis palustris	▮▮▮				▮▮▮
	Lilaeopsis occidentalis	▮▮▮				▮▮
	Glaux maritima		▮▮▮▮	▮▮▮	▮▮▮▮	▮
	Salicornia virginica		▮▮▮▮▮	▮▮▮		
	Distichlis spicata var. *spicata*		▮▮	▮▮▮▮▮		
	Spergularia canadensis		▮▮	▮▮	▮▮	
	Atriplex patula			▮▮▮	▮	
	Plantago maritima				▮▮▮▮	
	Puccinellia pumila				▮▮▮▮	
	Agrostis stolonifera					▮▮
	Carex lyngbyei	▮▮▮			▮▮	▮▮▮▮▮
	Potentilla egedii				▮▮	▮▮▮
	Deschampsia cespitosa				▮	▮▮
	Triglochin maritima				▮▮	▮▮
	Juncus arcticus					▮
	Plantago macrocarpa					
	Hordeum brachyantherum					
	Angelica lucida					
	Agrostis exarata					▮
	Cicuta douglasii					
	Aster subspicatus					
	Conioselinum gmelinii					
	Festuca rubra					
	Lathyrus palustris					
	Ranunculus orthorhynchus					
	Sium suave					
	Lupinus nootkatensis					
	Achillea millefolium					▮
	Trifolium wormskioldii					
	Poa trivialis					▮

Em06	Ed01	Ed02	Ed03	Common Name
				widgeon-grass
▮▮		▮	▮	common spike-rush
	▮			western lilaeopsis
	▮▮	▮	▮	sea-milkwort
				American glasswort
				seashore saltgrass
				Canadian sandspurry
		▮		common orache
	▮▮	▮		sea plantain
				dwarf alkaligrass
			▮	creeping bentgrass
▮▮▮▮▮	▮▮▮	▮▮▮	▮▮	Lyngbye's sedge
▮▮▮	▮▮▮	▮▮▮▮	▮▮▮▮	coast silverweed
▮▮▮	▮▮▮▮▮	▮▮▮▮▮	▮▮	tufted hairgrass
▮▮	▮▮	▮▮	▮▮	seaside arrow-grass
▮▮	▮▮	▮	▮▮▮▮▮	arctic rush
▮▮	▮▮	▮▮▮	▮▮▮	Alaska plantain
▮▮	▮▮	▮▮▮	▮	meadow barley
▮▮▮	▮	▮▮	▮▮	seacoast angelica
▮▮	▮▮	▮▮	▮▮	spike bentgrass
▮▮▮		▮	▮	Douglas' water-hemlock
▮▮▮		▮▮▮▮	▮▮▮▮	Douglas' aster
▮▮	▮	▮▮	▮	Pacific hemlock-parsley
▮▮	▮▮	▮▮	▮▮	red fescue
▮▮		▮	▮▮	marsh peavine
▮▮		▮▮	▮	straight-beaked buttercup
▮▮		▮	▮	hemlock water-parsnip
▮▮		▮	▮	Nootka lupine
	▮	▮▮▮	▮▮	yarrow
	▮	▮▮	▮▮	springbank clover
			▮▮	rough bluegrass

Ruppia maritima

General Description

The Widgeon-grass Site Association is common throughout coastal British Columbia. It occurs in brackish, mud-bottomed pools, lagoons, backwater sloughs, drainage channels, and mudflats that dissect lower portions of estuarine marshes. Tidal inundation is usually prolonged; locations in pools may be permanently flooded. Sites are often small in extent but occasionally can also occur over large areas of tidal flats where sedimentation rates are low.

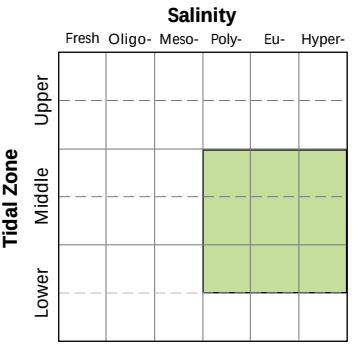
This species-poor community usually consists of pure stands of *Ruppia maritima*; however, a scattering of other species is possible.

Soils are silty Rego-Gleysols. Flooding can be permanent or prolonged during each tidal cycle. *Ruppia maritima* prefers water depths of approximately 0.5 m but occurs to depths of 4 m.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 0)
Herb layer (10 - **30** - 70)
Carex lyngbyei, Eleocharis palustris, Lilaeopsis occidentalis, ***Ruppia maritima***
Moss layer (0 - **0** - 0)

Estuarine Grid



Comments

Extensive widgeon-grass communities are found on tidal flats with muddy substrates (protected bays with low wave power or currents). Since Ruppia maritima *is tolerant of eusaline conditions, these flats can occur outside the influence of estuaries. The* ***Em01*** *can be found in conjunction with any estuarine meadow or marsh ecosystem, in depressions or pools, but it is most commonly below the limit of emergent vascular plants in the middle intertidal.*

Ruppia maritima *also occurs in saline ponds of the Interior (see section 5.8).*

General Description

Glasswort – Sea-milkwort stands are found in the Georgia Depression and outer coastal areas on sandy or pebbly deposits at the lowest edge of intertidal vegetation. These sites experience daily and prolonged flooding by strongly brackish water.

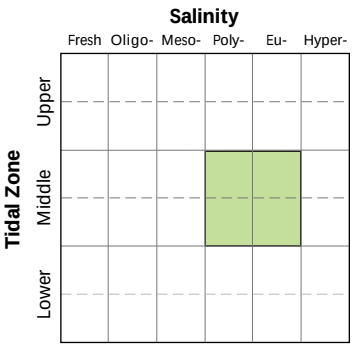
Species diversity is low; typically only *Salicornia virginica* and *Glaux maritima* are found in abundance. Small patches of *Distichlis spicata* or *Ruppia maritima* may occur. Plant cover can be continuous or open.

Soils are often fine textured but with a pebbly or gravelly layer that provides better drainage.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 0)
Herb layer (15 - **50** - 80)
Distichlis spicata, ***Glaux maritima***,
Salicornia virginica
Moss layer (0 - **0** - 0)

Estuarine Grid



Comments

*The **Em02** is tolerant of eusaline conditions and may be found outside of estuary influence in protected embayments with low wave power. It is often found adjacent to the **Em03**, which occurs on more poorly drained materials, or the **Em01**, which tolerates more prolonged flooding and continuous soil saturation.*

Distichlis spicata var. *spicata*

General Description

Seashore saltgrass sites are found mainly in estuaries of the Georgia Depression but also on southwest Vancouver Island. They occur at the lower limit of estuary vegetation on fine-textured, poorly drained sediments that are flooded for prolonged periods by weakly to strongly brackish water.

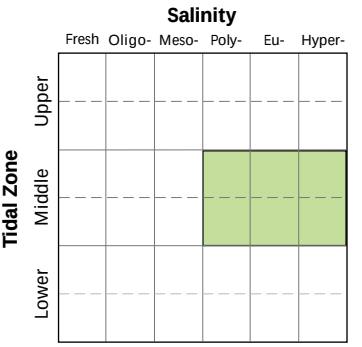
Species diversity is low. Seashore saltgrass is dominant but there can be significant cover of other low marsh species such as *Glaux maritima* or *Salicornia virginica*. Widgeon-grass pools and a scattering of other species sometimes occur.

Soils are fine textured and poorly drained.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 0)
Herb layer (30 - **70** - 99)
Atriplex patula, ***Distichlis spicata* var. *spicata*, *Glaux maritima*, *Salicornia virginica***
Moss layer (0 - **0** - 0)

Estuarine Grid



Comments

*The **Em03** is closely related to the **Em02** and these two communities are often found in complex. Hydrology of these two Site Associations is similar but the **Em03** occurs on fine-textured material that does not drain when the tide is out. A gravelly or pebbly layer in the **Em02** allows for better drainage.*

General Description

The Seaside plantain – Dwarf alkaligrass Site Association occurs mainly in the estuaries of the northern Coast and Mountains and protected shores on pebbly or gravelly flats in the middle and upper intertidal. These sites are protected from wave action and often have little freshwater influence. Tidal flooding and exposure occur with most tides. Suitable habitats occur in protected embayments where there is no accumulation of fine-textured sediment; however, such sites appear to be infrequent.

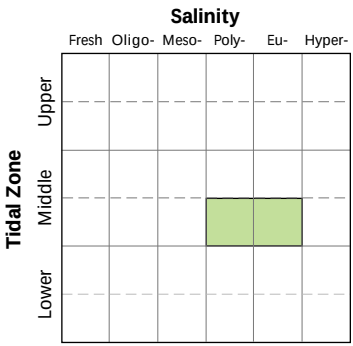
Species diversity is low. **Em04** sites are often small in extent and consist of a scattered cover of *Plantago maritima*, *Puccinellia pumila*, *Glaux maritima*, and the seaweed, *Fucus* spp.

The substrate is typically sandy/gravelly and gleyed.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 0)
Herb layer (30 - **50** - 65)
Fucus spp., ***Glaux maritima***, ***Plantago maritima***, ***Puccinellia pumila***
Moss layer (0 - **0** - 0)

Estuarine Grid



Comments

*This community is the northern equivalent of the **Em02**. It occurs below **Em05** or even **Ed01** sites where the shore zone is steep. Descriptions of similar communities in Alaska and on Vancouver Island include sites with* Puccinellia nutkaensis. *No sites with this species have been sampled; however, it is likely that they occur and should be treated as **Em04** sites.*

Carex lyngbyei

The Lyngbye's sedge Site Association is the most common and widespread estuarine Site Association throughout the coast. It occurs most frequently where there are strong fluctuations of brackish water, active sedimentation, and diurnal flooding and exposure—locations such as tidal flats and channel margins.

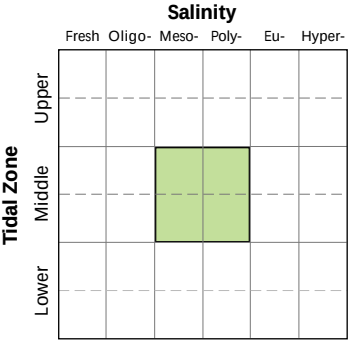
Low species diversity is typical; *Carex lyngbyei* often occurs in dense, pure stands. Some sites have scattered *Potentilla egedii, Deschampsia cespitosa*, *Glaux maritima*, and *Triglochin maritima.*

Soils are silty or fine-sandy Gleysols or Humic Gleysols. Most commonly they are on sites that experience continual erosion and deposition but do occur on less dynamic sites. Soil profiles frequently exhibit layered mineral deposits with embedded sedge roots and shoots.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 0)
Herb layer (30 - **75** - 99)
Carex lyngbyei, *Eleocharis palustris, Potentilla egedii*
Moss layer (0 - **0** - 0)

Estuarine Grid



Comments

*Along the riverine areas of the estuary, the **Em05** is often the lowest vegetated zone. **Ed02** meadows are often directly above **Em05** sites in medium-sized estuaries. The related **Em06** Site Association replaces the **Em05** on sites where freshwater influences predominate in tidal reaches.*

General Description

The Lyngbye's sedge – Douglas' water-hemlock Site Association occurs in fjord-type estuaries of larger rivers on the northern Coast and Mountains, where large freshwater inputs reduce salinity in the intertidal zone year-round. On the north Coast, the **Em06** has been observed along tidal reaches of the Skeena and Nass rivers. It occurs where there are strong fluctuations of weakly brackish water, active sedimentation, and diurnal flooding and exposure—usually in lateral bays along the river.

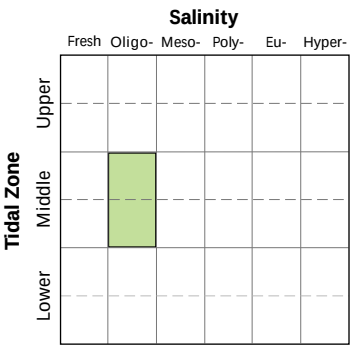
Species diversity is high relative to the similar **Em05** that is common in smaller estuaries. *Carex lyngbyei* is dominant. Many species intolerant of high salinity, especially members of the celery family (Apiaceae) are prominent. *Angelica lucida*, *Cicuta douglasii*, *Aster subspicatus*, and *Deschampsia cespitosa* are common associates.

Soils are always silty or fine-sandy Gleysols or Humic Gleysols that experience continual erosion and deposition. Buried layers of sedge shoots and roots are common in the profile.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 0)
Herb layer (80 - **90** - 99)
Angelica lucida, ***Aster subspicatus***, ***Carex lyngbyei***, ***Cicuta douglasii***, ***Deschampsia cespitosa***, *Eleocharis palustris*, *Juncus arcticus*, *Lathyrus palustris*, *Oenanthe sarmentosa*, ***Potentilla egedii***, *Ranunculus orthorhynchus*, *Sium suave*, *Triglochin maritima*
Moss layer (0 - **0** - 0)

Estuarine Grid



Comments

*The **Em06** is mostly limited to larger river systems where large freshwater inputs minimize salinity in tidal reaches. Some type locations include the Skeena and Nass rivers.*

*The **Em06** can occur adjacent to the **Em05**, **Wm02**, or **Wm04** sites.*

Deschampsia cespitosa ssp. *beringensis* – *Hordeum brachyantherum*

General Description

The Tufted hairgrass – Meadow barley Site Association occurs throughout the Coast in the upper intertidal zone on fan estuaries, on creekside areas within moderate-sized estuaries, and as narrow fringes on steep coastal shores with abundant groundwater seepage. These sites experience daily but generally brief flooding by brackish water.

The **Ed01** is characterized by relatively low species diversity and a dominance of *Deschampsia cespitosa* ssp. *beringensis*. *Hordeum brachyantherum* occurs commonly and occasionally other grasses, such as *Festuca rubra* or *Agrostis exarata*. *Potentilla egedii* and *Carex lyngbyei* are often present with low cover. In southern disturbed sites, introduced grasses such as *Agrostis stolonifera* can be dominant.

The soils are usually sandy or loamy-textured Gleysols and Regosols with little or no humus form development.

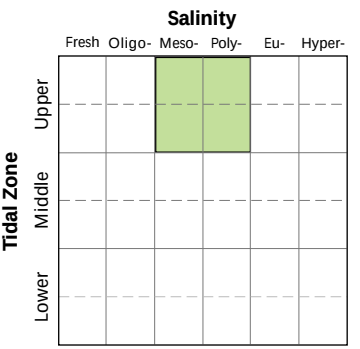
Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 0)
Herb layer (35 - **65** - 99)
***Carex lyngbyei*, *Deschampsia cespitosa* ssp. *beringensis*,** *Hordeum brachyantherum*, ***Potentilla egedii*,** *Triglochin maritima*
Moss layer (0 - **0** - 0)

Comments

*The **Ed01** often occurs above the **Em05** and below forest or Beach dunegrass – Beach lovage ecosystems. This Site Association is similar to the **Ed02** but occurs on more saline (and often wetter) sites.*

Estuarine Grid



General Description

The Tufted hairgrass – Douglas' aster Site Association is one of the most floristically diverse and widespread ecosystems in medium to large estuaries in the north and central Coast and Mountains. The **Ed02** occurs in the high marsh zone between the backshore shrub communities and the low marsh, usually in broad and extensive flats. These sites are limited to zones within the estuary where weakly brackish conditions predominate and inundation is irregular.

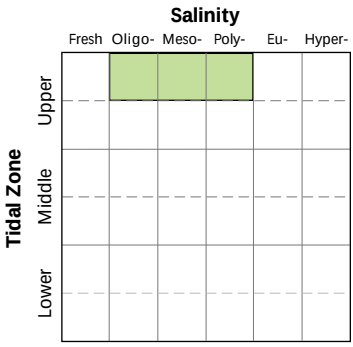
Deschampsia cespitosa and *Aster subspicatus* are dominant and diagnostic species, but many other species are often prominent.

Soils are mostly Humic Gleysols with silty and sandy textures, but Terric Mesisols have also been encountered.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 1)
Herb layer (60 - **85** - 99)
Achillea millefolium, *Agrostis exarata*, ***Aster subspicatus***, ***Carex lyngbyei***, *Conioselinum gmelinii*, ***Deschampsia cespitosa* ssp. *beringensis***, ***Hordeum brachyantherum***, ***Plantago macrocarpa***, ***Potentilla egedii***, *Triglochin maritima*
Moss layer (0 - **0** - 0)

Estuarine Grid



Comments

This community replaces the ***Em05*** *as tidal flats accrete and become removed from tidal influences.*

Juncus arcticus – Plantago macrocarpa

General Description

The Arctic rush – Alaska plantain Site Association occurs in estuaries of the Georgia Depression and southern Coast and Mountains, where there is a well-developed freshwater lens that reduces the salinity of tidal waters. The **Ed03** occurs in the high intertidal zone with brief diurnal tidal inundation—locations that would support **Ed01** or **Ed02** in more saline environments. Locations can be protected estuaries where fresh water is retained, brackish tidal reaches on larger rivers, estuaries near larger river systems, and localized depressions within estuarine meadows.

Juncus arcticus is the site dominant with *Plantago macrocarpa*, *Potentilla egedii*, and *Aster subspicatus* common in the herb layer. The herb layer is well developed and displays moderate species diversity of both graminoids and forbs.

Silty-textured Gleysols with a humic enriched surface horizon are typical. Minerally enriched Fibrisols also occur.

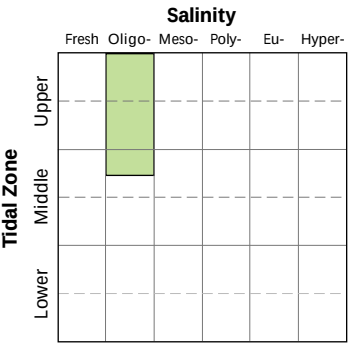
Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 0)
Herb layer (70 - **80** - 99)
Aster subspicatus, ***Juncus arcticus***, *Plantago macrocarpa*, ***Potentilla egedii***, *Triglochin maritima*
Moss layer (0 - **0** - 0)

Comments

*The **Ed03** typically occurs above **Ed01** or **Em05** sites and at the upper edge of estuarine vegetation before upland ecosystems.*

Estuarine Grid



Canadian sandspurry *Spergularia canadensis*

Canadian sandspurry sites occur in estuaries along the Coast, primarily in the Georgia Depression. They occur on muddy-bottomed depressions in the backshore of estuaries. Sites are protected from waterflow and wave action but have lengthy saturation. A sparse cover of *Spergularia canadensis* with few other species is typical.

Common spike-rush – Lyngbye's sedge
Eleocharis palustris – Carex lyngbyei

Eleocharis palustris occurs as a minor component of many estuarine communities throughout the Coast. However, stands dominated by common spike-rush are uncommon and occur in locations with prolonged tidal flooding but low salinity. These can be in protected inlets where there is little tidal flushing or along major river systems where tidal reaches can be fresh water. This Site Association is often represented by a near monoculture of *Eleocharis palustris* on heavily inundated sites in drainage channels, or with a mixture of meadow species in more protected areas. These latter sites can have *Deschampsia cespitosa*, *Triglochin maritima*, *Potentilla egedii*, and *Plantago macrocarpa*. The soils are either Gleysols or Organics (in protected sites only).

Creeping bentgrass *Agrostis stolonifera*

Agrostis stolonifera is an introduced European species that now forms the dominant component of the high marsh in many estuaries of the Georgia Depression.

Dune wildrye – Pacific hemlock-parsley
Leymus mollis – Conioselinum gmelinii

Dune wildrye – Pacific hemlock-parsley communities are common on raised beach ridges or berms where coarse-textured materials have been deposited by beach-forming processes. These sites generally experience little or no flooding. However, salt spray and inundation can occur during storm events. The herb layer is dominated by *Leymus mollis*. Other species such as *Achillea millefolium*, *Conioselinum gmelinii*, *Heracleum maximum*, and *Ligusticum scoticum* are often scattered throughout. The tree, shrub, and bryophyte layers are nearly absent. Small flowering plants such as *Fritillaria camschatcensis* can be found where the site is adjacent to a more protected high marsh community such as **Ed02**.

Eel-grass *Zostera marina*

Eel-grass beds occur in the upper subtidal areas of estuaries and are exposed only during the lowest low tides. They occur on fine-textured sediments in protected areas where sedimentation rates are not excessive. A open cover of *Zostera marina* is typical.

American bulrush *Schoenoplectus americanus*

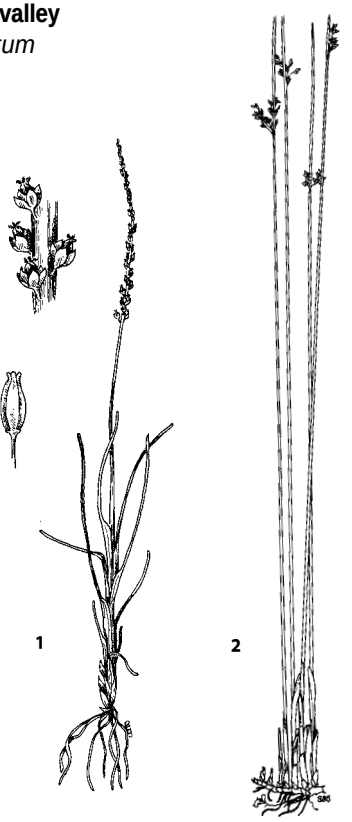
American or Olney's bulrush sites occur in the Fraser River delta and possibly other estuaries of the Georgia Depression in weakly brackish areas below **Em05** stands. *Schoenoplectus americanus* is the site dominant. Soil textures are sandy.

Pacific crabapple – False lily-of-the-valley
Malus fusca – Maianthemum dilatatum

The Pacific crabapple – False lily-of-the-valley Site Association occurs at the upper limit of tidal influence and many sites experience only salt spray and subirrigation. It is described in Chapter 5.7, Flood Classes.

Seacoast bulrush
Bolboschoenus maritimus

Seacoast bulrush sites occur in estuaries of the Georgia Depression in low-lying areas of the high marsh where soils are flooded or at least saturated at low tide and have high salinity. These are often small in extent and a monoculture of *Bolboschoenus maritimus*.



1 *Triglochin maritima*, seaside arrow-grass
2 *Juncus arcticus*, arctic rush

1 *Sandbar willow on wave-washed shore of Nicola Lake (BGxw1)* **2** *Sitka willow – Red-osier dogwood – Common horsetail low bench on a levee of the Hominka River, east of Prince George (SBSwk1)* **3** *Low and middle bench communities on the Skeena River floodplain, northern Coast and Mountains (CWHvm1)*

Definition

A flood ecosystem is a non-wetland ecosystem that occurs on regularly flooded riparian sites with well-drained soils. Sites can be tall shrub (low bench), deciduous forest (middle bench), or coniferous forest (high bench) .

General Description

Vegetation

Table 5.7.2 lists common species of the Low and Middle Bench Site Associations described in this guide. High bench plant community composition is similar to upland seepage sites. High bench associations are not described here because they are thoroughly described in regional BEC field guides. Low bench ecosystems have a tall shrub structure dominated by willow, alders, and other species tolerant of extended flooding and erosion. Middle benches have similar shrub species but also have a canopy of deciduous trees. The herb layer is dominated by rhizomatous species that can resprout after floods. Even though fresh mineral substrates are frequently exposed, annuals are uncommon on many sites because high shrub cover shades the ground surface. Herb cover is variable because scouring floods and sedimentation temporarily remove above-ground herb growth. These factors also limit bryophyte cover.

Landscape Position and Distribution

Flood ecosystems occur on the floodplains of rivers or wave-washed lakeshores, where there is deposition of fluvial or lacustrine materials. They usually abut the channel on sites elevated above the mid-season watertable. Lateral bars, midstream bars, point bars, and levees are common site locations for low benches; middle benches often occur on islands, level floodplain benches, and older inner-bend accretion areas.

Flood ecosystems occur throughout the province in all zones. However, they are infrequent at higher elevations where there are fewer topographic positions for floodplain development (Table 5.7.1).

Hydrology and Soils

Flood ecosystems are indundated during the spring freshet in the early part of the growing season. Low benches experience longer (20–40 days) and more powerful flooding than middle benches (< 25 days). Sites can be deeply flooded by stream waters for the first weeks of the growing season but are situated well above normal summer flows. In coastal regions,

fall and winter rain-on-snow storms produce the largest annual floods that will affect floodplains during the dormant season.

Soils are derived from fluvial sands, gravels, and silts. Vegetation grows under aerated soil conditions, with continual subirrigation for most of the growing season (Figure 5.7.1). Common soil types are Cumulic Regosols of stratified silts, sands, and gravels. Typically there is no, or very weak, humus development in low and middle bench ecosystems.

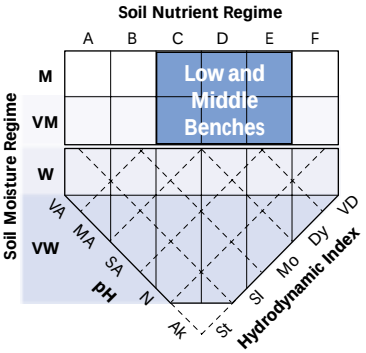


FIGURE 5.7.1 *Position of flood ecosystems on the edatopic grid.*

Other Comments

Flood ecosystems are maintained by a combination of annual flooding, erosion, and deposition. However, most floodplains are geomorphically dynamic; continous sediment deposition, bank erosion, and channel movements modify the site conditions on the floodplain regularly. Middle bench ecosystems will succeed low benches as sites accumulate sediments and become raised above the stream. Continued isolation of middle or low bench ecosystems from the regular flooding (through sediment accumulation or stream channel changes) effectively converts them into seral ecosystems that progress towards high bench or upland ecosystems.

