Sensitive Ecosystems Inventory: East Vancouver Island and Gulf Islands 1993 - 1997

Volume 2: Conservation Manual

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Pacific and Yukon Region 2000
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AU TRAVAIL POUR LE BASSIN DE GEORGIA

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Abstract

The Sensitive Ecosystems Inventory (SEI) mapped the remaining fragments of rare and fragile terrestrial ecosystems throughout the eastern coastal lowland of Vancouver Island and the Gulf Islands in British Columbia. Ecologically significant lands and important wildlife habitats are fast disappearing from this 4,000 square kilometre study area. Inventory results showed that less than 8% of the area remained relatively undisturbed by development. *Volume 1: Methodology, Ecological Descriptions and Results* documents and describes the inventory and summarises and analyses the results.

The main objective of the SEI project was to provide scientific information on selected sensitive ecosystems in support of sound land management decisions that encourage conservation and good land stewardship. This manual (*Volume 2*) describes the importance of the SEI ecosystems and the impacts affecting them, presents management guidelines for each of the nine SEI ecosystems, and describes conservation tools available to local and regional governments, landowners and other citizens, and senior governments. Policies and guidelines are also offered as models for use in Official Community Plans and Development Permits, although legal advice should be sought when preparing new legal documents or bylaws, or interpreting existing ones.

These sensitive ecosystems are not the only areas of ecological importance. A variety of other habitats, such as streams, lakes and coastal areas also contribute to a healthy environment. Sensitive ecosystems, and the wildlife they support, are an important part of the quality of life of the communities within the study area and must be protected. Many of the sites identified by the SEI are at high risk of conversion to other land uses or degradation by human use and invasion by non-native plants and animals. With so few of these rare and fragile ecosystems left in the study area, the need to treat seriously each one of the sites identified, and to fully evaluate all possible land use options before initiating any changes, is paramount.

Résumé

Des zones écologiques et des habitats fauniques importants disparaissent à un rythme accéléré dans les îles du Golfe et les basses terres du littoral est de l'île de Vancouver. C'est une des conclusions du dernier Inventaire des écosystèmes fragiles (IEF) qui a permis de cartographier les fragments restants des écosystèmes rares et fragiles présents sur les 4 000 kilomètres carrés de la zone d'étude. Les résultats de l'inventaire ont montré que moins de 8 % du secteur est resté relativement à l'abri des pressions intenses de développement. Le *Volume 1: Methodology, Ecological Descriptions and Results* documente et décrit l'inventaire puis en résume et analyse les résultats.

L'objectif principal de l'IEF est d'apporter des données scientifiques susceptibles d'aider à la prise de décision en matière d'aménagement du territoire dans une optique favorisant la conservation et la gérance efficaces des terres. Ce manuel (*Volume 2*) décrit l'importance des neuf écosystèmes répertoriés lors de l'IEF et les impacts qu'ils subissent, présente les directives de gestion pour chacun d'entre eux et décrit les mécanismes et les outils de conservation dont disposent les gouvernements locaux et régionaux, les propriétaires fonciers, les citoyens en général et les gouvernements provincial et fédéral. Les politiques et stratégies suggérées sont également présentées comme modèles à utiliser pour les permis officiels d'aménagement et de développement des collectivités, bien qu'il soit souhaitable de bénéficier des services d'un conseiller juridique pour la préparation de nouveaux règlements ou documents légaux, ou pour l'interprétation des documents ou règlements existants.

Ces écosystèmes fragiles ne sont pas les seuls éléments à revêtir une importance écologique. Divers autres habitats, tels que les écosystèmes aquatiques, contribuent eux aussi à la santé de la faune dans son ensemble ainsi qu'à nous-mêmes. Si les écosystèmes fragiles et la faune qu'ils abritent sont considérés comme des ingrédients essentiels de la qualité de vie des communautés à l'intérieur de la zone d'étude, il est normal qu'ils fassent l'objet d'une protection, sous une forme ou une autre. De nombreux sites répertoriés par l'IEF risquent fort d'être aménagés prochainement (pour une utilisation autre que la conservation) ou d'être dégradés par une fréquentation humaine excessive et par l'invasion de végétaux non indigènes. Compte tenu du faible nombre d'écosystèmes fragiles qui restent dans la zone d'étude, il est crucial de gérer avec beaucoup de précautions chacun d'entre eux et d'examiner en profondeur les conséquences de tout changement éventuel de l'utilisation des terres.

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Using This Manual

This conservation manual has been written for people and organisations that have the desire or responsibility to conserve and protect the remaining vestiges of important sensitive habitats. It was also written for landowners and developers who are planning activities that could impact sensitive ecosystems, and contains advice on how to avoid or minimise those types of impacts.

The manual contains two sections. ***Section One*** discusses the importance of the SEI ecosystems, describes the impacts of concern, and recommends steps that can be taken to avoid or minimise these impacts. ***Section Two*** discusses the legal conservation tools available to local governments, senior governments, landowners and other citizens. It also offers suggestions on how the management recommendations from Section One can be incorporated into various legal tools such as Official Community Plans and Development Permits.

Section One

Chapter 1 sets the context of the SEI project by describing the importance of biodiversity and how steps are now being taken globally, nationally, and regionally in an attempt to prevent further losses of biodiversity.

*See **Volume 1** for details on the Methodology, Ecological Descriptions and Results of the Sensitive Ecosystems Inventory project.*[1]

To apply the information contained in this manual, we encourage you first to review Chapters 2 through 4. ***Chapter 2: Ecosystems of Concern*** explains why there is concern about ecosystems in general and in the study area specifically. It defines the SEI ecosystems, discusses the wide range of ecological and socio-economic values inherent in the ecosystems, and briefly describes the SEI inventory project (see sidebar). ***Chapter 3: Impacts of Concern*** discusses the range of past and present impacts that have resulted in only 7.9% of the landscape remaining in a relatively undisturbed condition. ***Chapter 4: Planning and Management*** outlines the general steps to follow for effective conservation planning and presents some basic management principles that apply to all SEI and other important ecosystems.

[1] Ward et al. 1998.

Following this review, determine which ecosystem most closely describes the property or landscape of concern. The ecosystem descriptions in Table 1 (page 9) will often give a general idea of the ecosystem type under review, but using the ***Ecosystem Key*** (Appendix C, page 237) should help you to confirm your ecosystem type. Remember that there may be more than one type of ecosystem present.

Each of the nine SEI ecosystems is discussed in ***Chapters 5 through 13.*** Refer to the chapter on the ecosystem under review for a more detailed description of the specific ecosystem and its values, status (based on the SEI inventory results), impacts and management recommendations.

Section Two

Finally, depending on your needs and/or responsibilities, refer to this section for general guidance regarding legal tools available for conserving and protecting sensitive ecosystems.

Chapter 14: What local governments can do discusses many of the legal conservation tools available to local and regional governments, ranging from Official Community Plans (OCPs) to Animal Control Bylaws. Suggested wordings are also offered in this chapter as *models* of how to incorporate the management recommendations from Section One into such documents as OCPs, Development Permits and a number of other land use bylaws. *However, actual legal documents would be customised to reflect local practices and conditions and readers should seek legal advice when preparing new legal documents or bylaws, or interpreting existing ones.*

Chapter 15: What landowners and other citizens can do discusses how landowners and citizens can become involved in conservation efforts using tools such as conservation covenants and property tax relief.

Chapter 16: What senior governments can do outlines several key federal and provincial statutes that provide support for protecting sensitive ecosystems. Some examples of private-public partnerships are also given, which present opportunities for ecosystem conservation.

Other Aids in Protecting Sensitive Ecosystems

If you are a landowner, developer, planner, consultant or local resident concerned with a specific site, you are encouraged to review the SEI maps and local government Environmentally Sensitive Area (ESA) maps to determine whether or not the proposed activity is in or near a sensitive ecosystem. SEI maps are available for viewing through local municipal or regional planning offices, through the Ministry of Environment, Lands and Parks or Environment Canada.[2]

For developers, it is important to review requirements set out in local government bylaws, as well as those of the provincial Ministry of Environment, Lands, and Parks, and Fisheries and Oceans Canada (see ***Appendix B***, page 230 for addresses). Further assessment of sites that are sensitive is often required.

The Sensitive Ecosystems Inventory (SEI) data are intended to be used as a tool to 'flag' or identify sensitive ecosystems at an overview level. The SEI maps and database are an important information source for assisting in the identification of Environmentally Sensitive Areas (ESA) for local and regional governments. Approximately 30% of the 7,388 sensitive ecosystems identified during the inventory were field checked. **In most cases, however, for both ESA mapping and site-specific development, the SEI information will need to be confirmed and updated through field surveys.** The Ministry of Environment, Lands and Parks has procedures to follow in collecting field information for assessment purposes.

The SEI project team has a field form the type of inventory information required (see ***Appendix G***, page 250). Qualified professionals are required to undertake this information collection. Persons can also nominate sites for inclusion into the SEI (see ***Appendix E***, page 248 for SEI Site Nomination Form) or provide updated information on existing SEI sites (***Appendix F***, page 249, for SEI Update Form).

[2] See *Appendix H*, page 256.

Other Sources of Information

There are several sources available for learning more about sensitive ecosystems and how to conserve them. The ***Bibliography*** at the back of the manual includes the references used in the preparation of the manual and as well as some general references. For landowners who are interested in voluntary private land stewardship programs, there is a list of stewardship publications that may be useful (see ***Appendix A***, page 227). The ***Glossary*** (see page 205) describes technical terms used in the report.

Often conservation organisations, such as local natural history groups, conservancy groups, and land trusts have information about sensitive ecosystems. These groups can often be helpful in providing information about plant and animal species and habitats. Many groups are also involved in stewardship activities as well as acquisition and other conservation projects. ***Organisations and Resources*** (Appendix B, page 230) provides a useful list of government and non-government contacts.

Section One

Ecosystems of Concern

Impacts of Concern

Planning and Management

SEI Ecosystems

Descriptions
Status
Values
Management Recommendations

(J.Grundle)

Some examples of the rich biological diversity of the SEI study area (clockwise from top left): cougar, giant west coast slug, licorice fern, chum salmon, fly agaric, Meadowhawk, Pacific treefrog, arbutus, fawn lily, wandering garter snake, Great Blue Heron. (Collage: Cougar—Roy Ostling; others—Neil K. Dawe)

1 Introduction

This manual[3] was prepared to engage and encourage the involvement of local governments, landowners, developers and others in the protection, conservation and restoration of rare and fragile terrestrial ***ecosystems.***[4] Ecosystems identified by the Sensitive Ecosystems Inventory (SEI) are the main focus of this manual;[5] however, they are not the only areas worth preserving. They must be considered within the context of the overall landscape that includes other ***habitats*** of importance to a variety of flora and fauna.

The Sensitive Ecosystems Inventory[6] (SEI) is the first of its kind in British Columbia and is an outcome of the commitments made by the federal and provincial governments to the Canadian Biodiversity Strategy.[7] The inventory takes a broad ecosystem approach over a large area and provides scientific information on ecosystem distribution, vegetation, ecological attributes and quality. An important element of the SEI project is this conservation manual, a working document that provides the tools needed to protect, conserve, manage and, where appropriate, restore these ecosystems.

The manual describes the values of the SEI ecosystems and offers practical advice on how best to avoid or minimise damage to them,

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[3] This is the companion to ***Volume 1: Methodology, Ecological Descriptions and Results*** by Ward et al. 1998.

[4] The first occurrence of terms found in the Glossary (see page 205) is highlighted in **bold.**

[5] The manual is also relevant to sensitive ecosystems mapped in the Bowen and Gambier Local Trust Areas. Maps of this area are available, however the summary and analysis of inventory results will be published as part of the Sunshine Coast SEI, scheduled for 2002.

[6] Ward et al. 1998.

[7] See Glossary

while recognising human uses of the landscape. This is a working document that can be used to counter the damaging effects of our past activities. It is to be used to help conserve, restore, and manage the ecosystems so that future generations will know and enjoy them firsthand and not just vicariously through written descriptions or photographs in a book.

Between 1991 and 1996 eastern Vancouver Island, excluding the Capital Regional District, had the highest population growth rate in British Columbia.

During that period the population increased by 19% which, if continued, would double in less than four years.

This can be compared to average growth rates for British Columbia (13.5%), Canada (5.7%) and the Earth (1.4%).

Rapid population growth on the east coast of Vancouver Island and the Gulf Islands has caused the loss or degradation of many sensitive ecosystems. This region is one of two areas in British Columbia (and one of four in Canada) experiencing the greatest loss of natural systems.[8] It also has one of the highest rates of population growth in British Columbia (see sidebar).[9]

Only recently have we begun to appreciate the consequences of diminishing the biological diversity of the Earth. As a result, steps are now being taken globally, nationally, and regionally in an attempt to prevent further losses of biodiversity—biodiversity that ecological-economists call our *natural capital*.

What is biodiversity?

Biodiversity, or biological diversity, is not simply the variety of living organisms on the planet. It also includes the ecological roles they perform and the genetic diversity they contain.[10] Thus, ecosystems such as those covered by the Sensitive Ecosystems Inventory (SEI) are major components of the biodiversity of an area.

Global Commitment to Biodiversity

In 1992, at the United Nations Conference on the Environment and Development, over 160 nations agreed on a Global Convention on Biodiversity.[11] Biological diversity was recognised as "a common concern of humankind" and an integral part of development processes on a global scale. Signatories to the convention committed themselves to

- the conservation of biological diversity.
- the sustainable use of this diversity.

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[8] Garry oak ecosystems on southeast Vancouver Island, south Okanagan grassland ecosystems, tall-grass prairie ecosystems in southern Alberta, and Carolinian forests of southern Ontario are all threatened and endangered, and much of the little that remains is disturbed and degraded.
[9] 1996 Census.
[10] Wilcox 1984.
[11] United Nations Environment Program 1992.

- the equitable sharing of benefits arising from the use of genetic resources.

National and Provincial Commitment to Biodiversity

In December 1992, Canada became the first industrialised country to ratify the Convention on Biological Diversity. Canada's formal response to the Convention was the Canadian Biodiversity Strategy that was prepared in 1995. Ministers from every province and territory, as well as the federal government made a commitment to the Canadian Biodiversity Strategy

- to conserve biodiversity and use biological resources sustainably.
- to move to an ecological approach to resource management through an improved understanding of how ecosystems function.
- to improve Canadian's understanding of the need to conserve biodiversity.
- to develop incentives and legislation that promote conservation and sustainable use.
- to work with other countries to conserve biodiversity.

Local Commitment to Biodiversity

At local levels the maintenance of biodiversity is of growing concern and has been recognised as contributing to the quality of life of an area. For example, a goal of the Growth Management Plan for the Regional District of Nanaimo is to "protect environmentally significant features and ecosystem functions and other biologically sensitive ecosystems."[12]

Metchosin, in its Official Community Plan,[13] has the following commitments to conserve biodiversity.

- To promote the conservation of the biodiversity of the district—the variety of natural communities, native wild species and populations, and domesticated species and populations.
- To identify and preserve sensitive natural environments for future generations and to maintain sufficient lands in their natural state so that rare and diverse plant and animal life will continue to exist and flourish.

Biological diversity must be treated more seriously as a global resource, to be indexed, used, and above all, preserved. Three circumstances conspire to give this matter an unprecedented urgency.

First, exploding human populations are degrading the environment at an accelerating rate…. Second, science is discovering new uses for biological diversity in ways that can relieve both human suffering and environmental destruction. Third, much of the diversity is being irreversibly lost through extinction caused by the destruction of natural habitats….

— E.O. Wilson

[12] Regional District of Nanaimo 1997.
[13] Metchosin 1995.

Today, there is a recognition and concern on the part of most levels of government and others for the need to protect the remaining biological diversity within their jurisdictions. But who does it fall to to implement biodiversity conservation measures?

Who is responsible for conservation?

Much of the SEI study area is private land, a good part of which was granted to railway companies in the 1800s.[14] Private landowners, therefore, along with government agencies, are an important part of the conservation equation. But conservation planning and management of sensitive ecosystems is not solely the responsibility of governments and landowners. Ultimately, the responsibility falls on each of us.

Co-operation and collaboration are the heart of ecosystem conservation, because species and habitats cross property lines, municipal boundaries, or international borders. In addition, ecosystem management requires the expertise of many, including landowners, naturalists, municipal planners and scientists, many of whom have a strong relationship with the lands around them.

The following players are important to successful ecosystem conservation planning and management.

- **Landowners,** who communicate their goals, needs, desires, problems and preferences about sensitive ecosystems located on their property.
- **Municipal and Regional Governments,** who are empowered under the *Municipal Act* to enact appropriate bylaws to protect the environment, have the means and responsibility of integrating SEI conservation goals and priorities with other community needs such as housing, transportation, recreation, industry, infrastructure and services.
- **Developers,** who can work with the other groups and create opportunities to conserve and enhance sensitive ecosystems through creative and flexible development design.

[14] When British Columbia became a province of Canada in 1871, one of the terms of union was a train service from Victoria to Nanaimo. Robert Dunsmuir built the railway in exchange for a land grant of 810 million hectares of the Nanaimo Lowland. The land was later logged or sold for development and, as a result, most sensitive ecosystems today are on private property.

- **Decision-makers,** including politicians and staff at various levels of government, who approve plans and allocate budgets in order to achieve community goals equitably.
- **Consultants,** including biologists, landscape architects, planners, engineers, restoration ecologists, and foresters, who provide technical expertise for assessing, protecting, and restoring sensitive ecosystems.
- **Local Residents and Conservation Advocates,** who voluntarily enter the planning process and contribute a broad range of expertise and viewpoints. They may include local ratepayers groups, service organisations, naturalist clubs, and community land trusts and conservancies. These groups often provide the local link for establishing landowner contact and voluntary private land stewardship programs, and can initiate awareness and fund-raising campaigns for conservation.
- **Ecologists, Biologists and Other Scientists,** from environmental agencies in several levels of government, who have identified SEI areas for conservation, and have the expertise necessary to help formulate conservation plans and implement management techniques.

Trumpeter Swans (R. Savannah)

2 Ecosystems of Concern

Why the Concern?

Most of us, when we think about it, realise that we depend upon biological diversity for our foods, medicines, and the raw materials with which we manufacture industrial products such as fibres for clothing, lumber, or pulp. Plants and animals also provide us with countless hours of recreational enjoyment through activities such as gardening, birdwatching and eco-tourism. All these activities serve to bolster the economy.

But there's more to biodiversity than simply being an economic generator. Ecosystems regulate our climate, clean our freshwater, regulate and clean atmospheric gases, treat our wastes, generate and clean our soils, maintain genetic diversity, maintain the water cycle, recycle nutrients and pollinate our crops. Simply put, at no cost to us, ecosystems provide the services that allow us to live on the Earth.

If we had to pay for these services, what might they cost? Recently, a team of ecologists and economists estimated the annual value of the world's ecosystems taking into account *all* the services the ecosystems provide.[15] The team found that, conservatively, ecosystems provide at least US$33 trillion worth of services annually, which can be compared to a world GNP of around US$18 trillion per year.

Those who are really concerned with the environment—concerned with the well-being of posterity—must give the carrying capacity of the environment precedence over discontinuous human needs, however much these needs may tug at our heartstrings.

— Garret Hardin

[15] Costanza et al. 1997.

If significant irreversible thresholds are passed for irreplaceable ecosystem services, their value may quickly jump to infinity.

— Costanza et al.

Sadly, ecosystems are not fully considered in the marketplace nor are they valued along with other economic services and manufactured capital. In the past, if they were considered at all, they were given too little weight in policy decisions.[16]

Thus, it is easy to understand why much of the natural lands of eastern Vancouver Island and the Gulf Islands have been reduced to small remnants of former ecosystems that once defined the character of the region. Through the effects of our past activities, we have reduced our children's options along with those of future generations, by allowing the degradation and loss of these important areas.

What are Sensitive Ecosystems?

*Here, an ecosystem is defined as a portion of landscape with a relatively uniform **dominant** vegetation. A sensitive ecosystem is one which is rare and/or fragile.*

The Sensitive Ecosystems Inventory (SEI) distinguishes between *sensitive ecosystems* and *other important ecosystems*. *Sensitive ecosystems* refers to the seven relatively unmodified,[17] rare and fragile terrestrial[18] ecosystem types identified for this project (see Table 1). For many of these natural ecosystems, only remnants remain due to disturbance from human activities over the past 150 years. However, these remnant ecosystems possess qualities that make them important in the physical and social fabric of our communities and significant from both a provincial and national perspective.

Sensitive ecosystems provide, within developed landscapes, **patches** of natural areas that have intrinsic value and are critical to the survival of many species. They also play a significant role in creating healthy and attractive communities for people. Wetlands purify drinking water and protect from flooding; forests clean the air, refresh the spirit and provide visual relief from urban settings; open hilltop meadows carpeted with spring wildflowers provide spectacular views and resting places and **riparian** forests are cool, moist havens during the summer.

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[16] Costanza et al. 1997.

[17] Some of the sensitive ecosystems have undergone minor modifications. They are included in the inventory because of their rarity, because their ecosystem functions do not appear to have been impaired, and because of the relative ease by which the modifications could be removed and the site restored.

[18] Streams, lakes and marine areas are equally important, although not included in this particular inventory.

The two *other important ecosystems* are partially modified or are non-natural (see Table 2). They function as reservoirs for biodiversity in otherwise highly developed and urbanised landscapes, act as buffers between developed areas and the more fragile ecosystems and provide **wildlife** corridors and important habitat **niches** throughout developed areas. Even these modified ecosystems are increasingly threatened by development.

Table 1: Sensitive Ecosystems

Code	Sensitive Ecosystems	Ecosystem Description [19]
CB	Coastal Bluff	Vegetated rocky islets, rocky shoreline/grassland, rocky shoreline/moss or coastal cliff
SV	Sparsely Vegetated	Sand dunes, gravel spits and inland cliffs with sparse vegetation
HT	Terrestrial Herbaceous	Mosaics of rare coastal grassland and/or moss-covered rock outcrops; typically occur as openings in forested areas or adjacent to Garry oak woodlands
WN	Wetland	Wet soil and moisture-dependent plants; includes bogs, fens, marsh, swamps, shallow water and wet meadow
RI	Riparian	All stages of floodplain vegetation including riparian ecosystems associated with lake shorelines and gullies
WD	Woodland	Open stands of Garry oak or trembling aspen; mixed stands of Douglas fir-Garry oak and Douglas fir-arbutus
OF	Older Forest	Older than 100 years; coniferous, or mixed with broadleaf species

Characteristic vegetation for each sensitive ecosystem type within the SEI study area is provided in ***Chapters 5 - 11.***

Table 2: Other Important Ecosystems

Code	Other Important Ecosystems	Ecosystem Description
SG	Older Second Growth Forest	Larger stands of 60-100 year old forest; coniferous, or mixed with broadleaf component
FS	Seasonally Flooded Agricultural Field	Fields regularly flooded in winter months

[19] Expanded descriptions of each ecosystem type can be found in Ward et al. 1998.

The SEI project systematically identified, classified, and mapped these nine ecosystems. Although they were mapped individually, they are interdependent and should not be looked at in isolation. They must also be considered within the context of the overall landscape that includes sensitive terrestrial and aquatic ecosystems as well as some partially modified and non-natural ecosystems.

Why are these Ecosystems Important?

Our ethical boundaries should expand to include soils, waters, plants and animals, or, collectively: the land. It is necessary to do this, not just because we love nature, but because we are connected with it. We eat from it, we drink from it, it is our life-support system. Caring for it is no different from caring for ourselves.

— Aldo Leopold[20]

The ecological attributes and socio-economic values that are common to all SEI ecosystems are discussed below. Values and attributes unique to individual ecosystem types are discussed in the ecosystem chapters ***(Chapters 5 - 13).***

Ecological Attributes

- **Rarity** is a primary feature of sensitive ecosystems. It can be the result of human-related activities over the last 150 years or a measure of limited natural occurrence, both in terms of distribution and density. A species or ecosystem may be considered rare because it occurs at low densities or abundance, despite widespread distribution. A second kind of natural rarity comes about when species or ecosystems have high densities (many individuals) but occur only in a localised area.

  In each of the sensitive ecosystem chapters ***(Chapters 5 - 11),*** selected provincially rare **(red- and blue-listed)** species and natural plant communities[21] as of May 2000 are noted, as well as some uncommon and introduced species (see sidebar).

- **Fragility** is a measure of an ecosystem's sensitivity to a range of **disturbance** factors that could lead to ecosystem decline or loss of ecosystem health or integrity. These factors could include **direct** physical **impacts,** introduction of invasive

Conservation Data Centre web site: www.elp.gov.bc.ca/rib/wis/cdc

Check this web site for the latest ranks for rare plants, animals, and natural plant communities, since the status of these changes over time.

[20] Known as the father of the land ethic.

[21] Rare natural plant communities listed in this manual refer exclusively to those at a "climax" successional stage and relatively undisturbed by humans or domestic animals. An example of this is the Douglas-fir / salal plant association, an old-growth forest type which is extremely rare due to logging and development. By looking at the name alone, this plant community could easily be confused with the young second growth stands of Douglas-fir and salal that have replaced the original old-growth forest. If these second growth forests were classified, they would have a unique name to distinguish them from the older successional stage that they replaced.

species and **fragmentation.** Many of the SEI ecosystem types are fragile because they depend on complex **ecological processes** that are easily disrupted.