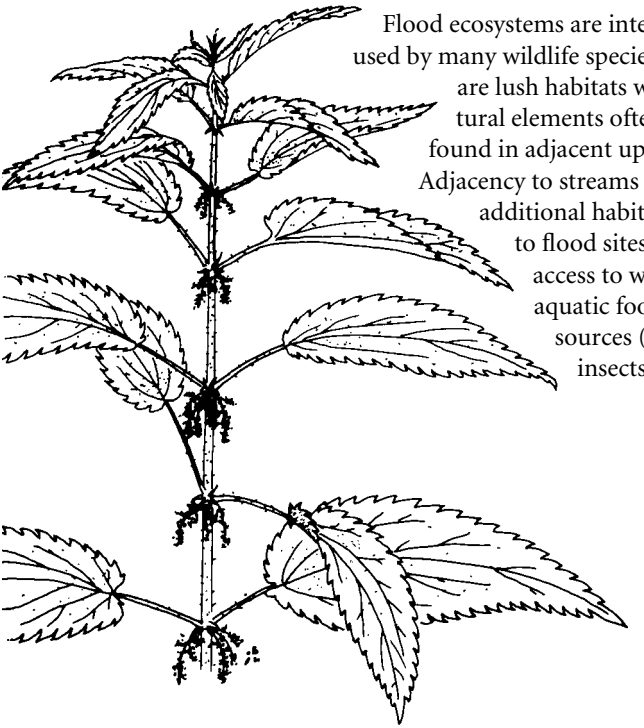
Conservation Issues

Low and Middle Bench Site Associations occur in the geomorphologically dynamic portion of the floodplain and are maintained by a combination of prolonged flooding and site erosion/sedimentation. The areal extent of flood ecosystems remains constant in a stream reach over time, given no fundamental change in water regime or sediment load, but their location in the floodplain changes in response to stream channel changes. Water control structures reduce the extent of floodplain communities by reducing sediment load and moderating flood levels.

Plant species that occur on the active floodplain are tolerant of mechanical disturbance and will recover from most surface disturbances. Interannual variation in flood intensity and duration is large and most plants will tolerate all but prolonged surface flooding.

Flood ecosystems act as sediment traps and prevent rapid erosion of streambank soils by binding soils and slowing floodwaters. In stream systems with high flood power, low bench ecosystems maintain channel form and protect important aquatic habitats. Their riparian location also means that they are major contributors of small and large organic matter that provides nutrients and habitat structure to the stream ecosystem. On small streams, the riparian community provides shade and moderates stream temperature.

Flood ecosystems are intensively used by many wildlife species. These are lush habitats with structural elements often not found in adjacent uplands. Adjacency to streams confers additional habitat values to flood sites, including access to water and aquatic food resources (aquatic insects, fish).



Urtica dioica, stinging nettle

TABLE 5.7.1 *Distribution of Flood Site Associations by biogeoclimatic zone*

		BG PP	BWBS SWB	ESSF	ICH	IDF	MS	SBPS SBS	CDF	CWH	MH
Fl01	Mountain alder – Common horsetail		xxx	x	xx	xx	xx	xxx		x	
Fl02	Mountain alder – Red-osier dogwood – Lady fern				xx			xx^{w}		x	
Fl03	Pacific willow – Red-osier dogwood – Horsetail	x	x			x		x		x	
Fl04	Sitka willow – Red-osier dogwood – Horsetail				xx			x^{w}		x	
Fl05	Drummond's willow – Bluejoint		x		x	x		xxx			
Fl06	Sandbar willow	x	x								
Fl07	Water birch – Rose	x				x^{h}					
Fm01	Cottonwood – Snowberry – Rose	x				xx		x			
Fm02	Cottonwood – Spruce – Red-osier dogwood	x	xx		xx	xx	xx	xx			
Fm03	Cottonwood – Subalpine fir – Devil's club				xx			x^{w}			
Fl50	Sitka willow – False lily-of-the-valley									x	
Fl51	Red alder – Salmonberry – Horsetail								xx	xx	
Fm50	Cottonwood – Red alder – Salmonberry								xx	xx^{xoc}	

x = incidental; < 5% of flood sites
xx = minor; 5–25% of flood sites
xxx = major; >25% of flood sites
w = wet/very wet subzones only
h = warm/hot subzones only
xoc = not on outer coast (hypermaritime)

TABLE 5.7.2 *Flood Species Importance Table*

	Species	FI04	FI05	FI06	FI03	FI07	FI01	FI02
Trees								
	Populus balsamifera ssp. *trichocarpa*							
	Picea X							
	Abies lasiocarpa							
	Alnus rubra							
	Picea sitchensis							
Shrubs	*Salix sitchensis*							
	Salix drummondiana							
	Salix exigua							
	Salix lucida							
	Betula occidentalis							
	Salix bebbiana							
	Alnus incana							
	Cornus stolonifera							
	Lonicera involucrata							
	Rosa woodsii							
	Rosa nutkana							
	Symphoricarpos albus							
	Acer glabrum							
	Rosa acicularis							
	Oplopanax horridus							
	Rubus parviflorus							
	Viburnum edule							
	Sambucus racemosa							
	Rubus spectabilis							
	Ribes bracteosum							
Herbs and Dwarf Shrubs	*Calamagrostis canadensis*							
	Equisetum arvense							
	Equisetum hyemale							
	Athyrium filix-femina							
	Urtica dioica							
	Heracleum maximum							
	Matteuccia struthiopteris							
	Poa pratensis							
	Osmorhiza berteroi							
	Pyrola asarifolia							
	Actaea rubra							
	Gymnocarpium dryopteris							
	Circaea alpina							
	Streptopus amplexifolius							
	Aster subspicatus							
	Stachys mexicana							
	Elymus glaucus							
	Maianthemum dilatatum							
Mosses and Lichens	*Brachythecium* spp.							
	Mnium spp.							
	Rhytidiadelphus squarrosus							

Fm01	Fm02	Fm03	Fl50	Fl51	Fm50	Common Name
▮▮▮▮	▮▮▮▮▮	▮▮▮▮▮	▮	▮▮	▮▮▮▮	black cottonwood
▮	▮▮▮	▮▮▮			▮	spruce
	▮	▮▮				subalpine fir
			▮▮	▮▮▮▮▮	▮▮▮	red alder
					▮▮	Sitka spruce
	▮		▮▮▮▮▮	▮▮	▮	Sitka willow
						Drummond's willow
▮						sandbar willow
▮	▮		▮▮			Pacific willow
▮						water birch
▮	▮					Bebb's willow
▮▮	▮▮▮	▮▮▮			▮	mountain alder
▮▮▮	▮▮▮▮	▮▮▮		▮▮▮	▮▮▮▮	red-osier dogwood
▮	▮▮	▮	▮▮	▮	▮▮	black twinberry
▮▮						prairie rose
▮▮	▮				▮	Nootka rose
▮▮▮	▮	▮			▮	common snowberry
▮▮	▮	▮▮			▮	Douglas maple
▮▮	▮▮	▮				prickly rose
	▮	▮▮▮▮▮			▮▮	devil's club
	▮▮	▮▮		▮▮	▮▮	thimbleberry
	▮▮	▮▮		▮	▮▮	highbush-cranberry
	▮	▮▮		▮▮	▮▮	red elderberry
		▮	▮▮	▮▮▮	▮▮▮▮	salmonberry
				▮▮▮	▮▮	stink currant
▮	▮▮	▮	▮▮▮		▮	bluejoint
▮▮	▮▮▮	▮▮▮	▮▮	▮▮▮▮▮	▮▮▮	common horsetail
▮▮	▮				▮	scouring-rush
	▮	▮▮	▮	▮▮	▮▮	lady fern
▮	▮	▮				stinging nettle
▮	▮▮	▮	▮▮	▮▮	▮	cow-parsnip
	▮					ostrich fern
▮▮					▮	Kentucky bluegrass
▮	▮▮	▮▮			▮▮	mountain sweet-cicely
	▮▮	▮▮			▮▮	pink wintergreen
▮	▮	▮▮		▮	▮	baneberry
	▮	▮▮▮		▮▮	▮▮	oak fern
	▮	▮▮		▮▮	▮▮	enchanter's-nightshade
	▮	▮▮			▮	clasping twistedstalk
▮	▮		▮▮▮			Douglas' aster
				▮▮▮	▮	Mexican hedge-nettle
▮	▮▮		▮▮	▮▮	▮▮	blue wildrye
			▮▮▮	▮	▮▮▮	false lily-of-the-valley
▮	▮▮	▮	▮		▮	feathermosses
	▮	▮▮	▮▮	▮▮	▮▮	leafy mosses
			▮▮		▮	bent-leaf moss

Alnus incana – Equisetum arvense

General Description

Mountain alder – Common horsetail low benches are common throughout the Interior at elevations below 1500 m. They occur on gravel or sand bars adjacent to relatively high-gradient creeks and streams that can have a "flashy" flood regime. Flood events are short during annual spring flooding and occur occasionally during summer storms.

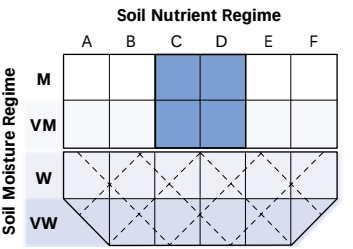
Alnus incana is the dominant shrub and forms a continuous canopy on most sites. The understorey can be well developed or sparse depending on recent flood history, but *Equisetum arvense* usually persists. The moss layer is often very sparse or absent because of high litterfall and recurring sediment deposition.

Soils are coarse-textured, often gravelly, Cumulic Regosols and Rego Gleysols.

Characteristic Vegetation

Tree layer (0 - **1** - 10)
Shrub layer (25 - **75** - 100)
Alnus incana, *Lonicera involucrata*
Herb layer (1 - **60** - 100)
Athyrium filix-femina, ***Equisetum arvense***, *Gymnocarpium dryopteris*, *Heracleum maximum*
Moss layer (0 - **1** - 40)
Brachythecium spp., *Mnium* spp.

Wetland Edatopic Grid



Comments

In wetter subzones, Alnus incana *stands that occur on fine-textured soils usually have an abundance of* Athyrium filix-femina *or* Matteuccia struthiopteris *and are described by the* ***FI02****. Alder sites are replaced by willow-dominated Site Associations, such as the* ***FI05****, on lower-gradient streams where fine-textured soils and longer flooding create conditions more favourable to willows.*

General Description

Mountain alder – Red-osier dogwood – Lady fern sites are common at low elevations in the wet climates of the Sub-Boreal Interior, Southern Interior Mountains, and Nass Basin, along streams and in creek gullies. Low-gradient floodplains with loamy or fine-textured soils and moderate duration of flooding are characteristic of this Site Association.

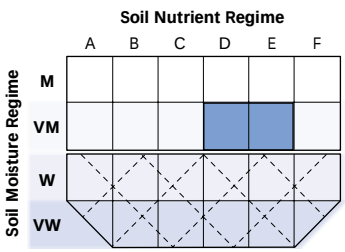
Alnus incana always dominates the canopy but a diversity of shrubs is common. *Cornus stolonifera* and *Lonicera involucrata* are frequently abundant. The understorey is diverse and lush, with a marked abundance of large ferns. In the eastern SBS and in some locations in the Skeena-Nass area, *Matteuccia struthiopteris* is the dominant fern; elsewhere *Athyrium filix-femina* predominates. The moss layer is usually very sparse.

Soils are Humic Gleysols or Cumulic Regosols.

Characteristic Vegetation

Tree layer (0 - **0** - 10)
Shrub layer (10 - **78** -100)
Alnus incana, ***Cornus stolonifera***, ***Lonicera involucrata***, *Sambucus racemosa*
Herb layer (20 - **75** - 100)
Athyrium filix-femina, ***Equisetum arvense***, *Heracleum maximum*, ***Matteuccia struthiopteris***, ***Urtica dioica***
Moss layer (0 - **4** - 20)
Brachythecium spp., *Mnium* spp.

Wetland Edatopic Grid



Comments

Similar but wetter sites with a perched water table have an abundance of Lysichiton americanus *and are described by the* ***Ws01****. Higher-gradient sites with gravelly or sandy soils are occupied by the* ***Fl01****. The* ***Fl02*** *is often found in association with* ***Fm02*** *or* ***Fm03*** *middle bench communities.*

Salix lucida – Cornus stolonifera – Equisetum

General Description

The Pacific willow – Red-osier dogwood – Horsetail Low Bench Site Association is uncommon and widely scattered throughout the Interior and Coast. It has been observed along large, low-gradient rivers with prolonged spring flooding, in locations protected from erosive currents.

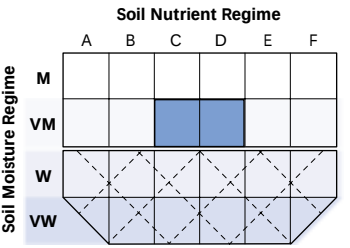
Salix lucida ssp. *lasiandra* on these sites can grow to impressive statures and form a closed canopy up to 15 m tall. A sparse to dense cover of *Cornus stolonifera*, *Alnus incana*, or *Salix prolixa* can be present. The understorey is often relatively sparse but horsetails can be abundant.

Soils are mostly Regosols derived from deposition of fluvial fine sands and silts. There is little surface organic accumulation.

Characteristic Vegetation

Tree layer (25 - **35** - 60)
Salix lucida* ssp. *lasiandra
Shrub layer (15 - **35** - 40)
Alnus incana*, *Cornus stolonifera*, *S. lucida*, *S. prolixa
Herb layer (2 - **17** - 25)
Equisetum arvense
Moss layer (0 - **10** - 40)
Mnium spp., *Brachythecium* spp.

Wetland Edatopic Grid



Comments

Pacific willow stands are often small in area and dissected by oxbows and drainage channels. They generally occur adjacent to black cottonwood floodplain ecosystems. More active low bench sites on similar large river systems may be occupied by the ***FI06****.*

General Description

Sitka willow – Red-osier dogwood – Horsetail stands are common at low elevations in the wet climates of the Sub-Boreal Interior and Southern Interior Mountains, and in coast transition areas of the Coast and Mountains. They occur primarily on levees or bars in the active floodplains of sluggish, low-gradient streams.

Salix sitchensis is consistently the dominant shrub, though some sites have appreciable cover of *Alnus incana*, *Salix drummondiana*, or *Salix lucida*. *Equisetum arvense* or *E. pratense* are found on most sites; but where recent floods have deposited new material, the herb layer can be very sparse.

Soils are generally fine-sandy, well drained, Cumulic Regosols or Gleysols that remain saturated at depth for much of the growing season.

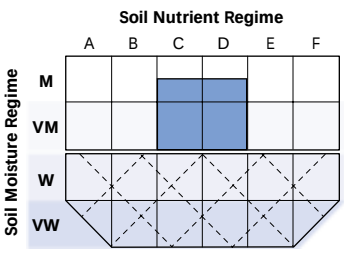
Characteristic Vegetation

Tree layer (0 - **0** - 5)
Shrub layer (50 - **95** - 99)
Cornus stolonifera, *Lonicera involucrata, Salix drummondiana*, ***S. sitchensis***
Herb layer (1 - **30** - 90)
Equisetum arvense
Moss layer (0 - **5** - 20)

Comments

*Wetter sites have sedge- or skunk cabbage–dominated understoreys and are described by Swamp Site Associations (**Ws06** and **Ws51**). In drier climates, similar low bench sites are usually occupied by the **Fl05**. On the outer Coast, the **Fl50** replaces the **Fl04**. Adjacent middle bench communities are **Fm50** in coastal areas and **Fm02** or **Fm03** in interior climates.*

Wetland Edatopic Grid



Salix drummondiana – Calamagrostis canadensis

General Description

The Drummond's willow – Bluejoint Low Bench Site Association is common at lower elevations throughout the Central Interior, Sub-Boreal Interior, and Northern Boreal Mountains, along small, low-gradient streams. Drummond's willow sites can be deeply flooded during the spring freshet but are much elevated above the mid-season watertable.

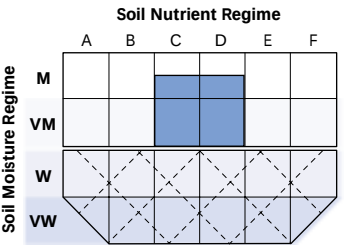
Salix drummondiana forms a continuous canopy, with other shrubs such as *Lonicera involucrata* occurring in the understorey. In wetter climates, *Spiraea douglasii* may co-dominate on some sites. The herb layer has a high cover of *Calamagrostis canadensis* but is otherwise variably developed, often with open patches of recently deposited fluvial materials.

Soils are nearly always silty to fine-sandy textured Cumulic Regosols.

Characteristic Vegetation

Tree layer (0 - **0** - 2)
Shrub layer (40 - **80** - 99)
Lonicera involucrata, ***Salix drummondiana***, *Spiraea douglasii*
Herb layer (4 - **40** - 90)
Calamagrostis canadensis
Moss layer (0 - **1** - 40)

Wetland Edatopic Grid



Comments

*This is the most common Low Bench Site Association on small, low-gradient streams in the sub-boreal forests (SBPS, SBS). It also occurs in the ICH, but in these wetter climates the **Fl04** is more common. It also occurs in the BWBS and IDF.*

*Low-lying sites adjacent to the **Fl05** are commonly occupied by **Ws04** or **Wm02**. Sites with more powerful flooding, as indicated by coarse sandy and gravelly soils, are often* Alnus incana*–dominated.*

General Description

The Sandbar willow Site Association is locally common at low elevations in the Interior along very large river systems. It occurs on sandy lateral bars that receive prolonged spring flooding by powerful currents. In the hot dry subzones of the Southern Interior, sandbar willow sites also occur around large lakes on wave-washed shores.

Plant diversity is low. *Salix exigua* is the site dominant, with a scattering of other species such as *Populus balsamifera* or *Alnus incana* appearing with increasing elevation above the stream. *Equisetum hyemale* is common in the generally very sparse understorey. Especially in warmer climates, annual weeds can seed-in on the exposed mineral soil of these sites. Typically there is no moss layer.

Soils are always sandy Cumulic Regosols.

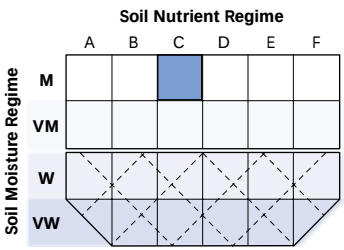
Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (15 - **50** - 80)
Populus balsamifera, ***Salix exigua***
Herb layer (1 - **5** - 20)
Equisetum hyemale
Moss layer (0 - **0** - 0)

Comments

Salix exigua *is a colonial species that resists strong currents, mobile sediments, and prolonged flooding. As sediments accumulate and raise the substrate above the watercourse,* Populus balsamifera *becomes more competitive and eventually replaces* S. exigua. *Conditions do not appear suitable for* S. exigua *on smaller river systems. Sufficiently large rivers (such as the Fraser, Thompson, Liard, and Stikine) are uncommon in the Interior, limiting the distribution of the* ***FI06***.

Wetland Edatopic Grid



Betula occidentalis – Rosa

General Description

Water birch – Rose ecosystems occur in warm and dry climates of the Southern Interior at low elevations. They occur in the riparian zone of ponds, lakes, and creeks often as a narrow band where flooding is minimal but the watertable remains within the rooting zone for much of the year.

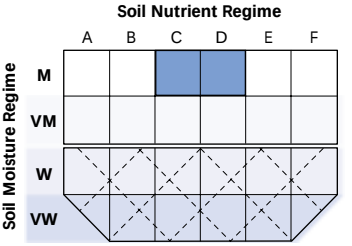
Betula occidentalis is consistently a dominant component of the shrub layer, but a variety of other shrub species including *Cornus stolonifera*, *Rosa* spp., *Salix bebbiana*, and *Symphoricarpos albus* usually occur. The herb layer is often well developed but variable in composition.

Soils are fine-textured morainal, lacustrine, or fluvial deposits, often with an organically enriched surface horizon. Gleyed Brunisols and Gleysols are common soil types.

Characteristic Vegetation

Tree layer (0 - **10**- 30)
Betula occidentalis
Shrub layer (20 - **70** - 85)
Betula occidentalis, *Cornus stolonifera, Rosa nutkana,* ***R. woodsii***, *Salix bebbiana, Symphoricarpos albus*
Herb layer (3 - **35** - 70)
Aster spp., *Poa pratensis, Maianthemum stellatum*
Moss layer (0 - **1** - 10)

Wetland Edatopic Grid



Comments

FI07 *is different from most Low Bench Site Associations described in this guide; it does occur in classic low bench locations (along watercourses where there is flooding and sedimentation), but also frequently establishes as a fringe habitat around lakes and ponds, where flooding is minimal but the watertable is maintained at depth.*

General Description

The Cottonwood – Snowberry – Rose Site Association is uncommon in the dry, warm climates of the Southern Interior and Southern Interior Mountains, where it occurs adjacent to streams, rivers, and lakes on sandy-gravelly flats that are part of the active floodplain. Flood events are short during the spring freshet and may not occur every year.

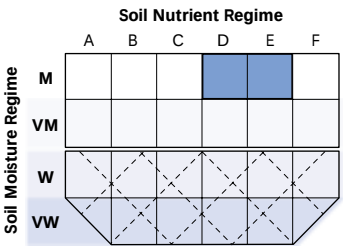
Populus balsamifera forms an open canopy with a dense to open understorey. A diversity of shrubs is common, with *Cornus stolonifera*, *Symphoricarpos albus*, and *Rosa* species being prominent. The herb layer is variable both in composition and total cover. Most sites have *Maianthemum stellatum*, *Equisetum hyemale*, *Aster conspicuus*, and/or *Elymus glauca*. *Poa pratensis* is common on grazed sites. The moss layer is usually absent.

Soils are commonly coarse-textured at depth with a loamy or sandy surface horizon. Cumulic Regosols or gleyed Brunisols are typical soil types.

Characteristic Vegetation

Tree layer (10 - **35** - 97)
Populus balsamifera
Shrub layer (5 - **45** - 80)
Acer glabrum, *Amelanchier alnifolia*, ***Cornus stolonifera***, *Populus balsamifera*, *Prunus virginiana*, *Rosa nutkana*, *R. woodsii*, ***Symphoriocarpus albus***
Herb layer (1 - **30** - 85)
Elymus glauca, *Maianthemum stellatum*, *Poa pratensis*
Moss layer (0 - **0** - 15)

Wetland Edatopic Grid



Comments

*These stands reflect a different environment than the **Fm02**, which also occurs in dry climates. The **Fm01** has a drier summer water regime because of warm, dry summer climates, shorter, less regular flood period, and coarser, more well-drained soils.*

*Grazing is common in many **Fm01** stands in British Columbia and few undisturbed sites occur. The natural herb layer may consist of species such as* Maianthemum stellatum, Equisetum hyemale, Aster conspicuus, *and* Elymus glauca, *with* Poa pratense *increasing on grazed sites.*

*The **Fm01** includes several existing BEC Site Series (see Appendix 4).*

Populus balsamifera – Picea X – Cornus stolonifera

General Description

The Cottonwood – Spruce – Red-osier dogwood Site Association is the most common middle bench community of low elevations thoughout the Interior on suitable sites. It occurs on sandy or gravelly fluvial materials adjacent to streams and rivers with short flood durations followed by continual subirrigation.

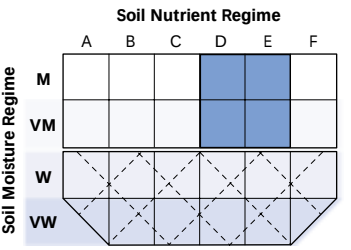
Populus balsamifera forms an open canopy with scattered interior spruce. *Cornus stolonifera* and *Alnus incana* are dominant in the shrub layer, but frequently with some cover of *Viburnum edule*, *Rosa acicularis*, and *Lonicera involucrata*. Along smaller river systems, *C. stolonifera* is often sparse and *A. incana* dominates. The herb layer can be well-developed or sparse depending on recent flood history, but *Equisetum arvense* usually persists. The moss layer is always poorly developed.

Soils are Cumulic Regosols or Gleyed Brunisols.

Characteristic Vegetation

Tree layer (10 - **40** - 80)
Picea X, ***Populus balsamifera***
Shrub layer (12 - **60** -100)
Alnus incana, ***Cornus stolonifera***, *Lonicera involucrata, Picea X, Populus balsamifera, Rosa acicularis, Viburnum edule*
Herb layer (1 - **30** - 75)
Equisetum arvense
Moss layer (0 - **2** - 50)

Wetland Edatopic Grid



Contents

*The **Fm02** describes middle bench communities from a wide range of climatic zones. The overwhelming influence of flood effects limits the species composition to those that can tolerate flooding.*

*The **Fm01** includes several existing BEC Site Series (see Appendix 4).*

General Description

The Cottonwood – Subalpine fir – Devil's club Site Association is uncommon in the cold interior rainforest climates of the Nass Basin and Sub-Boreal Interior. It occurs on sandy or gravelly flats adjacent to streams and rivers with relatively prolonged flood durations. Annual spring flood events are short during the freshet but there is prolonged subirrigation.

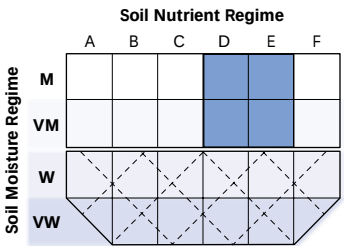
Cottonwood forms an open canopy with scattered subalpine fir and interior spruce. *Oplopanax horridus* is consistently abundant in the understorey. *Cornus stolonifera*, *Sambucus racemosa*, and *Alnus incana* frequently occur. The herb layer is often moderately developed with abundant *Gymnocarpium dryopteris*, *Equisetum arvense*, *Athyrium filix-femina*, and other forbs.

Soils are sandy or gravelly Cumulic Regosols or Gleysols.

Characteristic Vegetation

Tree layer (15 - **30** - 80)
Abies lasiocarpa, Picea X, ***Populus balsamifera***
Shrub layer (48 - **80** - 99)
Abies lasiocarpa, Alnus viridis, ***A. incana***, ***Cornus stolonifera***, ***Oplopanax horridus***, *Picea X, Sambucus racemosa, Viburnum edule*
Herb layer (5 - **45** - 95)
Actaea rubra, Athyrium filix-femina, Dryopteris expansa, ***Equisetum arvense***, ***Gymnocarpium dryopteris***, *Osmorhiza berteroi, Pyrola asarifolia, Rubus parviflorus, Streptopus amplexifolius*
Moss layer (0 - **1** - 60)
Rhytidiadelphus loreus

Wetland Edatopic Grid



Comments

The related ***Fm02*** *occurs on sites with more prolonged soil saturation and in regions with warmer summer climates.*

Salix sitchensis – Maianthemum dilatatum

General Description

The Sitka willow – False lily-of-the-valley Site Association is uncommon in the Coast and Mountains, where it is restricted to floodplains of maritime climates. It is generally found at the transition between the freshwater conditions of the fluvial system and the uppermost reaches of brackish influence in estuaries. Sitka willow sites can experience brief or temporary annual floods during the spring freshet but are much elevated above the mid-season watertable.

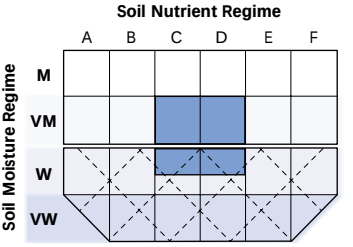
The shrub layer is dominated by *Salix sitchensis*, often with little development of other shrub species. The herb layer is moderately well developed and supports *Maianthemum dilatatum* and *Calamagrostis canadensis*. Other graminoid species and forbs such as *Agrostis exarata*, *Aster subspicatus*, and *Sanguisorba canadensis* are common. The moss layer is often poorly developed.

Soils are nearly always loamy to sandy-textured Gleysols or Regosols.

Characteristic Vegetation

Tree layer (0 - **0** - 3)
Shrub layer (45 - **70** - 90)
Rubus spectabilis, ***Salix sitchensis***
Herb layer (15 - **47** - 65)
Agrostis exarata, *Angelica genuflexa*, ***Aster subspicatus***, ***Calamagrostis canadensis***, *Heracleum maximum*, ***Maianthemum dilatatum***, *Sanguisorba canadensis*
Moss layer (5 - **15** - 35)
Rhytidiadelphus squarrosus

Wetland Edatopic Grid



Contents

*In outer coastal areas, the **FI50** replaces the **FI04** of more inland climates. **FI51** can be found in similar but slightly drier and better-drained sites. Tidal effects on soil moisture regime probably favour willows, which are more tolerant of prolonged flooding of the rooting zone.*

General Description

Red alder – Salmonberry – Horsetail low benches are widespread in the Coast and Mountains. They occur adjacent to river courses where flood duration is lengthy and sedimentation is abundant.

Alnus rubra forms a closed tall shrub or low tree canopy. *Cornus stolonifera*, *Ribes bracteostum*, and *Rubus spectabilis* are prominent in the understorey. The herb layer can be sparse or well-developed depending on recent flood history. *Equisetum arvense* always persists but other species commonly occur. The moss layer is often very sparse.

Soils are typically sandy Cumulic Regosols.

Characteristic Vegetation

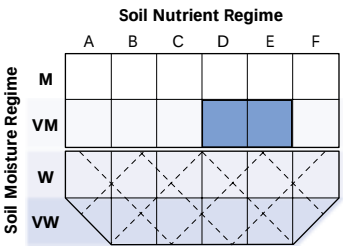
Tree layer (0 - **9** - 50)
Alnus rubra
Shrub layer (15 - **70** - 95)
Alnus rubra, ***Cornus stolonifera***, ***Ribes bracteosum***, *Rubus parviflorus*, ***R. spectabilis***, *Sambucus racemosa*
Herb layer (2 - **17** - 50)
Circaea alpina, *Elymus glauca*, ***Equisetum arvense***, *Stachys mexicana*
Moss layer (0 - **0** - 10)

Comments

Cleared high and middle bench floodplain forests will often regenerate to A. rubra *and in these cases will represent a community successional to conifer forest.* ***Fl51*** *stands establish on sites with more lengthy flooding than* ***Fm50*** *but also on similar sites where stand-initiating floods occur in autumn (a common occurrence in coastal watersheds).* A. rubra *drops seed in fall and will establish quickly on exposed mineral soils.* Populus balsamifera *drops seed in spring and its seedling will not establish where a thick cover of red alder already exists.*

The ***Fl51*** *includes several existing BEC Site Series (see Appendix 4).*

Wetland Edatopic Grid



Populus balsamifera – Alnus rubra – Rubus spectabilis

General Description

The Cottonwood – Red alder – Salmonberry Site Association is common along rivers in the Coast and Mountains. River benches that are flooded annually for moderately long periods are typical.

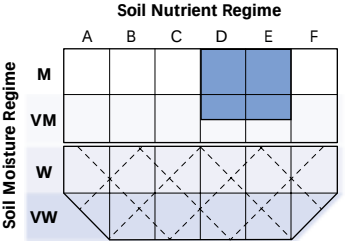
Populus balsamifera dominates the canopy but a subcanopy of *Alnus rubra* and scattered conifers is typical. The shrub layer is well-developed, often with *Rubus spectabilis* and *Cornus stolonifera* both being prominent. The herb layer can be sparse or well-developed, depending on recent flood history and cover of the canopy. *Equisetum* spp. and *Maianthemum dilitatam* are the major constituents. The moss layer is generally poorly developed.

Soils are sandy Cumulic Regosols.

Characteristic Vegetation

Tree layer (20 - **67** - 90)
Alnus rubra, *Picea sitchensis*, ***Populus balsamifera***, *Thuja plicata*
Shrub layer (15 - **70** - 95)
Alnus rubra, ***Cornus stolonifera***, *Lonicera involucrata*, *Oplopanax horridus*, *Picea sitchensis*, ***Rubus spectabilis***, *Sambucus racemosa*
Herb layer (3 - **45**- 95)
Equisetum arvense, ***Maianthemum dilatatum***
Moss layer (0 - **1** - 30)

Wetland Edatopic Grid



Comments

The typical floodplain successional sequence in the inner Coast and Mountains is ***Fl06*** *>>* ***Fm50*** *>> Sitka spruce – Salmonberry forests. These communities often occur adjacent to each other, indicating the accumulation of fluvial sediments, which progressively raises benches higher above normal waterflow.*

Fm50 *sites with silty or clayey layers within the soil profile are common. These sites often have some species more indicative of wetter sites such as* Oenanthe sarmentosa, Carex utriculata, *or* Scirpus microcarpus.

The ***Fm50*** *includes several existing BEC Site Series (see Appendix 4).*

Green alder *Alnus viridis*

Green alder is a common component of well-drained but periodically disturbed sites, such as avalanche tracks. Riparian fringe communities of *Alnus viridis* occur on river systems where flood periods are very short and soils are well-drained or where ice scour occurs during spring break-up. These are mostly narrow bands adjacent to streams. The understorey is variable.

Pacific crabapple – False lily-of-the-valley
Malus fusca – Maianthemum dilatatum

The Pacific crabapple – False lily-of-the-valley Site Association occurs on the outer Coast at the upper limit of tidal influence in the transition between the upland forest and estuarine ecosystems. Inundation occurs, generally briefly and often during the spring freshet, when salinity is low. However, many sites experience salt spray and tidal subirrigation. *Malus fusca* is the site dominant, accompanied by a sparse to well developed and diverse forb-dominated understorey. *Picea sitchensis* can be present on raised microsites with limited tidal influence. On floodplains, Pacific crabapple can progress to Sitka spruce forests because sediments accumulate and the site is raised higher above floodwaters.

Paper birch – Red-osier dogwood
Betula papyrifera – Cornus stolonifera

Fluvial stands dominated by paper birch (*Betula papyrifera*) are occasionally encountered where the **Fm02** is expected. These stands have shrub and understorey species are generally similar to the **Fm02**. The primary reason for the dominance of paper birch on these sites is likely the occurence of a stand-initiating fall flood. Unlike cottonwood, which seeds in the early summer as spring floods are receding, paper birch seeds in the fall. A fall flood that exposes mineral soil and then does not flood the following spring will regenerate to *B. papyrifera*. Most paper birch–dominated sites are in cool subzones or landscape positions (e.g., at the base of north-aspect slopes), which also seems to favour paper birch over cottonwood.

Red-osier dogwood *Cornus stolonifera*

In southern areas of the province, low bench communities characterized by dense thickets of red-osier dogwood occur adjacent to small streams. On some of these sites, other shrub species such as *Alnus incana* or

Betula occidentialis also occur. Dense shrub layers often limit herbaceous growth. Prolonged flooding occurs on many sites. Soils are typically fine-textured and poorly drained.

Trembling aspen – Red-osier dogwood
Populus tremuloides – Cornus stolonifera

Trembling aspen – Red-osier dogwood forests occur in drier climatic areas throughout the Interior where sites have seepage or subirrigation but limited flooding. They occur in riparian locations as well as upland habitats. Suitable riparian areas include lake edges and terraces of streams. Trembling aspen forms an open to closed canopy. *Cornus stolonifera*, *Symphoricarpos albus*, and *Rosa acicularis* form a well-developed and sometimes very dense shrub layer. Herb and moss layer composition and development is variable but *Equisetum arvense* is often prominent.

1 *Cornus stolonifera*, red-osier dogwood **2** *Calamagrostis canadensis*, bluejoint
3 *Equisetum arvense*, common horsetail

1 *Saline meadow zonation at the Meadow Lake marshes, 100 Mile House (IDFdk3)* **2** *A lush high-elevation Barclay's willow – Arrow-leaved groundsel shrub-carr, Causqua Creek (ESSFwv)* **3** *Dried lake bed with abundant* Salicornia rubra, *Stinky Slough near Cranbrook (IDFdm2)*

Two classes of ecosystems, saline meadows and shrub-carrs, have traditionally been described as wetlands in British Columbia (Runka and Lewis 1981; Steen and Roberts 1988). Neither of these ecosystem types meets the soils or vegetation critieria for wetlands. However, these ecosystems frequently occur adjacent to wetlands in a zone transitional to upland ecosystems and have structural similarities. For this reason, several of the more common saline meadow and shrub-carr site associations are presented here.

The environmental factors that cause the occurrence of these two classes are different but, for purposes of this guide, they are informally treated together as a "Transition" group. The saline meadow class is a member of the Grassland Group of the Terrestrial Realm; the shrub-carr class is a member of the Shrubland Group of the Terrestrial Realm.

Saline meadows

Saline meadows are ecosystems with moist, saline or alkaline soils that a) occur within the drawdown zone of shallow temporary or permanent ponds and lakes and b) are dominated by salt-, alkali-, and inundation-tolerant graminoids and forbs.

Vegetation

Table 5.8.2 lists species common to "transition" site associations. Saline meadows have a distinctive flora dominated by halophytes. Most sites are grass-, rush-, or sedge-dominated but extremely saline environments support only succulents. In British Columbia, there are no trees or shrubs species tolerant of saline soils. A group of diminutive moss species occurs almost exclusively in saline meadows (McIntosh 1986).

In many cases, saline meadows are dominated by congeners of estuarine species. These include the following saline meadow vs. estuarine pairs: *Deschampsia cespitosa* ssp. *cespitosa* vs. *D. cespitosa* ssp. *beringensis*, *Distichlis spicata* var. *stricta* vs *D. spicata* var. *spicata*, *Hordeum jubatum* vs. *H. brachyantherum*, *Juncus balticus* vs. *J. arcticus*, and *Potentilla anserina* vs. *P. egedii*.

Landscape Position and Distribution

Saline meadows occur primarily in the drawdown zone of small waterbodies, where there is early-season saturation or shallow flooding that give way to generally well-aerated soil conditions for much of the growing season. They are common in warm, semi-arid climates of the South

and Central Interior but mostly absent elsewhere in the province (Table 5.8.1).

Hydrology and Soils

Sites can be shallowly inundated or merely saturated in the early season; thereafter, the watertable falls well below the surface (Figure 5.8.1). Evaporation of standing water accumulates salts.

Soils are usually loamy or fine-textured Gleyed Brunisols, Humic Gleysols, or Solenetzics. Humus is thin.

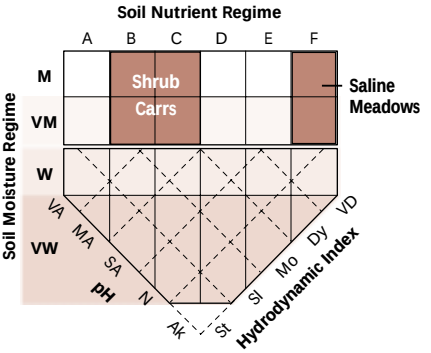


FIGURE 5.8.1 *Position of "transition" classes on the edatopic grid.*

Shrub-carrs

Shrub-carrs are low shrub ecosystems that occur on moist mineral soils in areas prone to growing-season frosts, which would support forested ecosystems under normal circumstances.

Vegetation

Shrub-carrs are always low shrub cover types and usually have highly diverse herb and moss layers. Few obligate hydrophytes occur. Shrubs that are tolerant of growing-season frosts and few growing degree days dominate.

Landscape Position and Distribution

Shrub-carrs occur in frost-prone depressions or cold-air drainage valleys where frost and cold, moist soils preclude establishment of trees. Such sites are often at the edge of wetlands but shrub-carrs can also occupy entire basins.

Shrub-carrs are most common in the cold and dry climates of the Chilcotin Plateau, the western Fraser Plateau, and the Northern Boreal Mountains.

Hydrology and Soils

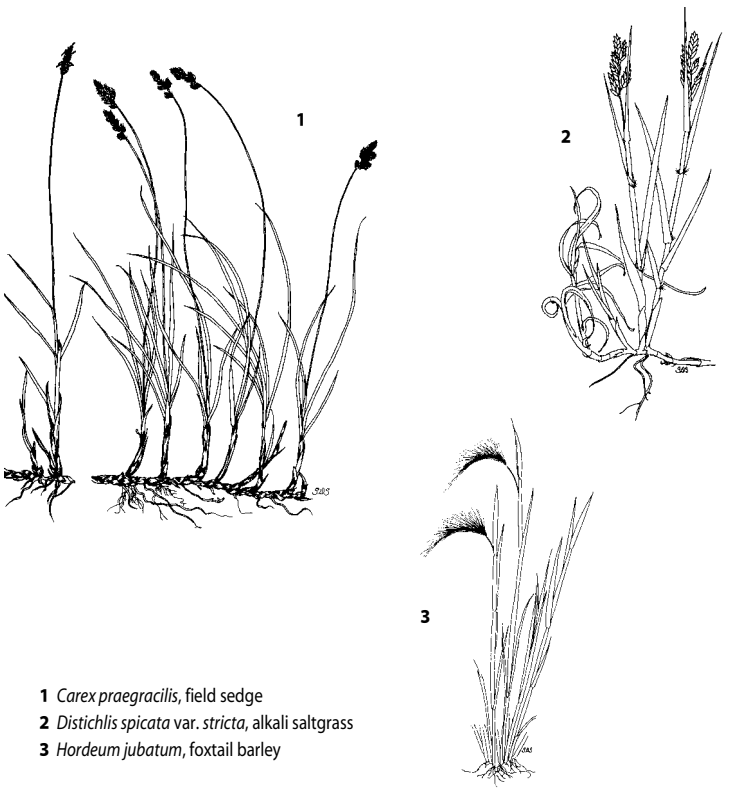
Sites have at most very moist soils and are never flooded. They are fed by groundwater or lateral subirrigation from adjacent wetlands. Soils are imperfectly drained and cold. Distinctly hummocky microtopography is common.

Soils are typically Gleyed Brunisols or Gleysols with thin moder or mull humus forms.

Conservation Issues

Both saline meadows and shrub-carrs occur in ranching country. These sites often have good forage and grazing potential. Forage production coupled with riparian location means that these sites often receive heavy use by livestock. Species such as *Deschampsia cespitosa* and *Puccinellia nuttalliana* will be replaced by *Poa pratensis* and *Hordeum jubatum*, respectively, under heavy grazing pressure.

Saline meadows have a limited distribution in the province and occur in areas where wetlands are even more important than usual for wildlife. The red-listed Tiger Salamander commonly rears in alkali waterbodies of the extreme southern Interior and will use the adjacent saline meadow as adults.



1 *Carex praegracilis*, field sedge
2 *Distichlis spicata* var. *stricta*, alkali saltgrass
3 *Hordeum jubatum*, foxtail barley

TABLE 5.8.1 *Distribution of "Transition" Site Associations by biogeoclimatic zone*

		BG PP	BWBS SWB	ESSF	ICH	IDF	MS	SBPS SBS	CDF	CWH	MH
Gs01	Alkali saltgrass	xx				xx^{d}					
Gs02	Nuttall's alkaligrass – Foxtail barley					xx^{d}	x^{d}	x^{v}			
Gs03	Field sedge	xx				xx^{d}		xx^{v}			
Gs04	Tufted hairgrass					x^{d}	xx^{d}	xx^{v}			
Sc01	Scrub birch – Kinnikinnick		xx			x^{dc}	xx^{dc}	xx^{v}			
Sc02	Grey-leaved willow – Glow moss		xx	x^{dc}		x^{dc}	xx^{dc}				
Sc03	Barclay's willow – Arrow-leaved groundsel		x	xxx							

x = incidental; < 5% of wetlands xx = minor; 5–25% of wetlands xxx = major; >25% of wetlands
d = dry subzones only v = dry subzones of the SBPS only dc = dry and cold subzones only

TABLE 5.8.2 *"Transition" Species Importance Table*

	Species	Gs01	Gs02	Gs03	Gs04
Shrubs	*Salix brachycarpa*				
	Betula nana				
	Salix glauca				
	Salix barclayi				
Herbs	*Distichlis spicata* var. *stricta*				
	Spartina gracilis				
	Suaeda calceoliformis				
	Aster ericoides ssp. *pansus*				
	Poa secunda				
	Hordeum jubatum				
	Puccinellia nuttalliana				
	Carex praegracilis				
	Elymus trachycaulus				
	Poa pratensis				
	Aster ericoides				
	Potentilla anserina				
	Juncus balticus				
	Deschampsia cespitosa				
	Potentilla gracilis				
	Taraxacum officinale				
	Carex utriculata				
	Achillea millefolium				
	Muhlenbergia richardsonis				
	Kobresia myosuroides				
	Koeleria macrantha				
	Arctostaphylos uva-ursi				
	Antennaria pulcherrima				
	Maianthemum stellatum				
	Aster ciliolatus				
	Calamagrostis canadensis				
	Thalictrum occidentale				
	Fragaria virginiana				
	Senecio triangularis				
	Valeriana sitchensis				
	Epilobium angustifolium				
	Erigeron peregrinus				
	Sanguisorba canadensis				
	Trollius albiflorus				
	Equistem arvense				
Mosses	*Bryum pseudotriquetrum*				
	Drepanocladus spp.				
	Aulacomnium palustre				
	Brachythecium spp.				
	Mnium spp.				

Sc01	Sc02	Sc03	Common Name
▮▮▮	▮		short-fruited willow
▮▮▮▮▮	▮▮▮▮		scrub birch
▮▮	▮▮▮▮▮		grey-leaved willow
▮	▮	▮▮▮▮▮	Barclay's willow
			alkali saltgrass
			alkali cordgrass
			seablite
▮			tufted white prairie aster
▮			Sandberg's bluegrass
▮			foxtail barley
			Nuttall's alkaligrass
▮▮	▮	▮	field sedge
▮	▮		slender wheatgrass
▮	▮		Kentucky bluegrass
▮			tufted white prairie aster
▮			common silverweed
▮▮▮	▮		Baltic rush
▮	▮		tufted hairgrass
▮	▮		graceful cinquefoil
▮	▮		common dandelion
	▮	▮	beaked sedge
▮▮	▮		yarrow
▮▮▮▮			mat muhly
▮			Bellard's kobresia
▮			junegrass
▮▮▮▮	▮▮		kinnikinnick
▮▮	▮		showy pussytoes
▮	▮		star-flowered false Solomon's-seal
▮	▮▮		Lindley's aster
▮	▮▮	▮▮	bluejoint
▮	▮▮	▮	western meadowrue
▮▮	▮▮▮	▮	wild strawberry
	▮	▮▮▮	arrow-leaved groundsel
		▮▮▮	Sitka valerian
▮	▮▮	▮	fireweed
	▮	▮	subalpine daisy
		▮	Sitka burnet
	▮	▮	globeflower
		▮▮	common horsetail
▮	▮▮	▮	
▮	▮		hook-mosses
▮	▮▮▮▮	▮▮▮	glow moss
▮		▮▮	feather-moss
		▮▮	leafy mosses

Distichlis spicata var. *stricta*

General Description

The Alkali saltgrass Saline Meadow Site Association is uncommon in the BG, PP, and dry IDF of the Central Interior and Southern Interior at elevations below 1000 m. **Gs01** meadows occur in the seasonally flooded riparian zone of small potholes and shallow lakes where evaporation accumulates salts. Brief flooding in the early season is followed by pronounced surface drying, occasionally leaving a distinct salt crust.

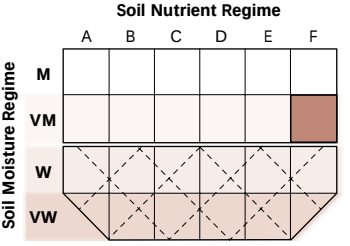
Only salt-tolerant plants are found on these sites; no shrubs or mosses occur. *Distichlis spicata* var. *stricta* is always prominent but some sites have high cover of *Spartina gracilis*, *Amphiscirpus nevadensis*, or *Poa secunda* ssp. *juncifolia*.

Soils are fine textured, saline or saline-alkali, imperfectly drained materials with minimal organic accumulation. Solonetzes and Gleysols are common soil groups.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 0)
Herb layer (22 - **82** - 92)
Amphiscirpus nevadensis, *Aster ericoides* ssp. *pansus*, ***Distichlis spicata* var. *stricta***, ***Hordeum jubatum***, *Puccinellia nuttalliana*, ***Salicornia rubra***, ***Spartina gracilis***, *Suaeda calceoliformis*
Moss layer (0 - **0** - 0)

Wetland Edatopic Grid



Comments

Sites occur that have a high abundance of Spartina gracilis, Amphiscirpus nevadensis, *or* Poa secunda *ssp.* juncifolia. *These sites are currently considered variations of the* ***Gs01****; further sampling might support separation of these ecosystems into new Site Associations.*

Gs01 *often occurs adjacent to shallow open-water sites and in complex with* ***Gs02*** *sites. Sites that are highly saline are often dominated by* Sueda calceoliformis *or* Salicornia rubra. Hordeum jubatum *is a naturally occurring species on* ***Gs01*** *sites but becomes more prominent with grazing or mineral soil exposure.*

This Site Association was previously described as part of a Saltgrass – Alkaligrass Wet Meadow Site Association by Steen and Roberts (1988).

General Description

Nuttall's alkaligrass – Foxtail barley saline meadows are uncommon in the dry IDF, MS, and SBPS subzones of the Central Interior and Southern Interior at elevations between 800 and 1200 m. **Gs02** meadows occur in the seasonally flooded riparian zone of small alkali potholes and shallow lakes where evaporation accumulates salts. Brief flooding in the spring gives way to merely moist conditions during the summer.

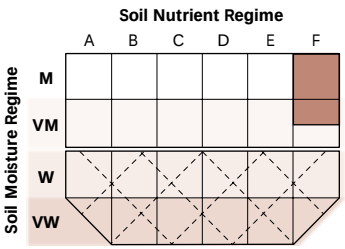
High overall graminoid cover is common; *Puccinellia nuttalliana* is a constant dominant. *Hordeum jubatum* occurs naturally with low cover on most sites but increases and may become dominant with soil disturbance. Shrubs are absent and the moss layer is poorly developed.

Soils are often fine textured, alkali, or saline-alkali Gleysols or Solonetzs on poorly to imperfectly drained materials. Sites often have dark surface horizons.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 0)
Herb layer (40 - **85** - 90)
Carex praegracilis, ***Hordeum jubatum***, ***Puccinellia nuttalliana***
Moss layer (0 - **0** - 10)

Wetland Edatopic Grid



Comments

Gs02 *can occur alone in basins or adjacent to other saline meadows or marshes such as the* ***Wm07*** *or* ***Wm06****. It occurs at generally higher elevations than the* ***Gs01****. In the IDF of the Chilcotin Plateau, where both* ***Gs01*** *and* ***Gs02*** *are relatively common, the* ***Gs02*** *occurs on more alkali sites.*

The ***Gs02*** *was previously described as part of a Saltgrass – Alkaligrass Wet Meadow Site Association by Steen and Roberts (1988).*

Carex praegracilis

General Description

Field sedge meadows are common throughout the Chilcotin Plateau region of the Central Interior and uncommon in the Southern Interior at elevations below 1250 m. **Gs03** sites form extensive stands in seasonally flooded, moderately alkaline depressions; or peripheral communities in the drawdown zone around permanent ponds and **Wm06** or **Wm07** marshes. The **Gs03** occurs where there is brief early-season inundation followed by a dropping of the watertable below the surface. The upper horizons often dry out by the early growing season.

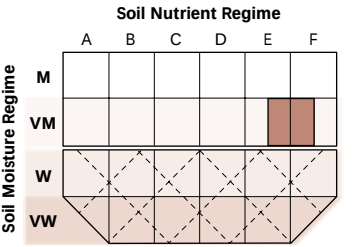
Carex praegracilis is the constant dominant on these sites. *Juncus balticus* occurs on wetter examples but never dominates (see **Wm07**). On grazed sites *Poa pratensis* becomes prominent but will occur even on undisturbed sites. These sites usually have no shrub and little moss layer development.