- **High biodiversity** is a common feature of most SEI ecosystems, largely because of the juxtaposition or mix of different ecosystem types.
- **Specialised habitats** occur throughout the SEI ecosystems. These **microhabitats** and niches support many species of plants and animals. Typically, these ecosystems are habitat for rare, threatened or endangered species or **communities.** Some of these occur nowhere else in British Columbia or Canada and their loss would result in the loss of biodiversity.

Pileated Woodpecker
(D. Gunn)

Socio-economic Values

- **Green space** networks for the region are formed by the various ecosystems. The diverse mix of species in some ecosystems, such as woodlands and older forests, enhances the potential for human enjoyment (including spiritual, inspirational and aesthetic) and for interaction with wildlife. The networks also provide **greenways,** such as riparian corridors or gullies, that form the backbone of many linear park systems.
- **High scenic values** of vegetated rocky bluffs, shorelines and islets, spits, dunes and inland cliffs and patches of meadow in an otherwise forested landscape, provide excellent opportunities for spectacular ocean or mountain views. These areas are often targeted for both recreational and residential development. The scenic beauty of these and other ecosystems attracts visitors and is a source of pride and pleasure for local residents.
- **Outdoor recreation** opportunities are provided by the SEI ecosystems when they occur on public parks and accessible open spaces where low-impact activities will not damage the habitat. Some of these are accessible to all income groups, particularly those who cannot afford the costs of "getting away to nature". Wildlife viewing is very important to Canadians[22] and contributes to our quality of life. Other passive recreational activities appropriate to some of the sensitive ecosystems include photography, painting and sketching, and nature appreciation.
- **Research and nature education** are important at all levels of the school system from early childhood through to university research as well as in adult and continuing education programs.

[22] Environment Canada 1999.

Many schools are now working with local groups on school projects (e.g., *Streamkeepers* and *Wetlandkeepers*) and most have a focus on native plant community creation and wildlife habitat restoration. Children and their families are learning directly about the need and means by which to care for the environment. Some communities have nature centres (e.g., Swan Lake in Victoria) which provide opportunities for local and regional community ecosystem conservation efforts through educational programs, hands-on workshops and conservation-based recreational activities such as Scotch Broom removal days.

- **Eco-tourism** is of growing economic importance and considerable expenditures are made for wildlife viewing.[23] Eco-tourism can also lead to increases in nearby commercial and service activities such as overnight accommodation, food concessions, and such ventures as shoreline kayaking and guided nature trips. Annual events such as the Brant Wildlife Festival in Qualicum Beach make significant contributions to the local economy as they attract visitors from well beyond the host community. For example, in 1993, the festival brought over $400,000 to the local area for the two-day event.[24]
- **Resource extraction** activities, such as the forestry and fishing industries, have benefited generations of Vancouver Island and Gulf Island residents and the remaining forests continue to provide economic benefits to those who harvest salal, pine mushrooms and yew bark.
- **Increased property value** is another benefit of green space and wild lands. Studies show that undeveloped green space measurably increases the value of property nearby[25] by between 5 and 32 percent[26] and thus contributes far more in property taxes than it costs in services.[27] Green space and wildlands can enhance the economic prospects of a community by creating a new image for business opportunities.
- **Horticultural industry** benefits can occur from the upsurge in interest of native plant gardening and backyard wildlife habitat creation. These also benefit landscape businesses in a community.

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[23] See previous note.
[24] Mid Island Wildlife Watch Society.
[25] Meadows 1999.
[26] U.S. National Parks Service 1990
[27] Fodor 1999.

Sensitive Ecosystems Inventory (SEI)

*See **Volume 1** for further discussion of inventory methods and results*

The purpose of the SEI project was to develop an inventory information base that would support sound land management decisions and promote good land stewardship of remnant rare and fragile terrestrial ecosystems. The goal was to provide senior levels of government with necessary data for a variety of resource management issues, and to provide municipalities, regional districts and the Islands Trust easier access to data for use in developing Regional Growth Strategies, Official Community Plans, Local Area Plans, Greenspaces and Parks Plans. It can be used a red 'flag' for more detailed mapping during these local planning processes. It can also be used in assessing development proposals and can provide land developers, public interest groups and the public with scientific information in support of conservation.

Study Area

The study area (Figure 1) of eastern Vancouver Island and the adjacent Gulf Islands encompasses approximately 4,120 square kilometres. The region, which has one of the highest population growth rates in British Columbia, is where seventeen of every twenty Vancouver Island and Gulf Islands residents (85%) live.[28]

Maps

The SEI maps[29] were developed using Arc/Info Geographic Information System (GIS). Nearly 7,400 sites were identified on air photos by experienced ecologists. Nearly two-thirds of the air photos were at a scale of 1:10,000 or larger and most of the rest were at 1:15,000. Thus, although the scale of the final maps was 1:20,000, the delineation of the site boundaries was accurate to the scale of the photos that is closer to the 1:5,000 (or larger) scale typically used for local land use planning.

The minimum targeted mapping size was 0.5 ha—an area 50m by 100m—for most ecosystems. However, many smaller wetlands were mapped due to their visibility on the air photos. Larger minimum sizes were considered more appropriate for forested ecosystems.

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[28] 1996 Census.

[29] Paper maps may be viewed at various locations throughout the study area and are available for purchase. Digital map files in Arc/Info formats and field data are also available upon request. See Appendix H for contacts.

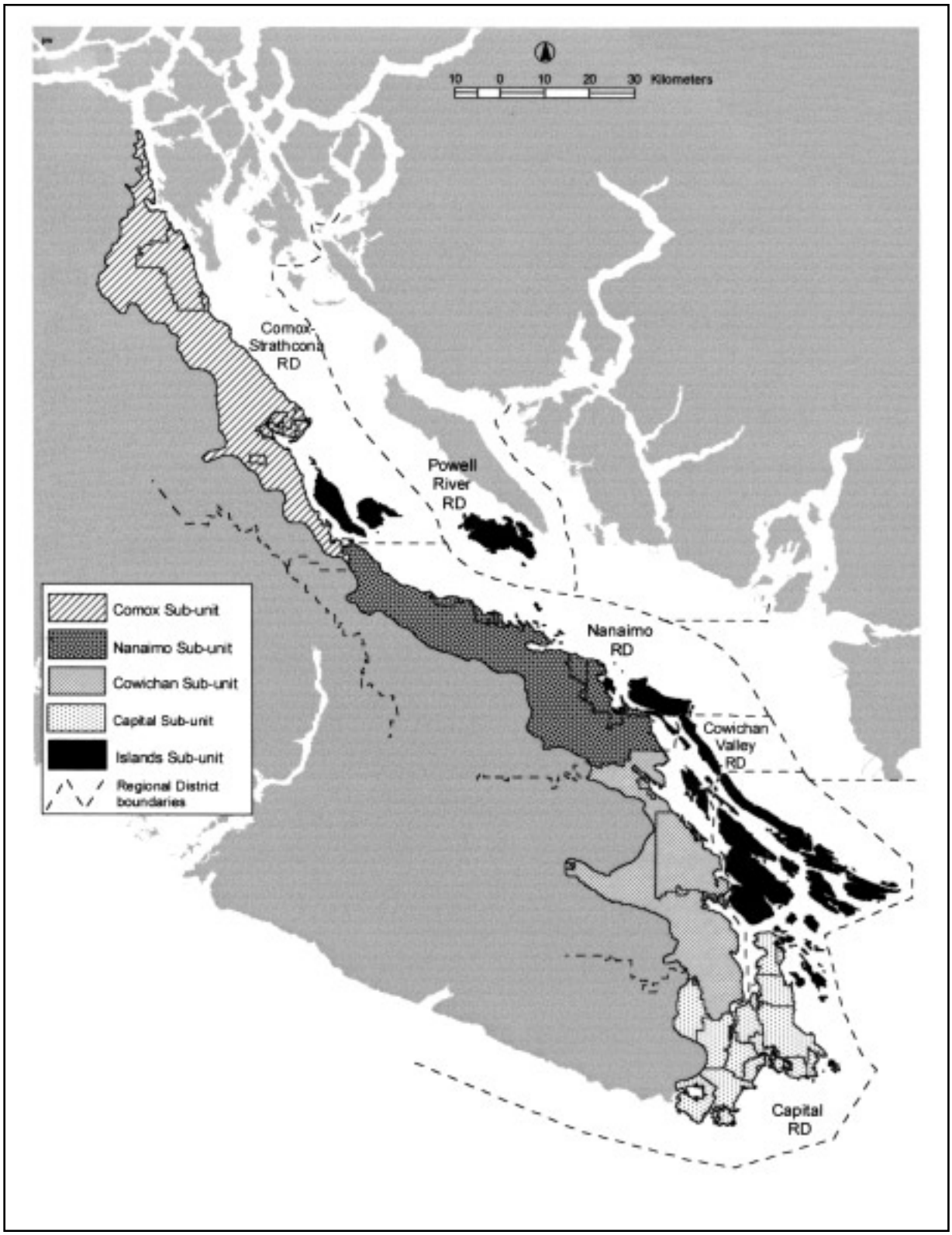


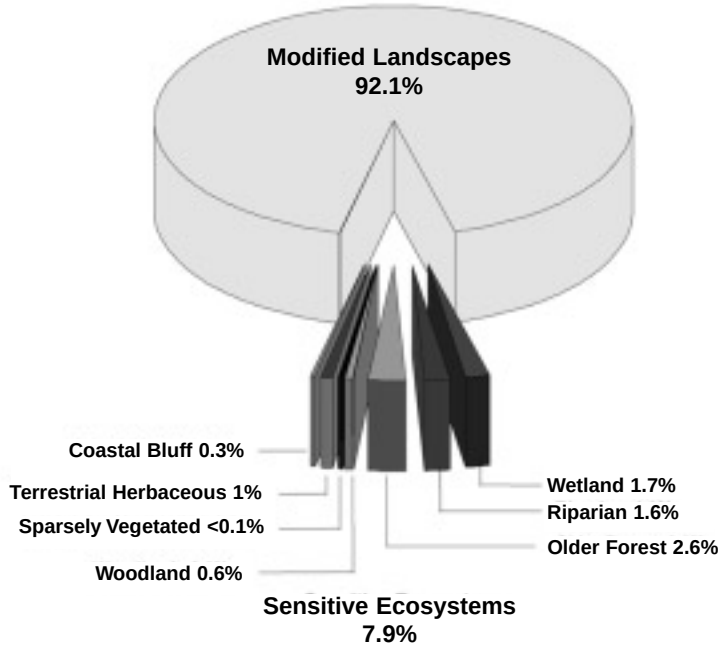
Figure 1: SEI Study Area

Overall, about 30% of the sites were visited to verify the initial air photo interpretations and to evaluate the condition of the sites (see Appendix G).

Both digital and hardcopy map formats were produced. The full set of 66 full-colour paper maps are at a scale of 1:20,000. Each map sheet includes a description of the project rationale, the ecological significance of ecosystems mapped, and a brief account of methods used. Photo centres and flight lines are labelled on each map and listed in a table indicating the photography dates. Another table lists each SEI polygon mapped and identifies the classification given to both primary and secondary ecosystem components with a notation of whether or not a field visit was made to assist users who need more detailed ecological information.

Inventory Results

Collectively the seven sensitive ecosystems cover 7.9% of the study area. Most of the study area (92.1%) is covered by 'modified' landscapes, defined here as urban and rural landscapes and forests younger than 100 years. The two other important ecosystems mapped during this project cover 11.6% of the study area, primarily due to large stands of older second growth forest (see Table 3). The inventory results were tabulated based on the dominant or primary ecosystem type present; in most cases the coloured **polygons** on the maps represent only one ecosystem type. However, in approximately 20% of the sites, more than one ecosystem was present and could not be delineated separately. It was therefore necessary to classify those sites using both a primary and secondary ecosystem types in order to accurately describe them.[30] The tabular results do not reflect this, since it was not possible to accurately measure the cover of dominant and secondary ecosystems within one polygon.



[30] See Volume 1, Section 2.3.2 for details.

Table 3: Summary of inventory results by sub-unit and dominant ecosystem type

Sensitive Ecosystems	***Comox Sub-unit***	***Nanaimo Sub-unit***	***Cowichan Sub-unit***	***Capital Sub-unit***	***Islands Sub-unit***	***Study Area total***
area of sub-unit in hectares	108,154.8	95,048.1	81,973.4	61,792.7	65,157.5	412,126.4
% of total study area	*26*	*23*	*20*	*15*	*16*	*100*
Coastal Bluff						
hectares	**34.2**	**35.5**	**41.8**	**312.1**	**619.4**	**1043.0**
% of land area	*<0.1*	*<0.1*	*<0.1*	*0.5*	*0.9*	*0.3*
no of sites	*13*	*25*	*30*	*116*	*407*	*591*
Sparsely Vegetated						
hectares	**92.7**	**42.9**	**24.6**	**38.0**	**136.2**	**344.4**
% of land area	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*0.2*	*<0.1*
no of sites	*28*	*17*	*7*	*9*	*25*	*86*
Terrestrial Herbaceous						
hectares	**1327.3**	**446.0**	**744.0**	**1042.6**	**683.0**	**4243.0**
% of land area	*1.2*	*0.5*	*0.9*	*1.7*	*1.0*	*1.0*
no of sites	*284*	*195*	*223*	*274*	*159*	*1135*
Wetland						
hectares	**3271.4**	**1556.8**	**1196.2**	**537.9**	**491.6**	**7053.9**
% of land area	*3.0*	*1.6*	*1.5*	*0.9*	*0.8*	*1.7*
no of sites	*879*	*630*	*522*	*403*	*211*	*2645*
Riparian						
hectares	**2618.0**	**2152.5**	**1323.8**	**381.7**	**36.5**	**6712.5**
% of land area	*2.6*	*2.3*	*1.6*	*0.6*	*<0.1*	*1.6*
no of sites	*393*	*245*	*243*	*73*	*6*	*960*
Woodland						
hectares	**24.3**	**82.0**	**357.2**	**1156.3**	**898.9**	**2518.8**
% of land area	*<0.1*	*<0.1*	*0.4*	*1.9*	*1.4*	*0.6*
no of sites	*5*	*15*	*58*	*275*	*260*	*613*
Older Forest						
hectares	**1117.0**	**1463.4**	**729.7**	**5031.9**	**2263.3**	**10605.1**
% of land area	*1.0*	*1.5*	*0.9*	*8.1*	*3.5*	*2.6*
no of sites	*81*	*77*	*83*	*104*	*125*	*470*
TOTAL Sensitive Ecosystems						
hectares	**10379**	**5779.2**	**4417.2**	**9771.3**	**5128.9**	**32510.7**
% of land area	*8.0*	*6.1*	*5.4*	*13.8*	*7.8*	*7.9*
no of sites	*1683*	*1204*	*1166*	*1254*	*1193*	*6500*

Table 3 continued

Other Important Ecosystems	***Comox Sub-unit***	***Nanaimo Sub-unit***	***Cowichan Sub-unit***	***Capital Sub-unit***	***Islands Sub-unit***	***Study Area total***
area of sub-unit in hectares	108,154.8	95,048.1	81,973.4	61,792.7	65,157.5	412,126.4
% of total study area	*26*	*23*	*20*	*15*	*16*	*100*
Older Second Growth						
hectares	**8594.2**	**7728.5**	**3294.1**	**10754.8**	**14519.0**	**44890.6**
% of land area	*7.9*	*8.1*	*4.0*	*17.4*	*22.3*	*10.9*
no of sites	*49*	*69*	*35*	*124*	*337*	*614*
Seasonally Flooded Agricultural Fields						
hectares	**491.4**	**956.8**	**772.5**	**325.2**	**232.9**	**2778.7**
% of land area	*0.5*	*1.0*	*0.9*	*0.5*	*0.4*	*0.7*
no of sites	*12*	*101*	*83*	*26*	*52*	*274*
Total Other Ecosystems						
hectares	**31604**	**8685.3**	**15369.9**	**32058.3**	**14751.8**	**47669.3**
% of land area	*8.4*	*9.1*	*5.0*	*17.9*	*22.7*	*11.6*
no of sites	*61*	*170*	*118*	*150*	*389*	*888*

3 Impacts of Concern

The incremental progression of urban and rural development, intensive agricultural use, logging and the construction of roads, railways, and power lines have all played a part in the rapid decline of sensitive ecosystems in the study area over the last 150 years. The consequences of these activities have been dramatic in terms of both the fragmentation of natural ecosystems into smaller and more isolated areas, and the growing list of endangered and threatened plant and animal species that depend upon these ecosystems for their continued existence. Some citizens also feel that there is a declining quality of life in communities that have lost their connection to their environment.

Many of the impacts have occurred incrementally over a long time period and are not always immediately apparent. Several landscape-wide concerns that seriously impact all ecosystems are discussed below and include *landscape fragmentation*, ***edge effects*** and *invasive species introduction*; *climate change* may also have far-reaching effects. Some activities have *direct* impacts on an ecosystem, whereas others may be ***indirect***, such as causing a change in hydrology of a wetland area.

This chapter describes impacts of concern that apply to ecosystems in general. How these impacts affect individual ecosystems and how each ecosystem should be managed to conserve its functions and values will be dealt with in the individual ecosystem chapters (see *Chapters 5 - 13*).

Landscape Fragmentation

The SEI has identified and documented the location and attributes of nine separate ecosystem types; however, these ecosystems relate to one another on a larger landscape level. In recent years, conservation biologists and environmental planners have increasingly focused on the broader landscape and the inter-connectedness of ecosystems across it. The landscape, in this case, refers to a large area of land (usually 50 to 5000 ha) that is a composite of landforms, ecosystems, and land uses. Another way to define landscape is the extent of what one can see in one view using the unaided human eye.

In the SEI study area, the patterns of ecosystem distribution repeat themselves across the landscape. Riparian ecosystems surrounding streams and rivers snake across valley bottoms. Dense conifer forests are found on the lower flanks of the mountains, whereas the lowlands are a mosaic of urban areas, farms, highways, and patches of forest. Woodlands occur on south facing slopes and rocky hills. These patterns can be used to guide planning initiatives to protect or maintain the connectedness of sensitive ecosystems across the landscape.

Fragmentation breaks the landscape into a series of isolated islands of habitat within developed areas. It has several general effects on sensitive ecosystems. It reduces the amount of land available to support functioning ecosystems because highways, railways, power lines, subdivisions, and logged areas occupy land that was once woodland, forest, or wetland. It limits the ability of species to move between habitat islands or colonise available habitat. Fragmentation also increases edge effects (see below), breaks down ecosystem landscape-level processes, and makes ecosystems more susceptible to the introduction of invasive species.

Wildlife species depend on a series of inter-connected habitat patches. Without connections to other patches, many parks and undeveloped areas are too small to protect species or **populations** that require large home ranges or seasonal migrations. A black bear may have a winter den under a hollow Sitka spruce stump in a river floodplain, eat skunk cabbage roots in a redcedar swamp ten kilometres away in spring, and use a corn field and apple orchard on the suburban fringe in the fall. Seasonal or daily variation in habitat use depends on appropriate corridors or linkages to connect habitat patches. Wildlife corridors allow **dispersal** of individuals or species between habitats. This helps maintain genetic diversity, and may

also allow for recolonisation of habitat patches following disturbance or loss of small local populations.

Invasive Species

The introduction of invasive species is one of the most widespread disturbance factors in sensitive ecosystems. Although this effect is less catastrophic than fragmentation or direct impacts on ecosystems, it can cause localised problems in many sensitive ecosystem types. Invasive species include many non-native plants and animals as well as some native species that rapidly colonise ecosystems because of their competitive abilities or adaptations to disturbed sites.

Some invasive species

English ivy
English holly
Scotch broom
spurge-laurel
purple loosestrife
yellow-flag iris
reed canary grass

European Starling
dogs
cats
feral sheep
feral goats
European slugs

For example, English ivy and English holly are widespread in forests, riparian ecosystems, and some types of wetlands because birds disperse their seeds from gardens. They can cause localised problems for native trees or understorey species. Woodland, terrestrial herbaceous, and coastal bluff ecosystems often support high numbers of introduced **grasses**, Scotch broom, and other species. Spurge-laurel, English ivy, and English holly colonise older and second-growth forest near developed areas. Purple loosestrife and yellow-flag iris can displace native wetland species.

Domestic or **feral** cats, dogs, sheep, and goats can cause localised problems in some ecosystem types. Even introduced European slugs have been identified as one cause of the decline of some wildflower species in oak woodlands. Domestic pets, such as cats and dogs, that are allowed to roam freely, can become predators responsible for unnecessary injury and death of wild species. For example, domestic cats can seriously affect bird populations and have been implicated in the **extinction** of over 20 species of wildlife.[31] Many research studies over the past 10 years, indicate that free-ranging cats prey largely on small mammals, songbirds, insects, snakes, and lizards. In particular, significant impacts have been noted on urban birds, ground-nesting birds and birds at feeders. When the species is rare, even the loss of a single breeding individual can affect the survival of the species.

Together, invasive, non-native species are a serious threat to the ecological integrity of sensitive ecosystems in the study area.

[31] Herron 1995.

Edge Effects

Edge effects, caused by fragmentation and adjacent development, include the introduction of non-native plants species and domestic cats, or other species into the core sensitive ecosystem. The blowdown of trees next to the boundary of new clear-cuts is a common example of an edge effect. Others are more subtle. Some bird species avoid nesting near edges because of increased predation or other disturbances. Smaller ecosystem islands may be more susceptible to edge effects because of the predominance of edge habitat compared to interior habitat. Generally, ecologists describe three types of edge effects:

- *Abiotic effects*—Microclimate changes, including air temperature, wind speed, light levels, soil temperature, and relative humidity were examined near clear-cut edges of forest patches in Oregon.[32] Although the changes to these factors varied considerably, the depth of edge influence could be greater than 240 metres in some situations. Edge orientation was an important modifier of microclimate change; southwest-facing edges experienced the greatest microclimate changes.

- *Direct biological effects*—Researchers have also studied effects of adjacent residential development on the use of forest patches by migrant songbirds. Diversity and abundance of migrant songbirds consistently declined as density of houses outside the forest patch increased.[33] The presence of domestic cats and grey squirrels or disturbance (e.g., noise) avoidance was put forward as a possible explanation for this decline. Other researchers found reduced bird use along road corridors because of traffic noise and collisions between birds and vehicles.[34]

- *Indirect biological effects*—Edges also provide a mechanism for introducing new species into forest habitats. These species tend to be generalists, with excellent dispersal abilities and capable of colonising disturbed habitats. For example, following the construction of an interstate highway in Maine, researchers found 16 percent of the bird species within 100 metres of the new highway to be “edge” species, whereas this group comprised less than 4 percent of the bird species in the 100 to 400 metre zone.[35] The effect is not just the intrusion of these edge species into the original avian community. There is evidence that edge species include nest predators and brood

[32] Chen et al. 1995.
[33] Friesen et al. 1995.
[34] Reijnen et al. 1997; Kuitunen et al. 1998.
[35] Feriis 1979.

parasites such as the Brown-headed Cowbird that can reduce breeding success of the forest interior species.

Global Climate Change

Global climate change is no longer supposition; most atmospheric scientists now agree that human activities around the Earth are affecting the climate. In September 1999, the Environment Program of the United Nations concluded: "indications are that it is too late to prevent global warming as a result of increased greenhouse gas emissions."[36]

Global climate models under a carbon dioxide doubling scenario predict winter and summer temperature increases in the SEI study area of 3 to 4ºC and 2 to 3ºC respectively. Precipitation changes would include winter increases of 30 to 40% and summer declines of 10%.

Greenhouse gas emissions will continue to increase and one—carbon dioxide—is expected to be double the pre-industrial level by 2030. As global warming increases, changes in precipitation patterns and temperature may occur that could have far-reaching effects on these ecosystems (see sidebar).[37] Any habitat changes associated with climate changes are difficult to predict; however, they could result in a complete change of species within the ecosystem.

Direct Impacts

Direct impacts occur on site and are the most visible. Direct impacts on sensitive and other important ecosystems include:

- **Vegetation removal** for construction, forestry, agriculture and recreation purposes. As well, **snags** and falling limbs are removed next to roads, buildings, and trails because of safety concerns.
- **Vegetation damage** from activities such as walking on fragile vegetation, riding mountain bikes, horses and motorised off-road vehicles (trail bikes and all-terrain vehicles), and grazing and trampling by livestock and feral animals.
- **Soils removal or compaction** caused by increased human access from trails or adjacent residential areas and livestock trampling; trails directly under trees may compact the root zone and lead to deterioration in tree health.
- **Ditching, draining and/or filling in aquatic ecosystems.**
- **Wildlife disturbance**—Nesting bird species are particularly vulnerable. Disturbance at a critical time could have serious consequences ranging from crushed eggs as disturbed birds

[36] United Nations Environment Program 1999.
[37] Harding and Taylor 1994.

leave their nests, to increased predation of the eggs by jays, crows and ravens, to premature fledging of the young, to complete abandonment of the nest. The nesting season for many coastal bird species ranges from March through August.[38]

Indirect Impacts

Indirect impacts causing habitat and species degradation are commonly associated with activities that are upstream, adjacent to, or distant from the ecosystems and may also be expressed over a short- or long-term period. Off-site impacts do not directly cause loss of trees, plant communities, or wildlife; however, their effects can be severe if careful planning and management is not undertaken. Examples of such impacts include:

- **Changes to hydrology** caused by development, deforestation, ditching, draining, increased impervious surfacing (e.g. rooftops, sidewalks, and highways), agriculture or even trail construction, can often affect adjacent ecosystems through the
  - reduction of the total amount of groundwater infiltration,
  - reduction of summer soil moisture,
  - increased mean annual **runoff** by reduction in **evapotranspiration** losses,
  - increased size, duration, and frequency of flood events,
  - disruption of surface and groundwater drainage patterns upon which nearby or even distant plant communities depend,
  - reduction of the storage capacity of the soil layer due to subsurface drainage associated with agriculture.
- **Changes to natural disturbance regimes**—Activities such as dyking, channel engineering, fire suppression and the construction of **jetties, breakwaters** and docks can result in
  - disruption of natural erosion processes which maintain coastal ecosystems such as dunes and spits,
  - prevention of fire regimes which enhance the structural diversity of forested ecosystems and maintain open woodlands by suppressing conifer and shrub growth,
  - prevention of natural flooding which can reduce the structural diversity and complexity of wetland and riparian ecosystems resulting in the loss of habitats upon which many species depend.