Soils are fine textured slightly alkaline Gleysols or gleyed Brunisols developed in poorly to imperfectly drained lacustrine materials, with up to 10 cm of surface organic accumulation.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 0)
Herb layer (60 - **90** - 99)
Carex praegracilis, ***Juncus balticus***, *Poa pratensis*
Moss layer (0 - **10** - 20)

Wetland Edatopic Grid



Comments

Gs04 *commonly occurs adjacent to the closely related* ***Wm07****, which occupies wetter locations. Interannual variation in water depth is typical where these Site Associations occur, and the extent of* ***Gs03*** *may increase during drier years. The* ***Gs03*** *occurs on less saline sites than the* ***Gs02****.*

The ***Gs03*** *was previously described as part of a Baltic rush – Field sedge Wet Meadow Site Association by Steen and Roberts (1988).*

Deschampsia cespitosa ssp. *cespitosa*

General Description

Tufted hairgrass meadows are uncommon in the cold, dry subzones of the Central Interior (SBPS and MS). They form extensive communities in frost-prone basins fed by seepage from the surrounding upland. These sites are usually saturated to the surface in the early part of the growing season.

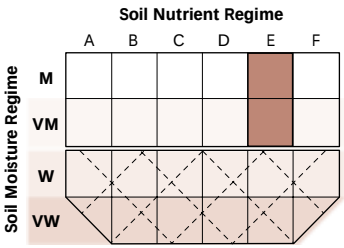
Deschampsia cespitosa ssp. *cespitosa* can form nearly pure stands and gives the site a tussocky appearance. Shrub and moss layers are poorly developed. In wetter microsites *Carex utriculata* can be prominent.

Soils are often fine textured, imperfectly drained, and weakly alkaline Brunisols or humic Gleysols with up to 15 cm of surface organic accumulation.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (0 - **0** - 0)
Herb layer (25 - **85** - 99)
Carex utriculata, ***Deschampsia cespitosa***
Moss layer (0 - **20** - 90)

Wetland Edatopic Grid



Comments

Gs04 *can occupy entire shallow depressions but more commonly it occurs in the moist riparian area around* ***Wm01*** *marshes or small ponds. In some areas, it may also be in complex with dry meadows dominated by* Danthonia intermedia *or* Festuca altaica.

Deschampsia cespitosa *is widely distributed in the province and is a common dominant in alpine and coastal estuarine ecosystems.*

The ***Gs04*** *is described by Steen and Roberts (1988).*

Betula nana – Arctostaphylos uva-ursi

General Description

The Scrub birch – Kinnikinnick Shrub-carr Site Association is common in the colder, drier subzones of the Central Interior. These shrub-carrs form small communities in frost-prone basins with moist, cold substrates and often surround larger wetlands. In drier climates, these sites are rarely, if ever, inundated, but subsurface saturation is typical in the early season. Sites are distinctly mounded with shrubs on relatively dry organic-rich mounds.

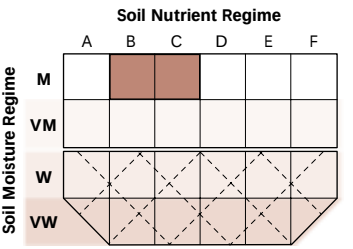
The **Sc01** has very high species diversity. *Betula nana* dominates the shrub layer with high cover of *Salix brachycarpa* and *S. glauca*. *Arctostaphylos uva-ursi* and *Muhlenbergia richardsonis* are common dominants of the very diverse herb layer. The moss layer is poorly developed and variable.

Soils are often fine textured, poorly to imperfectly drained materials with thin surface organic accumulation. Gleysols and gleyed Brunisols are common soil types.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (10 - **58** - 80)
Betula nana, ***Salix brachycarpa***, *S. glauca*
Herb layer (40 - **80** - 99)
Achillea millefolium, Antennaria pulcherrima, ***Arctostaphylos uva-ursi***, *Carex praegracilis, Fragaria virginiana,* ***Juncus balticus***, ***Muhlenbergia richardsonis***
Moss layer (0 - **15** - 40)

Wetland Edatopic Grid



Comments

Sc01 *occurs alone in shallow depressions or around the periphery of* ***Wf01***, ***Wm01***, *or* ***Gs03*** *ecosystems. Though the* ***Sc01*** *and* ***Sc02*** *occupy similar frost-prone sites, the* ***Sc01*** *occurs on drier site conditions.*

Betula nana*–dominated ecosystems are widespread in the Boreal, especially at higher elevations in the SWB. However, few plots in these communities have been established; it is possible that the* ***Sc01*** *also occurs in the Northern Boreal Mountains. Other scrub birch–dominated Shrub-carr Site Associations certainly occur but remain undescribed.*

The ***Sc01*** *is described by Steen and Roberts (1988).*

Salix glauca – Aulacomnium palustre

General Description

Grey-leaved willow – Glow moss shrub-carrs are uncommon in the colder, drier subzones of the Interior from the Southern Interior to the Northern Boreal Mountains. They form small communities in frost-prone basins and hollows with moist, cold substrates fed by seepage from upslope sites. These sites are often wetter than the **Sc01**. Standing water is not present between mounds, and subsurface saturation may be common early in the growing season.

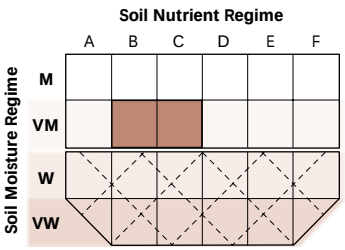
Salix glauca grows on elevated mounds and dominates the shrub layer. The herb layer is diverse with large numbers of species all having sparse cover. The moss layer is often well developed.

Soils are often fine textured, poorly to imperfectly drained materials with up to 15 cm of surface organic accumulation.

Characteristic Vegetation

Tree layer (0 - **0** - 1)
Shrub layer (20 - **80** - 90)
Betula nana, ***Salix glauca***
Herb layer (10 - **50** - 90)
Arctostaphylos uva-ursi, Aster ciliolatus, Calamagrostis stricta, C. utriculata, Deschampsia cespitosa, Epilobium angustifolium, ***Fragaria virginiana***, ***Thalictrum occidentale***, ***Valeriana dioca***
Moss layer (10 - **50** - 99)
Aulacomnium palustre, *Bryum pseudotriquetrum*

Wetland Edatopic Grid



Comments

Though the ***Sc02*** *and* ***Sc01*** *occupy similar frost-prone sites, the* ***Sc02*** *occurs on moister site conditions and at higher elevations.* Salix glauca*–dominated ecosystems are widespread in the Boreal, especially at higher elevations in the SWB. However, few plots in these communities have been established; it is likely that additional Grey-leaved willow Site Associations occur.*

Sc02 *is locally common at montane to low subalpine elevations (1070–1615 m) in the BWBS, MS, SBPS, and SWB zones.*

The ***Sc02*** *is described by Roberts (1984).*

Salix barclayi – Senecio triangularis

General Description

The Barclay's willow – Arrow-leaved groundsel Shrub-carr/Swamp Site Association is common in the subalpine climates of the Interior from the Southern Interior to the Northern Boreal Mountains. These shrub-carrs form extensive communities on subalpine seepage slopes, gullies, abandoned stream flats, and lake margins with cold, moist to very moist (wet) soils. Standing water is typically not present, but subirrigation is common.

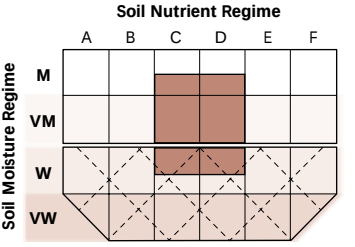
Salix barclayi is always present but can be shorter in stature than surrounding forb species. The herb layer is diverse, well developed, and dominated by subalpine forbs such as *Senecio triangularis* and *Valeriana sitchensis*.

Soils are commonly fine to medium textured, poorly to imperfectly drained mineral materials with well-humified surface organic horizons. Gleysols and gleyed Brunisols are most common but occasionally these sites occur on shallow peat.

Characteristic Vegetation

Tree layer (0 - **0** - 0)
Shrub layer (10 - **80** - 90)
Salix barclayi, *S. commutata*
Herb layer (5 - **50** - 90)
Calamagrostis canadensis, Equisetum arvense, ***Senecio triangularis***, ***Valeriana sitchensis***
Moss layer (10 - **55** - 99)
Aulacomnium palustre, *Brachythecium* spp., *Mnium* spp.

Wetland Edatopic Grid



Comments

Sc03 *is very widespread in British Columbia and can occupy substantial area in plateaus of upper montane and subalpine forest lands. It occurs alone in extensive flats or associated with forb meadows and high-elevation fens. The* ***Wf04*** *has a similar structure and occurs over the same geographic range but develops under wetter conditions.*

6 *Conservation and management issues*

Wildlife uses of wetlands are as diverse as wetland types. While marshes and shallow waters support the highest wildlife populations, bogs and other wetland types each support their own distinctive wildlife communities.

Wetlands and related ecosystems provide ecosystem services disproportionate to their limited extent in the landscape. They are valuable ecosystems with many functions:

- the majority of wildlife and fish species in the province use these ecosystems for part of their life history and some are entirely dependent upon them;
- they support large populations of economically important fur-bearers;
- wetlands and related ecosystems provide some of the highest-quality range for livestock; and
- they are an integral component of hydrological systems and good water quality.

This chapter outlines some general management principles for wetlands and related ecosystems. In addition, important habitat attributes and life history requirements for wetland-using wildlife are presented.

LIVESTOCK MANAGEMENT

Wetlands (mainly fens and marshes) and related ecosystems are important grazing lands throughout much of British Columbia. They are productive ecosystems often with a diversity and abundance of palatable species that maintain their forage quality later in the season than adjacent uplands. In addition, livestock favour riparian habitats because of their association with drinking water, cool microclimates, and shade. However, these characteristics can lead to habitat overuse and degradation by livestock without proper management.

Some effects of improper livestock management systems in riparian areas include:

- damage, reduction, or elimination of vegetation by browsing, grazing, or trampling;
- changes in plant communities through selective browsing and grazing;
- soil compaction and disturbance, which increases erosion and decreases water availability to plants;
- changes in fluvial process and aquatic ecosystems, through bank shearing, reduction of vegetative cover, and subsequent changes to stream channel characteristics;
- decrease in water quality though increased water temperatures, nutrients, suspended sediments, and bacterial counts; and
- reduced wildlife habitat quality from impacts to vegetation structure, species composition, and water quality.

A full review of livestock effects on riparian areas in British Columbia is presented in Powell et al. (2000).

Range Conditions

The *Range Resources Assessment Manual* (1999) outlines procedures for identifying proper functioning condition (PFC) of riparian areas. One attribute for assessment of range condition is the "potential natural community" (PNC) (B.C. Ministry of Forests 2002). The Site Association descriptions in Chapter 5 can be used as guidelines for identifying the PNC. A management plan that targets the maintanence of a healthy PNC will often limit impacts to other important indicators of PFC such as:

- **Stream channel shape and bank stability**: Excessive livestock use of streams and riparian areas can lead to widening and shallowing, stream trenching, or braiding, depending on the texture of fluvial materials and level of use.
- **Vegetation structure**: Some ecosystems, particularly willow swamps and low-bench ecosystems, can undergo structural changes (such as removal of low shrub layers, resprouting, clubbing, and highlining) that are indications of reduced ecosystem functioning.
- **Soil structure**: Sites with wet and fine-textured soils are susceptible to compaction and rutting, which will lead to an increase in erosion and weedy species.
- **Water nutrient levels**: Large inputs of livestock feces can elevate nutrient levels in streams and wetlands, leading to eutrophication.
- **Wildlife**: Wildlife can suffer direct impacts through trampling of ground nests and indirect impacts through habitat degradation and displacement.

Strategies for Minimizing Livestock Impacts on Vegetation

Livestock impacts on vegetation can be minimized through proper controls on timing and level of use. There are, broadly, four methods of managing livestock in riparian areas.

1) **Control animal distribution:** This generally means fencing to limit access to sensitive areas. However, providing dedicated access points or alternative sources of water, forage, and shelter away from wetlands and streams can reduce overuse of riparian zones.
2) **Control timing of access:** Negative impacts of livestock on native plant species are often related to season of use. Early-season use coincides with the period of highest resource demands by growing plants. Livestock use should be timed to occur after spring when key plants are less sensitive. For example, willows are adapted to and

tolerant of winter browsing but appear to be susceptible to early growing-season browsing.

The advantages of late-season grazing include good plant vigour and productivity, minimal soil disturbance, and minimized disturbance to wildlife during the breeding season (Kauffman 1982).

Many wetland sites have fine-textured soils that are susceptible to degradation when wet. Early-season use of wet sites by livestock can result in soil compaction, rutting, and erosion.

3) **Provide adequate rest periods:** Season-long, continuous use will have detrimental effects on range condition. Range programs with long growing-season rest periods allow plants to acquire and store resources, produce seed, and establish seedlings. Most native plants are not adapted to continual grazing and will be replaced by non-native species that are either unpalatable for livestock or tolerant of heavy use.

   Rest-rotation systems that allow for 1 rest year out of 3 or 2 rest years of spring-summer grazing out of 3 have been recommended to preserve riparian functioning (Kauffman and Krueger 1984).

4) **Control grazing intensity:** It is estimated that utilization rates below 25% will show little effect on streamside vegetation, but rates over 65% typically show measurable impacts (Platts 1982). Degraded sites may not have to be rested to allow full recovery if grazing intensity is low (Manoukian and Marlow 2002). However, where wildlife browsing is heavy, even light browsing by livestock can reduce productivity of willow (Brookshire et al. 2002).

Cattle will heavily use riparian areas around wetlands but use marshes mainly to access drinking water.

Of the Site Associations described in this guide, forest harvesting is possible only in some forested swamps (**Ws07**, **08**, **10**, **11**, **53**, **54**, **55**), bogs (**Wb08**), and middle-bench stands; other ecosystems do not have trees large enough for commercial timber production. Specific management guidelines can be found for most of these ecosystems in the regional BEC field guides. All wetlands are potentially affected by adjacent land clearing, especially where such activities are widespread or involve potential disruption of groundwater flow.

Harvesting Flood Forests

Functioning riparian areas are very important for stream ecosystems. Streamside vegetation provides the following important functions:

- maintains bank stability and channel form by binding soils and trapping sediments;
- provides large woody debris to streams, which produces important fish habitat;
- inputs fine organic debris that fuels stream ecosystems;
- moderates surface water temperatures;
- provides habitat for terrestrial and aquatic wildlife; and
- maintains in-channel and off-channel fish habitat.

Issues in Floodplain Management

Of the flood ecosystems in this guide, only cottonwood-dominated middle-bench communities are harvested commercially.[2] Most commercial sites occur on the floodplains of large rivers where extensive stands can be exploited for pulpwood. See Petersen et al. (1996) *Black Cottonwood and Balsam Poplar Managers' Handbook for British Columbia* for issues and approaches to management of these stands. Red alder stands can also be commercial but it is primarily successional forests that are managed.

Bank and floodplain erosion: Removal of tree cover can lead to instability of the floodplain and stream banks during flood events. Channel avulsion will be more common where vegetation has been removed.

Silvicultural issues: Prolonged flooding and vigorous competing brush can cause regeneration difficulties. Loss of seedlings can be an important issue in years when rodent populations are high.

2 High-bench floodplain forests, where commercial timber harvesting is common, are not covered in this guide.

Wildlife trees: Large cottonwood are valuable wildlife trees while standing or fallen. Large old cottonwood will be selected by birds that build large platform-like nests (e.g., Osprey, Bald Eagle, Great Blue Heron) and primary and secondary cavity nesters. They are valuable for several listed species such as Western Screech Owl, Lewis' Woodpecker, and various bat species. Some level of mature canopy retention is recommended on cottonwood floodplains outside of the reserve zone.

Fish/Forestry: Trees within one tree height of the water are particularly important for stream ecosystems. They provide shading, bank stability, litterfall, and large woody debris. Along coastal streams, floodplains provide critical off-channel habitat for coho salmon (*Oncorhynchus kisutch*). Temporary ponds in riparian forest are used extensively by over-wintering coho juveniles. This habitat needs to be assessed during winter high flows when it is most readily identified. Several management practices can minimize impacts (Hartman and Brown 1988):

- place culverts and bridges to permit movement of fish;
- maintain natural drainage;
- fall and yard away from wet depressions; and
- do not treat the riparian zone as a sediment trap; keep sedimentation to a minimum.

Harvesting Swamp and Bog Forests

Draining marginally productive swamp forest to improve tree growth is a common practice in the boreal forest outside of British Columbia and may play an increasing role here as timber reserves diminish. Most forested swamps are between intermediate wetland and upland habitats and will present significant silvicultural challenges if harvested.

- **Sensitive soils**. Wet and fine-textured soils are highly susceptible to compaction and rutting.
- **Overly wet site conditions**. Good tree growth is often limited to raised microsites. Where harvesting removes much of the canopy, watertables often rise, further reducing microsites that are dry enough to support trees.
- **High capability for competing vegetation**. Successful reforestation will require brush control.
- **Frost-prone locations**. Many wetlands occur in low areas of the landscape where cold air ponds and growing-season frosts are common. Frost damage and seedling mortality can be expected in cleared areas with no overstorey cover.
- **Low site potential**. The site index at 50 years for forested wetlands is less than 12 m for bogs and less than 17 m for most swamps. However,

this likely overestimates site potential for many of these sites for two reasons: 1) Severe site limitations restrict the maximum size of trees on these sites; height growth curves begin to flatten as early as 50 years. 2) Sampling methods for site index focus on the best growing-site trees; tree growth on wetland sites, however, is highly microsite-dependent with the largest trees growing on a few optimal microsites. Total volume production on forested wetlands is thus very low.

Characteristics of Sites Where Timber Harvest Should Be Avoided

There are several indicators that can be used to identify forested swamps that should probably not be harvested.

1) Sites with **poor tree growth**. These sites have low timber values and will clearly be the most problematic for reforestation. Site preparation such as mounding or ditching will likely be required to create drier microsites for planting. However, these site preparation techniques can result in further site degradation by creating extensive water ponding that restricts tree root development.
2) Some sites with good tree growth occur on **deep organic soils** with abundant lateral seepage. While the mature timber values may be good, they will prove difficult to reforest. All of the problem issues listed above will need to be considered. Only winter harvesting, while wet soils are frozen, will be possible. Mounded microtopography is typically critical to good tree growth on these sites. Heavy machinery will often damage this structure even in winter. Many elevated microsites are not composed of mineral soil but created from old "tip-ups" where replanting success is unlikely. Mounding site treatments are generally not useful on these sites due to high erosion rates of well-humified organic materials. Advanced regeneration can be critical for successful re-establishment of a coniferous canopy (Päivänen 1997). Cluster planting on raised microsites may be necessary to ensure adequate survival and growth of conifers.
3) Sites with **standing water in summer**. Trees in swamps extract abundant groundwater for growth, removing vast quantities of soil water and lowering the watertable through evapotranspiration. The presence of standing water on the site during the growing season indicates that the site is near the lowest threshold of productive tree growth. Removal of the canopy will lead to deeper and more persistent surface water; the ability of trees to regenerate will be compromised and availability of plantable spots will be further limited.

Harvesting around Wetlands

Impacts of harvesting upland forests in the riparian zone on adjacent wetland plant communities is typically not marked unless road building activities interrupt water inflow or outflow, or if forest clearing is extensive and affects overall watershed hydrology. Where the riparian zone is composed of swamp forest at level with the wetland, removal of large portions of it will lead to a raising of the watertable (see above), which can have an impact on plant communities in the rest of the wetland.

Most wetland-using wildlife species use both the wetland and adjacent riparian area. **When viewed from a wildlife perspective, the wetland and its riparian area should be viewed as a single functioning wetland ecosystem**. Terrestrial habitats may be exceptionally important for conservation of some species groups such as amphibians. Management plans targeting amphibian conservation that focus only on wetland land habitats are likely to be unsuccessful without consideration of the riparian area (Marsh and Trenham 2001).

Harvesting that maintains some canopy cover, minimizes soil disturbance and compaction, and retains downed wood will minimize impacts to wildlife populations.

Several objectives should be considered when harvesting around wetlands:

- **Protect wetland hydrology** – Ensure that surface and groundwater inlets and outlets are not interupted by road construction or harvesting activities.
- **Maintain vegetative cover** – Implement partial-cutting harvest plans and windfirm edges.
- **Maintain wildlife trees** – Maintain large standing snags and veterans.
- **Maintain downed wood** – Leave large stems on the ground.
- **Avoid wet depressions** – Avoid harvesting or skidding through low-lying areas of the stand.
- **Winter harvest** – Harvest during season of lowest wildlife use.

Landscape Planning

The cumulative effects of resource extraction, urban development, and transportation networks have resulted in a disconnected landscape. Noss (1994) cites Shaffer's (1992) assertions that long-term viability of large carnivores in North America is being compromised by the fragmentation of the original wilderness into small refugia. This phenomenon may be occurring at smaller scales for less mobile wetland animals, as wet-

lands become isolated from each other by development activities and resource extraction. Semlitsch and Bodie (1998) argue that small wetlands are extremely valuable for maintaining diversity in a number of plant, invertebrate, and vertebrate taxa (e.g., amphibians). However, the ability of many amphibian species to disperse may be under-appreciated and may be limited only where significant barriers, such as roads or urban development, exist (Marsh and Trenham 2001).

WETLANDS AS WILDLIFE HABITAT

Wetlands and related ecosystems have variable wildlife values. Some basic features that may influence a wetland's wildlife habitat value include:

1. **Presence of water**. Aside from the obvious habitat values for aquatic invertebrates, fish, and amphibians, ponds, lakes, and streams are often focal points for terrestrial animals as primary sources of drinking water.
2. **Structural diversity and cover**. In many landscapes, wetlands and riparian ecosystems are structurally distinct from the surrounding upland and provide unique habitats. High structural complexity within wetlands generally increases their value to wildlife by providing nesting cover and foraging habitat for a wide range of species.
3. **Abundant forage**. Wetlands and riparian areas can be productive habitats. Many wetland plant species provide important forage. Skunk cabbage, sedges, and horsetails form an important component of bear diets; pond-lilies, willows, and other shrubs are browsed by moose; and marsh emergents and aquatics are foraged by Muskrat, Beaver, and waterfowl.
4. **High prey densities**. The productive aquatic habitats adjacent to flood communities and shallow-water habitats frequently produce high concentrations of aquatic insects that are the food base for larger animals, especially birds and bats.
5. **Unique habitat**. Peatlands provide unique microhabitats that are used by specialized invertebrates (Finnamore and Marshall, 1994).
6. **Rarity in the landscape**. Especially in drier climates, water and aquatic habitats are especially valuable for wildlife but are also uncommon and often in areas of development. Good-quality wetland habitat is at a premium in these areas.

The most heavily used wetlands are marshes, with their high productivity and adjacency to open water, followed by swamps, fens, and bogs.

However, all of these habitats are vital for wetland-dependent species and important for upland species that use wetlands and their associated riparian areas for food, water, and cover.

Amphibian Habitat Requirements

Amphibians are generally associated with wetland habitats or other moist environments (excluding saline habitats, which are toxic to amphibians). British Columbia has 20 amphibian species, many of which are restricted to the relatively mild climates of the Coast and southern Interior. Adults of some amphibian species stay in or near water always; others stay near water but feed in adjacent uplands; several of British Columbia's amphibians are mainly terrestrial, using water only for breeding; and some are wholly terrestrial (Table 6.1).

In British Columbia, all amphibians, except Plethodontid salamanders, require water in which to lay their eggs. Wetlands are the most common habitats but some species such as Clouded Salamander and Tailed Frog lay their eggs in streams. Others such as Spadefoot Toad will deposit eggs in temporary ponds.

Broadly, wetlands with good vegetation structure for the egg mass attachment and sufficient flood duration for juvenile development are preferred breeding sites. Frogs generally metamorphose during the same season that the eggs are laid while salamanders can take several years to mature, especially in cold climates.

In a study of amphibian distribution in the Puget Sound Basin, Richter and Azous (1995) found that there was no statistically significant relationship between amphibian richness and wetland size, number of vegetation classes, presence of predators, characteristics of waterflow, and wetland permanence. Low-velocity flow and low water-level fluctuation were correlated with high species richness. Increasing water-level fluctuation and percent watershed urbanization were correlated with low species richness.

Amphibians are especially vulnerable to environmental pollutants. Their breathable skins readily absorb chemicals. Clearly, additions of pesticides, fuel, or other chemicals to waterbodies will affect local populations of amphibians and should be avoided.

Precipitous declines in some amphibian populations have been observed around the world. The cause of these declines has still not been pinpointed but several causal factors are likely, including increased ultraviolet (UV-B) irradiation, acid precipitation, adverse weather pat-

TABLE 6.1 *Distribution and habitat use by adult pond-breeding amphibians (from Province of British Columbia 1998)*

Species	Distribution	Seasonal	Terrestrial habitat	Aquatic habitat
Tiger Salamander	Red List; Okanagan	Migrates to water April–May	Underground burrows in grassland	Small, often alkali, lakes and temporary ponds; neotenes in cold lakes
Northwestern Salamander	Common on Coast	Migrates to water to breed	Moist forests	Lakes and streams; also in subalpine ponds
Long-toed Salamander	Common; widespread S. of 56°N.	Migrates to water to breed as early as December	Moist microhabitats (e.g., CWD and rock rubble) in forests and pastures	High- and low-elevation lakes and ponds; in pools along streams
Rough-skinned Newt	Common on Coast	Migrates to ponds to breed Feb–April	Forests	Vegetated fringes of permanent water-bodies and slow-moving streams
Great Basin Spadefoot	Blue List; Okanagan	Migrates to water to breed Feb–April	During dry weather, under the soil in burrows	Temporary or shallow ponds (alkali)
Western Toad	Locally common, widespread but patchy	Migrates May–June; at high elevation Sept–Oct	Most forested habitats in all biogeo-climatic zones and ecoregions	Temporary or permanent pools and small ponds
Pacific Treefrog	Common on Coast	Migrates to water for breeding Mar–May	Forests; often on trees and shrubs; also common along shores	Shallow water with lots of vegetation; not necessarily permanent
Striped Chorus Frog	Locally common; NE B.C.	Migrates to water for breeding Mar–June	Meadows, deciduous forests, and around marshes	Shallow standing water
Red-legged Frog	Locally common; SW B.C.	Mainly aquatic; may move to other small ponds; breeds Mar–April	Near small ponds in damp forests	Temporary or permanent ponds and slow-moving streams; Mar–April
Northern Leopard Frog	Red List; southern Interior	Migrates to ponds or swamps Mar–June	Near breeding sites, but may also forage in meadows and fields	Shallow, permanent marshes, ponds, and lakes, especially with emergent vegetation
Spotted Frog	Common, widespread in Interior	Very aquatic; may move over land during rainy periods	At edges of ponds and lakes	Prefers permanent ponds and small lakes in early spring
Wood Frog	Scattered; common in northern B.C.	Moves to water for breeding April–July	Meadows and forest near ponds; alpine tundra; very cold tolerant	Shallow clear ponds for only a few days in north
American Bullfrog	Introduced Van. Is. and SW mainland	Mainly aquatic; breeds May–July	Water edge	Permanent ponds of variable depth; prefers shallow water with vegetation
Green Frog	Introduced Van. Is. and SW mainland	Mainly aquatic; breeds May–July	Water edge	Permanent ponds

terns, environmental pollution, or infectious disease. While most of these are beyond the scale of management by field workers, the latter should be carefully considered by individuals who are visiting several wetlands.

In North America, mortalities caused by amphibian iridoviruses or Ranaviruses have been documented for species that occur in British Columbia, including Leopard Frog, Red-legged Frog, and Tiger Salamander. These viruses can persist under adverse conditions (such as dried mud on boots) for several months to several years. Field workers should, at minimum, rinse outerwear and equipment. Transport of adults or juveniles from one locality to another should also be avoided.

Pond-breeding Amphibians

The **Rough-skinned Newt** is the only newt species in British Columbia. It occurs throughout the Coast. Adults forage for slugs and worms in open seral and mixed forests near permanent water. Adults also feed on tadpoles and aquatic invertebrates. Shallow water in swamps, fens, and bogs is used for breeding. Larvae are carnivorous.

Four species of mole salamander occur in British Columbia: Long-toed Salamander, Northwestern Salamander, Tiger Salamander, and Pacific Giant Salamander. Adult mole salamanders spend much of their adult life underground in rodent burrows or under rocks. Juveniles are always aquatic and some are neotenous.

Long-toed Salamander are widespread on the Coast and in the Interior mostly south of 56 degrees north latitude. Adults prefer forested edge habitats near water and breed in still waters with abundant aquatic vegetation.

Northwestern Salamander occur along the Coast and are frequently neotenous. Larvae, if they develop into terrestrial adults, often take more than a single year to metamorphose. Breeding occurs in fishless, permanent, shallow ponds.

Tiger Salamander are widespread in North America but occur only in the warmest, driest areas of the southern Interior (south Okanagan) in British Columbia. Adults live mainly underground in grassland habitats. Breeding is primarily in alkali ponds and shallow lakes. Larvae transform in 3–4 months and live primarily in warm areas of ponds with abundant algae.

Great Basin Spadefoot occur in the dry climates of the Southern Interior. This is primarily a terrestrial species but eggs are laid in temporary or shallow alkali lakes and ponds. Larvae eat detritus, carrion, and aquatic vegetation and mature in about 6 weeks, after which they leave the natal pond.

The **Western Toad** occurs throughout British Columbia in all but the coldest climates. This widespread species is primarily terrestrial, travelling far from open water and wetlands. They prefer moist habitats where they can escape desiccating conditions. Breeding occurs in shallow ponds and pools with sandy bottoms.

Two species of treefrog occur in British Columbia: Pacific Treefrog and Northern Chorus Frog. The former is widespread along the Coast, Southern Interior, and Southern Interior Mountains. The latter occur only in the Boreal Plains and Taiga Plains.

Pacific Treefrog adults forage in forest edges and shrubby habitats sometimes far from open water. Shrub swamps and shrub fens are good habitats. Breeding occurs in shallow, weedy, permanent shallow water.

Northern Chorus Frog live mainly underground in grassy or wooded areas. Breeding occurs anywhere there is shallow water.

Four native frog species occur in British Columbia: Red-legged, Spotted, Northern Leopard, and Wood Frog. These "true" frogs are the most aquatic of the frog groups in British Columbia and are much more closely associated with open water as adults.

Red-legged Frog occur on Vancouver Island and the adjacent mainland where they occur in small waterbodies in forested landscapes. Adults can wander some distance into forest but most commonly remain near water.

Spotted Frog are widespread throughout the Interior in cold-water ponds and lakes.

Northern Leopard Frog are found in the Southern Interior Mountains and Southern Interior around permanent waterbodies. Adults forage in grassy uplands often far from open water. Eggs are laid in small, well-vegetated ponds and swamps.

Wood Frogs commonly use peatlands adjacent to open water.

Woodfrog occur throughout the Interior, mostly north of 51 degrees north latitude. This species is very cold-tolerant and occurs even in the cold climates of the northern boreal and subalpine. Adults will forage far from open water. Adults hibernate on land under debris and litter and rely on deep snows for insulation.

The two introduced frog species, **Bullfrog** and **Green Frog**, occur on the south Coast and in the Southern Interior. These species are both highly aquatic and rarely leave natal marshes and shallow-water habitats.

Stream-breeding Amphibians

Pacific Giant Salamander occur only in the mainland areas of the Georgia Depression south of the Fraser River. They breed in clear-flowing streams and the adults forage in the upland forest not far from this habitat.

Tailed Frog occur in and along fast-moving streams at higher elevations of the mainland Coast. Adults use adjacent upland forest and do not favour wetlands or related ecosystems.

Terrestrial Amphibians

Three species of lungless salamander (Plethodontidae) occur in British Columbia that live completely terrestrial lives: **Western Red-back Salamander**, **Ensatina**, and **Clouded Salamander**. They all occur on Vancouver Island and the adjacent mainland, except the latter, which is absent from the mainland.

These salamanders are not associated with open-water habitat even for breeding. As their common name suggests, Plethodontid salamanders have no lungs but breath through their skin and oral cavity. For this reason, they require habitats that allow them to keep their skins moist. These habitats are often moist forests with structures such as downed wood, rocks, or abundant litter under which they can hide from desiccating conditions and predators. Eggs are laid in large pieces of decayed wood that remain moist. Swamp forests are good habitat.

Waterbird Habitat Requirements

Wetlands provide valuable habitat for many species of birds, but waterbirds (pelicans, loons, grebes, phalaropes, swans, geese, ducks, herons, cranes, rails, shorebirds, terns) are the most dependent on wetland habitats. Natural wetlands that have seasonal and long-term fluctuations in water levels are generally the most productive for waterbirds. These fluctuations enhance productivity and maintain complex vegetation structure. Water depth and vegetation structure are important cues for waterbird use of wetland habitats (Reid 1993).

Wetlands are used for different life history requirements:

- summer breeding and feeding sites
- moulting sites (ducks and geese)
- feeding away from nesting sites (pelicans, herons, and waders)
- migration stops (shorebirds, ducks, and geese)
- food exploration after breeding (waders)
- wintering

Loons and Grebes

Loons and Grebes require large stretches of open water to achieve flight and therefore occur on larger waterbodies. They nest mostly on mounds of floating vegetation (often Muskrat haul-outs) within the cover of emergent vegetation. **Pacific Loons** will select large lakes that are more clear than coloured, because they are sight feeders and colour may inhibit foraging efficiency. **Horned Grebes** are likely to occur on larger wetlands with high pH and chlorophyll levels. **Eared Grebes** colonies nest on surface mats of filamentous green algae, sago pondweed, or bladderwort anchored in sedges and other emergents (Boe 1994).

The floating nests of Red-necked Grebes are found in shallow waters of lakes.

Herons, Cranes, and Rails

Great Blue Herons move from coastal, intertidal habitats during the breeding season to marshes and grasslands during November to February (Butler 1995). This seasonal shift in habitat use occurs because herons can no longer meet their daily energy needs by foraging on beaches. Herons nest in colonies, commonly forming rookeries in red alder or cottonwood.

Sandhill Cranes breed in bogs with a shrub layer, swampy ground with pink spirea, wetlands dominated by sedges, and coniferous forest (Cooper 1996). In British Columbia, Sandhill Cranes utilize wetlands in the

Great Blue Herons are commonly seen in marshes and estuaries but nest colonially in upland forests.

1–100 ha size range. Adults build nests out of mounds of vegetation in shallow wetlands within stands of emergent vegetation. Young and adults use coniferous forests for escape cover and possibly for resting and feeding. During migration stopovers, cranes use shallow, open wetlands with clear water for loafing, drinking, and roosting.

American Bitterns prefer vegetated edges and shorelines of wetlands that are dominated by tall, emergent vegetation (i.e., taller than the bird itself). They have been found in wetlands of all sizes, but appear to prefer impoundments or beaver-created wetlands (Gibbs et al. 1992). Use of wetlands appears to be restricted to those portions with water that are shallow enough to stand in (less than 10 cm). Nests are well-concealed platforms of reeds and other vegetation within dense emergent vegetation such as cattail and bulrush. Bitterns will occasionally nest on dry ground in dense vegetation greater than 30 cm tall in grasslands adjacent to wetlands (Gibbs et al. 1992).

Breeding **Virginia Rails** are rare to locally common in the Georgia Depression, Southern Interior, and Central Interior at low elevations. They favour regions with warm spring air temperatures. Virginia Rails use freshwater wetlands, but have also been found in salt marshes, favouring stands of robust vegetation including cattails and bulrushes (Conway 1995). They have been frequently observed in areas with 5–15 cm deep water, and heard from areas with less than 5 cm water. Nests are loosely woven baskets usually concealed with an overhead canopy. Nests can be well above the water, or at the base of taller vegetation (Harrison 1978).

Soras are fairly common along southeastern Vancouver Island, Fraser Lowlands, and in suitable habitat throughout the Interior to the Peace River and other boreal areas. Soras prefer freshwater and brackish wetlands with an interspersion of emergent vegetation and open water. Cup nests are often placed at vegetation edges, near patches of open water, in a mixture of robust and fine vegetation; the surrounding vegetation is folded over to form a covering dome. Dominant plants around nest sites often include cattails and sedges, and, less commonly, bulrushes, burreeds, and grasses.

Waterfowl

Waterfowl require abundant protein and calcium during nesting and moulting. Nesting waterfowl diets require invertebrates for the protein required for egg production and growth of young. Few duck species acquire substantial nutritional resources directly from consumption of

plant material other than seeds. Many wetlands with apparently good vegetative cover are infrequently used by breeding or moulting waterfowl because protein-rich prey is limited. Acidic wetlands are usually poor breeding habitat because the macroinvertebrate communities are dominated by dipterans with low protein and calcium content.

Saline/alkaline waterbodies in warmer climates typically have the highest density of breeding waterfowl in British Columbia. Saline lakes provide high quality and abundance of prey but broods must be moved to freshwater seeps or adjacent freshwater marshes (ducklings cannot tolerate salt levels greater than 15 ppt).

Waterfowl, grebes, loons, and coots undergo a complete, simultaneous wing moult that leaves them flightless. The moult occurs during the brood-rearing period of geese, the post-breeding period of male ducks, and the post–brood-rearing period of most female ducks. Feather regrowth requires 3–5 weeks, depending on the species. Birds often move to areas away from their breeding grounds to moult. Although little research has been done, it is believed that these moulting areas are rich in food and/or offer good cover for protection from predators.

Migrating Tundra Swans prefer wetlands with fennel-leaved pondweed (*Stuckenia pectinata*), while non-foraging swans prefer wetlands with large, open, unvegetated mud bars (Earnst 1994).

Trumpeter Swans feed on plant foods almost exclusively, although the type of plants consumed by each sex varies during the season. Before incubating, adults feed on submerged aquatic macrophytes, while during incubation, horsetails (*Equisetum fluviatile* and *E. arvense*) and the sedge, *Carex lyngbyei*, become the food item of choice for females, while males continue to feed on submerged aquatics. Adult swans and their young spend more time feeding on horsetail than all other foods combined. (Grant et al. 1994).

Dabbling ducks, also known as "marsh ducks," are capable of vertical takeoff and can use small waterbodies and terrestrial habitats. Species include Mallard, Gadwall, Northern Pintail, Green-winged Teal, Blue-winged Teal, Cinnamon Teal, Northern Shoveler, American Wigeon, and Eurasian Wigeon. Distribution and breeding habitat requirements for these species are outlined in Table 6.2.

Most dabbling ducks nest in a wide variety of riparian upland habitats. However, birds nesting in natural grass- and shrublands have the highest nesting success. In addition, seasonal wetlands can have higher fledging

TABLE 6.2 *Distribution and habitat use by dabbling ducks (from RIC 1999)*

Species	Distribution	Breeding habitat
Gadwall	Central-southern B.C. from Creston and Grand Forks north to Williams Lake, the Fraser Lowlands, and Peace Lowlands.	Wetlands in the grasslands and open forested areas. Coastal brackish marshes, farmlands, sewage lagoons, and lakes. Nests on the ground
American Wigeon (and Eurasian Wigeon)	Most abundant in Chilcotin-Cariboo and Peace River parklands; scattered throughout Interior, Kootenay and Nechako Lowlands, Peace River, and south Coast.	Freshwater wetlands and rivers in brushy upland habitats, sometimes far from water. Nests on ground very well concealed often by over-hanging shrubs.
Mallard	Widespread, most abundant in the Chilcotin-Cariboo.	Wetlands in urban (golf courses, ditches, parks) and rural (agricultural fields, sloughs, marshes, lakes, riparian woodlands) environments. Nests on ground concealed by vegetation.
Blue-winged Teal	South Coast east through the southern and central Interior and Peace River through boreal forest and west to Atlin. Concentrations in Chicotin-Cariboo, Okanagan, Nechako Lowlands, and Peace River.	Forested and open habitats near small bodies of water. Nests on ground near water.
Cinnamon Teal	Confined to southern B.C.—Victoria north to Powell River and throughout the Fraser Lowlands; Kootenays and from southern Okanagan Valley north to Nimpo Lake in the Chilcotin-Cariboo—the centre of abundance.	Wetlands, wet meadows, ditches, sewage lagoons, and slow-moving streams. Nests on ground surrounded by vegetation.
Northern Shoveler	Most abundant in the Chilcotin-Cariboo and Peace Lowlands. Distributed on the inner south Coast and from the southern Interior north to Atlin and the Peace.	Open and semi-open habitats in the vicinity of marshes, sloughs, ponds, bogs, lakes, ditches, and slow-moving streams.
Northern Pintail	Throughout the Interior, east of the Coast Ranges and locally on the south Coast and the Queen Charlotte Lowlands. Most abundant in the central-south Interior, the Peace Lowlands, and the east Kootenay.	Drier margins of lakes and wetlands, dry grasslands, shrubby fields, edges of mixed forests, damp meadows, and subalpine bogs. Nests on ground in sparse or low vegetation.
Green-winged Teal	Southern Vancouver Island, the Fraser Lowlands and northern Queen Charlotte Lowlands on the Coast. Widely distributed across the Interior.	Grassy, brushy, lightly wooded upland areas near freshwater marshes in the Interior; sloughs and ponds associated with estuaries on the Coast. Nests on ground in dense cover.

success than permanent wetlands; possibly because prey quality is better than in permanent water. Optimum conditions for dabbling duck populations occur during years when large numbers of seasonal ponds contain water. However, permanent wetlands are needed to maintain adult populations during periods of drought and as moulting areas (Mauser et al. 1994).

"**Lake**" **ducks** are associated primarily with lake habitats as they require sufficient open water to gain flight. "Lake" duck species in British Columbia include Redhead, Ring-necked Duck, Canvasback, Greater Scaup, Lesser Scaup, and Ruddy Duck. These ducks nest mostly in emergent vegetation of lacustrine marshes. Two sea ducks, Surf and White-winged Scoter, also nest in wetland habitats. Distribution and breeding habitat requirements for these species are outlined in Table 6.3.

There are several species of **cavity-nesting duck** in British Columbia: Bufflehead, Common Merganser, Hooded Merganser, Common Goldeneye, Barrow's Goldeneye, and Wood Duck. For these species, riparian management around good-quality wetland and lake habitat is essential. Cavity-nesting ducks use Pileated Woodpecker cavities or other hollows created by decay. Bufflehead are small enough to use excavations formed by smaller woodpecker species. Distribution and breeding habitat requirements for cavity-nesting ducks are outlined in Table 6.4.

Shorebirds

Most shorebirds use British Columbia's wetlands primarily during migration and wintering (Coast). They opportunistically use mudflats

A Killdeer chick hides in a coastal bog.

TABLE 6.3 *Distribution and habitat use by "lake" ducks (from RIC 1999)*

Species	Distribution	Breeding habitat
Canvasback	Central and southern Interior to Prince George, Vanderhoof, and Atlin and throughout the Peace Lowlands. Centre of abundance in Chilcotin-Cariboo.	Freshwater and alkali lakes, wetlands bordered by dense emergent vegetation, especially bulrush. Nests on water in dense emergent vegetation.
Redhead	Southeast Kootenays, Creston, and the Okanagan valley, widely throughout the Cariboo-Chilcotin, and in the Peace Lowlands.	On shallow freshwater lakes and wetlands with emergent vegetation. Nests over water in dense stands of emergent vegetation.
Ring-necked Duck	Widespread from the Okanagan and Creston north through the Chilcotin-Cariboo to the Peace Lowlands and on the east coast of Vancouver Island and the Fraser Valley.	Freshwater lakes, marshes, ponds, and sloughs, often in wooded situations. Nests on land or on water in grass clumps or emergent vegetation.
Lesser Scaup	Rare in the southern Interior but increasing northward through the Rocky Mountain Trench and the Thompson-Okanagan Plateau to the Cariboo-Chilcotin and Peace River areas .	Freshwater and alkaline lakes, marshes, and fields. Most nests concealed in dense grass, agricultural crops, or emergent vegetation.
Ruddy Duck	Nicola and Okanagan valleys to the east Kootenays, north through the Chilcotin-Cariboo to the Nechako Lowland region and in the Peace River area.	Freshwater wetlands with emergent vegetation such as bulrushes and cattails for nesting cover. Nests over water in emergent vegetation.
American Coot	Southeastern Vancouver Island, the Fraser Lowlands, east across southern B.C., north through the Chilcotin-Cariboo and Fraser Basin regions to the Peace Lowlands, Fort Nelson Lowlands, and Liard Basin.	Freshwater, alkali, and brackish wetlands with extensive stands of dense emergent vegetation along the margins. Nests on water in dense stands of emergent vegetation.
Surf Scoter	Peace and Fort Nelson lowlands of northeastern B.C., Thompson-Okanagan stands.	Freshwater lakes surrounded by spruce and muskeg or mature coniferous/deciduous.
White-winged Scoter	Fraser Plateau to the Peace Lowlands and west to Atlin.	Freshwater lakes and ponds in open country and boreal forest.

TABLE 6.4 *Distribution and habitat use by cavity-nesting ducks (from RIC 1999)*

Species	Distribution	Breeding habitat
Wood Duck	Southern Vancouver Island, Fraser Lowlands, southern Interior, especially Creston, north to Williams Lake.	Mature deciduous woodlands adjacent to lowland ponds, sloughs, and slow-moving rivers. Nests in cavities of mature deciduous trees.
Bufflehead	Across Interior, especially the Peace Lowlands and northern areas of the boreal forest.	Primarily on lakes and occasionally on rivers, sloughs, and ponds in aspen parklands, interior Douglas-fir forests, open ponderosa pine forests, farmland, and rangeland. Nests in tree cavities near the edge of wetlands.
Common Goldeneye	Uncommon but widespread in the southern third of B.C. east of the Coast Ranges. Sparse through the north.	Lakes, rivers, and associated floodplains, sloughs, ponds, and creeks, usually with wooded margins. Nests in tree cavities.
Barrow's Goldeneye	Widespread in the southern Interior east of the Coast Ranges. Most abundant in Chilcotin-Cariboo region.	Lakes associated with aspen parkland, open ponderosa pine forests, farmland, rangeland, and alpine meadows, as well as wetter, closed coniferous forests, including subalpine regions. Alkaline lakes are preferred. Nests in cavities of trees near the edge of a wetland.
Hooded Merganser	Centre of abundance in southwest from northern Queen Charlotte Islands, Kitsault, Fort St. James, and Prince George south through the rest of B.C.	Mostly fresh but occasionally brackish water sites, usually with wooded shorelines. Nests in tree cavities.
Common Merganser	Throughout B.C. except in extremely mountainous areas. Less common and widely scattered in northern B.C.	Near freshwater along forested shores of lakes, streams, rivers, inlets, and beaver ponds. Nests in tree cavities and on ground in small caves or crevices.

exposed during watertable drawdown. Shorebirds are attracted almost immediately to wet mud/shallow-water habitats that became available regardless of wetland history. These habitats are associated mostly with estuaries on the Coast and marshes in the Interior. Several species will nest in wetlands, including Wilson's Phalarope, Great Yellowlegs, Lesser Yellowlegs, Spotted Sandpiper, Solitary Sandpiper, and Least Sandpiper.

Other Birds' Habitat Requirements

A variety of passerines use wetlands extensively. Wetlands with high structural diversity, both vertically and horizontally, attract the most songbird species.

Common passerines that occur primarily in emergent wetlands include Common Yellowthroat, Red-winged Blackbird, Marsh Wren, Swamp Sparrow, Lincoln's Sparrow, Yellow-headed Blackbird, Le Conte's Sparrow, and Nelson's Sharp-tailed Sparrow.

Many other species extensively use wetland-upland edge habits and riparian deciduous shrubbery for nesting and foraging. These habitats provide cover, access to open habitat, high prey density, and multilayered structure. Some shrub ecotone–affiliated species include the *Empidonax* flycatchers, Eastern Kingbird, chickadee species, Hermit Thrush, Gray Catbird, Bohemian Waxwing, Cedar Waxwing, Tennessee Warbler, Yellow Warbler, Black-and-white Warbler, American Redstart, Northern Waterthrush, MacGillivray's Warbler, Wilson's Warbler, Yellow-breasted Chat, Savannah Sparrow, Fox Sparrow, Song Sparrow, Lincoln's Sparrow, White-throated Sparrow, Black-headed Grosbeak, and Rusty Blackbird.

A Yellow-headed Blackbird in typical habitat.

Eastern Kingbirds commonly use dead shrubs in flooded lake margins.

There are a few passerines that frequently use bog habitats, particularly in the Boreal and Taiga Plains where these habitats are extensive. These include Ruby-crowned Kinglet, Hermit Thrush, Palm Warbler, and Blackpoll Warbler.

Ruffed Grouse use shrubby riparian areas, particularly in the winter time. **Willow Ptarmigan** extensively use subalpine fens and shrub-carrs for forage.

Raptors and **Owls** will use wetland habitats where abundant prey exists. Northern Harrier nest on the ground, often in the emergent cover of marshes. **Bald Eagle** and **Osprey** will nest in larger riparian cottonwood. **Western Screech Owl** frequently use floodplain forests. **Great Gray Owl** are often associated with bog habitats.

Woodpecker species are not generally considered wetland users. However, forested wetlands and riparian forests are more likely to escape wildfire and become old forests. These old forests have large stems and abundant snags that are optimal for creation of nest cavities. The blue-listed Lewis' Woodpecker nest in floodplain cottonwood adjacent to grasslands. Woodpecker excavations in riparian areas are critically important for cavity-nesting ducks.

Wetland Mammal Habitat Requirements

There are several mammal species that are semi-aquatic and associated primarily with open water. These include three rodents (Beaver, Muskrat, Mountain Beaver) and two mustelids (Mink and River Otter). Beaver

and Muskrat play key ecological roles because they build structures that modify the environment and are used by many other wetlands animals. All but Mountain Beaver are also considered fur-bearers and are of economic importance.

Beaver

The Beaver is perhaps the most well-known wetland rodent species due to its role in wetland creation. Through dam-building, Beaver create numerous shallow-water habitats that are used extensively by many other wildlife species, especially waterfowl. Furthermore, Beaver rely heavily on riparian vegetation for forage and dam-building materials. These activities have a large impact on riparian plant communities: they cut down the dominant species (trees and shrubs), which allows understorey species to flourish; cutting is concentrated in the riparian zone; and Beaver harvest in excess of their nutritional needs (Johnson and Naiman 1990). *Populus tremuloides* is the primary food species but *Populus balsamifera*, *Salix* spp., and *Betula papyrifera* are important secondary sources. Other species such as *Cornus stolonifera*, *Amelanchier alnifolia*, *Corylus cornuta*, and *Betula nana* are other minor forage species. *Alnus* species are used primarily for dam-building. Fire is an important disturbance agent for creating optimal forage for Beaver.

Beaver is a keystone species that creates and modifies wetland habitats.

Muskrat

Muskrats are the most significant vertebrate consumer of emergent vegetation in North American wetlands. Muskrat foraging and house-building improves interspersion in dense stands of emergent vegetation, which increases invertebrate population levels and may result in increased avian abundance and diversity (Clark and Kroeker 1993). Muskrat haul-outs are used for nesting by species of grebe and diving duck. Cattail and bulrush in 0.5–1.5 m deep water is optimal habitat for lodge-building.

Mountain Beaver

Mountain Beaver is a red-listed species in British Columbia. They occur only in the southwest, coast-transition areas of the Cascade Range. They are associated with small streams or seeps in montane and subalpine forests between 1200 and 1800 m elevation where they build tunnels and dens in fine-textured soils. Primary food species often occur in wet forests or meadows and include *Valerian sitchensis*, *Equisetum* spp., *Streptopus* spp., *Rubus parviflorus*, and *Heracleum maximum*. Logging activities that disturb soils appear to have a strongly negative impact on Mountain Beaver populations (Gyug 2000).