[38] Campbell et al. 1990a, b; 1997

- **Water pollution**—Both point and **non-point source pollution** can come from the filling of wetlands, runoff from urban areas and farmlands (e.g. nitrates and agricultural and forestry pesticides entering the surface water and ground water, seepage from septic systems and landfills, runoff from roads), deforestation, construction activities near wetlands and other water bodies, and air pollution. Significant impacts to water quality resulting from the removal of streambank vegetation have been documented. Improper forest practices can be a source of increased sedimentation and other pollution problems that directly impact the quality of drinking water from forested watersheds.[39] These factors may
  - increase the incidence of water-borne disease,
  - affect the safe consumption of water by humans,
  - increase the loss of habitat or food for wildlife and deplete their populations,
  - disrupt the food chain,
  - impact, over the long term, wildlife reproduction and breeding success that ultimately threatens the survival of some species.

The clock cannot be turned back, but it is possible to rescue, preserve, protect, restore and enhance the ecosystem remnants so that they function well for future generations of humans and wildlife species that are dependent on them. Impacts at the landscape scale can be mitigated by landscape policy, planning, and management tools.

[39] Binkley and Brown 1993.

4 Planning and Management

Planning for Conservation

Effective conservation planning and management requires an understanding of the rarity, fragility, and vulnerability of sensitive ecosystems to all types of human disturbance. The dynamic nature of each ecosystem must be identified, along with the need to recognise both their geographical and ecological interconnections with the surrounding landscape (e.g., uplands, lakes, and coastal waters).

The aim is not to prevent changes from taking place—ecosystems and species will change even without the actions of man. It is, rather, to ensure that nothing in the existing natural order is permitted to become permanently lost as the result of man's activities except in the most unusual and carefully examined circumstances.

— David W. Ehrenfeld

Primary Goals

The primary goals of the guidelines presented throughout this manual reflect the differences between the two types of SEI ecosystems (see sidebar):

- **Sensitive ecosystem** guidelines seek to conserve the seven sensitive ecosystems in a relatively natural state.
- **Other important ecosystem** guidelines seek to maintain the resource use values of the two other important ecosystems while minimising the loss of ecosystem functions.

Sensitive Ecosystems
Coastal Bluff
Sparsely Vegetated
Terrestrial Herbaceous
Wetland
Riparian
Woodland
Older Forest

Other Important Ecosystems
Older Second Growth Forest
Seasonally Flooded
Agricultural Field

Information Requirements

Sound information is needed to establish a basis for effective conservation planning. This report deals with SEI information that is primarily at an overview level and is adequate for broad landscape planning purposes. However, proposed activities which have the potential to impact any of the SEI areas identified will require further refinement and confirmation of the existing information by detailed site surveys, field studies, and groundtruthing.

Established procedures should be followed for verifying and groundtruthing areas of interest (see *Guidelines for Site Conservation Evaluation*[40] and Appendix F*)* in co-operation with environmental agencies, fish and wildlife agencies, qualified professional consultants, the public and non-government organisations. This could involve workshops, open houses, advisory groups, or other participatory approaches to gather local knowledge and information.

The following steps are recommended to those responsible for local area planning. Management recommendations for site-specific concerns are described in the individual ecosystem chapters (see ***Chapters 5 - 13)***.

Develop a Local Ecosystems Plan

Examples of existing plans

Green and Blue Spaces Strategy, Capital Regional District

Millstream Creek Watershed Management Plan, Regional District of Nanaimo

The Millard - Piercy Watershed Management Plan—stewards have now mapped land use and resources, including sensitive ecosystems, within a small Courtenay area watershed and estimated projected buildout. Their goal is an integrated watershed management plan that will be recognized and adopted into official planning processes by local government.

An ecosystems plan can be developed by local governments through existing mechanisms such as Greenways, Parks and Open Spaces strategies, Official Community Plans, Regional Growth Strategies and biodiversity frameworks (see sidebar).

- **Identify the network of ecosystems** that exists within the larger landscape and any rare, threatened, or endangered species, communities or habitat features that are locally or provincially significant. Identify isolated ecosystems that require the (re) establishment of linkages.
- **Promote connectivity** between, and discourage fragmentation of, contiguous ecosystems to preserve landscape diversity, and allow wildlife use, movement, and dispersal. The impact of large-scale developments, roads and other linear developments on habitat connections should be evaluated and mitigated as part of an environmental impact assessment.
- **(Re) establish or enhance wildlife corridors and linkages** with larger ecosystem networks. Seasonal or daily variation in habitat use depends on appropriate corridors or linkages to connect habitat patches (see page 20).

[40] Kirkby 1998.

Develop a Protection Strategy

Because of the rarity and vulnerability of these sensitive ecosystems, all are considered a priority for protection in the SEI study area. Most sensitive ecosystems are on private property,[41] so the co-operation of landowners is extremely important in the long-term conservation of these ecosystems. Landowners working in concert with local government and conservation organisations can make a significant contribution towards the sustainability of these ecosystems. Various tools and mechanisms are available for ecosystem protection depending on the ownership and management policies of the existing land managers. Once land status is determined, appropriate measures may be taken, including:

See Section Two (pages 149 - 203) for a discussion of available conservation tools

- **Designation as Environmentally Sensitive Area (ESA)**—In the identification of local government ESAs, the seven sensitive ecosystems should receive a priority designation. In some cases, site boundaries should reflect the dynamic nature of the ecosystem (see **Delineate Buffers around Sensitive Ecosystems** below).

Chapter 14 discusses the various conservation planning tools available to local governments

- **Designation as nature or ecological reserve or other such protected status**—The most undisturbed, publicly owned of these remaining ecosystem fragments could be set aside with limited access for research, field studies and low-impact recreation.

Chapter 16 discusses the range of federal and provincial legislation that may be used to protect ecosystems

- **Acquisition of privately owned lands** containing sensitive ecosystems could be pursued by both government and non-government organisations.
- **Stewardship**—Private landowners who wish to retain ownership could become involved in voluntary stewardship initiatives, such as registering conservation covenants on their property to protect ecosystem values.[42]

Chapter 15 discusses steps landowners and other citizens can take towards conservation.

- **Use other protection techniques** such as cluster development, tree protection bylaws, Development Permit Areas, restrictive covenants and incentives.

[41] See footnote, page 4.
[42] Appendix A provides a list of stewardship publications.

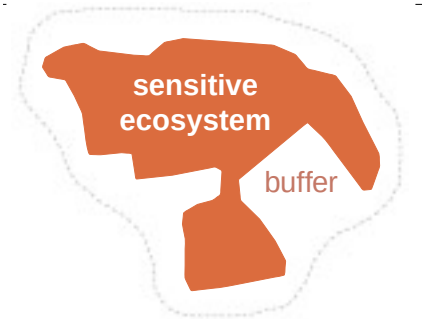
General Management Recommendations

Chapter 14 contains suggestions for incorporating these principles into local government policies and guidelines.

This section makes general recommendations on how to manage and protect sensitive ecosystems. Recommendations on how each ecosystem should be managed to conserve its functions and values will be dealt with in separate ecosystem chapters 5 through 11. For older second growth forest and seasonally flooded agricultural field ecosystems, conservation-oriented management practices are discussed.

Delineate Buffers around Sensitive Ecosystems

Buffered sensitive ecosystem



Wherever possible, the sensitive ecosystem would consist of a core area surrounded by a vegetated buffer designed to isolate the ecosystem from outside disturbance. Buffers would bear the brunt of edge effects such as **windthrow,** invasive species colonisation, and increased access. They may also maintain microclimate conditions that are critical to some ecosystems. Site assessment and fieldwork by qualified professionals may be needed to determine appropriate buffers and the best way to achieve conservation measures.

Avoid Direct and Indirect Impacts

The following actions should minimise impacts to sensitive ecosystems.

- **Discourage development within or adjacent to senstive ecosystems** except where it can be shown that the proposed development will not result in significant negative impacts.
- **Manage both land and water access**—Appropriate management tools may include fencing, trails, elevated boardwalks, railings, seasonal restrictions, signs and livestock restrictions.
- **Prevent disturbance of nesting or breeding areas** (see page 23). Specific information can be obtained from BC Environment's Fish and Wildlife staff or biologists from the Canadian Wildlife Service of Environment Canada.
- **Control invasive species** including plants, feral animals and pets (see page 21). Appropriate active control methods for invasive plant species include hand clearing, pruning, mowing, excavation, planting of appropriate native species and animal

fencing. In some cases a broad invasive species management zone can be established.

Invasive species often spread from adjacent residential areas, roadsides, or clear-cuts. Instead of using species that may invade the sensitive ecosystem, homeowners and land developers should be encouraged to plant native tree and herb species to enhance or restore wildlife habitat and provide a buffer. Native plantings could be used to demonstrate the benefits of planting species adapted to local conditions. A conservation management fund could be required from developers, which would pay for active management to keep exotic species out of adjacent sensitive ecosystems.

- **Allow natural disturbances and successional functions and processes to occur**—Natural ecological functions and processes that are critical to the creation or maintenance of a sensitive ecosystem must be maintained and protected. These may include: hydrologic and nutrient regimes, coastal erosion, sediment **accretion,** flooding, seasonal drawdown, groundwater **recharge** and discharge, stream channel movement, windthrow, tree death, fire and disease. A qualified professional may be required to assess the potential impact of a specific activity.

  For example, factors such as the source, velocity, renewal rate and timing of water entering a wetland affect the type and location of the wetland and the sediment nutrients which, in turn, affect the ecosystem characteristics such as species composition, primary productivity and nutrient cycles. Activities including ditching and draining, or the creation of large hardwood plantations adjacent to a wetland, such as the many poplar plantations springing up in the SEI study area, may have a profound effect on these wetland ecosystems.

- **Maintain water quality**—In the SEI study area, marine waters, lakes, wetlands, creeks and rivers provide drinking water, agricultural capabilities, habitat for fish and other wildlife, recreational activities, and aesthetic enjoyment. Clean water is essential for all those important needs. It is critical to the survival of resident and anadromous fish and a wide variety of other organisms, from aquatic insects, to molluscs, to the higher vertebrates such as the birds and mammals that feed on them.

Canadian Drinking Water Standards provide minimum water quality criteria for human consumption.

Develop Carefully

Check for existing inventory information with

Canadian Wildlife Service, Environment Canada
Ministry of Environment, Lands and Parks
B.C. Conservation Data Centre[43]
Local governments
Local naturalists
Environmental groups
Universities
First Nations

In cases where land development activities cannot be excluded from sensitive ecosystems, those activities should be planned, designed and implemented in a manner that will not adversely affect the functions and values of the core ecosystem.

In order to determine the specific core ecosystem values of specific sites, a qualified professional should conduct an ecological inventory *before* any land development activities take place. Ideally, this inventory should take place through the seasons over a period of a year. Like a shopkeeper, the land manager has to know what is "on the shelves." Otherwise, for example, trails could be built over the only patch of rare orchids on the site or could pass close to an owl nesting tree and, in each of those cases, destroy or disturb the very values the land manager is attempting to maintain.

Local governments could help restrict the introduction of invasive plant species by encouraging landowners and developers to landscape with native species that have adapted to that specific habitat. This simple action would also reduce water consumption as well as pesticide and chemical fertiliser use in or near these fragile areas.

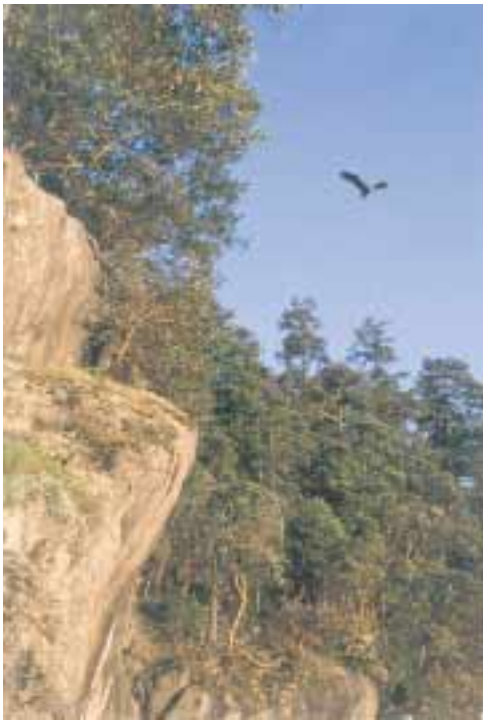
Local governments should require development proponents to fund and commission ecological inventories (by qualified professionals) in, near, or adjacent to sensitive ecosystems PRIOR to permitting or authorising development. A qualified professional should also interpret the available inventory data and work together with the development proponent to incorporate designs that are sensitive to the natural ecosystem (see sidebar), clearly delineating sensitive areas prior to and during construction and minimising impacts to the core ecosystem's

- vegetation, including trees, snags and root systems,
- endangered, threatened or vulnerable species and natural plant communities (and uncommon plant species) identified during the planning and inventory stages,
- terrain features such as rock and soils,
- adjacent wetlands, lakes, streams and foreshore and marine areas,
- microhabitats and habitat niches characteristic of the ecosystem, such as nesting and breeding areas.

Where possible, plants should be salvaged from the land-clearing footprint in areas being developed and transplanted to other sites.

[43] The B.C. Conservation Data Centre (CDC) tracks rare plants, animals, and natural plant communities throughout the province. Please check the CDC website (see Appendix G) for current tracking lists.

Plants growing in the dry, shallow soils in rock crevices and depressions of coastal bluff ecosystems can easily be disturbed or dislodged. (Photo: Mark Kaarremaa)



Undisturbed coastal bluff ecosystems such as this coastal cliff are one of the rarest sensitive ecosystems in the study area. (Photo: Mark Kaarremaa)

Rocky islets and other coastal bluffs are choice nesting sites for a number of bird species such as the Turkey Vulture (below). (Photo: above—Mark Kaarremaa; below—Neil K. Dawe)

5 Coastal Bluff

What are Coastal Bluff Ecosystems?

Coastal bluff ecosystems include rocky shorelines with grasslands, rocky shorelines with mosses, vegetated rocky islets that are dominated by grasses, **forbs**, mosses and lichens (CB) and coastal cliffs (CB:cl). Coastal bluff ecosystems begin at the water's edge, and for the pruposes of this inventory, inlcude only lands above the high tide mark. These two classes of coastal bluff encompass several different landforms that provide specialised wildlife habitats, and support distinct plant communities. Because of their general rarity, all coastal bluffs are of conservation concern in the SEI study area.

Coastal bluff ecosystems are noted for their general lack of soils. Glacial outwash deposits, left in rock crevices and depressions sheltered from prevailing winds, give rise to dry, shallow soils that support plant growth. These ecosystems are distinct because their plant communities are formed by species adapted to hostile environmental conditions such as salt-spray from crashing waves, winds, storms and heat. It takes many years for organic matter to accumulate and distinct horizons to develop. Soils are usually sand to sandy-loam, often with high salinity (conductivity). Steep slopes limit the accumulation of soil organic matter to bedrock fissures on cliffs and bluffs. Thus, the lack of continuous soil coverage on these ecosystems makes the few microsites where soil has developed very important.

Familiar locations

Coastal bluffs

Ballenas/Winchelsea Is.
North and South Trial Is.
Yellow Point
Wallace Point
Active Pass bluffs

Coastal cliffs

Lyall Harbour
Komas Bluffs
Gordon Head
Newcastle Island
Chrome Island

Because of the composition of coastal bluff soils, which typically only have a thin organic layer to protect the surface from erosion and disturbance, they are particularly sensitive to any type of use or development. Plant root systems can easily be disturbed or destroyed, causing major disruption of ecosystem components and processes.

Both coastal bluff classes generally lack continuous vegetation cover over their entire landforms; the remainder is exposed bedrock. Where the land mass is large enough and environmental conditions are more conducive for upland vegetation to occur inshore of the coastal bluffs, coastal bluff ecosystems may be interspersed with—and share many common species with—other SEI ecosystems such as terrestrial herbaceous, woodland, older forest and sparsely vegetated.

Rare*[44] *plants of coastal bluffs

Geyer's onion (R) *(Allium geyeri var. tenerum)*
contorted-pod evening primrose (R) *(Camissonia contorta)*
snake-root (R) *(Sanicula arctopoides)*
Carolina meadow-foxtail (R) *(Alopecurus carolinianus)*
dune bentgrass (B) *(Agrostis pallens)*
Tracy's romanzoffia (B) *(Romanzoffia tracyi)*
water-plantain buttercup (R, COSEWIC-E) *(Ranunculus alismifolius)*
Macoun's meadowfoam (B, COSEWIC-SC), *(Limnanthes macounii)*

Rare plant communities of coastal bluffs

Idaho fescue/junegrass (R) *(Festuca idahoensis/Koeleria macrantha)*
tiny mousetail/montia spp./Macoun's meadowfoam (R) *(Myosurus minimus/Montia* spp.*/Limnanthes macounii)*

Plants of coastal bluff ecosystems

Trees	Garry oak *(Quercus garryana)*, krummholtz forms arbutus (*Arbutus menziesii*) Douglas-fir *(Pseudotsuga menziesii)* Rocky Mountain juniper (U) *(Juniperus scopulorum)*, occasionally
Shrubs	baldhip rose *(Rosa gymnocarpa)* Nootka rose *(Rosa nutkana)* kinnikinnick *(Arctostaphylos uva-ursi)* Saskatoon *(Amelanchier alnifolia)* oceanspray *(Holodiscus discolor)* snowberry *(Symphoricarpos albus)* salal (sun-dwarfed) *(Gaultheria shallon)*
Herbs	California oatgrass *(Danthonia californica)* Alaska brome *(Bromus sitchensis)* spreading stonecrop *(Sedum divergens)* broad-leaved stonecrop *(Sedum spathulifolium)* licorice fern *(Polypodium glycyrrhiza)* small-flowered alumroot *(Heuchera micrantha)* brittle prickly-pear cactus *(Opuntia fragilis)* entire-leaved gumweed *(Grindelia integrifolia)* beach pea *(Lathyrus japonicus)* Menzies' larkspur *(Delphinium menziesii)*

[44] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) species as of May 2000 are noted; species ranked as infrequent or uncommon (U) are noted in the table. Nationally rare species ranked by **COSEWIC**, as of May 2000, are noted as endangered (E), threatened (T) or of special concern (SC). See Glossary for further discussion.

sea blush *(Plectritis congesta)*
tiger lily *(Lilium columbianum)*
death camas *(Zigadenus venenosus)*
nodding onion *(Allium cernuum)*
slimleaf onion (U) *(Allium amplectens)*
Hooker's onion (U) *(Allium acuminatum)*
thrift (U) *(Armeria maritima)*
wooly eriophyllum *(Eriophyllum lanatum var. lanatum)*
blue-eyed Mary *(Collinsia parviflora)*
gold star (U) *(Crocidium multicaule)*
goldenback fern (U) *(Pentagramma triangularis)*
two-coloured lupine (U) *(Lupinus bicolor)*
common camas *(Camassia quamash)*
fool's onion *(Triteleia hyacinthina)*
harvest brodiaea (U) *(Brodiaea coronaria)*
Howell's montia (U) *(Montia howellii)*

Mosses
Lichens
Spikemosses

Wallace's selaginella *(Selaginella wallacei)*
roadside rock moss *(Racomitrium canescens)*
hoary rock moss *(Racomitrium lanuginosum)*
broom moss *(Dicranum scoparium)*
awned haircap moss *(Polytrichum piliferum)*
sea tar lichen *(Verrucaria maura)*
seaside kidney lichen *(Nephroma laevigatum)*
coastal reindeer lichen *(Cladina portentosa)*
caloplaca lichen *(Caloplaca sp.)*

Introduced plants

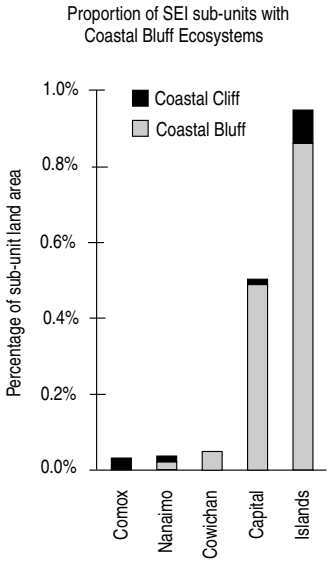
early hairgrass *(Aira praecox)*
silver hairgrass *(Aira caryophyllea)*
hedgehog dogtail *(Cynosurus echinatus)*
sweet vernalgrass *(Anthoxanthum odoratum)*

gold star (U) *(Crocidium multicaule)* (E.J. Stephen)

Status

Coastal bluffs are one of the most poorly represented of all sensitive ecosystems in the study area, representing only 0.3% (1,043 ha) of the land area of the entire study area (see Table 4). Less than 10% of these units were classified as coastal cliffs.

The occurrence and distribution of coastal bluff ecosystems are influenced by the presence of exposed bedrock geology and by proximity to the shoreline, exposure to tidal waters, and prevailing winds. The Capital and Islands sub-units (see Figure 1, page 14) contain nearly 90% of the coastal bluff ecosystems within the SEI study area (see sidebar). These sub-units have extensive areas where exposed bedrock occurs close to the shoreline or offshore on numerous rocky islets. Towards the northern end of the study area,



coastal bluffs are rarely encountered because shorelines are more protected from the elements, and deep glacial and fluvial deposits still bury the bedrock surface.

See Volume 1, section 4.2.2, for further discussion of inventory results relating to coastal bluff ecosystems

Table 4: Area (ha) of coastal bluff ecosystems by sub-unit

SEI Sub-unit	Coastal Bluff	Coastal Cliff	Total
Comox	2.1	32.1	34.2
Nanaimo	22.7	12.8	35.5
Cowichan	40.7	1.1	41.8
Capital	302.0	10.1	312.1
Islands	562.3	57.1	619.4
Total	929.8	113.2	1043.0

Why are they Important?

Ecological attributes and socio-economic values pertaining to coastal bluff ecosystems are listed below. Some of these are common to all SEI ecosystems and are more fully discussed in Chapter 2.

Common Murre
(D. Gunn)

Rare Birds of Coastal Bluffs

'Anatum' Peregrine Falcon (R, COSEWIC-T)
Brandt's Cormorant (R)
Double-crested Cormorant (B)

Ecological Attributes

- **Rarity**—Due to environmental and geographic factors, coastal bluff ecosystems are naturally rare in the study area; undisturbed sites are very rare. Their continued existence contributes to the high level of biodiversity of the region.
- **Fragility**—Although rocky islets, shorelines and cliffs are generally robust and stable, their shallow soils and the species that inhabit them are susceptible to damage from development or recreational activities such as house construction or hiking (see also page 10).
- **High biodiversity**—The juxtaposition of this ecosystem with the inter-tidal zone tends to increase species richness (see also page 11).
- **Specialised habitats**—There are a number of species unique to these habitats within the SEI study area, and within the province in general. Some species are rare, and are only known to occur in these ecosystems. Others which are rare in British Columbia represent **disjunct populations** surviving at the northern or western limits of their range.
- Important microhabitats and **niches** in this ecosystem may encompass only a few square inches or feet. Moist shoreline gullies, swales and **vernal pools** on islets and headlands are occupied by species with very restricted ranges such as the

vulnerable and COSEWIC-SC listed Macoun's meadowfoam.[45] The red-listed water-plantain buttercup,[46] found in moist shoreline swales on East Ballenas Island, was recently added to the federal COSEWIC-E[47] list of endangered species. Moist seepage areas on cliffs host ferns and **bryophytes**. Deep rock crevices are used for shelter, feeding, and **hibernacula** by snakes and lizards.

- **Isolation from predators** makes coastal bluffs and rocky islets choice nesting sites for a number of birds including some provincially-rare species (see sidebar opposite).[49] Many tend to nest directly on the ground and human intrusion can result in damage to eggs and nests or nest abandonment through disturbance. Rocky islets and shorelines are also used as haul-out sites by river otters, harbour seals, and northern and California sea lions.