Mink

American Mink are semi-aquatic predators that spend much of their time in water. They are a major predator of muskrat, fish, marine invertebrates, frogs, waterfowl, and eggs. High densities of mink will occur in habitats with high populations of potential prey. They occur throughout the province along fish-bearing streams and marshes. They will nest in muskrat or beaver burrows. Mink favour good riparian cover, and clearing or heavy grazing of wetland edges will reduce habitat quality.

Other Mustelids

River Otters use a wide range of wetland habitats throughout the year with beaver-created wetlands favoured (Newman and Griffen 1994). Marten and Fisher use large trees in riparian forest for denning. Other species such as Short-tailed Weasel, Common Raccoon, and Striped Skunk also use wetlands, particularly marshes for hunting.

Small-mammal Habitat Requirements

Of the 32 species of small terrestrial mammal and 16 species of bat that occur in British Columbia, only some are associated with wetlands and related ecosystems.

Bats

In a review of the importance of riparian habitat in British Columbia to bats, Brigham (1993) summarizes available information about foraging and roosting in various riparian habitats. The following species have been detected foraging over calm water: California Myotis, Western Small-footed Myotis, Long-eared Myotis, Western Long-eared Myotis, Keen's Long-eared Myotis, Northern Long-eared Myotis, Little Brown Myotis, Yuma Myotis, Big Brown Bat, and Spotted Bat. As well, Townsend's Big-eared Bat has been captured at streams, lakes, and small marshes dominated by willow, poplar, and birch species.

All of these species feed on flying insects and focus on wetland habitats with abundant insect populations.

Jumping Mice

Meadow Jumping Mouse are found throughout the northern half of British Columbia, east of the Coast Ranges in association with brushy margins of streams and in marshes.

Western Jumping Mouse are found throughout mainland British Columbia except in the extreme southwest and Taiga Plains. They use a variety of habitats but they prefer dense cover with lush grass and herb growth near open water.

Voles and Lemmings

Long-tailed Vole occur throughout mainland British Columbia. They use variable habitats that include marshes and alder or willow thickets along watercourses.

Meadow Vole occur throughout the Interior. They use habitats with high ground cover of sedges, grasses, and forbs, usually near water.

Southern Red-backed Vole are found throughout the province except the coastal islands and Boreal Mountains and Plateaus. They forage in bogs and forested swamps.

Townsend's Vole occur on Vancouver Island and the Fraser Delta in a variety of habitats, which include marshes, estuaries, and sedge meadows.

Northern Bog Lemming occur throughout the province except on the islands. Although this species primarily inhabits bogs, it may also be present in other wet habitats such as deep mossy spruce woods, wet subalpine meadows, and alpine tundra.

Shrews

Five of the 11 shrew species in British Columbia are often associated with wetlands: Arctic Shrew, Common Water Shrew, Dusky Shrew, Pacific Water Shrew, and Pygmy Shrew. These are primarily insectivores but will prey opportunistically on other small animals. Generally, they use a wide variety of habitats of which wetlands are often focal.

The **Arctic Shrew** is restricted to the Taiga Plains where it forages in tamarack and spruce swamps, in marshy areas, and along the edge of bogs and marshes in alder or willows.

Common Water Shrew occur throughout the province (except the Queen Charlotte Islands) usually in or near water. Lakes, ponds, swift and sluggish small streams, cold fast mountain streams, and stagnant water of bogs and marshes are all used.

Dusky Shrew are widespread at all elevations. They use a wide variety of different habitats under a wide range of climatic conditions but are frequently found in marshes, streamside *Equisetum* stands, and bogs.

The red-listed **Pacific Water Shrew** has a limited distribution in British Columbia, occurring only in the Fraser River delta where it uses a wide variety of habitats but favours riparian red alder forests or forested skunk cabbage swamps.

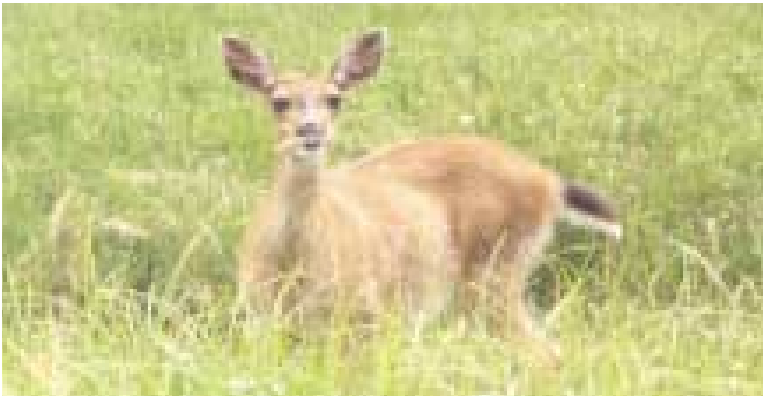
Pygmy Shrew are found throughout the Interior and are generally uncommon. They use a wide variety of habitats, which include bogs and marshes.

Ungulate Use of Wetlands and Related Habitats

Moose are the most wetland-associated ungulate in British Columbia. Browse makes up 80% of the diet, and favoured species such as willow and red-osier dogwood are associated with wetlands. An overview of the forage value of 15 willow species found in the Lower Skeena and Bulkley valleys is presented by Roberts (1986). Moose also use aquatics in the summer and will dive for *Nuphar* rhizomes.

Elk dwell primarily in open forest habitats in dry climates. They are not specifically wetland users but will graze sedges where they are available.

Mule Deer and **White-tailed Deer** will use wetland habitats for cover, especially in otherwise open terrain.



Coastal estuaries are high-quality habitat for many species, including Black-tailed Deer.

Bear Use of Wetlands and Related Habitats

Some wetlands are important **Grizzly Bear** and **Black Bear** habitats. Productive swamp and estuarine habitats typically support forbs and fruiting shrubs favoured by bear. Important spring forage species include (bold are major forage species): *Athyrium filix-femina*, ***Calamagrostis canadensis***, ***Carex lyngbyei***, *Conioselinum pacificum*, ***Empetrum nigrum***, ***Equisetum arvense***, ***Heracleum maximum***, ***Lysichiton americanus***, *Oplopanax horridus*, *Populus balsamifera*, *Scirpus microcarpus*, and *Taraxacum officinale*.

In summer and fall, the fruits of many shrubs and forbs are consumed: *Arctostaphylos uva-ursi*, *Cornus stolonifera*, *Corylus cornuta*, *Empetrum nigrum*, ***Gaultheria shallon***, *Lonicera involucrata*, *Malus fusca*, ***Oplopanax horridus***, *Ribes bracteosum*, *Rosa* spp., ***Rubus idaeus***, ***R. parviflorus***, ***R. spectabilis***, ***Sambucus racemosa***, *Streptopus* spp., ***Vaccinium* spp.**, *Valeriana sitchensis*, and *Viburnum edule*.

Macroinvertebrates

Macroinvertebrates, including annelid worms, molluscs, insects, and crustaceans, are extremely important components of wetland ecosystems. They convert plant matter to high-protein prey that support many wetland vertebrates.

The highest macroinvertebrate populations are frequently associated with wetlands with high levels of annual vegetation growth. Sites with abundant vegetation growth have good stuctural complexity important

for many life history requirements: forage, escape cover, sites for oviposition, emergence, respiration, attachment, and pupation. The most productive wetlands are those with fluctuating watertables, and non-acid waters (marshes). Drawdowns facilitate nutrient release and foster plant growth that contributes to nutrient and detritus supply on reflooding. Sites with permanent and stable water levels have lower macroinvertebrate biomass because litter quantities are reduced, but they frequently have more diverse communities with a full range of detritivores and their predators.

Inland saline waters are often highly productive for waterfowl, in part because these habitats lack fish competitors for prey. Predation by fish is a profound influence on invertebrate abundance and community structure and abundance. Coleopterans, Hemipterans, and Amphipods are common in saline waters.

*A Swallowtail on the rare Henderson's checker-mallow (*Sidalcea hendersonii*).*

The following ordination diagrams are based on average species cover values for the Site Associations described in this guide. In general, ecosystems that occur close together in the diagrams are similar in species composition. The axes of the diagrams are not directly related to environmental gradients, but correlations to gradients can be inferred from known attributes of the ecosystems ordinated.

Ordinations were generated by Nonmetric Multidimensional Scaling (NMS) for average species cover values for the Site Associations described in this guide. Site Associations are identified by letter code (or a short name where units have not been coded) and also symbol-coded by Site Class. All ordinations were performed using the NMS autopilot routine of PC-ORD 4.0 (McCune and Mefford 1999) with the following attributes: Distance measure = SORENSEN, Number of axes = 4, Random number seed starting configuration, 15 runs with real data and 30 runs with randomized data.

Figure A1.1 is an ordination of all numbered Site Associations used in the guide including some representative shallow-water ecosystems. Final stress for 3-dimensional solution was 14.74 (Monte Carlo $p<0.0323$) reached after 166 iterations with a final instability of 0.00010.

Figure A1.2 is an ordination of only numbered wetland Site Associations. Final stress for 3-dimensional solution was 12.23 (Monte Carlo $p<0.0323$) reached after 91 iterations with a final instability of 0.00008.

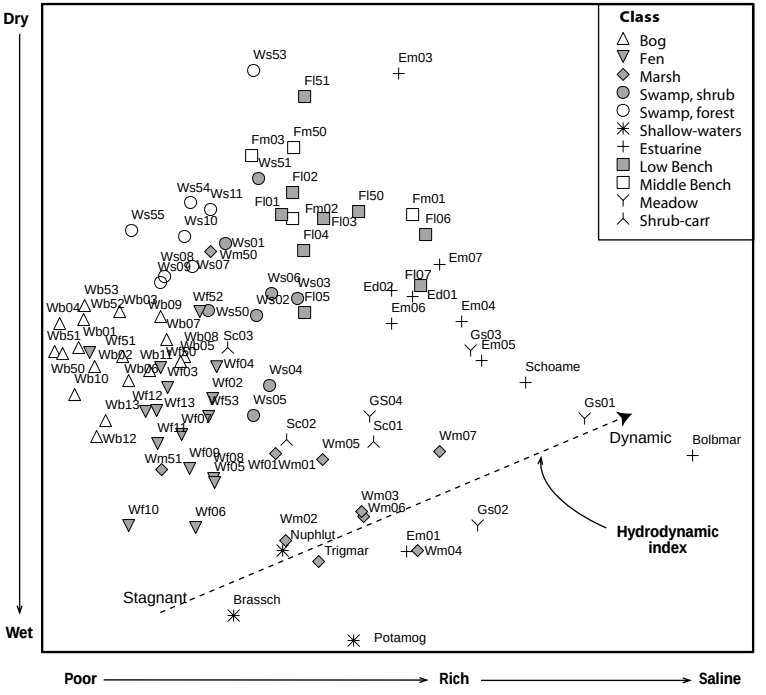


FIGURE A1.1 *NMS ordination of numbered wetland and related Site Associations including some shallow-water units.*

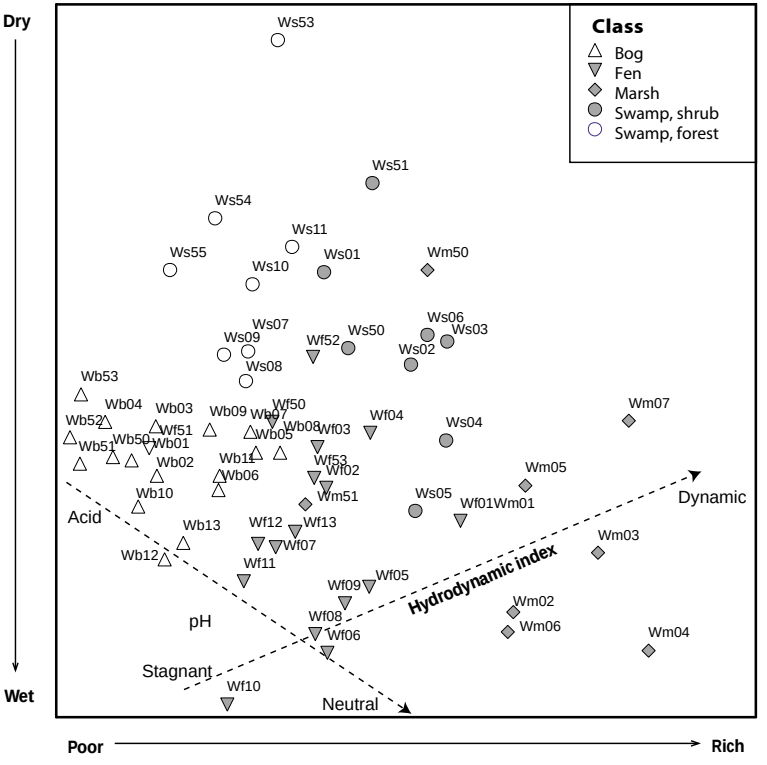


FIGURE A1.2 *NMS ordination of numbered wetland Site Associations only.*

The following overlays on the wetland edatopic grid indicate the ecological space of various vegetation characteristics.

Woody plants are limited by excessive moisture or prolonged flooding. Figure A2.1 indicates the approximate areas of the grid where physiognomic types are likely to occur. Forest occurs on very moist sites or wet sites where there are sufficient elevated microsites to support good tree growth. Trees and shrubs <10 m in height can occur on wet sites but wetter sites will not support tall shrub communities. Some very wet sites will support low shrubs where sufficient microtopography exists.

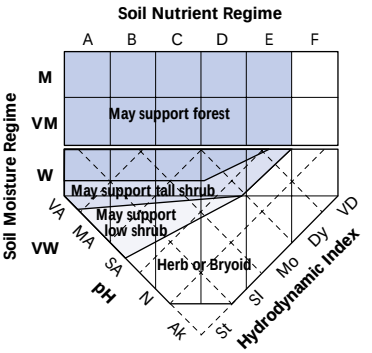


FIGURE A2.1 *Edatopic grid position of vegetation physiognomy.*

Figure A2.2 shows the grid location of peat-accumulating ecosystems (peatlands) and dominant bryophyte groups or species. Stagnant and sluggish sites are peatlands and are accumulating peat. Sites with mobile waters often have some thin, well decomposed peat veneers, while more dynamic sites will have minimal surface organic matter.

Sphagnum mosses dominate in acidic peat-accumulating sites, while more minerotrophic species occur in slightly acidic to alkali peatlands. Wetlands with more dynamic hydrology often have low bryophyte cover because of prolonged deep surface flooding or excessive shading and litterfall from a vigorous deciduous canopy.

Broad classes from vegetation classification are defined based on vegetation similarity, which does not exactly match site class boundaries. Eight

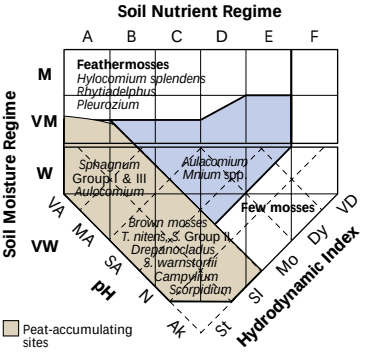


FIGURE A2.2 *Edatopic grid position of major bryophyte groups and peat-accumulating sites.*

vegetation classes that cover the range of wetlands and related ecosystems are presented in Figure A2.3. Meidinger et al. (2001) provide full descriptions of the following wetland and related vegetation classes.

Class Oxycoccus oxycoccos – Sphagnum
Communities of interior and coastal bogs and poor fens with stagnant, acidic, base-poor, organic soils. Characterized by the prevalence of *Sphagnum* species in the bryophyte layer and of other species tolerant of saturated, highly acidic soils. Site conditions are wet or very wet and nutrient-poor to very poor. Orders of this Class reflect climatic variation.

Class Populus balsamifera – Alnus
Forests throughout province dominated by, or with a significant component of, *Populus balsamifera*, or (for floodplains) associated with *Populus balsamifera* forests.

Class Carex – Drepanocladus
Communities of interior fens with high, stable watertables and high base-cation availability. Variously dominated by *Cyperids* such as *Carex lasiocarpa*, *C. limosa*, *Eleocharis quinqueflora*, *Trichophorum cespitosum*, or *T. alpinum* and with brown mosses such as *Drepanocladus* species, *Campylium stellatum*, *Scorpidium scorpioides*, or *Tomentypnum nitens*.

Class Magnocarex
Communities of interior peatlands and flooded mineral substrates dominated by large sedges, especially *Carex aquatilis*, *C. sitchensis*, or *C. utriculata*, but also other large cyperids such as *C. atherodes*,

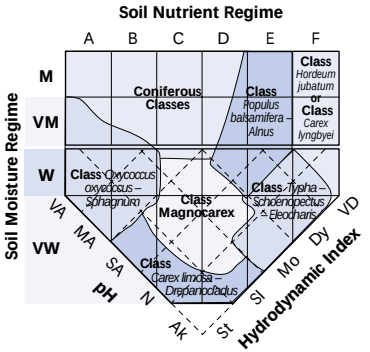


FIGURE A2.3 *Edatopic grid position of Classes from the British Columbia Vegetation Classification (Meidinger et al. 2001).*

C. exsiccata, *Dulichium arundinaceum*, or *Scirpus microcarpus*. Site conditions are Wet to Very Wet with a circum-medium nutrient regime and slightly acidic to circum-neutral soils. Shallow flooding followed by growing-season drawdown to just below the surface is typical. These are tall shrub, low shrub, or graminoid-dominated communities with large *Cyperaceae* always being prominent.

Class Typha – Schoenoplectus – Eleocharis
Communities of interior and coastal marshes deeply flooded with mobile, often strongly fluctuating watertables, and abundant available nutrients. Often simple communities strongly dominated by one to few emergent grass or grass-like species.

Class Hordeum jubatum
Interior communities of saline or alkali meadow/marshes occurring in warm and semi-arid climates. Located in basins and lake margins where evaporative drawdown accumulates mineral precipitates. These are low-diversity communities with flood- and salt- or alkali-tolerant grasses and forbs such as *Carex praegracilis*, *Distichlis spicata* var. *stricta*, *Hordeum jubatum*, *Juncus balticus*, *Poa juncifolia*, *Puccinellia nuttalliana*, *Salicornia rubra*, *Suaeda depressa*, *Spartina gracilis*, and *Triglochin maritima*.

The following tables includes all plant species used in this guide and their value as indicators of wetland environments.

The water-saturated environment of wetlands supports a unique group of plants called "hydrophytes." These plants are adapted to grow in water-logged soils. Species are designated as one of three indicator types.

Obligate Hydrophytes – Species that occur only under wetland conditions (Table A3.1).

Facultative – wetland affiliated – Species that grow primarily under wetland conditions but also, less commonly, in uplands (Table A3.2).

Facultative – upland affiliated – Species that occur in wetlands but are widespread in uplands (Table A3.3).

TABLE A3.1 *List of Obligate Hydrophytes*

Shrubs

Chamaedaphne calyculata
Salix athabascensis
Salix candida
Salix pedicellaris

Herbs and Dwarf Shrubs

Bolboschoenus fluviatilis
Bolboschoenus maritimus
Carex aquatilis
Carex atherodes
Carex buxbaumii
Carex canescens
Carex chordorrhiza
Carex cusickii
Carex diandra
Carex exsiccata
Carex flava
Carex gynocrates
Carex lanuginosa
Carex lasiocarpa
Carex leptalea
Carex limosa
Carex livida
Carex lyngbyei
Carex magellanica
Carex pauciflora
Carex pluriflora
Carex sitchensis
Carex tenuiflora
Carex utriculata
Carex viridula
Cicuta bulbifera
Comarum palustre
Drosera anglica
Drosera rotundifolia
Dulichium arundinaceum
Eleocharis palustris
Eleocharis quinqueflora
Equisetum fluviatile
Eriophorum angustifolium
Eriophorum brachyantherum
Eriophorum chamissonis
Glyceria borealis
Glyceria grandis
Glyceria occidentalis
Hypericum anagalloides
Iris pseudacorus
Kalmia microphylla
Lycopodiella inundata
Lycopus uniflorus
Menyanthes trifoliata
Oxycoccus oxycoccos
Phragmites australis
Polygonum amphibium
Ranunculus gmelinii
Ranunculus sceleratus
Rhynchospora alba
Rubus arcticus ssp. *acaulis*
Rubus chamaemorus
Sanguisorba officinalis
Sarracenia purpurea
Scheuchzeria palustris
Schoenoplectus acutus
Schoenoplectus tabernaemontani
Scirpus microcarpus
Scutellaria galericulata
Sium suave
Trichophorum alpinum
Trichophorum cespitosum
Triglochin maritima
Triglochin palustris
Typha latifolia
Viola palustris

Note: Species in ***bold*** can be very abundant or dominant on wetland sites.

TABLE A3.1 *Continued*

Aquatics

Brasenia schreberi
Calla palustris
Ceratophyllum demersum
Chara spp.
Elodea canadensis
Hippuris vulgaris
Lemna minor
Lemna trisulca
Myriophyllum verticillatum
Nuphar lutea
Potamogeton natans
Potamogeton richardsonii
Ranunculus aquatilis
Ricciocarpos natans
Ruppia maritima
Schoenoplectus subterminalis
Sparganium angustifolium
Sparganium emersum
Sparganium eurycarpum
Spirodela polyrhiza
Subularia aquatica
Utricularia intermedia
Utricularia macrorhiza
Vallisneria americana
Zostera marina

Lichens and Mosses

Calliergon cordifolium
Calliergon giganteum
Calliergon richardsonii
Calliergon stramineum
Calliergonella cuspidata
Campylium stellatum
Drepanocladus sendtneri
Fontinalis antipyretica
Hamatocaulis lapponicus
Hamatocaulis vernicosus
Hypnum lindbergii
Meesia longiseta
Meesia triquetra
Paludella squarrosa
Philonotis fontana
Scorpidium revolvens
Scorpidium scorpioides
Siphula ceratites
Sphagnum angustifolium
Sphagnum austinii
Sphagnum balticum
Sphagnum capillifolium
Sphagnum centrale
Sphagnum compactum
Sphagnum contortum
Sphagnum cuspidatum
Sphagnum fimbriatum
Sphagnum fuscum
Sphagnum lindbergii
Sphagnum magellanicum
Sphagnum majus
Sphagnum mendocinum
Sphagnum pacificum
Sphagnum palustre
Sphagnum papillosum
Sphagnum rubellum
Sphagnum russowii
Sphagnum subnitens
Sphagnum subsecundum
Sphagnum tenellum
Sphagnum teres
Sphagnum warnstorfii
Tomentypnum nitens
Warnstorfia exannulata
Warnstorfia fluitans
Warnstorfia sarmentosa

TABLE A3.2 *List of Facultative Hydrophytes – Wetland Affiliated*

Trees

Larix laricina
Pinus contorta var. *contorta*

Shrubs

Alnus incana
Betula occidentalis
Ledum groenlandicum
Myrica gale
Salix barrattiana
Salix lucida
Salix maccalliana
Spiraea douglasii

TABLE A.3.2 *Continued*

Herbs and Dwarf Shrubs

Agrostis aequivalvis
Agrostis scabra
Alopecurus aequalis
Amphiscirpus nevadensis
Anagallis minima
Anemone occidentalis
Angelica arguta
Angelica genuflexa
Aster borealis
Aster modestus
Beckmannia syzigachne
Berula erecta
Bolboschoenus maritimus
Calamagrostis stricta
Caltha leptosepala
Carex anthoxanthea
Carex capillaris
Carex disperma
Carex echinata
Carex nigricans
Carex obnupta
Carex stylosa
Cicuta douglasii
Coptis aspleniifolia
Coptis trifolia
Distichlis spicata
Dodecatheon jeffreyi
Epilobium palustre
Equisetum palustre
Equisetum sylvaticum
Equisetum variegatum
Fauria crista-galli
Galium trifidum
Gaultheria hispidula
Gentiana douglasiana
Gentiana sceptrum
Glaux maritima
Glyceria elata
Glyceria striata
Juncus arcticus
Juncus balticus
Juncus effusus
Juncus ensifolius
Kobresia sibirica
Leptarrhena pyrolifolia
Lilaea scilloides
Lobelia kalmii
Lysichiton americanus
Lythrum salicaria
Maianthemum trifolium
Microseris borealis
Mimulus guttatus
Muhlenbergia glomerata
Parnassia fimbriata
Parnassia palustris
Pedicularis parviflora
Petasites frigidus
Petasites sagittatus
Pinguicula vulgaris
Plantago maritima
Platanthera dilatata
Platanthera stricta
Puccinellia nutkaensis
Puccinellia nuttalliana
Puccinellia pumila
Ranunculus aquatilis var. *diffusus*
Ranunculus orthorhynchus
Rorippa palustris
Rubus arcticus
Salicornia virginica
Sanguisorba canadensis
Sanguisorba menziesii
Schoenoplectus americanus
Schoenoplectus saximontanus
Scolochloa festucacea
Senecio atropurpureus
Spartina gracilis
Spartina patens
Torreyochloa pauciflora
Triantha glutinosa
Trientalis europaea ssp. *arctica*

Lichens and Mosses

Aulacomnium palustre
Brachythecium salebrosum
Brachythecium turgidum
Campylopus atrovirens
Drepanocladus aduncus
Mylia anomala
Philonotis fontana
Plagiomnium ellipticum
Pohlia nutans
Pohlia wahlenbergii
Rhizomnium pseudopunctatum
Sphagnum squarrosum

TABLE A3.3 *List of Facultative Hydrophytes – Upland Affiliated*

Trees

Abies amabilis
Abies lasiocarpa
Alnus rubra
Betula papyrifera
Malus fusca
Physocarpus capitatus
Picea engelmannii
Picea engelmannii x *glauca*
Picea glauca
Picea mariana
Picea sitchensis
Pinus contorta var. *latifolia*
Thuja plicata
Tsuga heterophylla
Tsuga mertensiana