Some common bird species that nest at coastal bluffs

Pelagic Cormorant (Y)[48]
Turkey Vulture
Glaucous-winged Gull
Pigeon Guillemot
Black Oystercatcher

Socio-economic Values

- **Green space** (see page 11).
- **High scenic values**—As they only occur along coastlines coastal bluff ecosystems probably have the highest scenic values of all the sensitive ecosystems. They contribute to landscape diversity and are highly visible from the water. The scenic beauty of this sensitive ecosystem attracts many recreational boaters and cruise ships, which contribute to local, regional and provincial economies (see also page 11).
- **Outdoor recreation** (see page 11).
- **Research and nature education** (see page 11).
- **Eco-tourism** (see page 12).
- **Increased property values**—Coastal bluff ecosystems often contain higher-valued properties because of the scenic views and waterfront location (see also page 12).

The scenic values of several coastal bluffs have already been recognised, and their features protected by Provincial Park designation:

Boyle Point Park
Newcastle Island Park

Many local and regional parks have also been created for the scenic values of their coastal bluffs.

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45 Douglas et al. 1998.
46 See note above.
47 Committee on the Status of Endangered Wildlife in Canada. *See* Glossary.
48 Yellow-listed species (see Glossary).
49 Fraser et al. 1999

Management Recommendations

See Chapter 14 for suggestions on incorporating these recommendations into local government policies and guidelines.

Beachfront property is highly desirable for tourism, recreation, commercial and residential purposes. Effective conservation management of coastal bluff ecosystems must acknowledge their rarity and exceptional vulnerability to all types of human disturbance. In these ecosystems, nature is in the process of achieving a dynamic equilibrium that can be easily disrupted. Even a small rise in sea levels resulting from global climate change would return many of the rocky islets to the inter-tidal zone or ocean ecosystem (see also page 23).

Oystercatcher (D. Gunn)

Some cliffs and bluffs may already have been identified as "hazard or undevelopable lands" because of their steep slopes (>30%) and erosion or mass wastage potential It is equally important to recognise their habitat values for other species. These wildlife values increase in importance with isolation from human activities.

When developing a management plan for coastal bluff ecosysems, it is assumed that a local ecosystems plan and protection strategy have been carried out (see pages 28 and 29). The following recommendations will aid in the site management of coastal bluff ecosystems:

Delineate Buffers around Coastal Bluff Ecosystems

On James Island, a setback of three times the bluff height is required for intensive land use or buildings.

Wherever possible, vegetated buffers should be delineated around each coastal bluff ecosystem as described in Chapter 4 (page 30). In addition to a site assessment, which may be needed to determine appropriate buffers, geo-technical engineers should also be consulted to determine the safety zone for active and eroding areas around coastal bluff ecosystems (see sidebar).

Avoid Direct and Indirect Impacts

In relatively undisturbed coastal bluff ecosystems, even minor damage to rocky shorelines and cliffs can make plant communities less stable. Plants can be easily trampled or dislodged by human foot traffic, livestock or feral animal access along a coastal bluff. Soil compaction can encourage erosion by reducing the thin surface crust that allows for safe runoff in heavy rains. The following actions will help minimise impacts to coastal bluff ecosystems.

- **Discourage development within or adjacent to coastal bluff ecosystems**
- **Restrict recreational access**—Prevent damage to soils and vegetation by restricting access of horses, mountain bikes, and all-terrain vehicles that are inappropriate in coastal bluff areas. Recreational activities such as kayaking allow ocean access to coastal bluffs that may be unreachable by land; even foot traffic can seriously disturb these ecosystems. In some instances fencing may be an appropriate management tool to restrict access to designated points within the coastal bluff ecosystem. Rock climbing should be restricted in areas where rare plant species or communities and/or breeding wildlife are present (see also page 23).
- **Restrict livestock and feral animal access**—Feral sheep and goats can be controlled by erecting fencing around the land perimeter of the coastal bluff (see also page 21).
- **Prevent disturbance of nesting or breeding areas**—In addition to the many songbirds and raptors that nest on coastal bluffs, a number of colonial nesting species, such as the cormorants and Great Blue Heron use these ecosystems and their adjacent upland areas for nesting and breeding and are very susceptible to disturbance during the nesting season (see also page 23).
- **Control the introduction or spread of invasive plant species** such as Scotch broom and various non-native grasses such as early hairgrass, soft brome, sweet vernal grass and hedgehog dogtail (see also pages 21 and 32).
- **Control pets** (see page 21).
- **Allow successional functions and processes to occur naturally**—Docks and piers, **groins,** jetties, and breakwaters unintentionally and/or intentionally interrupt natural processes such as waves, ocean currents, tides and sediment accretion / erosion. This can adversely affect the development and maintenance of these ecosystems. In some cases, a qualified professional will be required to assess the potential of these types of structures to interfere with the natural coastal processes (see also page 31).
- **Maintain water quality**—Sources of pollution affecting these ecosystems include docks and piers constructed out of creosote-treated lumber and piles, products of marine dumping and ocean disposal of boat sewage that eventually return to shore by way of tides and currents. Some of this material (e.g. oily bilge) is toxic and can have serious long-term impacts on wildlife and the ocean environment (see also page 25 and 31).

Animal fencing has been used successfully around parts of the perimeter of Ecological Reserve #4 on Lasqueti Island.

Develop Carefully

Where development is allowed in coastal bluff ecosystems, the general development guidelines described in Chapter 4 (page 32) should be followed, namely:

- **Require an ecological inventory conducted by a qualified professional.**
- **Plan, design and implement all land development activities in a manner that will not adversely affect or disturb**
  - vegetation, trees, snags, and root systems,
  - endangered, threatened, or vulnerable species and natural plant communities (and uncommon plant species) associated with coastal bluff ecosystems and vernal pools identified during the planning and inventory stages,
  - terrain features such as rock and, in this ecosystem especially, soils,
  - adjacent foreshore and marine areas,
  - birds and other wildlife and their habitats, such as nesting and breeding areas, microhabitats and habitat niches characteristic of this ecosystem.

River otter (D. Gunn)

For suggestions on how to incorporate the above recommendations into Official Community Plans and Development Permit Areas, see Chapter 14

Sparsely vegetated spits and dunes are very susceptible to disturbance. Plants growing in the unconsolidated sand and gravel particles can easily be dislodged and destroyed by foot traffic. (Photo: Trudy Chatwin)

The ledges, crevices, caves and open faces of sparsely vegetated inland cliffs provide habitat for bats, raptors and other birds, overwintering snakes and lizards. (Photo: Nick Page)

Flat, open sand and gravel spits provide ideal habitats for nesting, overwintering and migrating shorebirds. (Photo: Nick Page)

Killdeer use open spits and dunes for nesting. (Photo: Peggy Ward)

6 Sparsely Vegetated

What are Sparsely Vegetated Ecosystems?

Sparsely vegetated ecosystems include coastal sand dunes (SV:sd), coastal sand and gravel spits (SV:sp) and inland cliffs and bluffs (SV:cl). Vegetation is usually discontinuous, interspersed with bare sand, gravel, or exposed bedrock. These unique landforms are often in a dynamic state of change due to factors such as water level changes, sediment deposition, sediment erosion (spits and dunes) and mass wasting (cliffs). Although species diversity is low in these ecosystems in comparison to other sensitive ecosystems, they provide a variety of specialised wildlife habitats. They support newly- and slowly-developing plant communities that are formed by species adapted to hostile environmental conditions.

Spits and *dunes* are typically formed through the accretion of sand and gravel and are highly unstable and fragile. In their formative years, they lack distinct soil horizons and organic layers and vegetation is slow to establish due to **natural disturbance** processes such as wave-pounded beaches, shifting sands, relentless winds, salt-spray and saline soils, and full exposure to summer heat. Plant communities evolve and eventually stabilise through the interaction of natural processes over thousands of years.

Steep inland *cliffs* and *bluffs* typically form as a result of erosion, catastrophic failure or mass wastage of rock faces and riverbanks. Environmental factors influencing plant and animal establishment or use of these cliffs and bluffs are: steepness and activity of slopes; **aspect** and position on a slope; exposure to severe weather

Familiar locations

Sidney Spit
Shingle Spit

Island View Beach dunes
Cordova Spit dunes

Cowichan River cliffs
Mount Benson cliffs

conditions such as full sun or full shade; lack of moisture or continuous seepages; and whether the site is wind-blown or fully sheltered. Rapid drainage and the accumulation of soil organic matter that is limited to bedrock fissures and ledges results in stunted trees, shrubs, grasses, mosses and lichens developing in these shallow soils. Vegetation here is similar to that on coastal bluffs and is usually interspersed with other ecosystems types such as rocky terrestrial herbaceous and older second growth forest ecosystems.

Deltoid balsamroot
(Balsamorhiza deltoidea)
(E.J. Stephen)

Rare*[50] *plants of dunes and spits

contorted-pod evening primrose (R) *(Camissonia contorta)*
sand-dune sedge (B) *(Carex pansa)*
deltoid balsamroot (R, COSEWIC-E) *(Balsamorhiza deltoidea)*

Plants of dunes and spits

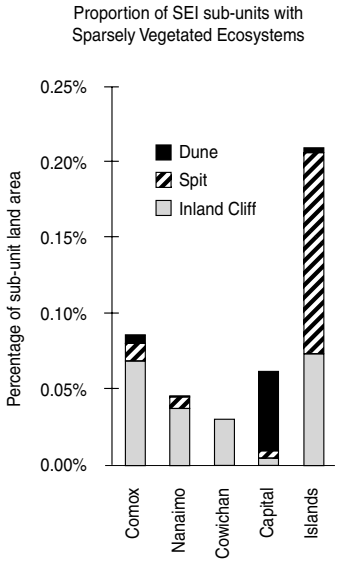
Shrubs *(generally absent)*	some species sometimes establish behind the strandline, and in back dune areas furthest away from the shore, for example: kinnikinnick (*Arctostaphylos uva-ursi*) Nootka rose (*Rosa nutkana*) Pacific crabapple (*Malus fusca*)
Herbs	silver burweed (*Ambrosia chamissonis*) dunegrass (*Elymus mollis*) American searocket (*Cakile edentula*) gumweed (*Grindelia integrifolia*) seabeach sandwort (*Honkenya peploides*) seaside plantain (*Plantago maritima*) thrift (U) (*Armeria maritima*) silverweed (*Potentilla anserina*) beach pea (*Lathrys japonicus*) coastal strawberry (*Fragaria chiloensis*) red fescue (*Festuca rubra*) yellow sand verbena (U) (*Abronia latifolia*) gold star (U) (*Crocidium multicaule*) beach bindweed (U) (*Convolvulus soldanella*) beach bluegrass (U) (*Poa confinis*) seashore lupine (U) (*Lupinus littorale*) seaside rein orchid (U) (*Piperia maritima*) seashore bluegrass (U) (*Poa macrantha*) large-headed sedge (U) (*Carex macrocephala*)
Mosses *(rare)*	hairy screw moss (*Tortula ruralis*) can occur behind the strand

[50] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) species as of May 2000 are noted; species ranked as infrequent or uncommon (U) are noted in the table. Nationally rare species ranked by COSEWIC, as of May 2000, are noted as endangered (E), threatened (T) or of special concern (SC). See Glossary for further discussion.

Plants of inland cliffs	
Trees	Garry oak (*Quercus garryana*), krummholtz forms. arbutus (*Arbutus menziesii*) Douglas-fir (*Pseudotsuga menziesii*)
Shrubs	baldhip rose (*Rosa gymnocarpa*) kinnikinnick (*Arctostaphylos uva-ursi*) hairy manzanita (*Arctostaphylos columbiana*
Herbs	broad-leaved stonecrop (*Sedum spathulifolium*) small-flowered alumroot (*Heuchera micrantha*) licorice fern (*Polypodium glycyrrhiza*) saxifrage (*Saxifraga* sp.) woolly eriophyllum (*Eriophyllum lanatum* var. *lanatum*) field chickweed (*Cerastium arvense*) blue-eyed Mary (*Collinsia parviflora*) harvest brodiaea (U) (*Brodiaea coronaria*)
Ferns ***Mosses*** ***Spikemosses***	Wallace's selaginella (*Selaginella wallacei*) hoary rock moss (*Racomitrium lanuginosum*) goldenback fern (U) (*Pentagramma triangularis*) juniper haircap moss (*Polytrichum juniperinum*) broom moss (*Dicranum scoparium*)

Status

These ecosystems were the most poorly represented of all ecosystems in this study area, covering only 335 ha or less than 0.1% of the study area (see Table 5). Inland cliffs and bluffs were the most abundant sub-category, representing 55% of the total SV area. They occurred throughout the study area and were generally found in combination with older second growth forest and rocky terrestrial herbaceous ecosystems. Their occurrence is influenced by topography, bedrock type, and presence and depth of surficial materials. Several active **talus** slopes found in the Comox Sub-unit are included in this class.



The occurrence and distribution of sand dunes and sand and gravel spits is influenced by proximity to the shoreline and by exposure to tidal waters, ocean currents, and prevailing winds. Topography and geology also influence dune and spit distribution because steeply sloped coastal bluff areas are prevalent in the SEI study area, and generally inhibit dune and spit development. Spits accounted for 26 of the 86 SV polygons and occurred in all sub-units except for Cowichan. They were best represented in the Islands Sub-unit,

likely because of the greater coastline length and the presence of Nanaimo Group sandstones. Only 8 units were classified as dunes, occurring primarily in the Capital Sub-unit.

Table 5: Area (ha) of sparsely vegetated ecosystems by sub-unit

SEI Sub-unit	Dune	Spit	Inland Cliff or Bluff	Total
Comox	5.8	13.1	73.8	92.7
Nanaimo	0	7.7	35.3	43.0
Cowichan	0	0	24.6	24.6
Capital	32.1	3.4	2.5	38.0
Islands	1.6	87.1	47.6	136.3
Total	39.5	111.3	183.8	334.6[51]

*See **Volume 1,** section 4.2.3, page 59, for further discussion of inventory results relating to sparsely vegetated ecosystems*

Why are they Important?

Ecological attributes and socio-economic values pertaining to sparsely vegetated ecosystems are listed below. Some of these are common to most SEI ecosystems and are discussed in Chapter 2.

Greater Yellowlegs
(M. Hames)

Ecological Attributes

- **Rarity**—Sparsely vegetated ecosystems are the rarest of the sensitive ecosystem types in the SEI study area. Undisturbed examples of this ecosystem are very rare (see page 10).
- **Fragility**—Sand dunes, sand and gravel spits are typically highly unstable landforms with thin, limited soils resulting in plant root systems that can easily be disturbed or destroyed (see also page 10).
- **Biodiversity**—Species diversity is low in comparison to other ecosystems in the SEI study area. Sparsely vegetated ecosystems support a narrow range of plant and animal species that have adapted to their harsh environment.
- **Specialised habitats**—A variety of specialised habitats occur in these ecosystems. There are a number of species, some of them rare, which are unique to these habitats within the SEI study area, and the province in general.

[51] Some discrepancies may occur between figures in this report and ***Volume 1*** due to minor corrections in the database.

Spits and their adjacent beaches are summer home ranges for the wandering and northwestern garter snakes that find cover from driftlogs and food on these dry sites. A variety of migrating shorebirds also use these flat, open habitats. Large numbers of wintering shorebirds such as Black Turnstones, Dunlin and Black-bellied Plover frequent spits and Killdeer and Spotted Sandpipers nest on sand dunes and sand or gravel spits. During spring migration thousands of Brant geese depend on spits and the adjacent intertidal habitat for loafing, feeding, and maintenance activities.

Open ledges and horizontal fissures on cliffs and bluffs are known to provide nesting sites for birds such as the Turkey Vulture and many songbird species. Cliff crevices are used for roosting by bats, and the open cliff faces are used for foraging. The COSEWIC and red-listed Keen's long-eared bat and the blue-listed Townsend's big-eared bat use caves and rock crevices.[53] Deep crevices are used for shelter and hibernacula by overwintering snakes and lizards. Moist seepage areas host ferns and mosses.

Rare vertebrates of sparsely vegetated ecosystems

Dunes and spits[52]

Hudsonian Godwit (R)
Sandhill Crane (B)
American Golden-Plover (B)
Short-billed Dowitcher (B)
Califonia Gull (B)

Inland cliffs and bluffs

Sharp-tailed snake (R, COSEWIC-E)
'Anatum' Peregrine Falcon (R, COSEWIC-T)
Keen's long-eared bat (R, COSEWIC-SC)
Townsend's big-eared bat (B)
Turkey Vulture

Socio-economic Values

- **Green space** (see page 11)
- **High scenic values** (see page 11)
- **Outdoor recreation** (see page 11)
- **Research and nature education** (see page 11)
- **Eco-tourism** (see page 12)
- **Increased property value**—Sparsely vegetated spits contain some of the more desirable properties because of their scenic views and waterfront location. However, caution is warranted; see **Avoid Direct and Indirect Impacts** and **Develop Carefully** under **Management Recommendations** below.

The scenic values of some sparsely vegetated ecosystems have already been recognised, and their features protected by Provincial Park designation:

Sidney Spit Marine Park
Tribune Bay Park

[52] Fraser et al. 1999.
[53] Cannings et al. 1999.

Management Recommendations

See Chapter 14 for suggestions on incorporating these recommendations into local government policies and guidelines.

Effective management of sparsely vegetated ecosystems requires an understanding of their rarity, fragility, and exceptional vulnerability to all types of human disturbance. Nature is in the process of achieving a dynamic equilibrium, which can be perplexing to those that can only envision perceptibly static ecosystems wherein change takes place in geological time. Many expect a boundary to stay put once it has been defined, whether it is a natural shoreline or an administrative property line. This expectation is unrealistic for sparsely vegetated ecosystems and can lead to many problems. They are not always going to be safe places on which to live. Even a small rise in sea level would return many of the spits and sand dunes to the intertidal zone (see also page 23).

Inland cliffs and bluffs may already have been identified as "hazard or un-developable lands" because of their steep slopes (>30%), and erosion or mass wastage potential. It is equally important to recognise their habitat values for other species that increase in importance with isolation from human activities.

Silver burweed *(Ambrosia chamissonis)* (E.J. Stephen)

When developing a management plan for sparsely vegetated ecosysems, it is assumed that a local ecosystems plan and protection strategy have been carried out (see pages 28 and 29). The following recommendations will aid in the site management of sparsely vegetated ecosystems:

Delineate Buffers around Sparsely Vegetated Ecosystems

Wherever possible, vegetated buffers should be delineated around each sparsely vegetated ecosystem as described in Chapter 4 (page 30). For *spits* and *dunes*, the site assessment required to determine appropriate buffers should take into account the adjacent intertidal area and areas that are actively accreting or eroding. The site assessment for buffering *cliffs* and *bluffs* should consider adjacent upland forest as well as the habitat at the cliff base.

Avoid Direct and Indirect Impacts

Beachfront property is highly desirable for tourism, recreation, commercial and residential purposes. Many housing or commercial developments have already been constructed on spits in the SEI study area. Even minor damage to sparsely vegetated ecosystems

can make plant communities less stable, and plants can be easily trampled or dislodged by foot traffic.

Sand spit and sand dune soils are very different from those found in other SEI ecosystems, as are eroding cliffs composed of glacial **till** such as those found above Witty's Beach. Because they are composed of unconsolidated sand particles that rarely have an organic layer to protect the surface from erosion and disturbance, they are particularly sensitive to any type of use and development.

In tourist areas, sand is sometimes imported to replenish the eroding shoreline. This would have a direct impact if done within the dune or spit ecosystem, and an indirect impact if it occurred elsewhere on the coast, but would contribute to an alteration in the rate and amount of accretion. The following actions will help minimise impacts to sparsely vegetated ecosystems.

Little brown bat (L. Friis)

- **Discourage development within or adjacent to sparsely vegetated ecosystems**—These sites are relatively unstable due to their shifting substrates and, in the case of spits and coastal dunes, offer very real threats from flooding and winter storms.
- **Restrict recreational access**—Activities such as riding mountain bikes, horses, and motorised, off-road vehicles (trail bikes and all-terrain-vehicles) are inappropriate in these areas and can result in damage to soils and vegetation. Even foot traffic can seriously disturb these ecosystems. Elevated boardwalks, fences, railings, seasonal trail closures, and signs may be used to reduce related impacts. Rock climbing is unsafe on eroding inland cliffs and bluffs, and depending on rare plant species and presence of breeding wildlife, should be restricted to stable cliffs (see also page 23).
- **Restrict livestock and feral animal access** (see page 21).
- **Prevent disturbance of nesting or breeding areas**—The nesting season for birds using sparsely vegetated sites ranges from early March through August[54] (see also page 23). Shorebirds nesting on dune and spit habitats, such as the killdeer, lay their eggs in small scrapes on the ground and rely on camouflage to protect the eggs and recently fledged young. Thus most people would not know that they were near a nest or young even if they were to tread upon them. Any public use should have well-marked trails and fencing to control access to these fragile areas such as has been done in Rathtrevor Park (see also page 23).
- **Control the introduction or spread of invasive species** such as Scotch broom, and various non-native grasses (see also page 21 and page 30).

[54] Campbell et al. 1990b.

Black Brant (CWS)

- **Control pets** (see page 21).
- **Allow successional functions and processes to occur naturally**—Natural ecological processes that are critical to the creation or maintenance of sparsely vegetated ecosystems include waves, tides, ocean currents, winds, storms, sediment accretion, and mass wastage. These functions and processes should be maintained and protected where they do not pose a danger to safety or property. Docks and piers, groins, jetties, and breakwaters, which are unintentionally and intentionally constructed to interrupt the natural processes of coastal accretion or erosion could adversely affect the development of dune and spit ecosystems.

  Wherever possible, natural coastal processes should be left undisturbed around sparsely vegetated coastal ecosystems. The form and character of structures should be regulated by Development Permit (DP) designations within 300 metres of the sparsely vegetated coastal ecosystem in either direction along the shoreline. The DP process should require an environmental site plan and impact assessment conducted by a qualified professional indicating that there will be "no effect."

  Aquaculture/mariculture should not be permitted in areas that would be environmentally sensitive to such development. Artificial reefs should not be permitted within the 300m zone.

Develop Carefully

Where development is allowed in sparsely vegetated ecosystems, the general development guidelines described in Chapter 4 (page 32) should be followed, namely:

- **Require an ecological inventory conducted by a qualified professional.**
- **Plan, design and implement all land development activities in a manner that will not adversely affect or disturb**
  - vegetation, trees, snags, and root systems,
  - endangered, threatened, or vulnerable species and natural plant communities (and uncommon plant species) associated with sparsely vegetated ecosystems identified during the planning and inventory stages,
  - terrain features such as rock and especially soils,
  - adjacent foreshore and marine areas, including natural sand features and vegetation that supports them,

- birds and other wildlife and their habitats, such as nesting and breeding areas, microhabitats and habitat niches characteristic of this ecosystem.

For suggestions on how to incorporate the above recommendations into Official Community Plans and Development Permit Areas, see Chapter 14

Terrestrial herbaceous ecosystems are rare, fragile and exceptionally vulnerable to all types of human disturbance. The shallow soils take a long time to form and the grasses and broad-leaved plants, mosses and lichens can be easily trampled or dislodged. Seepage areas and vernal pools are home to several globally rare plant species. (Photo: Mark Kaarremaa)

Grassy hilltops and wildflower meadows offer spectacular displays of colour in the spring. Some plant species are rare, and are only known to occur in these ecosystems. (Photo: Mark Kaarremaa)

Scotch broom is one of the most invasive species displacing native plants in sensitive ecosystems. (Photo: Mark Kaarremaa)

7 Terrestrial Herbaceous

What are Terrestrial Herbaceous Ecosystems?

Terrestrial herbaceous ecosystems (HT) are the open wildflower meadows and grassy hilltops of the SEI study area, containing a rich tapestry of colour created by herbs–grasses and forbs—and mosses and lichens. They are found outside the salt spray zone near shorelines, all the way to the summits of local hills and mountains.

The predominantly herbaceous vegetation is continuous except where interspersed with bare rock outcrops. The minimal tree and shrub cover characteristic of this ecosystem type is a result of shallow and rapidly draining soil conditions. Summer heat and light create drying conditions.

The SEI recognised three classes of terrestrial herbaceous ecosystem: grass-forb dominated areas with less than 10% tree cover and less than 20% shrub cover (HT); grass-forb areas interspersed with rocky outcrops (HT:ro); and grass-forb areas with more than 20% shrub cover (HT:sh). Various combinations of these three classes were found in the study area, which is reflected in the inventory results (see Table 6).

When found near shorelines, there may be an overlap with species common to the coastal bluff ecosystem. Where environmental conditions are more conducive for woodland and forest growth, terrestrial herbaceous ecosystems may be interspersed with other SEI ecosystems such as woodland, older forest, and older second growth forest.