Shrubs

Betula nana
Cornus stolonifera
Crataegus douglasii
Elliottia pyroliflorus
Juniperus communis
Ledum glandulosum
Lonicera involucrata
Menziesia ferruginea
Pentaphylloides floribunda
Ribes bracteosum
Ribes lacustre
Rosa acicularis
Rubus spectabilis
Salix alaxensis
Salix barclayi
Salix bebbiana
Salix brachycarpa
Salix commutata
Salix drummondiana
Salix glauca
Salix pseudomonticola
Sambucus racemosa
Vaccinium alaskaense
Vaccinium ovalifolium
Vaccinium uliginosum
Viburnum edule

Herbs and Dwarf Shrubs

Achillea millefolium
Agrostis exarata
Aster subspicatus
Athyrium filix-femina
Blechnum spicant
Calamagrostis canadensis
Calamagrostis nutkaensis
Carex praegracilis
Carex scoparia
Claytonia cordifolia
Cornus canadensis
Cornus suecica
Cotula coronopifolia
Danthonia intermedia
Delphinium glaucum
Deschampsia cespitosa
Distichlis spicata var. *stricta*
Dryopteris expansa
Dryopteris filix-mas
Empetrum nigrum
Epilobium angustifolium
Epilobium ciliatum
Equisetum arvense
Equisetum pratense
Erigeron peregrinus
Fragaria virginiana
Gaultheria shallon
Geum macrophyllum
Gymnocarpium dryopteris
Heracleum maximum
Hordeum brachyantherum
Hordeum jubatum
Juncus arcticus ssp. *sitchensis*
Lilaeopsis occidentalis
Lycopodium annotinum
Maianthemum dilatatum
Maianthemum stellatum
Matteuccia struthiopteris
Mentha arvensis
Mitella nuda
Mitella pentandra
Muhlenbergia richardsonis
Phalaris arundinacea
Plantago macrocarpa
Poa palustris
Poa pratensis
Potentilla anserina
Pyrola asarifolia
Pyrola chlorantha
Pyrola minor
Rubus parviflorus
Rubus pedatus
Salicornia maritima
Senecio triangularis
Spergularia canadensis
Streptopus amplexifolius
Suaeda calceoliformis
Trollius albiflorus
Urtica dioica
Vaccinium vitis-idaea
Vahlodea atropurpurea
Valeriana sitchensis
Veratrum viride

Lichens and Mosses

Cladina rangiferina
Cladonia borealis
Hylocomium splendens
Pellia neesiana
Pleurozium schreberi
Polytrichum juniperinum
Rhytidiadelphus loreus
Rhytidiadelphus triquetrus
Sphagnum girgensohnii

APPENDIX 4 Crosswalk to other classifications

TABLE A4.1 *Wetland and related ecosystem Site Associations with corresponding BEC site series*

	BEC Site Series
Fl02	ICHvc/52, ICHwc/52
Fl50	CWHdm/10, CWHds1/10, CWHds2/10, CWHmm1/10, CWHms1/09, CWHms2/09, CWHvm1/11, CWHwm/07, CWHws1/09, CWHws2/09, CWHxm/10
Fl51	CWHvh1/10, CWHvh2/10, CWHwh1/09
Fm01	BGxw1/08, IDFdk1a/94, IDFxh1a/98, IDFxh2a/95, PPdh2/04
Fm02	ICHmc1/05, ICHmc2/06, SBSdk/08, BWBSmw2/05
Fm03	ICHvc/05, ICHwc/06
Fm50	CDFmm/08, CWHdm/09, CWHds1/09, CWHds2/09, CWHmm1/09, CWHms1/08, CWHms2/08, CWHvm1/10, CWHvm2/10, CWHws2/08, CWHxm/09
Wb01	SBSdk/09
Wb02	ICHmm/07, SBSvk/08, SBSwk3/05, SBSwk3a/05
Wb03	BWBSmw2/08, BWBSdk1/10, BWBSdk2/07, BWBSmw1/08
Wb05	ICHmc2/08, SBPSdc/07, SBPSmc/07, SBPSmk/08, SBSdh1/08, SBSdh2/08, SBSmc2/12, SBSmc3/09, SBSmk1/10, SBSmw/10, SBSwk1/11
Wb06	BWBSdk2/08
Wb08	SBPSdc/07, SBPSmk/08, SBSdh/08, SBSmk1/10, SBSdk/10, SBSdw2/11, SBSdw3/10 (in part)
Wb09	BWBSdk1/09, BWBSwk1/07, BWBSwk2/07
Wb51	CWHvh2/31
Wb52	CWHvh2/32
Wb53	CWHvh2/12
Wf01	ICHmk1/08
Wf03	ESSFdc1/07, ESSFdc2/09, ESSFvc/06, ESSFwc1/05, ESSFwc2/10
Ws01	ICHvc/52, ICHwc/52
Ws07	ICHdk/09, ICHmc2/07, ICHmk2/06, ICHvc/06, ICHwc/08, IDFdk2/06, IDFdk3/09, IDFdk4/10, IDFdm2/07, IDFxm/09, MSdc2/08, MSdk/06, MSdm2/07, MSdv/09, MSxv/08, SBPSdc/08, SBPSmc/06, SBPSmk/07, SBSdk/07, SBSdw1/09, SBSdw3/09, SBSmc1/08, SBSmc2/10b, SBSmc2/11, SBSmc3/08, SBSmk1/09, SBSmk2/06, SBSmw/09, SBSwk1/09, SBSwk2/06
Ws08	ESSFdc1/06, ESSFdk/06, ESSFdv/06, ESSFmc/09, ESSFmc/10, ESSFmk/06, ESSFmm1/07, ESSFmv1/05, ESSFmv2/06, ESSFmv3/07, ESSFmv4/05, ESSFmw/08, ESSFvc/05, ESSFwc3/03, ESSFwc4/07, ESSFwk1/07, ESSFwv/09, ESSFxc/08
Ws10	ICHmw2/08, ICHmw3/08, ICHvk1/06, ICHvk2/06, ICHwk1/08, ICHwk2/08, ICHwk3/09
Ws11	SBSvk/10
Ws53	CDFmm/11, CWHxm/12
Ws54	CWHds1/12, CWHds2/12, CWHmm1/12, CWHms1/11, CWHms2/11, CWHvh1/13, CWHvh2/13, CWHvm1/14, CWHwh1/12, CWHwh2/06, CWHws1/11, CWHws2/11
Ws55	MHmm2/09, MHwh1/09, MHwh2/09

TABLE A4.2 *Wetland Site Associations corresponding to the Cariboo wetland classification*

	Cariboo IDF (Steen and Roberts 1988)	Cariboo SBPS (Roberts 1984)
Gs01	Alkali saltgrass – Nuttall's alkaligrass meadow (IDFb2/W1)	Saltgrass – Alkaligrass meadow (SBSa/W1)
Gs02	Nuttall's alkaligrass – Foxtail barley meadow (IDFb2/W2)	
Gs03	Arctic rush – Field sedge meadow (IDFb2/W3)	Arctic rush – Field sedge meadow (SBSa/W2)
Gs04		Tufted hairgrass meadow (SBSa/W3)
Sc01	Scrub birch – Kinnikinnick shrub-carr (IDFb2/W4)	Scrub birch – Kinnikinnick shrub-carr (SBSa/W4)
Sc02		Grey-leaved willow – Moss shrub-carr (SBSa/W5)
Wb01		Labrador tea – *Sphagnum* bog SBSa/W9)
Wf01	Beaked sedge – Water sedge fen (IDFb2/W9)	Beaked sedge fen (SBSa/W12)
Wf05	Slender sedge – Moss fen (IDFb2/W10)	Slender sedge fen (SBSa/W14)
Wf06	Buckbean – Slender sedge fen (IDFb2/W11)	
Wf07	Low willow – Buckbean fen (IDFb2/W7)	Bog willow – Sedge low shrub fen (SBSa/W8)
Wm03	Awned sedge fen-marsh (IDFb2/W8)	Awned sedge marsh (SBSa/W11)
Wm05	Cattail marsh (IDFb2/W13)	
Wm06	Great bulrush marsh (IDFb2/W14)	Bulrush marsh (SBSa/W15)
Wm07	Arctic rush – Field sedge meadow (IDFb2/W3)	Arctic rush – Field sedge meadow (SBSa/W2)
Ws04		Drummond's willow – Sedge swamp (SBSa/W7)
Ws05	MacCalla's willow – Beaked sedge fen (IDFb2/W6)	MacCalla's willow – Sedge tall shrub fen (SBSa/W6)

TABLE A4.3 *Wetland Site Associations corresponding with Klinka et al. 1997*

Fl04	*Equisetum arvense – Salix sitchensis* (in part)
Fl50	*Equisetum arvense – Salix sitchensis* (in part)
Wb50	*Ledum groenlandicum – Sphagnum* Assoc.
Wf50	*Eriophorum – Carex aquatilis* Assoc.
Wf52	*Carex lasiocarpa* and *sitchensis – Myrica gale* Assoc.
Wf53	*Nuphar polysepala*: *Carex lasiocarpa* Subassoc.
Wm04	*Nuphar polysepala*: *Eleocharis paustris* Subassoc.
Wm05	*Juncus ensifolius – Typha latifolia* Assoc., *Oenanthe sarmentosa – Typha latifolia* Assoc.
Wm06	*Nuphar polysepala*: *Scirpus validus* Subassoc.
Wm51	*Menyanthes trifoliata – Dulichium arundinaceum* Assoc.
Ws50	*Spiraea douglasii – Carex sitchensis*, *Spiraea douglasii – Carex phyllomanica* and *sitchensis* Assoc.
Ws51	*Lysichiton americanum – Salix lasiandra* and *sitchensis* Assoc.
Ws52	*Carex obnupta – Alnus rubra* Assoc.

TABLE A4.4 *Wetland Site Associations corresponding with coastal classifications in Washington and Alaska*

	Coastal Washington (Kunze 1994)	Copper River Delta, Alaska (Boggs 2000)
Em04		*Puccinellia nutkaensis* c.t.
Em05	*Carex lyngbyei* c.t.	*Carex lyngbyaei* c.t.
Em06		*Carex lyngbyaei* – Mixed-herb c.t.
Fl01	*Alnus incana* c.t.*	
Fl04		*Salix sitchensis* c.t.
Fl50	*Cornus stolonifera – Salix sitchensis* c.t.	*Salix sitchensis* c.t.
Fl51	*Alnus rubra/Rubus spectabilis* c.t.	
Wb50	*Kalmia occidentalis – Ledum groenlandicum/Sphagnum* spp. c.t.	
Wf04		*Salix barclayi – Carex sitchensis* c.t.
Wf50		
Wf51	*Carex sitchensis – Sphagnum* c.t.	*Carex sitchensis – Sphagnum* c.t.
Wf52	*Myrica gale* c.t.	
Wf53	*Carex lasiocarpa* c.t.	
Wm01	*Carex rostrata* c.t.	*Carex rostrata* c.t.
Wm02	*Equisetum fluviatile* c.t.	*Equisetum fluviatile* c.t.
Wm04	*Eleocharis palustris* c.t.	*Eleocharis palustris* c.t.
Wm05	*Typha latifolia* c.t.	
Wm06	*Scirpus acutus* c.t.	
Wm07	*Juncus balticus* c.t.	
Wm50	*Carex sitchensis* c.t.	*Carex sitchensis* c.t.
Wm51	*Dulichium arundinaceum* c.t.	
Ws06		*Salix sitchensis* c.t.
Ws50	*Spiraea douglasii* c.t./*Sphagnum*; *Spiraea* c.t.	
Ws52	*Alnus rubra – Lysichiton americanum* c.t.	
Ws53	*Thuja plicata – Tsuga heterophylla/Lysichiton americanum* c.t.	

* Community type

TABLE A4.5 *Wetland Site Associations corresponding with classifications in Washington and Montana*

	Lincoln County, Washington (Crawford 2000)	Montana (Hansen et al. 1995)
Fl01		*Alnus incana* c.t.
Fl02	Mountain alder/red-osier dogwood assoc.	
Fl03		*Salix lasiandra* c.t.
Fl05		*Salix drummondiana*/*Calamagrostis canadensis* h.t.**
Fl06	Sandbar willow assoc.	*Salix exigua* c.t.
Fl07	Water birch/Wood's rose c.t.*	
Fm01	Black cottonwood/Common snowberry forest	
Gs01	Saltgrass – Clustered field sedge c.t.	*Distichilis spicata* h.t.
Gs02		*Hordeum jubatum* c.t.
Gs04	Tufted hairgrass assoc.	*Deschampsia cespitosa* h.t.
Wb02		*Salix planifolia*/*Carex aquatilis* h.t.
Wf01		*Carex rostrata* h.t. and *Carex aquatilis* h.t.
Wf02		*Betula nana*/*Carex rostrata* h.t.
Wf05		*Carex lasiocarpa* h.t.
Wf08		*Carex limosa* h.t.
Wf09		*Eleocharis pauciflora* h.t.
Wm01	Northwest Territory sedge assoc.	
Wm02		*Equisetum fluviatile* h.t.
Wm04	Common spikerush assoc.	*Eleocharis palustris* h.t.
Wm05		*Typha latifolia* h.t.
Wm06	Hard-stem bulrush assoc.	*Scirpus acutus* h.t.
Wm07	Baltic rush – Silverweed cinquefoil c.t.	*Juncus balticus* c.t.
Ws03		*Salix bebbiana* c.t.
Ws04		*Salix drummondiana*/*Carex rostrata* h.t.

* Community type

** Habitat type

Abies amabilis	amabilis fir
Abies lasiocarpa	subalpine fir
Acer glabrum	Douglas maple
Acer macrophyllum	bigleaf maple
Achillea millefolium	yarrow
Actaea rubra	baneberry
Agrostis aequivalvis	Alaska bentgrass
Agrostis exarata	spike bentgrass
Agrostis stolonifera	creeping bentgrass
Alnus viridis ssp. *crispa*	green alder
Alnus incana	mountain alder
Alnus rubra	red alder
Alopecurus aequalis	little meadow-foxtail
Amphiscirpus nevadensis	Nevada bulrush
Andromeda polifolia	bog-rosemary
Angelica lucida	seacoast angelica
Antennaria pulcherrima	showy pussytoes
Arctostaphylos uva-ursi	kinnikinnick
Aster ciliolatus	Lindley's aster
Aster conspicuus	showy aster
Aster ericoides	tufted white prairie aster
Aster subspicatus	Douglas' aster
Athyrium filix-femina	lady fern
Atriplex patula	common orache
Aulacomnium palustre	glow moss
Barbilophozia sp.	leafy liverwort
Betula nana	scrub birch
Betula occidentalis	water birch
Betula papyrifera	paper birch
Blechnum spicant	deer fern
Bolboschoenus maritimus	seacoast bulrush
Brachythecium spp.	feathermosses
Brasenia schreberi	water shield
Bryum pseudotriquetrum	marsh thread-moss
Calamagrostis canadensis	bluejoint
Calamagrostis stricta	slimstem reedgrass
Calliergon sp.	water-moss
Calliergon stramineum	straw spear-moss
Caltha leptosepala	white mountain marsh-marigold
Campylium sp.	star-moss
Campylium stellatum	yellow star-moss
Campylopus atrovirens	bristly swan-neck moss

Carex anthoxanthea	yellow-flowered sedge
Carex aquatilis	water sedge
Carex atherodes	awned sedge
Carex chordorrhiza	cordroot sedge
Carex disperma	soft-leaved sedge
Carex exsiccata	inflated sedge
Carex lanuginosa	woolly sedge
Carex lasiocarpa	slender sedge
Carex leptalea	bristle-stalked sedge
Carex limosa	shore sedge
Carex livida	pale sedge
Carex lyngbyei	Lyngbye's sedge
Carex magellanica	poor sedge
Carex obnupta	slough sedge
Carex pauciflora	few-flowered sedge
Carex pluriflora	many-flowered sedge
Carex praegracilis	field sedge
Carex sitchensis	Sitka sedge
Carex tenuiflora	sparse-leaved sedge
Carex utriculata	beaked sedge
Ceratophyllum sp.	hornwort
Ceratophyllum demersum	common hornwort
Chamaecyparis nootkatensis	yellow-cedar
Chamaedaphne calyculata	leatherleaf
Chara sp.	stonewort
Cicuta douglasii	Douglas' water-hemlock
Circaea alpina	enchanter's-nightshade
Cladina spp.	reindeer lichens
Cladonia spp.	clad lichens
Comarum palustre	marsh cinquefoil
Conioselinum gmelinii	Pacific hemlock-parsley
Coptis trifolia	three-leaved goldthread
Cornus canadensis	bunchberry
Cornus stolonifera	red-osier dogwood
Deschampsia cespitosa ssp. *beringensis*	tufted hairgrass
Deschampsia cespitosa ssp. *cespitosa*	tufted hairgrass
Deschampsia cespitosa	tufted hairgrass
Distichlis spicata	seashore saltgrass
Distichlis spicata var. *spicata*	seashore saltgrass
Distichlis spicata var. *stricta*	alkali saltgrass
Drepanocladus sp.	hook-mosses
Drepanocladus aduncus	common hook-moss
Drosera anglica	great sundew
Drosera rotundifolia	round-leaved sundew

Dulichium arundinaceum	three-way sedge
Eleocharis palustris	common spike-rush
Eleocharis quinqueflora	few-flowered spike-rush
Elliottia pyroliflorus	copperbush
Elodea canadensis	Canadian waterweed
Elymus glaucus	blue wildrye
Elymus trachycaulus	slender wheatgrass
Empetrum nigrum	crowberry
Epilobium angustifolium	fireweed
Equisetum sp.	horsetail
Equisetum arvense	common horsetail
Equisetum fluviatile	swamp horsetail
Equisetum hyemale	scouring-rush
Equisetum pratense	meadow horsetail
Equisetum telmateia	giant horsetail
Erigeron peregrinus	subalpine daisy
Eriophorum angustifolium	narrow-leaved cotton-grass
Eriophorum chamissonis	Chamisso's cotton-grass
Fauria crista-galli	deer-cabbage
Festuca rubra	red fescue
Fragaria virginiana	wild strawberry
Fritillaria camschatcensis	northern rice-root
Fucus sp.	brown seaweed
Galium trifidum	small bedstraw
Gaultheria hispidula	creeping-snowberry
Gaultheria shallon	salal
Geum macrophyllum	large-leaved avens
Glaux maritima	sea-milkwort
Glyceria borealis	northern mannagrass
Glyceria elata	tall mannagrass
Gymnocarpium dryopteris	oak fern
Heracleum maximum	cow-parsnip
Homatocaulis vernicosus	stick hook-moss
Hordeum brachyantherum	meadow barley
Hordeum jubatum	foxtail barley
Hylocomium splendens	step moss
Hypericum anagalloides	bog St. John's-wort
Iris pseudacorus	yellow iris
Isoetes echinospora	bristle-like quillwort
Juncus arcticus	arctic rush
Juncus balticus	Baltic rush
Juniperus communis	common juniper
Kalmia microphylla	western bog-laurel
Eurhynchium praelongum	slender beaked-moss
Kobresia myosuroides	Bellard's kobresia
Koeleria macrantha	junegrass

Larix laricina	tamarack
Lathyrus palustris	marsh peavine
Ledum groenlandicum	Labrador tea
Lemna sp.	duckweed
Leptarrhena pyrolifolia	leatherleaf saxifrage
Leymus mollis	dune wildrye
Ligusticum scoticum	beach lovage
Lilaeopsis occidentalis	western lilaeopsis
Lobelia dortmanna	water lobelia
Lonicera involucrata	black twinberry
Lupinus nootkatensis	Nootka lupine
Lysichiton americanus	skunk cabbage
Lythrum salicaria	purple loosestrife
Maianthemum dilatatum	false lily-of-the-valley
Maianthemum stellatum	star-flowered false solomon's-seal
Malus fusca	Pacific crab apple
Matteuccia struthiopteris	ostrich fern
Meesia triquetra	three-ranked hump-moss
Menyanthes trifoliata	buckbean
Menziesia ferruginea	false azalea
Mnium spp.	leafy mosses
Muhlenbergia richardsonis	mat muhly
Myrica gale	sweet gale
Myriophyllum spicatum	Eurasian water-milfoil
Myriophyllum sp.	water-milfoil
Myriophyllum verticillatum	verticillate water-milfoil
Najas flexilis	wavy water nymph
Nuphar lutea	yellow pond-lily
Nuphar lutea ssp. *polysepala*	yellow pond-lily
Oemleria cerasiformis	Indian-plum
Oenanthe sarmentosa	Pacific water-parsley
Oplopanax horridus	devil's club
Osmorhiza berteroi	mountain sweet-cicely
Oxycoccus oxycoccos	bog cranberry
Phalaris arundinacea	reed canarygrass
Philonotis fontana	spring moss
Phragmites australis	common reed
Picea X	spruce
Picea mariana	black spruce
Picea sitchensis	Sitka spruce
Pinus contorta	lodgepole pine
Pinus contorta var. *contorta*	shore pine
Pinus contorta var. *latifolia*	lodgepole pine
Pinus monticola	western white pine
Plantago macrocarpa	Alaska plantain
Plantago maritima	sea plantain

Platanthera dilatata	fragrant white rein orchid
Pleurozium schreberi	red-stemmed feathermoss
Poa pratensis	Kentucky bluegrass
Poa secunda ssp. *juncifolia*	Nevada bluegrass
Poa secunda	Sandberg's bluegrass
Poa trivialis	rough bluegrass
Polygonum amphibium	water smartweed
Polystichum munitum	sword fern
Populus balsamifera	balsam poplar
Populus balsamifera ssp. *trichocarpa*	black cottonwood
Populus tremuloides	trembling aspen
Potamogeton sp.	pondweed
Potamogeton amplifolius	large-leaved pondweed
Potamogeton foliosus	closed-leaved pondweed
Potamogeton gramineus	grass-leaved pondweed
Potamogeton natans	floating-leaved pondweed
Potamogeton praelongus	long-stalked pondweed
Potamogeton pusillus	small pondweed
Potamogeton richardsonii	Richardson's pondweed
Potamogeton robbinsii	Robbin's pondweed
Potentilla anserina	common silverweed
Potentilla egedii	coast silverweed
Potentilla gracilis	graceful cinquefoil
Pteridium aquilinum	bracken fern
Ptilium crista-castrensis	ostrich-plume feather-moss
Puccinellia nuttalliana	Nuttall's alkaligrass
Puccinellia pumila	dwarf alkaligrass
Pyrola asarifolia	pink wintergreen
Racomitrium lanuginosum	hoary rock-moss
Ranunculus aquatilis	white water-buttercup
Ranunculus flammula	lesser spearwort
Ranunculus orthorhynchus	straight-beaked buttercup
Rhynchospora alba	white beak-rush
Rhytidiadelphus loreus	lanky moss
Rhytidiadelphus squarrosus	bent-leaf moss
Ribes bracteosum	stink currant
Rosa acicularis	prickly rose
Rosa nutkana	Nootka rose
Rosa sp.	rose
Rosa woodsii	prairie rose
Rubus chamaemorus	cloudberry
Rubus parviflorus	thimbleberry
Rubus spectabilis	salmonberry
Ruppia maritima	widgeon-grass
Salicornia virginica	American glasswort

Salix barclayi	Barclay's willow
Salix bebbiana	Bebb's willow
Salix brachycarpa	short-fruited willow
Salix candida	sage willow
Salix commutata	under-green willow
Salix drummondiana	Drummond's willow
Salix exigua	sandbar willow
Salix glauca	grey-leaved willow
Salix lucida ssp. *lasiandra*	Pacific willow
Salix lucida	Pacific willow
Salix maccalliana	MacCalla's willow
Salix myrtillifolia	bilberry willow
Salix pedicellaris	bog willow
Salix planifolia	tea-leaved willow
Salix prolixa	Mackenzie willow
Salix sitchensis	sitka willow
Sambucus racemosa	red elderberry
Sanguisorba canadensis	sitka burnet
Sanguisorba officinalis	great burnet
Sarracenia purpurea	common pitcher-plant
Scheuchzeria palustris	scheuchzeria
Schoenoplectus acutus	hard-stemmed great bulrush
Schoenoplectus americanus	American bulrush
Schoenoplectus pungens	sharp bulrush
Schoenoplectus subterminalis	water clubrush
Schoenoplectus tabernaemontani	soft-stemmed great bulrush
Scirpus microcarpus	small-flowered bulrush
Scorpidium sp.	sausage-moss
Scorpidium revolvens	rusty hook-moss
Scorpidium scorpioides	hooked scorpion-moss
Senecio triangularis	arrow-leaved groundsel
Siphula ceratites	northern waterfingers
Sium suave	hemlock water-parsnip
Sparganium angustifolium	narrow-leaved bur-reed
Sparganium natans	small bur-reed
Spartina gracilis	alkali cordgrass
Spergularia canadensis	Canadian sand-spurry
Sphagnum sp.	peat-moss
Sphagnum angustifolium	poor-fen peat-moss
Sphagnum austinii	tough peat-moss
Sphagnum capillifolium	common red peat-moss
Sphagnum fuscum	common brown peat-moss
Sphaghum magellanicum	Magellanic peat-moss
Sphagnum papillosum	fat peat-moss
Sphagnum Group I	peat-mosses, Group I
Sphagnum Group II	peat-moss - Group II

Sphagnum Group III	peat-mosses, Group III
Sphagnum Group IV	peat-mosses, Group IV
Spiraea douglasii	pink spirea
Stachys mexicana	Mexican hedge-nettle
Streptopus amplexifolius	clasping twistedstalk
Streptopus lanceolatus	rosy twistedstalk
Stuckenia pectinata	fennel-leaved pondweed
Suaeda calceoliformis	seablite
Subularia aquatica	awlwort
Symphoricarpos albus	common snowberry
Taraxacum officinale	common dandelion
Thalictrum occidentale	western meadowrue
Thuja plicata	western redcedar
Tiarella trifoliata	foamflower
Triantha glutinosa	sticky false-asphodel
Tomentypnum sp.	fen moss
Tomentypnum nitens	golden fuzzy fen moss
Triantha glutinosa	sticky false-asphodel
Trichophorum alpinum	Hudson bay clubrush
Trichophorum cespitosum	tufted clubrush
Trifolium wormskioldii	springbank clover
Triglochin maritima	seaside arrow-grass
Trollius albiflorus	globeflower
Tsuga heterophylla	western hemlock
Tsuga mertensiana	mountain hemlock
Typha latifolia	common cattail
Urtica dioica	stinging nettle
Utricularia gibba	humped bladderwort
Utricularia intermedia	flat-leaved bladderwort
Utricularia macrorhiza	greater bladderwort
Utricularia sp.	bladderwort
Vaccinium sp.	blueberry
Vaccinium alaskaense/ ovalifolium	Alaska/oval-leaved blueberry
Vaccinium uliginosum	bog blueberry
Vaccinium vitis-idaea	lingonberry
Vahlodea atropurpurea	mountain hairgrass
Valeriana sitchensis	Sitka valerian
Veratrum viride	Indian hellebore
Veronica scutellata	marsh speedwell
Viburnum edule	highbush-cranberry
Viola palustris	marsh violet
Warnstorfia sp.	hook-mosses
Zostera marina	common eel-grass

APPENDIX 6 Wildlife species Affiliated with Wetlands and Related Ecosystems

The following list includes wildlife species that commonly live in or use wetlands and related ecosystems.