Familiar locations

Terrestrial herbaceous ecosystems

Nanoose Hill
Beacon Hill Park

Rocky terrestrial herbaceous ecosystems

Mt. Tolmie
Mt. Finlayson
Mt. Douglas
Siwash Ridges
Mt. Benson
Campbell Lake
Quinsam Lake
Burgoyne Bay
Jervis Island
Mount Jeffrey
Bamberton

Shrub-dominated terrestrial herbaceous ecosystems

Woodley Range
Mount Tzuhalem

	Plants of terrestrial herbaceous ecosystems
Trees *(occasional)*	Garry oak (*Quercus garryana*) arbutus (*Arbutus menziesii*) Douglas-fir (*Pseudotsuga mensiesii*) shore pine (*Pinus contorta* var. *contorta*)
Shrubs	baldhip rose (*Rosa gymnocarpa*) kinnikinnick (*Arctostaphylos uva-ursi*) oceanspray (*Holodiscus discolor*) snowberry (*Symphoricarpos albus*) tall Oregon-grape (*Mahonia aquifolium*)
Herbs	western fescue (*Festuca occidentalis*) junegrass (*Koeleria macrantha*) blue wildrye (*Elymus glaucus*) Columbia brome (*Bromus vulgaris*) Alaska brome (*Bromus sitchensis*) California oatgrass (*Danthonia californica*) small-flowered alumroot (*Heuchera micrantha*) broad-leaved stonecrop (*Sedum spathulifolium*) death camas (*Zigadenus venenosus*) sea blush (*Plectritis congesta*) tiger lily (*Lilium columbianum*) Menzies' larkspur (*Delphinium menziesii*) white fawn lily (*Erythronium oregonum*) chocolate lily (*Fritillaria affinis*) satin-flower (*Olsynium douglasii* var. *douglasii)* fool's onion (*Triteleia hyacinthina*) common camas (*Camassia quamash*) miner's lettuce (*Claytonia perfoliata*) nodding onion (*Allium cernuum*) great camas (*Camassia leichtlinii*) short-stemmed sedge (*Carex brevicaulis*) rusty-haired saxifrage (*Saxifraga rufidula*) field chickweed (*Cerastium arvense*) woolly eriophyllum (*Eriophyllum lanatum* var. *lanatum)* early blue violet (*Viola adunca*) blue-eyed Mary (*Collinsia parviflora*) broad-leaved shooting star (*Dodecatheon hendersonii*) yarrow (*Achillea millefolium*) western buttercup (*Ranunculus occidentalis*) spring-gold (*Lomatium utriculatum*) Lemmon's needlegrass (U) (*Stipa lemmonii*) large-headed sedge (U) (*Carex macrocephala*)

Rare*[55] *plants of terrestrial herbaceous ecosystems

deltoid balsamroot (R, COSEWIC-E) *(Balsamorhiza deltoidea)*
yellow montane violet (R) *(Viola praemorsa)*
scalepod (R) *(Idahoa scapigera)*
dune bentgrass (B) *(Agrostis pallens)*

Rare natural plant community

Idaho fescue/junegrass (R) *(Festuca idahoensis/Koeleria macrantha)*

[55] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) species as of May 2000 are noted; species ranked as infrequent or uncommon (U) are noted in the table. Nationally rare species ranked by COSEWIC, as of May 2000, are noted as endangered (E), threatened (T) or of special concern (SC). See Glossary for further discussion.

hairy manzanita (U) (*Arctostaphylos columbiana*)
tomcat clover (*Trifolium tridentatum*)
goldenback fern (U) (*Pentagramma triangularis*)
harvest brodiaea (U) (*Brodiaea coronaria*)
slimleaf onion (U) (*Allium amplectens*)
gold star (U) (*Crocidium multicaule)*
farewell-to-spring (U) (*Clarkia amoena*)
Hooker's onion (U) (*Allium acuminatum*)
poverty clover (U) (*Trifolium depauperatum*)
two-coloured lupine (U) (*Lupinus bicolor*)
chickweed monkey-flower (U) (*Mimulus guttatus*)
Nuttall's quillwort (U) (*Isoetes nuttallii*)
Gairdner's yampah (U) (*Perideridia gairdneri*)

May also include moisture-loving species in seepage areas and vernal pools such as
slender plantain (*Plantago elongata*)
blue-eyed grass (U) (*Sisyrinchium idahoense* var. *macounii*)

Mosses

roadside rock moss (*Racomitrium canescens*)
step moss (*Hylocomium splendens*)
Oregon beaked moss (*Kindbergia oregana*)
electrified cat's-tail moss (*Rhytidiadelphus triquetrus*)
hoary rock moss *(Racomitrium lanuginosum)*

Introduced plants

early hairgrass (*Aira praecox*)
silver hairgrass (*Aira caryophyllea*)
hedgehog dogtail *(Cynosurus echinatus)*
sweet vernalgrass *(Anthoxanthum odoratum)*

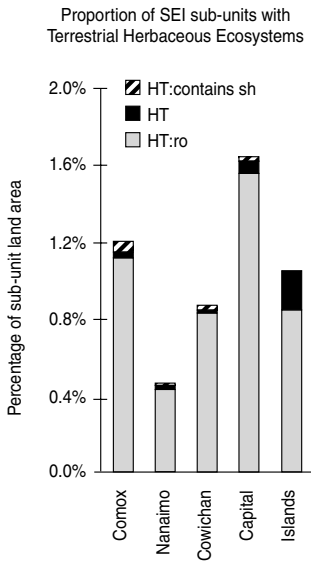
Slender wooly-heads (R)
(Psilocarphus tenellus)
(E.J. Stephen)

Status

These ecosystems occur throughout the study area and account for about 1% of the total land base. Terrestrial herbaceous ecosystems containing rocky outcrops (HT:ro) were the most abundant sub-category, representing 90% of the total HT area (see Table 6).

The occurrence and distribution of terrestrial herbaceous ecosystems is strongly influenced by the presence of exposed bedrock geology, often on gentle to moderate slopes, and often near the summits of hills and mountains in the study area.

The Capital and Comox sub-units account for over half of the area of terrestrial herbaceous ecosystems because of the greater presence of the older bedrock type, and because of more hilly or mountainous terrain. The Islands and Nanaimo sub-units are composed primarily of much younger Nanaimo Group sandstones, shales and conglomerates, and have been more prone to erosion. The result is fewer high hills and mountains such as are found elsewhere on Vancouver Island. The Lasqueti Island archipelago is



the one exception; this group of islands is mainly of the Karmutsen formation, and has extensive rocky herbaceous sites. Many terrestrial herbaceous ecosystems throughout the study area have been taken over by shrubs due to fire suppression.

Table 6: Area (ha) of terrestrial herbaceous ecosystems by sub-unit

SEI sub-unit	HT	HT:ro	HT:sh	HT:ro:sh	HT:sh:ro	Total
Comox	30.6	1210.5	59.0	27.3	0	1327.4
Nanaimo	16.5	416.4	13.2	0	0	446.1
Cowichan	11.8	683.8	20.6	26.2	1.8	744.2
Capital	36.7	963.6	14.2	26.8	1.4	1042.7
Islands	129.9	552.6	0.6	0	0	683.1
Total	225.4	3826.8	107.4	80.3	32.	4243.5

*See **Volume 1**, section 4.2.4, page 60, for further discussion of inventory results relating to terrestrial herbaceous ecosystems*

Why are they Important?

Ecological attributes and socio-economic values pertaining to terrestrial herbaceous ecosystems are listed below. Some of these are common to most SEI ecosystems and are discussed in Chapter 2.

Ecological Attributes

- **Rarity**—These ecosystems are very rare in the SEI study area, because of a combination of geographical location, geological age, bedrock type, and Mediterranean climate. These factors give rise to the erosional processes required to expose bedrock, or restrict soil development to thin sandy veneers over the bedrock (see also page 10).
- **Fragility**—Whereas the bedrock beneath is generally robust and stable, the species that inhabit these ecosystems are less so. Thin and rapidly draining soils are easily disturbed (see also page 10).
- **High biodiversity**—The frequent juxtaposition of terrestrial herbaceous ecosystems with the coastal bluff, woodland, older forest and older second growth forest ecosystems increases species richness of these sites (see also page 11).
- **Specialised habitats**—Terrestrial herbaceous ecosystems contain highly specialised microhabitats, including vernal pools. Because of the fragility of these sites, microhabitats and niches may encompass only a few square inches or feet. As a result, there are a number of species unique to these habitats within the SEI study area, and the province in general. Seepage

Edith's checkerspot (R)
(C. Guppy)

areas are hotspots for plants of conservation concern. Some of the species are rare, and are only known to occur in these ecosystems. Others represent disjunct populations surviving at their most northern or western range limits.

Vernal pools, rare even in this ecosystem, form during the wet autumn and winter months and dry up during the summer. A variety of organisms have evolved to use these ephemeral "wetlands." **Obligate** vernal pool species are dependent on these pools for various aspects of their life history and, in the study area, include winged water-starwort and Nuttall's quillwort.

Some species, such as butterflies, have very restricted or patchy habitats, perhaps utilising only one plant species within a geographic area. One such butterfly is the red-listed Edith's checkerspot, known only from terrestrial herbaceous ecosystems on Hornby Island, where its larvae feed on plantain species. Another, the red-listed Bremner's silverspot fritillary, is found in open meadows interspersed amongst old-growth Douglas-fir forests on Saltspring Island. Violets, such as the early blue violet, are larval host plants for this butterfly.

Rare butterflies of terrestrial herbaceous ecosystems

Edith's checkerspot, taylori subspecies (R)
Bremner's silverspot (R)
Propertius duskywing (B)

Socio-economic Values

- **Green space** (see page 11).
- **High scenic values**—Visitors to meadows in spring or early summer will encounter a wildflower display that is second to none. Because these sites are frequently found on hilltops, they also offer spectacular viewpoints (see also page 11).
- **Outdoor recreation** (see page 11).
- **Research and nature education** (see page 11).
- **Eco-tourism**—The spectacular spring wildflower displays in the terrestrial herbaceous ecosystems are one of the best-kept wildlife viewing secrets on Vancouver Island. With adequate protection of these important ecosystems and suitable public access controls to minimise disturbance, they could become an important part of the island's eco-tourism marketing strategy (see also page 12).

Protected terrestrial herbaceous ecosystems

Provincial parks

Sandy Island Park
Helliwell Park
Gowlland Tod Park

Local and regional parks

Uplands Park
LoneTree Regional Park
Mount Tolmie Park
Mount Douglas Park
Mount Work Regional Park

Management Recommendations

See Chapter 14 for suggestions on incorporating these recommendations into local government policies and guidelines.

Terrestrial herbaceous ecosystems, like coastal bluffs and sparsely vegetated ecosystems, are rare, fragile and exceptionally vulnerable to all types of human disturbance.

When developing a management plan for terrestrial herbaceous ecosysems, it is assumed that a local ecosystems plan and protection strategy have been carried out (see pages 28 and 29). The following recommendations will aid in the site management of terrestrial herbaceous ecosystems:

Delineate Buffers around Terrestrial Herbaceous Ecosystems

Wherever possible, vegetated buffers should be delineated around each terrestrial herbaceous ecosystem as described in Chapter 4 (page 30). Site assessments required to determine appropriate buffers should take into account for example, the adjacent coastal bluff, older forest or woodland. It is very important to establish adequate buffers for terrestrial herbaceous ecosystems, as they are particularly vulnerable to adjacent land uses, for example, clearcutting land adjacent to the core ecosystem results in colonization by agressive invasive alien plant species, which then spread into the adjacent sensitive ecosystem.

Avoid Direct and Indirect Impacts

The thin layer of soil coverage in terrestrial herbaceous ecosystems makes the microsites where soil has developed very important. These soils typically only have a thin organic layer to protect the surface from erosion and disturbance and are particularly sensitive to any type of use or development. The following actions will help minimise impacts to terrestrial herbaceous ecosystems.

- **Discourage development within or adjacent to terrestrial herbaceous ecosystems**—(see page 31).
- **Control recreational access**—The impacts of recreational activities such as mountain biking and horse riding should be carefully considered and suitable trails constructed before such uses are allowed. All-terrain vehicles are inappropriate in terrestrial herbaceous areas, as they cause damage to fragile soils and vegetation. The thin soils take a long time to form and are easily disturbed. Herbaceous plants can be easily trampled,

or dislodged onto bare rock where they cannot re-establish. Plant root systems can easily be disturbed or destroyed through compaction as well, thus causing major disruption of ecosystem components and processes. What may seem to be passive recreational activities—such as walking—may cause irreparable damage in which case access may have to be restricted.

Elevated boardwalks, fences, railings, seasonal trail closures, and signs may be used to reduce related impacts. Trails should be designed carefully to avoid altering drainage patterns and to minimise erosion and seasonal flooding.

- **Restrict livestock and feral animal access** (see page 21).
- **Prevent disturbance of nesting or breeding areas**—The nesting season for birds using terrestrial herbaceous sites ranges from early March through July and early August (see also page 23).[56]
- **Control the introduction or spread of invasive species**—Common species include Scotch broom and various non-native grasses. A conservation management fund could be required from developers that would pay to mitigate inevitable impacts from adjacent developments (see also pages 21 and 30).
- **Control pets** (see page 21).
- **Allow successional functions and processes to occur naturally**—Natural ecological processes that are critical to the creation or maintenance of terrestrial herbaceous ecosystems include seasonally variable soil moisture and nutrient regimes. Any alteration to these conditions, through activities such as septic discharge and garden watering from further up slope, should be restricted on the advice of a qualified professional as indicated on page 31. Avoid disturbing seepage areas and water flows within areas with recreational trails.

Develop Carefully

Where development is allowed in terrestrial herbaceous ecosystems, the general development guidelines described in Chapter 4 (page 32) should be followed, namely:

- **Require an ecological inventory conducted by a qualified professional.**
- **Plan, design and implement all land development activities in a manner that will not adversely affect or disturb**

[56] Campbell et al. 1990b, 1997.

Propertius duskywing (B)
(C. Guppy)

- grasses, forbs, shrubs, bryophytes, trees, snags, and root systems,
- endangered, threatened, or vulnerable species and natural plant communities (and uncommon plant species) associated with terrestrial herbaceous ecosystems identified during the planning and inventory stages,
- terrain features such as rock and especially soils and soil conditions,
- adjacent foreshore and marine areas,
- birds and other wildlife and their habitats, such as nesting and breeding areas, microhabitats and habitat niches characteristic of this ecosystem.

- **Maintain native meadows and their spectacular wildflower displays** by encouraging landowners and developers to maintain these natural areas, instead of landscaping with non-native plant species.

For suggestions on how to incorporate the above recommendations into Official Community Plans and Development Permit Areas, see Chapter 14

Undisturbed wetlands such as this freshwater marsh are rare in this dry region. All wetlands are complex ecosystems and are highly vulnerable to human disturbance. The remaining intact wetlands continue to contribute to the area's high level of biodiversity. (Photo: Mark Kaarremaa)

An estuarine marsh during winter high tides (top) and lush summer growth (bottom). These are the most productive of all wetland classes, supporting a rich diversity of plants and animals. (Photo: Neil K. Dawe)

Treed swamp and shallow water wetland with characteristic floating and submerged plants. (Photo: SEI)

8 Wetlands

What are Wetland Ecosystems?

Wetlands (WN) are characterised by daily, seasonal, or year-round water, either at or above the surface, or within the root zone of plants. Their plant communities are adapted to wet conditions; some are tolerant of complete submergence whereas others depend on drier conditions during the summer growing season.

The Sensitive Ecosystem Inventory recognises six wetland classes: *bog, fen, marsh, swamp, shallow water*, and *wet meadow*. These classes encompass a range of communities including western redcedar and skunk cabbage swamps, cattail marshes, *Sphagnum* moss-dominated bogs, and coastal salt and estuarine marshes. All are of conservation concern in the SEI study area. As a result of successional processes, disturbance, and other factors, some wetlands are mosaics of several wetland classes, and many are transitional between more than one wetland class. Common transitions occur between bogs and fens, as well as between fens and swamps.

Within the typology of wetland classes, wetlands are generally divided into peatlands and mineral wetlands. An understanding of the unique ecology of both will help in determining their sensitivity to disturbance and deciding what needs to be done to conserve them.

Familiar locations

Somenos Marsh
Hamilton Marsh
Burns Marsh
Campbell River estuary
Cowichan River estuary
Englishman River estuary
Little Qualicum River estuary
Nanaimo River estuary
Nanoose and Bonell estuaries
Dyke slough
Rithet's Bog

*See **Volume 1,** section 3.5 for a description of the site factors, plants and animals for each wetland class.*

Sphagnum moss
(C. Tunnoch)

Peatlands include bogs and fens, which are characterised by continuously wet, organic soils (mainly *Sphagnum* or sedge peat) that accumulate because plant growth exceeds decomposition. Digging into a bog reveals the fibrous remains of mosses and other plants that have taken hundreds or thousands of years to accumulate. Peat deposits can be greater than 5 m deep. Bogs are hydrologically isolated from the surrounding landscape and are characteristically acidic, low in nutrients, and saturated for the entire year. Fens receive water enriched with minerals and nutrients from upslope drainage or groundwater, and support a higher diversity of plant species than bogs.

The following are partial lists of characterisic vegetation that can occur in each of the wetland types identified by the SEI.

Bog plants	
Trees	shore pine (*Pinus contorta* var. *contorta*) western hemlock (*Tsuga heterophylla*), occasionally
Shrubs	Labrador tea (*Ledum groenlandicum*) low birch (*Betula pumila* var. *glandulifera*) western bog-laurel (*Kalmia microphylla s*sp. *occidentalis*) bog-rosemary (*Andromeda polifolia*) bog cranberry (*Oxycoccus oxycoccos*) salal (*Gaultheria shallon*) crowberry (*Empetrum nigrum*) cloudberry (*Rubus chamaemorus*)
Herbs	white bog-orchid (*Platanthera dilatata* var. *dilatata*) round-leaved sundew (*Drosera rotundifolia*) Northern starflower (*Trientalis arctica*) great burnet (*Sanguisorba officinalis*) Alaska bentgrass (*Agrostis aequivalis*) green sedge (*Carex viridula*)
Mosses	various species of *Sphagnum* moss species including: small red peat moss (*Sphagnum capillifolium*) fat bog moss (*Sphagnum papillosum*) Pacific peat moss *(Sphagnum pacificum)* Brown peat moss *(Sphagnum fuscum)*

Fen plants	
Trees	shore pine (*Pinus contorta* var. *contorta*) western hemlock (*Tsuga heterophylla*) western redcedar (*Thuja plicata*)
Shrubs	sweetgale (*Myrica gale*) hardhack (*Spiraea douglasii*)
Herbs	Sitka sedge (*Carex sitchensis*) water sedge (*Carex aquatilis*) beaked sedge (*Carex utriculata*) slough sedge (*Carex obnupta*) inflated sedge *(Carex exsiccata*) common rush (*Juncus effusus*) white beak-rush (*Rhynchospora alba*) dulichium (*Dulichium arundinaceum*) buckbean (*Menyanthes trifoliata*) king gentian (*Gentiana sceptrum*) narrow-leaved cotton-grass (*Eriophorum angustifolium*) Chamisso's cotton-grass (*Eriophorum chamissonis*)
Mosses	ribbed bog moss (*Aulacomnium palustre*) sickle moss (*Drepanocladus uncinatus*) *Sphagnum* spp.

Fens, one of two wetland types characterized by wet organic soils, support a higher diversity of plant species than bogs. (Photo: Andrea Ward)

Mineral wetlands include freshwater, brackish and saline marshes, treed and shrub swamps, shallow water, and wet meadows. The greater seasonal or daily water level fluctuation results in higher decomposition rates, as well as increased nutrient availability. Organic matter does not normally accumulate because changing water levels or higher nutrient levels promotes decomposition. Wildlife values are typically higher in mineral wetlands because of the productive food supplies, such as aquatic plants and insects, and the presence of open water.

Mallard (CWS)

Rare*[57] *plants of saline and brackish marshes

graceful arrow-grass (R) *(Triglochin concinnum)*
Henderson's checkermallow (B) *(Sidalcea hendersonii)*
beach sand-spurry (B) *(Spergularia macrotheca)*
fleshy jaumea (B) *(Jaumea carnosa)*

Marsh plants	
Shrubs (rarely)	Pacific crabapple *(Malus fusca)* willow species (*Salix* spp.) red-osier dogwood *(Cornus stolonifera)*
Herbs	***Freshwater Marshes*** beaked sedge *(Carex utriculata)* Sitka sedge *(Carex sitchensis)* slough sedge *(Carex obnupta)* small-flowered forget-me-not *(Myosotis laxa)* tapered rush *(Juncus acuminatus)* common spike rush *(Eleocharis palustris)* cattail *(Typha latifolia)* buckbean *(Menyanthes trifoliata)* reed canary grass *(Phalaris arundinacea)* ***Saline and Brackish Marshes*** American glasswort *(Salicornia virginica)* seashore saltgrass *(Distichlis spicata)* seacoast bulrush *(Scirpus maritimus)* Lyngby's sedge *(Carex lyngbyei)* sea arrow-grass *(Triglochin maritimum)* arctic rush *(Juncus arcticus* ssp. *sitchensis)* seaside plantain *(Plantago maritima* ssp. *juncoides)* tufted hairgrass *(Deschampsia cespitosa)* alkaligrass *(Puccinellia* spp.*)*
Introduced plants	orache *(Atriplex patula)*

[57] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) species as of May 2000 are noted; species ranked as infrequent or uncommon (U) are noted in the table. Nationally rare species ranked by COSEWIC, as of May 2000, are noted as endangered (E), threatened (T) or of special concern (SC). See Glossary for further discussion.

Swamp plants	
Trees	western redcedar *(Thuja plicata)* Pacific crabapple *(Malus fusca)* red alder *(Alnus rubra)* black cottonwood *(Populus balsamifera* ssp. *trichocarpa)* Pacific willow *(Salix lucida* ssp. *lasiandra)* Scouler's willow *(Salix scouleriana)*
Shrubs	hardhack *(Spiraea douglasii)* red osier dogwood *(Cornus stolonifera)* Pacific ninebark *(Physocarpus capitatus)* salmonberry *(Rubus spectabilis)* black hawthorn *(Crataegus douglasii)* stink currant *(Ribes bracteosum)* sweet gale *(Myrica gale)* Sitka willow *(Salix sitchensis)* Scouler's willow *(Salix scouleriana)* Pacific willow *(Salix lucida* ssp. *lasiandra)* Hooker's willow *(Salix hookeriana)*
Herbs ***Ferns***	skunk cabbage *(Lysichiton americanum)* lady fern *(Athryrium felix-femina)* slough sedge *(Carex obnupta)* Pacific water-parsley *(Oenanthe sarmentosa)*
Introduced Plants	creeping buttercup *(Ranunculus repens)* stinging nettle *(Urtica dioica* ssp. *dioica)*

Examples of shrub and treed swamps are shown in photographs on page 81.

Shallow water wetland plants	
Herbs	floating-leaved pondweed (*Potamogeton natans*) yellow pond-lily (*Nuphar polysepalum*) hard-stemmed bulrush (*Scirpus lacustris*) water-plantain (*Alisma triviale*) water smartweed (*Polygonum amphibium*) grass-leaved pondweed (*Potamogeton gramineus*) greater bladderwort (*Utricularia vulgaris*) watershield (*Brasenia schreberi*) common mare's- tail (*Hippuris vulgaris*)
Mosses (only on floating wood)	common water moss (*Fontinalis antipyretica*) Sphagnum moss

Rare plant of shallow water wetlands

water-pepper (B) *(Polygonum hydropiperoides)*

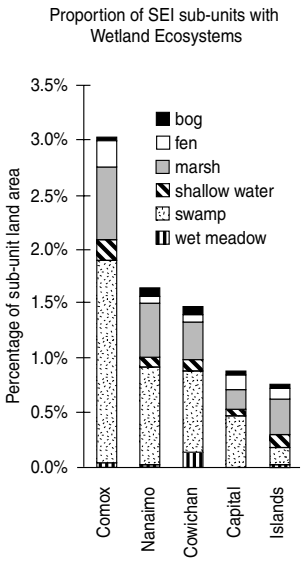
	Wet meadow plants
Shrubs *(rarely*	Pacific crab apple (*Malus fusca)* willow species *(Salix* spp.*)* red-osier dogwood (*Cornus stolonifera)*
Herbs	reed canary grass (*Phalaris arundinacea*) tufted hairgrass (*Deschampsia cespitosa*) tall mannagrass (*Glyceria elata*) Sitka sedge (*Carex sitchensis*) beaked sedge (*Carex utriculata*) tapered rush (*Juncus acuminatus*) slough sedge (*Carex obnupta*)) small flowered forget-me-not (*Myosotis laxa*) cattail (*Typha latifolia*) buckbean (*Menyanthes trifoliata*) cow parsnip (*Heracleum lanatum*) common spike-rush (*Eleocharis palustris*)

Rare plants of wet meadows

green-sheathed sedge (B) *(Carex feta)*
Geyer's onion (R) *(Allium geyeri)*
Northern adder's tongue (R) *(Ophioglossum pusillum)*

Status

Wetland ecosystems account for 1.7% (7,054 hectares) of the entire SEI area. The most common wetland classes in the study area are swamps and marsh; bogs and wet meadows are the least common (see Table 7).



Climate and topography influence the occurrence and distribution of wetlands. The Georgia Basin is warmer and drier than other areas of coastal B.C. and the rain-shadow climate of the east coast of Vancouver Island and Gulf Islands further restricts wetland development. In a typical year, Victoria receives 858 mm of precipitation and Campbell River receives 1,409 mm, whereas Tofino, on the West coast of the island, receives 3,295 mm. Most precipitation falls from October to March, with a pronounced summer dry period. Colder, wetter climates encourage wetland development by saturating soils or ponding water in depression areas, reducing evapotranspiration, and creating cooler, saturated soils, which hinder organic decomposition. Bogs and fens in particular thrive in poorly-drained, cooler environments. Topography also influences wetland creation. Sloped areas generally support fewer wetlands than flat or undulating terrain.

In the Capital Sub-unit and the Islands Sub-unit, wetlands cover less than 1% of the land surface, compared to 3% of the cooler and wetter Comox Sub-unit. This is partially due to the increased prevalence of hummocky, bedrock-controlled topography in the

southern part of the study area. In these areas, wetlands are individually very small and widely scattered.

Table 7: Area (ha) of wetland ecosystems by sub-unit

	Comox	Nanaimo	Cowichan	Capital	Islands	Total
bog	33.5	62.9	47.00	12.1	16.3	171.8
fen	261.8	68.2	60.9	82.5	66.0	539.4
marsh	719.3	473.5	284.0	120.0	210.7	1807.5
shallow water	204.8	75.2	82.7	37.3	80.1	480.1
swamp	2014.3	865.8	617.7	283.5	102.6	3883.9
wet meadow	36.6	8.3	103.5	1.0	10.8	160.2
wetland-general[58]	1.3	2.9	0.4	1.5	5.1	11.2
all wetlands	3238.1	1493.9	1149.2	525.8	475.3	6882.3

See Volume 1, section 4.2.5, page 61, for further discussion of inventory results relating to wetland ecosystems.

Although the number of SEI sites and their total area reflect the current status of wetlands, these figures do not provide an estimate of how many wetlands occurred historically and how many have been lost during the last 150 years. It has been well documented that wetlands have declined globally because of agricultural development, flood control, forestry, coastal development, and urbanisation. Many of these same factors have affected wetlands in the SEI study area. Salt and estuarine marshes on eastern Vancouver Island have declined an estimated 32 percent since the early 1900s. Most of the loss was associated with early settlers dyking coastal[59] and freshwater marshes for agriculture; however, recent log handling impacts and marina construction has also affected these marshes. In Washington State, where land use is similar to the Georgia Basin, the areal extent of wetlands has declined an estimated 31 percent since 1780.[60]

Of seven bogs once found in the Saanich area, only one—Rithet's Bog—still remains.

[58] No sub-category recorded during inventory.
[59] Prentice and Boyd 1988.
[60] Dahl 1990.

Why are they Important?

Historically, wetlands have been converted to "more productive" land uses such as agriculture or forestry without recognition of their economic, cultural, or ecological values as functioning ecosystems. More recent understanding of some of the economic benefits that wetlands provide, and a growing awareness and interest in their intrinsic ecological or cultural values, has increased the value and protection of wetlands.

Ecological attributes and socio-economic values pertaining to wetland ecosystems are listed below. Some of these are common to all SEI ecosystems and are discussed in Chapter 2.

Ecological Attributes

- **Rarity**—Due to environmental and geographic factors, wetland ecosystems are naturally rare in the study area relative to other areas of coastal B.C. and undisturbed wetlands are very rare (see also Status above). In addition, wetlands have declined in the SEI study area due to agriculture, forestry and urban development. Those remaining continue to contribute to the high level of biodiversity of the region.
- **Fragility**—Wetlands are highly vulnerable to a range of disturbance factors, particularly those related to hydrologic change (see also page 10).
- **High biodiversity**—Most wetlands are nodes of high biological diversity and support a disproportionate number of rare species or plant communities. Most wetlands, particularly mineral wetlands, are extremely productive as breeding and feeding areas for wildlife and they support a high number of habitat niches. A typical wetland might have a central area of open water that supports ducks and geese, a marsh fringe where herons feed on threespine stickleback and northwestern salamanders lay their eggs, and a forested swamp margin where black bears feed on skunk cabbage roots in the spring.

  Estuarine wetlands are one of the most productive habitats that occur in the SEI study area—indeed in the world—and are critical habitats for thousands of wintering waterbirds (see sidebar). British Columbia's relatively mild winter climate encourages these birds to overwinter where they usually find snow- and ice-free freshwater wetlands and agricultural fields

Pacific treefrog
(K. Taylor)

The SEI study area is on the Pacific Flyway, a major migratory route for birds traveling between northern breeding grounds and southern wintering areas.

that, together with the estuaries, form a "wetlands complex."[61] Occasionally, however, severe weather does occur and during these times, estuaries are the only habitats available that are ice-free and have enough food to support the birds. Estuaries are also critical to the survival of Pacific salmon. It's in the estuaries where they acclimatise themselves to the changing water salinities when they leave the rivers as smolts and when they return as adults to spawn.

- **Maintenance of water quality**—Wetlands reduce the levels of sediment, nutrients, and toxic chemicals in outflow water. Learning from the natural wetlands, many communities now use biofiltration wetlands in urban and agricultural areas to mimic natural wetland processes and remove contaminants before they enter streams. Biofiltration acts by using vegetation and microbes to treat polluted water, but must be carefully managed to prevent concentration of contaminants or water temperature problems.

Socio-economic Values

- **Economic value**—The economic value of the ecological benefits provided by terrestrial wetlands has been measured compared to other types of ecosystems (see sidebar). The value has been estimated at more than $22,000 per hectare per year for the hydrological, water quality, habitat and other functions they provide, in contrast to forest, grassland, and cropland at a fraction of this value. The only systems that are valued higher than terrestrial wetlands are estuaries, valued at $34,000 per hectare per year, and seagrass algae beds, valued at over $28,000 per hectare per year.[62] Estuaries are included within the SEI definition of wetlands.

Many ecological functions or "services" are not fully captured in markets or quantified in terms comparable to economic services, and are therefore rarely given enough weight in land use decisions.

— Costanza et al.

- **Green space** (see page 11).

- **Resource use**—Some wetlands are habitat for fish and wildlife with important economic values. Rainbow trout, cutthroat trout, and coho salmon, as well as species such as ducks and geese are economically important to communities in the SEI study area. Young coho salmon rely on floodplain swamps and marshes as overwintering habitat. Other salmon species including chinook salmon, chum salmon, cutthroat trout, and steelhead depend on intertidal marshes for feeding and rearing. Indeed, the loss of estuarine habitat has been recognised as a contributing factor in

[61] Eamer 1985.

[62] Costanza et al. 1997. Their calculations were based primarily on published studies that estimated market and non-market components of the value of services such as water regulation, water supply, erosion control, waste treatment, habitat refugia, food production, and recreation.

the decline of fish stocks in the Georgia Basin. Other commercial activities in wetlands may include peat mining and American glasswort *(Salicornia)* harvesting.

- **International obligation**—Canada has an obligation, as a member of the Pacific Coast Joint Venture (PCJV), to ensure the long-term maintenance of coastal wetland ecosystems. The PCJV is an international partnership involving Canada, the United States and Mexico and was established under the North American Waterfowl Management Plan in 1991.

(R. Savannah)

- **Outdoor recreation**—Wetlands are treasured both for their diversity of life and as opportunities to observe nature. Birdwatching, nature photography, and other passive recreational activities occur at or around wetlands. Wetlands also provide recreational activities such as hunting and fishing. Other wetland features that attract visitors include *Sphagnum* bogs that support rare or unusual plants such as insectivorous sundews and showy bog orchids (see also page 11).
- **Research and nature education** (see page 11).
- **Eco-tourism**—The Trumpeter Swan Festival in Courtenay is an example of an event in which wetland ecosystems play an important role. Visitors to events such as these contribute to local economies through the purchase of equipment, food, accommodation, and other amenities (see also page 12).
- **Flood protection**—Wetlands slow rainfall runoff into streams and rivers by acting as storage sites for surface water. Runoff is released slowly which reduces the **peak** storm **flows** and increases summer base flows. Flooding in urban areas is often caused by loss of wetland and soil storage areas, and a concurrent increase in impervious surfaces such as roofs, roads, and parking areas. In some areas, municipal governments and private developers must now create flood storage ponds to compensate for the loss of wetlands and the increase in impervious surfaces.

Management Recommendations

The ecological functions that wetlands provide, specifically water storage and maintenance of water quality, are provided free of charge. Yet, when these functions are removed from an area through the loss or degradation of local wetlands, the costs to replace them through technological means can be exorbitant. We cannot live without water, nor can other organisms. ***Community leaders and local governments should be diligent in promoting the protection of every wetland in their area whether the wetland is on private or public lands.***

The world's freshwater ecosystems have been degraded at an alarming rate over the past 30 years. Many species that depend on these habitats have disappeared; others are on the brink of extinction. At the same time, all signs point to an increasing global shortage of water for essential human purposes such as drinking, sanitation, food production and energy generation.

— World Wide Fund for Nature[63]

Effective wetland conservation requires an understanding of the vulnerability of wetlands to human disturbance and the complexity of wetland processes. This vulnerability also has serious consequences for the wildlife dependent on those ecosystems. The filling of a wetland eliminates the habitat for thousands of organisms dependent on that wetland. Many simply cannot leave the wetland and those that can usually find other wetlands already occupied, and therefore unavailable. In addition to the relatively recent extinction of numerous wetland-dependent species (see sidebar), hundreds of additional species of fishes, snails, crayfishes, and amphibians are considered threatened; they are dying out five times faster than land species, and three times faster than coastal marine mammals.[64]

Since 1900, at least 123 freshwater animal species have become extinct in North America.

— Ricciardi and Rasmussen

This manual emphasises the interconnectedness between wetlands and surrounding terrestrial areas, and the complexity of functional processes related to climate, topography, and wetland vegetation. The diversity of wetland classes and the range of vegetation communities found in the SEI study area highlight this level of complexity.

Activities such as dredging, dyking, or filling can cause severe impacts to wetlands. Many wetlands, estuaries in particular, have been severely fragmented, separating some portions of the ecosystem from others. Earth or gravel fill has been used to raise the surface of the land above the water table for residential or commercial development. In addition, although many wetlands were converted to agricultural lands long ago, clearing and dyking of bogs and other wetlands for cranberry cultivation has recently become a concern in the Comox-Strathcona Regional District.

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[63] Formerly known as the World Wildlife Fund.
[64] Ricciardi and Rasmussen 1999.

Occasionally, these fragmented wetland ecosystems can be restored,[65] and restorative efforts should be encouraged whenever possible (see page 20). Also, the impacts from human activities can sometimes be mitigated,[66] at least in part, but caution is warranted.[67] Wetlands in their natural state are critical to both wildlife and people and they must be protected.

The world water cycle seems unlikely to be able to cope with the demands that will be made of it in the coming decades. Severe water shortages already hamper development in many parts of the world, and the situation is deteriorating…

Finally, the indications are that it is too late to prevent global warming as a result of increased greenhouse gas emissions; in addition, many of the targets agreed on in the Kyoto Protocol may not be met.

—UNEP, GEO-2000

The role of climate in wetlands development makes them especially vulnerable to climate change. A number of agencies, including the United Nations Environment Program, now believe that we can no longer prevent global warming (see sidebar).[68] However, we can and should try to minimise its severity. Changes to regional precipitation and temperature patterns may cause shrinkage or loss of wetlands. Sea level change may also cause rapid changes in vegetation and productivity of estuarine marshes and other coastal wetlands or cause them to disappear altogether. Researchers have identified three ways that global warming may affect wetlands:

- Changes to wetland hydrology may cause rapid **succession** of some wetland classes or reduction in their areal extent.
- Frequency of inundation will change.
- Drying conditions will increase conflicts between wetland values and agriculture or urban land uses (see also page 23).[69]

When developing a management plan for wetland ecosysems, it is assumed that a local ecosystems plan and protection strategy have been carried out (see pages 28 and 29). The following recommendations will aid in the site management of wetland ecosystems.

Delineate Buffers around Wetland Ecosystems

Wherever possible, vegetated buffers should be delineated around each wetland ecosystem and its associated riparian ecosystem as described in Chapter 4 (page 30). Wetlands are particularly sensitive to adjacent land use, which can affect the hydrology of the wetland ecosystem. In establishing buffers, the larger watershed should be considered, including the inflow and outflow locations in the core sensitive ecosystem area. Identification of watershed areas can also be helpful in designing landowner contact and stewardship programs.

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65 Dawe and McIntosh 1987.
66 Brownlee et al. 1984.
67 Dawe et al. in prep.
68 United Nations Environment Program 1999.
69 Hebda 1994.

Ecologists should be consulted to determine the location of the wetland boundary. This boundary can be identified in the field by the presence of hydrophytic vegetation, saturated, gleyed or mottled soils, or seasonal signs of flooding (floating debris deposits). In wetland margins, wet soils will reduce the windfirmness of trees. Therefore, buffers should be designed with a smooth windward edge and be located in areas of deep soils and well rooted trees

Avoid Direct and Indirect Impacts

The following actions will help minimise impacts to wetland ecosystems.

- **Discourage development within or adjacent to wetland ecosystems.**

- **Maintain wetland hydrology**—Changes to wetland hydrology are the most significant indirect impact to wetlands. Urban wetlands are often degraded by the loss of groundwater recharge caused by impervious area or flood control drainage. Urban development causes more rapid runoff and reduces the total amount of groundwater infiltration and summer soil moisture. Agriculture is often associated with drain pipe systems which reduce the storage capacity of the soil layer. Clearcut logging can increase mean annual runoff by reducing evapotranspiration through tree removal.

  Bogs and fens are particularly vulnerable to hydrologic change. Draining a bog causes the upper layer of peat to decompose and become drier. This can allow trees to invade the wetland and change it from a moss and low shrub dominated environment to a closed canopy forest.

  Wetland hydrologists may need to be consulted to determine methods for protecting wetland hydrology. These processes should be maintained as follows, unless they pose a safety or property danger.

  - Avoid drainage or ditching within the wetland's zone of hydrologic influence.
  - Prevent direct unfiltered stormwater discharges into the wetland.
  - Protect beaver dams or other natural features that influence wetland hydrology, wherever possible.
  - Use porous pavements, infiltration galleries and innovative development planning to minimize the effects of impervious area coverage on groundwater infiltration.

Please also refer to Section Two for further suggestions for incorporating guidelines into local government policies and regulations

Muskrat (L. Friis)

- **Maintain water quality**—Water pollution and changes to water quality may arise in wetlands from such activities as urban storm drainage, nutrient-rich agricultural runoff, and sediment from road building and forestry harvesting. Septic fields can also contaminate wetlands and cause human health problems. Algae blooms or high levels of coliform bacteria are indicators of high nutrient levels in wetlands (see also pages 25 and 31). Even limited changes in nitrogen or phosphorous levels or changes to seasonal inundation patterns can reduce the zone in which specific wetland inhabitants can live (see also page 25).

  - Prevent the addition of these nutrient or sediment-rich waters into wetlands. Bogs and fens are particularly vulnerable to the addition of nutrient-rich water.

- **Restrict recreational access**—Wetland soils are typically saturated for at least part of the year, and are often high in organic materials. Shrub and tree root systems as well as the soils, are more easily damaged by trampling and trail development in wetlands. Recreational trails can widen considerably in wet sites adjacent to wetlands, as users tend to move progressively away from the trail centre to avoid wet conditions. Sediment from excessive trail damage can wash into wetlands and affect amphibian and insect populations.

  Horseback riding, mountain biking, all-terrain vehicle use and hiking trails are inappropriate in wetland areas. Depending on the sensitivity of the wetland, powerboats and jet skis may have to be excluded and even canoeing may have to be controlled during the nesting season. Where trails need to access shoreline viewing points or cross portions of a wetland, elevated boardwalks, viewing platforms, fences, railings, seasonal trail closures, and signs should be used to reduce access related impacts. To minimise water quality changes, limestone-based trail surfacing materials, bark mulch, and some types of preserved wood should *not* be used. In some instances fencing may be an appropriate management tool to restrict access to designated points around the wetland.

- **Restrict livestock access**—Livestock grazing and trampling can damage native species, compact soils and increase the distribution of invasive species by compacting or exposing the upper soil layer. Where grazing does occur, landowners should work with government agencies and stewardship groups to assess the impacts and, if necessary, take protective measures such as fencing. Erecting fencing around the perimeter of the wetland and allowing them access at one point only can mitigate damage from livestock needing access to the water.

- **Restrict road access to inaccessible wetlands**—Wherever possible, road access to inaccessible wetlands should be prevented or carefully managed to reduce damage.
- **Prevent disturbance of nesting or breeding areas**—Recreational activities on wetlands, such as canoeing at inappropriate times, may impact nesting waterbirds such as grebes and other waterfowl. Shallow open water wetlands with adjacent marshes and forested edges are important breeding areas for waterbirds such as Pied-billed Grebes, Mallards, Wood Ducks, and Blue-winged and Cinnamon Teal. Amphibians such as rough-skinned newts, long-toed and northwestern salamanders, frogs and toads lay their eggs in the early spring and the eggs are vulnerable to disturbance at that time. Older red alder- and black cottonwood-dominated swamps may support a high proportion of snags or damaged trees—nesting sites for cavity nesters. Wood Ducks, woodpeckers, and some species of owls nest in forested swamps. Nesting for many coastal wetland species is from March through July and, for some species, well into August (see also page 23).[70]
- **Control the introduction or spread of invasive plant species** by designating a broad invasive species management zone within the wetland ecosystem. Purple loosestrife, reed canary grass, yellow-flag iris, European glasswort, and European bittersweet were commonly identified in the wetlands surveyed. Eurasian water-milfoil and a variety of clams are also a potential threat to natural wetlands and their inhabitants (see also page 21).

  Appropriate active control methods for invasive plants include hand clearing, pruning, mowing, excavation, and planting of appropriate native species. Consult agencies and people with expertise in techniques and timing likely to be the most successful for controlling individual species.
- **Control pets** (see page 21).
- **Allow natural ecological processes to occur**—Processes critical to wetlands creation or maintenance include surface and subsurface drainage processes that sustain the wetland such as winter flooding, seasonal drawdown, beaver activity, sediment accretion, tidal activity, and groundwater recharge and discharge. In general, losses of water or greater water level fluctuations cause wetland contraction or rapid wetland succession.

  Changes to natural disturbance regimes such as river and coastal dyking prevents seasonal or daily flooding of some wetland classes, resulting in loss of wetland functions (see also page 24).

Common garter snake
(K. Taylor)

[70] Campbell et al. 1990a, 1990b.

Develop Carefully

Where development is allowed in wetland ecosystems, the general development guidelines described in Chapter 4 (page 32) should be followed, namely:

- **Require an ecological inventory conducted by a qualified professional.**
- **Plan, design and implement all land development activities in a manner that will not adversely affect or disturb:**
  - Wetland vegetation and structure—the loss of the vegetation of any wetland removes habitat niches for other organisms. For example, marsh vegetation is an important component in the detrital food chain of estuaries and loss of parts of an estuarine wetland can affect its productivity and thus the number of organisms it can support. Loss of wetland vegetation may also have some negative impacts on the water quality of an area.
  - Endangered, threatened, or vulnerable species and natural plant communities (and uncommon plant species) associated with wetland ecosystems identified during the planning and inventory stages.
  - Wildlife habitats, such as important breeding and nesting sites.
  - Wetland soils and soil conditions.
- **Involve upstream land managers where possible** to ensure their activities do not adversely impact the wetland. Even small wetlands on lands that are drained and filled may affect the hydrology of an area and cause indirect impacts in other areas far from the damaged site.

Rough-skinned newt (K. Taylor)

For suggestions on how to incorporate the above recommendations into Official Community Plans and Development Permit Areas, see Chapter 14

This treed swamp represents a rare plant association with aspen (moss covered), sedge and Pacific crab apple. Wetlands such as this are extremely productive as breeding and feeding areas for wildlife and they support a high number of habitat niches. (Photo: Faye Smith)

Hardhack (foreground) is characteristic of shrub swamps, the most commonly occurring type of wetland in the SEI study area. They are normally not associated with open water. (Photo: Andrea Ward)

This wetland demonstrates a typical concentric pattern of plant distribution, with an edge of shrub swamp surrounding marsh and shallow water. (Photo: Neil K. Dawe)

The rich moist soils of riparian ecosystems support rapid tree growth and diverse understorey species-the number of vascular plants, mosses, invertebrates, and small mammals is higher here than in upslope areas. (Photo:Mark Kaarremaa)

Early stage in the development of a riparian ecosystem. (Photo: Mark Kaarremaa)

Over half of the SEI riparian ecosystems are young riparian forests, characterized by a dense, lush understorey and low structural diversity which reflects the uniform age of the vegetation. (Photo: Nick Page)

In mature riparian ecosystems, natural disturbances such as flooding, windthrow, channel changes, slope failures and debris flows result in a variety of structural features which contribute to the high biological diversity. (Photo: Mark Kaarremaa)

Seepage areas along riparian gully walls maintain moist soil conditions in the gully bottom. (Photo: Neil K. Dawe)

9 Riparian

What are Riparian Ecosystems?

Riparian ecosystems (RI) occur adjacent to lakes, streams, and rivers, where increased soil moisture supports plant communities and soils distinct from surrounding terrestrial areas. This definition encompasses a broad range of sites including lake and marsh margins, the floodplains of large rivers and small streams, and gullies. Gullies may not be associated with surface water flow, but often seepage areas along the gully walls maintain moist soil conditions.

The width of a riparian ecosystem may vary from a few metres next to small streams with steep banks to more than 100 metres near larger rivers like the Puntledge and Little Qualicum. Because of their association with rivers and streams, riparian ecosystems are often linear, winding across valley bottoms. However, the complex history of forestry, agriculture, and urban development in the SEI study area has increased fragmentation and reduced the continuity of many riparian ecosystems.

The Sensitive Ecosystems Inventory only recognised riparian ecosystems that are relatively undisturbed by human activities. Narrow bands of streamside forest surrounded by agricultural fields were not recognised as a riparian ecosystem. Likewise, urban stream corridors were not typically included as riparian ecosystems. Those that were identified were typically at an older stage and had been isolated from active human disturbance or were at a younger stage in floodplain areas. However, although not highlighted by this study, they are still important components of the urban and rural landscapes.

Riparian ecosystem vs. Riparian zone

'Riparian ecosystems' vary in width and are delineated by site-specific vegetation, soil, and topographic features.

The term 'riparian zone' is often used to describe a fixed width management area surrounding streams and wetlands.

Douglas' aster *(Aster subspicatus)*
(E.J. Stephen)

Riparian ecosystems are highly dynamic. **Natural** chronic and episodic **disturbances** include shifting channels, which can undercut trees, periodic flooding, and windthrow of shallow rooted trees. These events increase structural forest features such as snags, downed logs, and a multi-layered, uneven aged canopy, as well as a range of successional stages from recently exposed gravel bars to western redcedar forest. These features contribute to high habitat diversity.

Riparian ecosystems commonly vary in **dominant** plant species, vegetation age, and structure radiating out from the aquatic feature due to changing soil moisture and light levels. This pattern of zonation is more pronounced along large rivers. Nearest the river channel, grasses, sedges, and some forbs such as Douglas' aster, cow-parsnip, and purple-leaved willowherb colonise the highest part of exposed gravel or cobble bars. Willows, alder and black cottonwood also grow rapidly, once seeds from surrounding areas are lodged between rocks or covered by layers of gravel or silt. Upslope from the channel margin, red alder, black cottonwood, western hemlock, and western redcedar are the dominant species. These trees thrive in the rich, moist soils of riparian ecosystems and are tolerant of periodic flooding.

Structural Stages

Riparian ecosystems in the SEI are classified and named according to structural stage (see sidebar). Structural stages are based on the age and structure of dominant vegetation. Examples of common riparian plant communities in the SEI are described below.

*See **Volume 1,** Appendix 2 for a full description of structural stages.*

Most riparian ecosystems identified by the SEI using air photos were assemblages of more than one structural stage.

*For example, the code **RI:5:2** in the SEI database denotes a riparian ecosystem with young forest **(RI:5)** as the dominant stage with herb areas **(RI:2)** secondary.*

- **Early stages**
  - **Stage 1 (RI:1):** Sparse/bryoid—moss and lichen dominated, <10% treed, <20% shrub/herb;
  - **Stage 2 (RI:2):** Herb—herb dominated, <20% shrub, <10% treed;
  - **Stage 3 (RI:3):** Shrub/herb—>20% shrub, <10% treed.

  Sparsely or non-vegetated areas such as gravel bars and other recently disturbed riparian sites support a distinct assemblage of herb and grass species, intermixed with early successional trees and shrubs <10m tall. Seedlings of red alder, Scouler's or Sitka willow, and black cottonwood are common where seeds have washed or blown onto sand or gravel. Plant colonisation is often patchy. Colonising species are typically tolerant of seasonal inundation, flood scouring, and gravel or cobble dominated substrates. Older gravel bar communities can support dense growths of willows, red-osier dogwood, and

Pacific ninebark. Dense growth is commonly associated with specific topographic or structural features on the gravel bar surface. Areas of finer sediment, debris jams, large logs contribute to vegetation establishment by providing higher soil moisture or protected sites for plant establishment.