Amphibians

Mole Salamanders *Ambysomatidae*	
Northwestern Salamander	*Ambystoma gracile*
Long-toed Salamander	*Ambystoma macrodactylum*
Tiger Salamander	*Ambystoma tigrinum*
Giant Salamanders *Dicamptodontidae*	
Pacific Giant Salamander	*Dicamptodon tenebrosus*
Lungless Salamanders *Plethodontidae*	
Wandering Salamander	*Aneides vagrans*
Ensatina	*Ensatina eschscholtzii*
Coeur d'Alene Salamander	*Plethodon idahoensis*
Western Red-backed Salamander	*Plethodon vehiculum*
Newts *Salamandridae*	
Rough-skinned Newt	*Taricha granulosa*
Tailed Frogs *Ascaphidae*	
Coastal Tailed Frog	*Ascaphus truei*
Rocky Mountain Tailed Frog	*Ascaphus montanus*
Spadefoots *Pelobatidae*	
Great Basin Spadefoot	*Spea intermontana*
True Toads *Bufonidae*	
Western Toad	*Bufo boreas*
Treefrogs *Hylidae*	
Pacific Treefrog	*Hyla regilla*
Boreal Chorus Frog	*Pseudacris maculata*
True Frogs *Ranidae*	
Red-legged Frog	*Rana aurora*
Bullfrog	*Rana catesbeiana*
Green Frog	*Rana clamitans*
Columbia Spotted Frog	*Rana luteiventris*
Northern Leopard Frog	*Rana pipiens*
Oregon Spotted Frog	*Rana pretiosa*
Wood Frog	*Rana sylvatica*

Reptiles

Western Pond Turtle	*Clemmys marmorata*
Painted Turtle	*Chrysemys picta*
Rattlesnake	*Crotalus viridis*
Gopher Snake	*Pituophis melanoleucus*
Common Garter Snake	*Thamnophis sirtalis*
Western Terrestrial Garter Snake	*Thamnophis elegans*

Birds

Loons *Gaviidae*

Red-throated Loon	*Gavia stellata*
Pacific Loon	*Gavia pacifica*
Common Loon	*Gavia immer*

Grebes *Podicipedidae*

Pied-billed Grebe	*Podilymbus podiceps*
Horned Grebe	*Podiceps auritus*
Red-necked Grebe	*Podiceps grisegena*
Eared Grebe	*Podiceps nigricollis*
Western Grebe	*Aechmophorus occidentalis*
Clark's Grebe	*Aechmophorus clarkii*

Pelicans *Pelecanidae*

American White Pelican	*Pelecanus erythrorhynchos*

Bitterns and Herons *Ardeiadae*

American Bittern	*Botaurus lentiginosus*
Great Blue Heron	*Ardea herodias*
Great Egret	*Casmerodius albus*
Cattle Egret	*Bubulcus ibis*
Green Heron	*Butorides striatus*
Black-crowned Night Heron	*Nycticorax nycticorax*

Swans, Geese, and Ducks *Anatidae*

Tundra Swan	*Cygnus columbianus*
Trumpeter Swan	*Cygnus buccinator*
Mute Swan	*Cygnus olor*
Greater White-fronted Goose	*Anser albifrons*
Snow Goose	*Chen caerulescens*
Brant	*Branta bernicla*
Canada Goose	*Branta canadensis*
Wood Duck	*Aix sponsa*
Green-winged Teal	*Anas crecca*

American Black Duck	*Anas rubripes*
Mallard	*Anas platyrhynchos*
Northern Pintail	*Anas acuta*
Blue-winged Teal	*Anas discors*
Cinnamon Teal	*Anas cyanoptera*
Northern Shoveler	*Anas clypeata*
Gadwall	*Anas strepera*
Eurasian Wigeon	*Anas penelope*
American Wigeon	*Anas americana*
Canvasback	*Aythya valisineria*
Redhead	*Aythya americana*
Ring-necked Duck	*Aythya collaris*
Greater Scaup	*Aythya marila*
Lesser Scaup	*Aythya affinis*
Northen Long-tailed Duck	*Clangula hyemalis*
Common Goldeneye	*Bucephala clangula*
Barrow's Goldeneye	*Bucephala islandica*
Bufflehead	*Bucephala albeola*
Hooded Merganser	*Lophodytes cucullatus*
Common Merganser	*Mergus merganser*
Red-breasted Merganser	*Mergus serrator*
Ruddy Duck	*Oxyura jamaicensis*
Rails and Coots *Rallidae*	
Virginia Rail	*Rallus limicola*
Sora	*Porzana carolina*
American Coot	*Fulica americana*
Cranes *Gruidae*	
Sandhill Crane	*Grus canadensis*
Hawks and Eagles *Accipitridae*	
Osprey	*Pandion haliaetus*
Bald Eagle	*Haliaeetus leucocephalus*
Grouse and Ptarmigans *Phasianidae*	
Blue Grouse	*Dendragapus obscurus*
Willow Ptarmigan	*Lagopus lagopus*
Ruffed Grouse	*Bonasa umbellus*
Sharp-tailed Grouse	*Tympanuchus phasianellus* ssp. *columbianus*

Plovers *Charadriidae*

Semipalmated Plover	*Charadrius semipalmatus*
Killdeer	*Charadrius vociferus*
Lesser Golden-Plover	*Pluvialis dominica*

Stilts and Avocets *Recurvirostridae*

American Avocet	*Recurvirostra americana*

Sandpipers *Scolopacidae*

Greater Yellowlegs	*Tringa melanoleuca*
Lesser Yellowlegs	*Tringa flavipes*
Solitary Sandpiper	*Tringa solitaria*
Willet	*Catoptrophorus semipalmatus*
Spotted Sandpiper	*Actitis macularia*
Upland Sandpiper	*Bartramia longicauda*
Hudsonian Godwit	*Limosa haemastica*
Semipalmated Sandpiper	*Calidris pusilla*
Western Sandpiper	*Calidris mauri*
Least Sandpiper	*Calidris minutilla*
Baird's Sandpiper	*Calidris bairdii*
Pectoral Sandpiper	*Calidris melanotos*
Dunlin	*Calidris alpina*
Sanderling	*Calidris alba*
Stilt Sandpiper	*Calidris himantopus*
Buff-breasted Sandpiper	*Tryngites subruficollis*
Short-billed Dowitcher	*Limnodromus griseus*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Common Snipe	*Gallinago gallinago*
Wilson's Phalarope	*Phalaropus tricolor*
Red-necked Phalarope	*Phalaropus lobatus*

Gulls and Terns *Laridae*

Bonaparte's Gull	*Larus philadelphia*
Mew Gull	*Larus canus*
Ring-billed Gull	*Larus delawarensis*
California Gull	*Larus californicus*
Herring Gull	*Larus argentatus*
Franklin's Gull	*Larus pipixcan*
Forster's Tern	*Sterna forsteri*
Black Tern	*Chlidonias niger*
Caspian Tern	*Sterna caspia*
Common Tern	*Sterna hirundo*

Owls *Strigidae*	
Great Gray Owl	*Strix nebulosa*
Great Horned Owl	*Bubo virginianus*
Northern Hawk Owl	*Surnia ulula*
Kingfishers *Alcedinidae*	
Belted Kingfisher	*Ceryle alcyon*
Tyrant Flycatchers *Tyrannidae*	
Alder Flycatcher	*Empidonax alnorum*
Willow Flycatcher	*Empidonax trailii*
Eastern Kingbird	*Tyrannus tyrannus*
Waxwings *Bombycillini*	
Bohemian Waxwing	*Bombycilla garrulus*
Cedar Waxwing	*Bombycilla cedrorum*
Dippers *Cinclidae*	
American Dipper	*Cinclus mexicanus*
Wrens *Troglodytidae*	
House Wren	*Troglodytes aedon*
Winter Wren	*Troglodytes troglodytes*
Marsh Wren	*Cistothorus palustris*
Chickadees *Paridae*	
Black-capped Chickadee	*Parus atricapillus*
Swallows *Hirundinidae*	
Purple Martin	*Progne subis*
Tree Swallow	*Tachycineta bicolor*
Violet-green Swallow	*Tachycineta thalassina*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Bank Swallow	*Riparia riparia*
Cliff Swallow	*Hirundo pyrrhonota*
Barn Swallow	*Hirundo rustica*
Kinglets and Thrushes *Muscicapidae*	
Ruby-crowned Kinglet	*Regulus calendula*
Veery	*Catharus fuscescens*
Gray-cheeked Thrush	*Catharus minimus*
Hermit Thrush	*Catharus guttatus*

Warblers *Sylviidae*

American Redstart	*Setophaga ruticilla*
Ovenbird	*Seiurus aurocapillus*
Northern Waterthrush	*Seiurus noveboracensis*
Common Yellowthroat	*Geothlypis trichas*
Yellow-rumped Warbler	*Dendroica coronata*
Yellow Warbler	*Dendroica petechia*
Palm Warbler	*Dendroica palmarum*
MacGillivray's Warbler	*Oporornis tolmiei*
Wilson's Warbler	*Wilsonia pusilla*
Yellow-breasted Chat	*Icteria virens*

Sparrows and Blackbirds *Fringillinae*

American Tree Sparrow	*Spizella arborea*
Chipping Sparrow	*Spizella passerina*
Savannah Sparrow	*Passerculus sandwichensis*
Fox Sparrow	*Passerella iliaca*
Song Sparrow	*Melospiza melodia*
Lincoln's Sparrow	*Melospiza lincolnii*
Sharp-tailed Sparrow	*Ammodramus caudacutus*
Swamp Sparrow	*Melospiza georgiana*
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Red-winged Blackbird	*Agelaius phoeniceus*
Bobolink	*Dolichonyx oryzivorus*
Rusty Blackbird	*Euphagus carolinus*
Brewer's Blackbird	*Euphagus cyanocephalus*

Mammals

Shrews *Soricidae*

Black-backed Shrew	*Sorex arcticus*
Pacific Water Shrew	*Sorex bendirii*
Pygmy Shrew	*Sorex hoyi*
Dusky Shrew	*Sorex monticolus*
Water Shrew	*Sorex palustris*

Bats *Chiroptera*

Big Brown Bat	*Eptesicus fuscus*
Spotted Bat	*Euderma maculatum*
Silver-haired Bat	*Lasionycteris noctivagans*
Western Red Bat	*Lasiurus blossevillii* ssp. *frantzi*
Hoary Bat	*Lasiurus cinereus*

California Myotis	*Myotis californicus*
Western Small-footed Myotis	*Myotis ciliobrum*
Western Long-eared Myotis	*Myotis evotis*
Keen's Long-eared Myotis	*Myotis keenii*
Little Brown Myotis	*Myotis lucifugus*
Northern Long-eared Myotis	*Myotis septentrionalis*
Yuma Myotis	*Myotis yumanensis*
Townsend's Big-eared Bat	*Plecotus townsendii*
Mountain Beavers *Aplodontiidae*	
Mountain Beaver	*Aplodontia rufa*
Beavers *Castoridae*	
Beaver	*Castor canadensis*
Voles and Lemmings *Arvicolidae*	
Southern Red-backed Vole	*Clethrionomys gapperi*
Northern Red-backed Vole	*Clethrionomys rutilus*
Water Vole	*Microtis richardsonii*
Meadow Vole	*Microtis pennsylvannicus*
Townsend's Vole	*Microtis townsendii*
Long-tailed Vole	*Microtis longicaudus*
Brown Lemming	*Lemmus sibiricus*
Northern Bog Lemming	*Synaptomys borealis*
Muskrat	*Ondatra zibethicus*
Jumping Mice *Zapodidae*	
Western Jumping Mouse	*Zapus princeps*
Meadow Jumping Mouse	*Zapus hudsonius*
Weasels *Mustelidae*	
Wolverine	*Gulo gulo*
Mink	*Mustela vison*
River Otter	*Lontra canadensis*
Striped Skunk	*Mephitis mephitis*
Ermine	*Mustela erminea*
Long-tailed Weasel	*Mustela frenata*
Racoon *Procyonidae*	
Raccoon	*Procyon lotor*

Bears *Ursidae*	
Black Bear	*Ursus americanus*
Grizzly Bear	*Ursus arctos*
Deer *Cervidae*	
Moose	*Alces alces*
Elk	*Cervus elaphus*
Mule Deer	*Odocoileus hemionus*
Caribou	*Rangifer tarandus*

Aerobic Occurring in the presence of free oxygen, either as a gas in the atmosphere or dissolved in water.

Alkaline Water or soil with a pH greater than 7.4. Relatively high concentration of available base cations.

Anaerobic Occurring in conditions devoid of oxygen.

Annual flood Flooding occurs at least once per year.

Biogeoclimatic subzone A climatic region characterized by a distinct climax plant association on zonal sites.

Biogeoclimatic zone A climatic region with similar broad macroclimate characterized by a distinct zonal plant order.

Brown mosses A guild of peatland mosses usually indicating mineral rich site conditions. Includes *Campylium stellatum*, *Drepanocladus* spp., *Scorpidium* spp., and *Tomenthypnum nitens*.

Canopy Cover of branches and leaves formed collectively by the crowns of trees, shrubs, or other plants.

Capillary In a soil, the fine spaces between soil particles.

Capillary action Particles attract soil moisture, and surface tension is strong enough to cause moisture to rise up through the soil, above the watertable.

Class, site Ecosystems with broadly similar vegetation physiognomy (or species guild), hydrology, and water quality (NWWG 1997).

Clayey Predominant textural classes are clay, silty clay, sandy clay, or clay loam.

Climax community A self-perpetuating community whose species composition is expected to be relatively stable and long lasting.

Closed basin or pond Basin receives water from surrounding upland only, no inlet or outlet channel.

Coarse water sedges Large, broad-leaved sedge species including *Carex aquatilis*, *C. atherodes*, *C. exsiccata*, *C. sitchensis*, and *C. utriculata*.

Common Occurs frequently, and representative ecosystems are readily found, but it is not a predominant association of the region (Steen and Roberts 1988).

Common species Species that can occur in a Site Association, but do not define the community. They usually have a presence >30% and a cover >1%.

Constant species Species that occur in a classification unit with relatively high frequency but low mean cover that may help to define the community. They are defined as having presence of >66% and cover <10%.

Diagnostic species A species that occurs primarily within a single classification unit.

Diatomaceous earth Composed mainly of the siliceous shells of diatoms. It is frequently more nearly mineral than organic in composition.

Disclimax A self-perpetuating community that strongly differs in species composition from the edaphic or climatic climax expected for the site; normal succession has been arrested by an external physical or anthropogenic factor. Results from changes to physical characteristics of the site, associated with disturbances such as fire, intensive grazing, or avalanche (Province of British Columbia 1998).

Dominant species The strucurally most dominant species within a site or the species that contributes greatest vegetation cover to the community.

Drawdown Decrease in water level of lakes or steams, exposing substrate that is normally submerged.

Dwarf shrubs Plants with woody stems that are generally less than 15 cm tall at maturity. *Andromeda polifolia*, *Arctostaphylos uva-ursi*, *Empetrum nigrum*, *Gaultheria hispidula*, *Kalmia microphylla*, *Linnaea borealis*, *Oxycoccus oxycoccos*, *Rubus chamaemorus*, *Rubus pedatus*, *Vaccinium caespitosum*, and *Vaccinium vitis-idaea* are the most common wetland dwarf shrub species.

Emergents Upright plants rooted in water or exposed to seasonal flooding, emerging above water surface. Does not include some submergents that normally lie entirely under water but have flowering parts that break the surface. Includes mostly sedges, rushes, bulrushes, and other grass-like forbs.

Ericaceous shrubs Shrubs of family Ericaceae. *Andromeda*, *Chamaedaphne*, *Gaultheria*, *Kalmia*, *Ledum*, *Oxycoccus*, and *Vaccinium* are the most common wetland genera.

Eutrophic Very rich nutritional status, abundant supply of nutrients.

Feathermosses Upland moss species with a feather-like form including *Hylocomium splendens*, *Pleurozium schreberi*, and *Ptilium crista-castrensis*.

Fibric Poorly decomposed peat with large amounts of well-preserved fibre readily identifiable as to botanical origin.

Flark Elongated wet depressions separated by raised ribs in patterned peatlands. The long axis is always perpendicular to the direction of waterflow.

Floating mat Mat of peat held together by roots and rhizomes underlain by water or fluid, loose peat (NWWG 1988).

Floating-leaved plants Rooted or free-floating plants with leaves normally floating on water surface.

Flooding Surface inundation by moderate to fast moving water. Usually associated with sedimentation and erosion (see also Inundation).

Fluvial Sites occurring along flowing watercourses, the watercourse itself, and the surrounding (riparian) terrain and vegetation. Subject to flooding and sedimentation processes (Province of British Columbia 1998).

Forb Any non-graminoid herb species.

Forested Sites with >10% canopy cover of tree species >10 m tall (see also Treed).

Frequent flooding Flood return interval of 2–5 years.

Gleyed A soil condition resulting from prolonged soil saturation, which is manifested by the presence of bluish or greenish colours throughout the soil mass or in mottles (usually orange spots or streaks).

Graminoid Plants with a grass-like growth form including rushes (Juncaceae), grasses (Poaceae), and sedges (Cyperaceae).

Groundwater Water passing through or standing in soil and underlying strata. Free to move by gravity (NWWG 1988).

Herb Non-woody vascular plants. Includes forbs and graminoids.

Hollow 1. A wet depression or pool found between hummocks or mounds. 2. A sunken basin or depression, often sloped and having an outflow. Includes gullies with slow streams where there is little sedimentation or erosion.

Humic Highly decomposed organic material. Small amounts of fibre can be identified to botanical origin (NWWG 1988).

Hummock A mound composed of organic material, often composed of *Sphagnum* peat (see also Mound). Slight hummocks are 0.3–1 m tall and spaced >7 m apart. Moderate hummocks are 0.3–1 m tall and spaced 3–7 m apart. Strong hummocks are 0.3–1 m tall and spaced 1–3 m apart.

Humus Dead and decaying organic material at the soil surface.

Hydric 1. A site where water is removed so slowly that the watertable is at or above the soil surface all year. 2. A Gleysol or Organic soil.

Hydrogeomorphic classification Classification of wetland and riparian ecosystems based on hydrological and geomorphological features and processes.

Hydrophytic plant species Any plant adapted for growing on permanently saturated soils deficient in oxygen.

Hygric Water removed slowly enough to keep soil wet for most of the growing season; permanent seepage and mottling usually below 30 cm in depth.

Hypereutrophic Sites with very high salinity or alkalinity.

Inundation Surface flooding by standing or slow-moving water.

Lacustrine Sites adjacent to lakes and ponds directly affected by lake wave action, sedimentation, and flooding.

Lagg Depressed margin of a bog or fen; generally wetter than surrounding area, often contains open water.

Lawn Relatively flat expanse of wetland moss usually raised above water level. Contrast with Hummock and Hollow.

Lifeform A plant growth form that displays an obvious relationship to important environmental factors (Mueller-Dombois and Ellenberg 1974).

Limnic material Composed of coprogenous earth (sedimentary peat), diatomaceous earth, or marl.

Linked basin Basin receives water from upland and an inflow stream; excess water flows through an outflow. Includes basins with slow streams where there is little sedimentation or erosion (Province of British Columbia 1998).

Loamy Textural classes are loam and sandy loam (Steen and Roberts 1988).

Marl Sediments composed of shells of aquatic animals and $CaCO_3$ precipitated in water.

Mesic 1. Organic material in an intermediate stage of decomposition where some fibres can be identified as to botanical origin. 2. Medium soil moisture regime where a site has neither excess soil moisture nor a moisture deficit.

Microtopography Small-scale (i.e., < 2 m) variations in soil surface elevation (e.g., hummocks and hollows).

Minerotrophic Nourished by mineral water. Refers to wetlands that receive nutrients from flowing or percolating mineral groundwater (NWWG 1988).

Minerotrophic indicator species Plant species requiring relatively high concentrations of nutrients associated with mineral groundwater.

Mire British term embracing all kinds of peatlands and peatland vegetation (modified from NWWG 1988).

Moderately acidic Having a soil pH value of 4.5–5.5.

Moist No water deficit occurs. Current need for water does not exceed supply; temporary groundwater table may be present (Pojar et al. 1987).

Montane A high-elevation region occurring below the subalpine.

Mound Mounds composed of mineral materials (see also Hummock).

Muskeg Algonquin term for peatland. Usually applied to areas with *Sphagnum* mosses, tussocky sedges, and an open growth of scrubby trees (modified from NWWG 1988).

Neotenous An animal that is sexually mature in the larval stage.

Neutral pH Having a soil pH value between 6.5 and 7.4. Available base cation concentration is high enough to buffer acidic conditions.

Occasional flooding Flood interval greater than 5 years.

Oligotrophic Relatively poor in nutrients.

Ombrotrophic Nourished by rain. Peatlands entirely dependent on nutrients deposited by precipitation (NWWG 1988).

Overflow basin Basin receives water from upland only; excess water flows through an outlet channel (Province of British Columbia 1998).

Paludification Succession or conversion of upland or mineral wetland habitats to peatland through accumulation of peat.

Palustrine Basins, depressions, slopes, and small waterbodies with a continually high watertable and poor-drainage wetland landscape units.

Palustrine hollow Hollow receives groundwater from upslope; excess water flows through channel or watertrack.

Patterned peatland Peatlands marked by distinct patterns of vegetation in alternating raised ridges and depressions (flark) forms. Sites are slightly sloping and ridges form perpendicular to the direction of waterflow.

Peat Partly decomposed plant material deposited under saturated soil conditions.

Peatland A generic term including all types of peat-covered terrain. Many peatlands are a complex of swamps, bogs, and fens, sometimes called a "mire complex" (NWWG 1988).

Physiognomic Referring to vegetation structure or strata.

Rarely flooded Flooding occurs only during extreme events.

Riparian Along the bank of a river, lake, or wetland.

Saline The presence of soluble salts in the soil parent material at concentrations that affect plant growth.

Sandy Textural classes are loamy sand and sand (Steen and Roberts 1988).

Saturated A soil condition in which all voids (pore spaces) between soil particles are filled with water.

Sedimentary peat (coprogenous earth) Peat formed beneath a body of standing water composed of aquatic plant debris modified by aquatic animals. Material is loosely consolidated, slightly sticky, dark brown to black, and usually well decomposed (humic). Synonyms: aquatic peat, loonshit, allochthonous peat, detrital peat, gyttja (NWWG 1988).

Seepage Groundwater discharge having less flow than a spring.

Shrub Perennial plants usually with more than one low-branching woody stem and <10 m tall.

Silty Predominant textural classes are silt and silt loam (Steen and Roberts 1988).

Site Association A group of related ecosystems physically and biologically similar enough that they have or would have similar vegetation at climax (Meidinger and Pojar 1991).

Slightly acidic Having a soil pH value of 5.5–6.5.

Stand A plant community that is relatively uniform in composition, structure, and habitat conditions.

Subassociation Subunits of an association that are floristically very similar but distinguished by the predominance of one to several differentiating species.

Subhydric Soil moisture regime where water is removed slowly enough to keep watertable at or near the surface for most of the year; permanent seepage 0–30 cm below surface.

Subhygric Water removed slowly enough to keep soil wet for a significant part of the growing season; some temporary seepage and possibly mottling below 20 cm.

Submergents Plants that normally lie entirely beneath water. Some species have flowering parts that break the water surface.

Succession Replacement of one community by another; often progresses to a stable terminal community called the climax.

Treed Sites with >10% canopy cover of tree species >2 m and <10 m tall (see also Forested).

Tussock A thick tuft of sedge or other vegetation forming a small mound of solid ground in a wetland (NWWG 1988).

Uncommon Occurs infrequently in a region (Steen and Roberts 1988).

Very acidic Having a soil pH value less than 4.5. Low concentration of available base cations.

Very moist Rooting-zone groundwater present during the growing season (water supply exceeds demand). Groundwater table >30 cm deep (Pojar et al 1987).

Very wet Groundwater table at or above the ground surface throughout most of the growing season.

von Post A qualitative scale of peat decomposition.

Watertable The upper surface of the zone of saturation within the soil profile.

Wet Rooting-zone groundwater present during the growing season (water supply exceeds demand). Groundwater table >0 cm but < 30 cm below soil surface (Pojar et al 1987).

Wetland Sites dominated by hydrophytic vegetation where soils are water-saturated for a sufficient length of time such that excess water and resulting low soil oxygen levels are principal determinants of vegetation and soil development.

Wetland complex Consists of two or more wetland communities occurring in close proximity in the same system and influenced or linked by the same moisture and nutrient regime.

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