- **Pole/sapling (RI:4)**—Trees >10m tall, densely stocked, may be coniferous, deciduous, or mixed stand between 10 and 40 years old. Red alder stands are prevalent throughout the SEI study area and reflect the patterns of forest harvesting and land clearing in riparian ecosystems as alder is one of the first tree species to colonise disturbed areas. Young big-leaf maple, western redcedar, black cottonwood, western hemlock, and Douglas-fir occur within the red alder canopy. Understorey development varies from dense salmonberry to sparse forbs and ferns because of heavy shade.
- **Young forest (RI:5)**—Natural thinning of red alder has occurred and structural diversity increases, although it is generally low, reflecting the uniform age of young forests and the lack of snags or downed logs. Trees are generally less than 80 years old. The understorey is dense and lush with shrubs such as salmonberry. Red alder and salmonberry can be persistent on some riparian sites, and slow or prevent conifer succession.
- **Mature forest (RI:6)**—These may be second-growth coniferous or mixed coniferous-deciduous stands with distinct layering of the canopy, generally 80 to more than 200 years old. Understorey species are generally well developed as the canopy opens up. Mixed stands occur in less frequently inundated sites, such as hummocks or high flood benches. Conifers such as Douglas-fir are less tolerant of wet soils and frequent flooding than deciduous species. Other stands are comprised of senescing red alder with conifers such as western redcedar in canopy gaps. Western redcedar is the climax tree species in many riparian ecosystems due to moist conditions. Western redcedar and western hemlock are shade tolerant which allows them to regenerate under closed deciduous canopies. Understorey diversity varies. Mosses, ferns, and false lily-of-the-valley may predominate on moist sites, whereas wetter sites support dense growth of salmonberry and red elderberry.
- **Old Forest (RI:7)**—Trees >250 years old. These old structurally complex stands consist of shade tolerant tree species although some long-lived **seral** species may persist in the upper canopy. Species composition is similar to mature forest, with a canopy of western redcedar, Sitka spruce, or Douglas-fir and a sub-canopy of bitter cherry, big leaf maple or cascara. Snags and coarse woody debris in various stages of

Little brown bat (L. Friis)

decay are common. Understories are patchy and variable depending on the number and size of canopy gaps. These stands were very rare in the study area.

Vancouver Island beggarticks (U) *(Bidens amplissima)*
(E.J. Stephen)

Plants of riparian ecosystems

Trees	red alder (*Alnus rubra)*
	black cottonwood (*Populus balsamifera* ssp. *trichocarpa*)
	western redcedar (*Thuja plicata*)
	bigleaf maple (*Acer macrophyllum*)
	Douglas-fir (*Pseudotsuga menziesii*)
	western hemlock (*Tsuga heterophylla*)
Shrubs	Scouler's willow (*Salix scouleriana*)
	Pacific ninebark (*Physocarpus capitatus*)
	red-osier dogwood (*Cornus stolonifera*)
	thimbleberry (*Rubus parviflorus*)
	salmonberry (*Rubus spectabilis*)
	red alder (*Alnus rubra*)
	black cottonwood (*Populus balsamifera* ssp. *trichocarpa*)
	devil's club (*Oplopanax horridus*)
	red elderberry (*Sambucus racemosa*)
	stink currant (*Ribes bracteosum*)
	trailing blackberry (*Rubus ursinus*)
	Indian-plum (*Oemleria cerasiformis*)
Herbs	cow-parsnip (*Heracleum maximum*)
	Douglas' aster (*Aster subspicatus*)
	palmate coltsfoot (*Petasites frigidus* var. *palmatus*)
	purple-leaved willowherb *(Epilobium ciliatum)*
	vanilla-leaf (*Achlys triphylla*)
	baneberry (*Actaea rubra*)
	false lily-of the valley (*Maianthemum dilatatum*)
	small-flowered wood rush (*Luzula parviflora*)
	skunk cabbage (*Lysichiton americanum*)
Mosses	roadside rock moss (*Racomitrium canescens*)
Ferns	horsetail species (*Equisetum* spp.)
	Menzies' tree moss (*Leucolepis acanthoneuron*)
	slender beaked moss (*Kindbergia praelonga*)
	badge moss (*Plagiomnium insigne*)
	sword fern (*Polystichum munitum*)
	lady fern (*Athyrium felix-femina*)
	Oregon beaked moss (*Kindbergia oregana*)

Rare*[71] *plants of riparian ecosystems

Smith's fairybells (B) *(Disporum smithii)*
semaphore grass (B) *(Pleuropogon refractus)*
Scouler's corydalis (R) *(Corydalis scouleri)*

[71] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) species as of May 2000 are noted; species ranked as infrequent or uncommon (U) are noted in the table. Nationally rare species ranked by COSEWIC, as of May 2000, are noted as endangered (E), threatened (T) or of special concern (SC). See Glossary for further discussion.

Status

Riparian ecosystems occupy approximately 1.6% (over 6,700 hectares) of the study area (see Table 8). About 20% of the riparian category comprises early seral stages of unvegetated or shrubby gravel bars (stages 1-3); most of it (55%) is mapped as immature or young deciduous or coniferous forest (structural stages 4 and 5). Another 22% of the total represents mature forests (stage 6). Old growth-dominated floodplain forests (structural stage 7) are very rare—only 12 sites were identified in this category, representing less than 2% of the total riparian area mapped.

Riparian ecosystems are widely distributed in the SEI study area, but, similar to wetlands, their areal extent varies substantially between the five sub-units. They are at their maximum extent in the Comox Sub-unit but decline in extent southwards; the Capital and Islands sub-units have the lowest representation. Many riparian ecosystems are associated with the floodplains of large, **alluvial** rivers such as the Cowichan, Little Qualicum, Nanaimo, and Tsolum. The undulating topography and drier climate of the south island restricts the development of large rivers. As a consequence, these areas support fewer and less extensive riparian ecosystems.

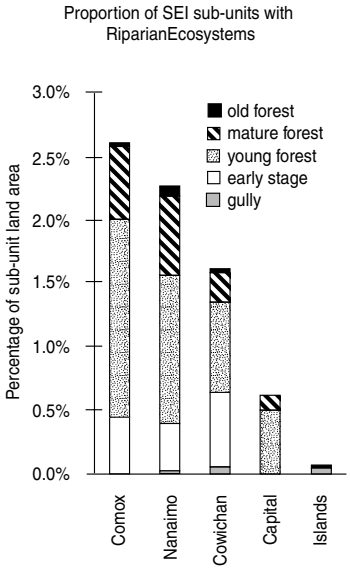


Table 8: Area (ha) of riparian ecosystems by sub-unit

SEI sub-unit	early stages (1-3)	young forest (4-5)	mature forest (6)	old forest (7)	gully (g)	Total
Comox	469.6	1696.7	622.2	20.6	9.0	2818.1
Nanaimo	370.9	1108.9	605.4	63.5	3.7	2152.4
Cowichan	480.8	584.7	194.3	22.5	41.5	1323.8
Capital	2.8	307.4	67.7	3.8	0	381.7
Islands	5.5	21.0	9.9	0	0	36.4
Total	1329.6	3718.7	1499.6	110.4	54.1	6712.4

See Volume 1, section 4.2.6, page 63, for further discussion of inventory results relating to riparian ecosystems.

Why are they Important?

Ecological attributes and socio-economic values pertaining to riparian ecosystems are listed below. Some of these are common to all SEI ecosystems and are more fully discussed in Chapter 2.

Ecological Attributes

Structural complexity and diversity in natural forests provide the key to much of the species richness of organisms, habitat, and processes
— Franklin 1992

- **High biodiversity**—Of all the sensitive ecosystems, riparian ecosystems support a disproportionately higher number of wildlife species for the area they occupy. The number of vascular plant, moss, invertebrate, and small mammal species is higher than in upslope areas. Reasons for this include:
  - These nutrient-rich environments rarely have summer soil moisture deficits. Tree growth is rapid and understories are rich in species and sometimes impenetrably dense.
  - Wildlife use is high because riparian ecosystems combine three critical habitat elements—food, water, and cover. Riparian species include muskrat, river otter, mink, and the red-listed Vancouver Island water shrew.[72] Waterfowl, such as the Common Merganser, nest along river banks and songbirds like the Yellow Warbler and Warbling Vireo depend on riparian habitats for parts of their life cycle. The dense cover is important to many species that use riparian ecosystems for migration and dispersal.
  - There is a concentration of varied habitat niches (i.e., structural elements such as snags, downed logs, coarse woody debris and a multi-layered forest canopy) that are important for wildlife species.
  - There are more internal edges and layers in a short distance due to understorey shrubs, deciduous trees, and coniferous trees than in adjacent upslope forest stands.
  - The linear shape of most riparian ecosystems maximises the amount of edge habitats with surrounding forest, as well as with water, thus creating diverse and productive habitats for the species adapted to these conditions.
  - Riparian ecosystems have different microclimates from surrounding coniferous forests due to increased humidity, a higher rate of transpiration, and greater air movement; these conditions are preferred by some species during hot weather.

[72] Cannings et al. 1999.

- Varying soil moisture conditions also contribute to plant diversity.

- **Aquatic habitat protection**—Riparian ecosystems contribute to the ecological health of adjacent aquatic areas through shading, bank stability, and the addition of large logs into the stream or lake margin. Recent research has focused on the benefits of forested riparian ecosystems in maintaining the ecological health of small streams (see sidebar).[73] Researchers in Washington State found that stream health declined as riparian forest became narrower. [74]

  Riparian ecosystems shade the streams, maintaining the cool water temperatures required by many aquatic organisms; they stabilise banks, provide large logs to increase channel habitat, and are a source of insects, leaves, and small branches—the building blocks of an aquatic food chain. Fish habitat values associated with the structural complexity of small streams is due largely to high levels of stable wood debris that originates in riparian ecosystems.

A band of riparian forest greater than 30 metres wide is needed to maintain the highest levels of fish and aquatic insects in a stream.

- **Maintenance of water quality**—The soils and vegetation in riparian ecosystems can act as a filter to prevent nutrients, water-borne sediments and toxic material from reaching the adjacent stream, river, or lake. Nutrients from heavily fertilised agriculture fields and urban runoff are removed by soil micro-organisms and vegetation uptake as soil water passes through riparian soils. Filtering is only effective if the riparian area is 15 to 50 metres, or in some cases even wider (see also page 31).[75]

- **Wildlife corridors**—The linear nature of some riparian ecosystems contributes to their effectiveness as wildlife corridors and provides linkages within the broader landscape. They allow individuals or species to disperse between habitats, which is important for maintaining genetic diversity, and may also allow for recolonisation of habitat patches following disturbance or loss of small local populations (see also page 20).

[73] Millar et al. 1997.
[74] May et al. 1997.
[75] Millar et al. 1997.

Socio-economic Values

Examples of remnant riparian areas used as park corridors:

Mack Laing Park, Comox
Rosewall Creek Provincial Park
Millstone River Greenway, Nanaimo

- **Green space**—In many jurisdictions, riparian ecosystems are used as park corridors because they are linear and are often the only remnant natural vegetation that remains in urban areas. Airphotos of the SEI study area highlight the stream corridors and gullies as narrow fingers of vegetation within urban and rural landscapes. These riparian ecosystems with their associated floodplains and steep ravines or gullies have been partially protected by their difficult development constraints. The lack of continuity of most riparian ecosystems in the SEI reduces their suitability as corridors; however, some jurisdictions have taken advantage of this remnant green space (see sidebar, also page 11).
- **Research and nature education** (see page 11)
- **Flood protection and erosion reduction**—Like wetlands, riparian ecosystems can reduce peak flows by slowing or storing runoff. Infilling of floodplain areas by development reduces water storage capacity and removes vegetation that can reduce water velocity and scouring. Dense root growth of vegetation in riparian ecosystems also provides bank stability. Unvegetated banks are prone to erosion, undercutting and slumping. However, even within these ecosystems, dynamic channel changes can lead to tree fall and bank slumping, threatening properties. Riparian areas can buffer these effects if development is not allowed too close.

Management Recommendations

Some disturbed riparian ecosystems not identified as part of the SEI are still important for many wildlife species and may still require protection under the Canada Fisheries Act and the British Columbia Fish Protection Act.

Riparian ecosystems have attracted considerable public attention in the last decade because of increased awareness of their value in stream and river protection, and greater emphasis on connecting natural areas and urban parks with greenways or park corridors. Most protection has focused on fisheries or wildlife values, with less emphasis on the diversity and ecology of riparian vegetation communities. Buffer zones, restrictive covenants, and tree or watercourse protection bylaws have been used by many jurisdictions in the SEI study area to protect riparian ecosystems. As well, the process by which ecosystems or habitat areas are protected during development is better developed for riparian ecosystems than for other sensitive ecosystem types. Again, this is because of the link between fish habitat protection and the management of riparian ecosystems.

Many riparian ecosystems in the SEI are characterised by lack of continuity and intense fragmentation. Efforts should be made to maintain connections with adjacent upland ecosystems and to reduce fragmentation in order to preserve wildlife migration and dispersal functions (see also page 20).

When developing a management plan for riparian ecosysems, it is assumed that a local ecosystems plan and protection strategy have been carried out (see page 28). The following recommendations will aid in the site management of riparian ecosystems.

Delineate Buffers around Riparian Ecosystems

Existing fish and wildlife habitat management buffer requirements should be followed where necessary.

Wherever possible, vegetated buffers should be delineated around each riparian ecosystem as described in Chapter 4 (page 30) (see also sidebar). As in wetlands, the wet soils around riparian ecosystems may cause trees to be shallow rooted and prone to windthrow. Other edge effects include increased susceptibility to invasive species colonisation and loss of habitat features or plant communities associated with the interior (non-edge) ecosystems (see page 22). Similarly, riparian ecosystems are more affected by indirect disturbances and upland land use.

Buffers need to be large enough to protect the core ecosystem from edge effects, such as increased light and temperature and decreased moisture, noise and windthrow. For example, logging activity to the edge of a riparian ecosytem produces an increase in light, temperature and humidity. The need to maintain riparian moisture and temperature levels is critical to many animals that use riparian for feeding, breeding and nesting.

Buffering riparian ecosystems is more complex than buffering upland forest; however, similar principles can be applied to the buffer edge whether it be forested or developed. If the buffer is forested, apply the following.

- The windward edge should be smooth and located in areas of deep soils and well rooted trees.
- Buffers should be widened in areas with even aged forests with poor root stability, particular in stands dominated by western hemlock.
- Edge stabilisation treatments including feathering, sail pruning, topping, and removal of unsound trees should be used to ensure a windfirm edge.

If the buffer is non-forested, consider reforesting and follow the recommendations in the next sections.

Palmate coltsfoot *(Petasites frigidus* var. *palmatus)* (E.J. Stephen)

Avoid Direct and Indirect Impacts

Development in floodplain areas has increased property damage, which has increased the justification for large-scale channel engineering.

Although riparian protection has increased in recent years, incremental damage still occurs in many urbanising areas and on private forest lands. Maintaining the hydrological system is critical to ecosystem management. Vegetation loss or damage can result from logging, land development, river engineering and floodplain filling, road, powerline or pipeline crossings of rivers or streams, the construction of recreational facilities including trails and access roads, and livestock grazing. Even in areas that lack grasses or forbs, sheep, cattle, or goats can rapidly browse and damage understorey shrubs and tree seedlings. The following actions will help minimise impacts to riparian ecosystems.

- **Discourage development within or adjacent to riparian ecosystems**— (see page 31).
- **Manage access**—Reduce the effects of recreational or other human access in riparian ecosystems using active control methods including fences and railings, passive methods such as signs and careful site selection for trails (see Develop Carefully below).
- **Restrict livestock access**—Install permanent or temporary fences using barbed wire or high tensile steel (not page-wire which restricts wildlife movement). A 45 cm gap between the ground and the first wire should be installed to allow wildlife access between riparian and upslope areas.

Mink (L. Friis)

- **Prevent disturbance of nesting or breeding areas**—see also page 23)
- **Control invasive species**—Invasive plant species that originate in surrounding residential gardens can disrupt riparian vegetation communities. Livestock grazing can also increase the distribution of invasive species by compacting or exposing the upper soil layer. Early seral riparian ecosystems are particularly prone to colonisation and dominance of giant knotweed, reed canary grass and Himalayan blackberry whereas English ivy, spurge-laurel and English holly are common in the later stages.

  Control the introduction or spread of invasive species by designating a broad invasive species management zone (see also Chapter 4, page 30). Consult a specialist to determine the best techniques and timing for control of invasive species (see also page 21).
- **Protect structural features**—Protect snags, downed logs, and large live trees. Many of these will be effectively protected using buffer zones, however, additional recognition of their importance for riparian ecology is needed in some situations.

Snags can pose a safety risk near trails and shake block cutting can rapidly deplete large, downed western red cedar logs from riparian ecosystems.

- **Allow natural disturbances and successional processes to occur**—Flooding, windthrow, channel changes, slope failures and debris flows are recognised as important factors in the creation and maintenance of high diversity riparian habitats. These events and processes should be maintained as follows unless they pose a threat to safety or property.
  - Minimise bank or flood protection. Human changes such as channel stabilisation, deposition of rip-rap and tree removal result in the loss of the range of habitats upon which many species depend.
  - Maintain natural flow regimes. Deforestation or increased impervious surfacing can result in significant increases in the size, duration, and frequency of floods. Vegetation change can also result as flood tolerant species replace coniferous trees. Bank erosion can also worsen.

Develop Carefully

Where development is allowed in riparian ecosystems, the general development guidelines described in Chapter 4 (page 32) should be followed, namely:

- **Require an ecological inventory conducted by a qualified professional.**
- **Plan, design and implement all land development activities (including road crossings, utility rights-of-way, or trails) in a manner that will not adversely affect or disturb:**
  - Trees, understorey plants, and other riparian vegetation.
  - Endangered, threatened, or vulnerable species and natural plant communities (and uncommon plant species) associated with riparian ecosystems identified during the planning and inventory stage.
  - Natural processes related to disturbance events and ecological succession, such as natural flow regimes of streams, seasonal flooding, stream channel movement, **senescence** of seral species, windthrow or blow-down of trees, and natural slope failures.
  - Nesting and denning sites; many activities can destroy habitat and disturb or destroy active nests.
  - Standing dead and dying trees, snags, fallen trees, downed logs, and similar forest features.

Black bear (L. Friis)

- Natural corridors and connectivity of riparian species and habitats with important upland ecosystems.

- **Design road crossings, utility rights-of-way and other narrow corridors** as follows.
  - Roads should be narrow, perpendicular to the riparian ecosystem, and elevated or bridged if possible to maintain wildlife connections such as daily or seasonal movements of amphibians and mammals.
  - Within corridors, plant native vegetation to provide habitat and cover for animals living in or passing through these corridors (see also page 20).

- **Align trails** as follows. Trails directly under trees may compact the root zone and lead to deterioration in tree health; trails in areas of groundwater recharge or discharge areas can disrupt the groundwater regime that nourishes nearby or even distant trees.
  - Provide the most direct route to viewing areas or crossing structures.
  - Avoid areas with high soil compaction potential.
  - Avoid sensitive or unique vegetation including root systems.
  - Prevent intrusion into wet areas including seepage sites and wetlands.
  - Avoid erodable stream or ravine banks or, preferably, locate inland of the stream or river.

For suggestions on how to incorporate the above recommendations into Official Community Plans and Development Permit Areas, see Chapter 14

Arbutus-Douglas-fir woodlands are common on dry sites such as south facing slopes with rocky, nutrient-poor soils. Understorey species are generally less diverse and productive than in Garry oak woodlands. (Photo: Nick Page)

Garry oak woodlands have been reduced to less than 5% of their original extent. (Photo: Trudy Chatwin)

Trembling aspen woodlands are rare in the SEI study area. (Photo: Mark Kaarremaa)

10 Woodland

What are Woodland Ecosystems?

Woodland ecosystems (WD) are open deciduous forests composed of pure or mixed stands of Garry oak, mixed stands of arbutus and Douglas-fir, or pure stands of trembling aspen. Woodlands are found on a broad range of sites where disturbance or soil conditions restrict the establishment of closed conifer forest. However, most occur on rocky knolls, south facing slopes, and ridges where summer soil moisture is low and shallow soils are common. Trembling aspen woodlands are an exception, and are typically associated with moist, rich sites. Mature big-leaf maple is also recognised as the dominant tree species in several woodland sites. Although these stands do not meet the strict definition of "woodland" used in the SEI study area, they were included in the database because of their diversity and local significance.

Isolated Garry oak, arbutus, or trembling aspen trees scattered throughout many areas of the SEI are not considered woodland ecosystems. These areas support too few of the plant or animal species that make up the woodland to be considered functioning ecosystems.

In a region where coniferous forest often extends from the ocean to the mountaintops, open woodlands are distinct in ecology, history, and biological diversity. B.C.'s oak and arbutus woodlands are peripheral populations with close affinities to ecosystems in Washington, Oregon, and California. They occur on the southeast coast of Vancouver Island and on the adjacent Gulf Islands largely because of the warm, dry, rainshadow climate and historically frequent fire that characterise the Georgia Basin. The northern part of the SEI study area is wetter and cooler and hence supports fewer woodlands.

White-topped aster
(Aster curtus) (E.J. Stephen)

The open stand structure, soil conditions, and disturbance regime create an environment favouring the shrub, grass, and forb species characteristic of these ecosystems. Thus, woodlands may also be interspersed with other SEI ecosystems such as coastal bluff or terrestrial herbaceous ecosystems. Woodlands are artifacts of previous climate, the remnants protected from conifer invasion by disturbance events such as lightning-induced wildfire, aboriginal burning, and elk and deer grazing. All of these processes are critical to maintaining woodland health and the ecosystem's natural cycles. For example, fires thinned out competing coniferous species, recycled nutrients into the soil, released and **scarified** seeds, and maintained the open woodland canopy for sunlight to enter. Changes to the disturbance regime, such as fire suppression, has caused Douglas-fir and shrubs to invade some woodlands. The prevalence of invasive species and reduced regeneration success of some woodland tree species may be the result of changes in the frequency and severity of these disturbance events.

Garry Oak Woodlands

Garry oak woodlands are the most biologically rich of the three woodland communities. They support the highest number of species of conservation concern in the SEI study area and are highly vulnerable to urban and rural development. Oak woodlands encompass a number of inter-related communities including open oak woodlands and meadows, as well as more densely forested oak/conifer plant associations. The occurrence of oak woodlands is usually due to a lack of summer rainfall, shallow soils, excessive drainage, or disturbance events such as fire. Garry oak forms pure stands in some sites but is often mixed with Douglas-fir, grand fir, and arbutus depending on site conditions.

Rare*[76] *plants of Garry oak woodlands

seaside birdsfoot trefoil (R) *(Lotus formosissimus)*
white-topped aster (R, COSEWIC-T) *(Aster curtus)*
Howell's triteleia (R) *(Triteleia howellii)*
yellow montane violet (R, COSEWIC-T) *(Viola praemorsa)*
deltoid balsamroot (R, COSEWIC-E) *(Balsamorhiza deltoidea)*
apple moss (R, COSEWIC-E) *(Bartramia stricta)*

[76] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) species as of May 2000 are noted; species ranked as infrequent or uncommon (U) are noted in the table. Nationally rare species ranked by COSEWIC, as of May 2000, are noted as endangered (E), threatened (T) or of special concern (SC). See Glossary for further discussion.

Plants of Garry oak woodland ecosystems	
Trees	Garry oak *(Quercus garryana)* Douglas-fir *(Pseudotsuga menziesii*), occasionally arbutus *(Arbutus menziesii)*
Shrubs	oceanspray *(Holodiscus discolor)* snowberry *(Symphoricarpos albus)* tall Oregon grape *(Mahonia aquifolium)*
Herbs	common camas *(Camassia quamash)* great camas *(Camassia leichtlinii)* California brome *(Bromus carinatus)* yarrow *(Achillea millefolium)* field chickweed *(Cerastium arvense)* spring-gold *(Lomatium utriculatum)* blue wildrye *(Elymus glaucus)* Alaska oniongrass *(Melica subulata)* broad-leaved shooting star *(Dodecatheon hendersonii)* satin-flower *(Olsynium douglasii* var. *douglasii)* Pacific sanicle *(Sanicula crassicaulis)* blue-eyed Mary *(Collinsia parviflora)* western buttercup *(Ranunculus occidentalis)* Menzies larkspur *(Delphinium menziesii)* chocolate lily *(Fritillaria affinis)* long-stoloned sedge (U) *(Carex inops)* Nuttall's quillwort (U) *(Isoetes nuttallii)* white fawn lily *(Erythronium oregonum)* harvest brodeia (U) *(Brodiaea coronaria)* fool's onion *(Triteleia hyacinthina)* few-flowered shooting star *(Dodecatheon pulchellum)*
Mosses ***Ferns*** ***Spikemosses***	electrified cat's tail moss *(Rhytidiadelphus triquetrus)* broom moss *(Dicranum scoparium)* Wallace's selaginella *(Selaginella wallacei)* licorice fern *(Polypodium glycyrrhiza)*

Garry oak (B. Penn)

Rare natural plant communities of Garry oak woodlands

Garry oak/arbutus (R) *(Quercus garryana/Arbutus menziesii)*
Garry oak/California brome (R) *(Quercus garryana/Bromus carinatus)*
Garry oak/oceanspray (R) *(Quercus garryana/Holodiscus discolor)*
Douglas-fir/Garry oak/Alaska oniongrass (R) *(Pseudotsuga menziesii/Quercus garryana/Melica subulata)*

Arbutus—Douglas-fir Woodlands

Arbutus—Douglas-fir woodlands are common on dry sites such as south facing slopes with rocky, nutrient-poor soils. This community exhibits a large variation in composition but it is typically comprised of arbutus with lesser components of Garry oak and Douglas-fir. Pure stands of arbutus sometimes arise after cutting of Douglas-fir and burning. These fire-created stands were not identified as sensitive ecosystems due to their disturbance history.

Understorey species diversity and productivity is typically lower than in Garry oak woodlands due to reduced nutrient levels. Low growth of salal and dull Oregon grape is common in many sites. Invasive species are less common in arbutus—Douglas-fir woodlands than in oak woodlands.

Rare natural plant communities of arbutus—Douglas-fir woodlands

Garry oak/arbutus (R) *(Quercus garryana/Arbutus menziesii)*
Douglas-fir/arbutus (B) *(Pseudotsuga menziesii/Arbutus menziesii)*
Douglas-fir/shore pine/arbutus (B) *(Pseudotsuga menziesii/Pinus contorta* var. *contorta/Arbutus menziesii)*

Plants of arbutus—Douglas-fir woodland ecosystems

Trees	arbutus (*Arbutus menziesii*) Douglas-fir (*Pseudotsuga menziesii)* Garry oak (*Quercus garryana*), occasionally
Shrubs	oceanspray (*Holodiscus discolor*) tall Oregon grape (*Mahonia aqufolium*) baldhip rose (*Rosa gymnocarpa*) trailing blackberry (*Rubus ursinus*) snowberry (*Symphoricarpos albus*) salal (*Gaultheria shallon*) hairy honeysuckle (*Lonicera hispidula*) falsebox (*Paxistima myrsinites*)
Herbs	blue wildrye (*Elymus glaucus*) Alaska oniongrass (*Melica subulata*) California brome (*Bromus carinatus*) Scouler's hairbell (*Campanula scouleri*) purple peavine (*Lathyrus nevadensis*) yerba buena (*Satureja douglasii*) Pacific sanicle (*Sanicula crassicaulis*)
Mosses	electrified cat's tail moss (*Rhytidiadelphus triquetrus*) Oregon beaked moss (*Kindbergia oregana*) broom moss (*Dicranum scoparium*)

Trembling Aspen Woodlands

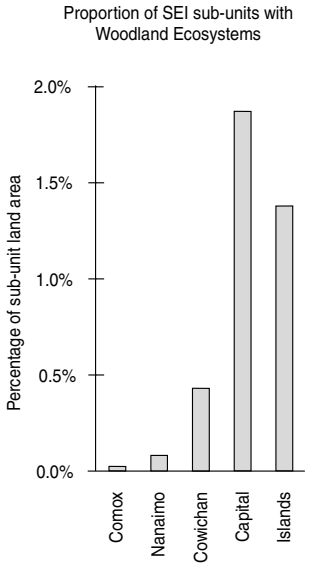
Trembling aspen woodlands have similar ecological requirements to red alder and are common on disturbed sites with moist soils. Little is known about the ecology of trembling aspen on the coast. In the interior, it is often a fire-associated species and resprouts following intense fires. Trembling aspen is a clonal plant species that expands vegetatively through runners. Many trembling aspen stands are a single organism connected by a network of roots.

Trembling aspen woodlands are designated as sensitive ecosystems in the SEI study area because of their limited occurrence and vulnerability to habitat loss or alteration. Some trembling aspen woodlands are encompassed within riparian and wetland ecosystems.

Plants of trembling aspen woodland ecosystems

Trees	trembling aspen (*Populus tremuloides*)
Shrubs	black hawthorn (*Crataegus douglasii*) hardhack (*Spiraea douglasii*) cascara (*Rhamnus purshiana*) red-osier dogwood (*Cornus stolonifera*) snowberry (*Symphoricarpos albus*) Indian-plum (*Oemleria cerasiformis*) baldhip rose (*Rosa gymnocarpa*) saskatoon (*Amelanchier alnifolia*) red elderberry (*Sambucus racemosa*) trailing blackberry (*Rubus ursinus*)
Herbs	large-leaved avens (*Geum macrophyllum*) Pacific water-parsley (*Oenanthe sarmentosa*)

Song Sparrow (M. Hames)



See Volume 1, section 4.2.7, page 65, for further discussion of inventory results relating to woodland ecosystems.

Status

Woodlands are one of the most threatened ecosystems in the SEI study area, covering only 0.6% (2419 ha) of the SEI region (see Table 9). Most occur in the Capital and Islands sub-units and are less common in the Nanaimo and Comox-Strathcona sub-units. This distribution pattern is associated with increasing summer rainfall further north, which results in increased competition from Douglas-fir and other conifers. Over 80% of woodland sites cover less than 5 hectares (the mean size is just under 2 hectares).

Most woodlands have been lost to urban and rural development. Estimates indicate that about 5% of historic Garry oak woodlands are still present, and of these remnants, many are seriously degraded by invasive species. Any further losses pose a big threat to this ecosystem type. Arbutus–Douglas-fir woodlands have been less affected by urban development but are more vulnerable to forestry activities. The areal extent of trembling aspen woodlands is extremely small.

Table 9: Area (ha) of woodland ecosystem by sub-unit

SEI sub-unit	Woodland	No. of Sites
Comox	24.3	5
Nanaimo	82.1	15
Cowichan	357.2	58
Capital	1156.3	275
Islands	898.9	260
Total	2518.8	613

The geographical range of woodland has also been reduced. Prior to settlement in the 1860s, between 250 and 350 hectares of oak woodland-grassland mosaic occurred in the Tsolum River valley north of Courtenay. This population is the most northern limit of Garry oak in North America and provides an example of a cultural landscape that was likely managed through aboriginal burning. Although many groups of large oaks still occur in the area, none are recognised by the SEI inventory because their size is less than the minimum mapping size of 0.5 hectare and because of the loss of understorey species and other ecosystem attributes. This is not to say, however, that these remnant stands are not worth protecting as part of community and cultural values.

Why are they Important?

Ecological attributes and socio-economic values pertaining to woodland ecosystems are listed below. Some of these are common to most SEI ecosystems and are discussed in Chapter 2.

Ecological Attributes

- **Rarity**—Woodlands are nationally, provincially and regionally rare (see above) and highly fragmented (see also page 10).
- **High biodiversity**—A rich assemblage of plants, insects, reptiles, and birds are drawn to the habitat diversity and food sources of woodland ecosystems. The frequent juxtaposition of woodlands with terrestrial herbaceous and coastal bluff ecosystems also increases species richness of these sites. Oak woodlands support the highest plant species diversity of any terrestrial ecosystem in coastal British Columbia.

  The high biological diversity within oak and arbutus woodlands is closely linked to elements of stand structure including the open canopy, mixed age classes, snags, seasonal leaf fall and organically enriched upper soil layers. Stand openness in particular, allows a rich mosaic of native wildflowers, grasses, and shrubs to thrive.

  Woodlands are often associated with other vegetation communities that are physically very different. Remnant patches of older Douglas-fir forest, older second growth forest, open meadows or rock outcrops commonly occur adjacent to or inter-mixed with woodlands. The proximity of these varied habitats contributes to high wildlife use and plant species diversity. For wildlife such as hawks, this allows perching or nesting sites in close proximity to hunting areas. Blacktailed deer also use open woodlands for grazing in the early morning or evening, and spend the middle of the day in denser forest.
- **Specialised habitats**—The diverse physical structure of woodland stands—snags, rotten limbs, downed logs and other features more common in mature forests—exist alongside young trees. These types of structural features increase the range of habitat niches available to different species. Woodlands are also patchy with gaps where rock knolls restrict tree growth or Douglas-fir trees grow in pockets of deeper soil. Even the bark of Garry oak provides habitat for insects, spiders, mosses, and lichens.

Rare animals of Garry oak woodlands

Butterflies

Edith's checkerspot, taylori subspecies (R)
Bremner's silverspot (R)
Propertius duskywing (B)
Moss' elfin (B)

Reptiles

Sharp-tailed snake (R, COSEWIC-E)

Species using these habitat niches in woodlands include rare butterflies such as Edith's checkerspot and Propertius duskywings who rely on oak and meadow species as host plants. Uncommon reptile species such as the northern alligator lizard and the red-listed sharp-tailed snake[77] use rock outcrops for basking. Many oak woodlands occur in bedrock dominated areas where fissures and folds in the rock collect seepage flow.

- **Peripheral populations**—Woodlands in the SEI include species whose northern populations occur on the Pacific coast, contributing to their importance to biological diversity. **Peripheral populations** are often genetically significant, and adapted to conditions at the fringe for that species. Genetic elasticity is a feature of fringe populations, which may make them less vulnerable to climate change or other large-scale disturbances.

Socio-economic Values

- **Green space**—The diverse mix of species in woodland ecosystems enhances the potential for human enjoyment and is most evident in spring and summer when woodlands are carpeted with a profusion of colourful wildflowers (see also page 11).

A profusion of wildflowers including blue camas, tall camas, blue-eyed Mary, spring-gold, satin-flower, chocolate lily and shooting star carpet oak meadows in the spring.

- **High scenic values** (see page 11)
- **Outdoor recreation**—Woodlands in public parks and accessible open spaces within urban communities provide numerous opportunities for low-impact recreation. Passive recreational activities that are appropriate within woodland ecosystems include photography, painting or sketching, and nature appreciation (see also page 11).
- **Research and nature education** (see page 11)
- **Eco-tourism** (see page 12)
- **Increased property values** (see page 12)
- **Horticultural industry** (see page 12)

[77] Cannings et al. 1999.

Management Recommendations

Historically, woodlands occurred as inter-connected patches across the landscape: some small, some large. Both natural and human influences have resulted in woodland fragmentation and lack of connectivity in urban and rural areas. This has made them vulnerable to invasive species colonisation and reduced use by some wildlife species (see also page 20). Efforts should be made to maintain ecological interconnections with the surrounding landscape (coastal bluffs, terrestrial herbaceous and forested ecosystems).

See Section Two for further information regarding planning and stewardship tools for conserving ecosystems.

Part of the ecological value of woodlands is the diversity of shrub, herb, and moss species in the understorey. Protecting woodland ecosystems therefore requires emphasis on shrub and understorey layers, soil, and regenerating woodland tree species.

When developing a management plan for woodland ecosysems, it is assumed that a local ecosystems plan and protection strategy have been carried out (see pages 28 and 29). The following recommendations will aid in the site management of woodland ecosystems.

Delineate Buffers around Woodland Ecosystems

Wherever possible, vegetated buffers should be delineated around each woodland ecosystem as described in Chapter 4 (page 30). It is very important to establish adequate buffers for woodland ecosystems as they are particularly vulnerable to adjacent land uses, for example, clearcutting adjacent land results in colonization by agressive invasive alien plant species, which then spread into the adjacent sensitive ecosystem. Buffers should be designed as follows.

- Forested buffers should have the least possible amount of edge per unit area (i.e., should be as close to round as practical).
- In some situations, the buffer should be of sufficient width to minimise changes to microclimate (e.g., increased temperature) on rare plant communities, and to reduce noise and human disturbance on wildlife use.

Northern alligator lizard
(K. Taylor)

Avoid Direct and Indirect Impacts

The open stand structure of woodlands and their proximity to developed areas makes them particularly vulnerable to the intrusion of non-native species and other impacts resulting from increased access, livestock grazing, and changes to nearby surface and groundwater regimes. Although off-site activities do not cause loss of trees, plant communities, or wildlife directly, their effects can be severe if careful planning and management is not undertaken. For example, reductions in wildlife use can occur because of the severing of wildlife corridors in the surrounding landscape. The following actions will help minimise impacts to woodland ecosystems.

Moss' elfin (B) (C. Guppy)

- **Discourage development within or adjacent to woodland ecosystems**—(see page 31).
- **Restrict recreational trail access**—Trail construction and use can affect tree density, tree canopy, understorey vegetation, soil, tree health, or stand age structure. Where trails are allowed, see **Develop Carefully** below.
- **Restrict road access**—Wherever possible, road access to woodland parcels should be prevented. If road access is absolutely necessary, a site inventory and access management plan should be prepared to ensure that the impacts of increased access and invasions of exotic species to the woodland parcel are minimised (see **Develop Carefully** below).
- **Limit or prevent livestock grazing**—Vegetation damage and soil compaction results from moderate to heavy livestock grazing which stimulates alien weed invasion and tramples young woodland tree seedlings. Livestock grazing should be avoided in woodland ecosystems. Where grazing does occur, landowners should work with government agencies and stewardship groups to assess the impacts and if necessary, use protective measures such as fencing.
- **Prevent disturbance of nesting or breeding areas**—(see also page 23).
- **Control invasive species**—Many introduced grasses and shrubs are sun-loving plants that compete most effectively in these open woodland areas. Snowberry, although a native species, has invaded oak meadows and has resulted in the loss of meadow plant species. European slugs browsing new seedlings have also had a devastating impact on some native plants (see also page 21).

Control the introduction or spread of invasive grass, shrub, and forb species by designating a broad invasive species management zone in and around the woodland ecosystem. Special attention should be paid to corridors of disturbance that act as vectors for invasion of woodlands.

Active control methods such as hand clearing, pruning, and mowing, around woodlands are appropriate if timed to minimise impacts to native forbs and grasses. Annual mowing can favour native wildflowers by simulating burning of the understorey, thus keeping down exotic and native shrubs. This should be done after spring blooms die off and before asters bloom.

- **Consider re-introducing fire**—Managed fire can be used to sustain woodland plant communities and reduce the prevalence of non-native species. Natural fires cannot be allowed to burn because of public safety concerns, property damage, air quality, personnel and equipment requirements, and other factors. Controlled prescribed-burns, however, are an important management tool that can be used in some cases even in urban areas to maintain or restore habitats and ecosystem processes, control invasive plant species, and reduce the amount of hazardous woody fuels that may built up in the ecosystem. Prescribed-burns are now essential natural-area management tools used safely in various types of ecosystems throughout North America.
- **Maintain hydrologic regime**—Changes to the surface and groundwater regime that nourishes nearby or even distant woodland vegetation can be caused by the construction of trails, development of roads and houses and other activities. Despite the association with dry sites, woodland surface drainage patterns are important for woodland diversity.

Non-native plants occurring in Garry oak and arbutus-Douglas-fir woodlands

Scotch broom
hairy vetch
ripgut brome
orchard grass
Kentucky bluegrass
hedgehog dogtail grass
Himalayan blackberry
English ivy
sweet vernal grass
common vetch
spurge-laurel
periwinkle
soft brome

Fire suppression and shrub invasion will result in hotter fires than would have occurred historically.

Develop Carefully

Where development is allowed in woodland ecosystems, the general development guidelines described in Chapter 4 (page 32) should be followed, namely:

- **Require an ecological inventory conducted by a qualified professional.**
- **Plan, design and implement all land development activities** (including recreational facilities such as trails and access roads, and vegetation management such as danger tree removal and appropriate park maintenance) **in a manner that will minimise impacts to**:
  - The root systems of trees, tree density, tree canopy, tree health, or stand age structure.
  - Shrub, herb, grass, moss, and lichen understorey species.
  - Standing dead and dying trees, fallen trees, snags and downed logs, fallen limbs, leaf litter, and other natural detritus.
  - Soil conditions.
  - Ground or surface water drainage regimes.
  - Nesting and denning sites—development activities should be phased or timed to avoid the spring nesting and breeding season for coastal wildlife.
- **Locate infrastructure away from these ecosystems and their root masses.** For example, generally staying back a distance equal to the height of a tree from its base or 15 metres, whichever is greater, will achieve this.
- **Protect any endangered, threatened, or vulnerable species and natural plant communities (and uncommon plant species) and habitat features associated with woodland ecosystems identified during the planning and inventory stages:**
  - Patches of rare plants, nesting trees, snags, vernal pools, or seepage areas that are nodes of biological diversity within the woodland landscape.
  - Standing dead and dying trees, which should be retained, and fallen trees, limbs, leaf litter and soil which should be left in place to provide foraging opportunities and nesting and denning sites.
- **Design and implement appropriate sediment and erosion control measures.**

Cooper's Hawk (BC Gov't)

Most native plant associations in woodland ecosystems could be considered threatened or endangered.

- **Design trails based on the ecological inventory** (see above):
  - Avoid the root zone of trees which is generally defined as the drip line—trails located directly under trees can compact the root zone and lead to deterioration in tree health.
  - Trails should be placed to avoid any shallow subsurface flows.
  - Trails should be well designed for the intended use and to minimise erosion and seasonal flooding.
  - Trails should avoid areas of hazardous trees.
  - Barriers such as fences should be used where necessary, to prevent recreationalists from leaving the trial in sensitive areas.

For suggestions on how to incorporate the above recommendations into Official Community Plans and Development Permit Areas, see Chapter 14

Large fallen logs, large live trees and large standing dead trees are characteristic features of older forests. (Photo: Trudy Chatwin)

An average older Douglas-fir forest is relatively open and dry with few woody shrubs, forbs, and grasses in the understorey. (Photo:Trudy Chatwin)

Older coastal western hemlock forests are cooler and wetter than coastal Douglas-fir forests, and have a thick mat of needles, small branches and mosses on the acidic forest floor. (Photo: Mark Kaarremaa)

Trails through older forests should be designed to avoid damage to the root systems of trees, understorey vegetation, and soil. (Photo: Neil K. Dawe)

11 Older Forest

What are Older Forest Ecosystems?

Older Forest ecosystems (OF) are conifer-dominated forests with an average tree age of 100 years or greater. This age was selected because many of the structural features associated with high biodiversity values in older forests—snags, downed wood, coarse woody debris, and fully developed moss layer—begin to develop after 80 years of growth. Two sub-categories of older forest were recognised by the SEI: *coniferous* stands with less than 15 percent deciduous trees; and *mixed* coniferous-deciduous stands in which deciduous trees occupied more than 15 percent of the canopy. Mixed forests are generally more structurally diverse and more productive for wildlife species than coniferous stands.

Older Forest vs. Old-growth

No commonly accepted definition of 'old-growth' exists for BC's forests. Definitions often refer to a lack of large-scale human disturbance and a specific size or age of trees. Because of the relatively recent history of logging in coastal B.C., forests older than 120 years are almost exclusively unlogged areas. [78]

Historically, older coniferous forests were the dominant vegetation community in south coastal British Columbia with Douglas-fir, western hemlock, grand fir, and western redcedar the primary tree species depending on site conditions. Douglas-fir is the dominant tree on drier sites in much of the SEI study area. It lives up to over one thousand years. It can regenerate under its own canopy in dry, open stands or following fire. On sites with higher precipitation and moister soil conditions, western hemlock or western redcedar are more common. Large redcedar stumps are common in stream corridors and moist ravines and provide evidence of the tree size and historical occurrence of redcedar forests in riparian ecosystems.

Bald Eagle (Y) (D. Gunn)

Older forests are biologically rich ecosystems that are distinct from younger second growth forests in both stand structure and species

[78] MacKinnon and Eng 1995.

composition. They have three prominent characteristics: large live trees, large standing dead trees, and large fallen trees.[79] On some sites, Douglas-fir or western redcedar may be greater than 1.5 metres in diameter and more than 55 metres tall. Snags, some as tall as the forest canopy, are intermixed with live trees of varying ages. Nurse logs, with rows of western hemlock seedlings sprouting from a mat of mosses and lichens, lie along the forest floor. Shrubs and Douglas-fir saplings grow dense and high where fallen trees have resulted in forest canopy gaps.

Most of these structural features originate during natural disturbance events such as fire, disease, or windthrow and can take more than a century to develop in coastal forests. Natural disturbance also affects vegetation composition.

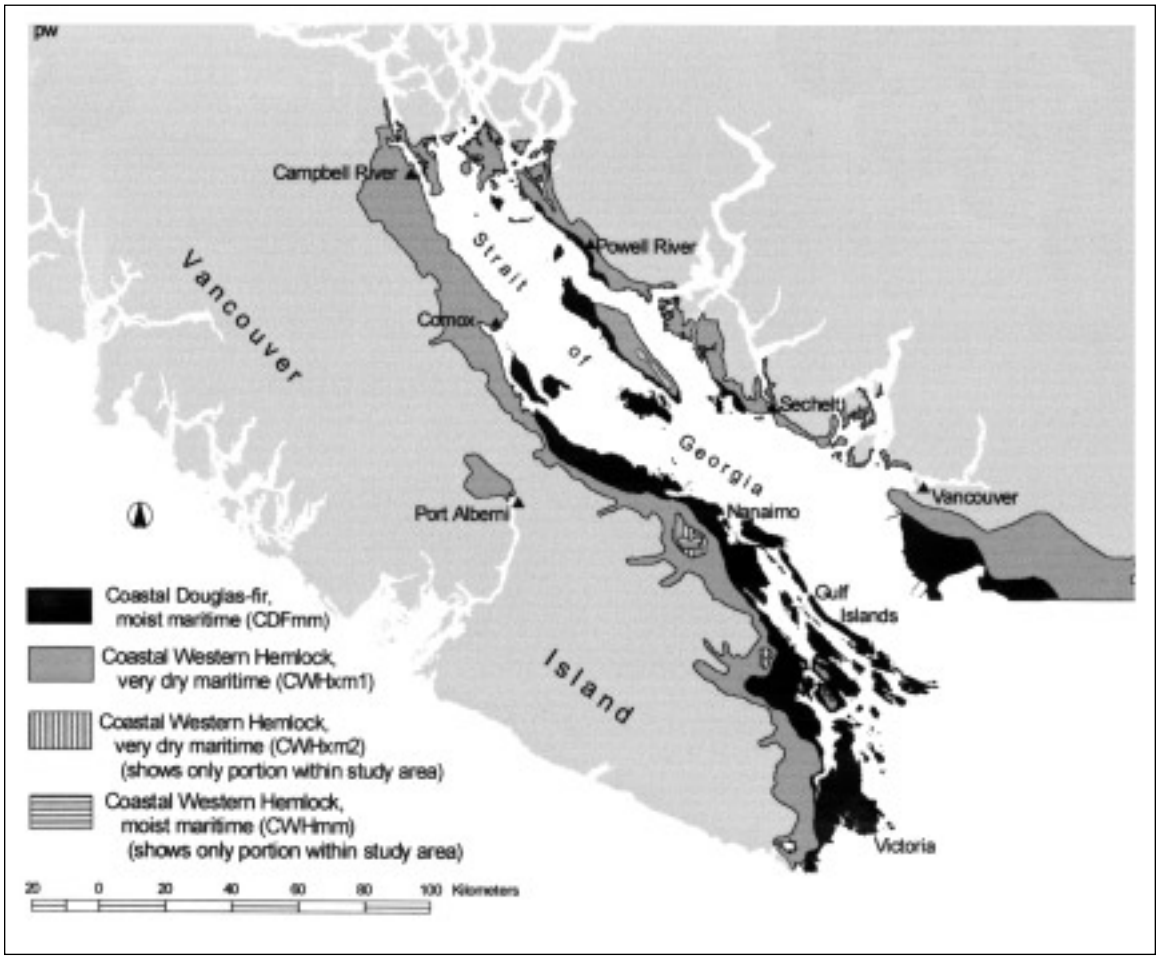


Figure 2: Biogeoclimatic zones of the SEI study area

[79] Maser 1997.

Older forests encompass a broad range of plant communities that reflect the influences of climate and site conditions such as soil depth, moisture, and nutrient levels. The Biogeoclimatic Ecosystem Classification (BEC) System[80] provides a useful framework by which to describe representative older forest plant communities identified by the SEI. Two biogeoclimatic subzones are represented in the SEI study area: the **Coastal Douglas-fir, moist maritime** subzone (CDFmm) and the **Coastal Western Hemlock, very dry maritime** subzone (CWHxm1) (see Figure 2).

See Volume 1, page 4, for further discussion of biogeoclimatic zones in SEI study area.

Coastal Douglas-fir, moist maritime subzone (CDFmm)

The CDFmm subzone occurs in the southeastern portion of the study area, at elevations below 150 m above sea level, and covers roughly 40% of the study area. Average, or 'zonal' sites in this subzone are drier than those considered zonal for the CWHxm subzone. Low soil moisture favours open stand structure and low growth of woody shrubs and forbs and grasses in the understorey. Leaves, twigs, and other organic materials decompose rapidly and the dense litter and moss layer common in hemlock forests do not develop.

Townsend's Warbler (M. Hames)

Wetter sites in the CDFmm are also dominated by Douglas-fir but may have more western redcedar and grand fir in the canopy. Sword fern and three-leaved foamflower are more common understorey plants in moist, rich sites. **Drier sites** are transitional to Garry oak and arbutus/Douglas-fir woodlands. Drier coniferous older forest is generally open with oceanspray, purple peavine, grasses, and lilies.

[80] Developed by Krajina, 1965, the Biogeoclimatic Ecosystem Classification System (BEC) provides the basis for forest classification and management in British Columbia. It classifies areas of similar regional climate, expected climax plant communities and site factors such as soil moisture and soil nutrients. The subzone is the basic unit of this classification system. The system is described in detail in a variety of publications including Meidinger and Pojar 1991, and Green and Klinka 1994.

Rare[81] natural plant communities in the CDFmm

Douglas-fir/salal (R) *(Pseudotsuga menziesii/Gaultheria shallon)*
grand fir/dull Oregon grape (R) *(Abies grandis/Mahonia nervosa)*
grand fir/three-leaved foamflower (R) *(Abies grandis/Tiarella trifoliata)*
western redcedar/snowberry (R) *(Thuja plicata/Symphoricarpos albus)*
western redcedar/vanilla leaf (R) *(Thuja plicata/Achlys triphylla)*
western redcedar/Indian plum (R) *(Thuja plicata/Oemleria cerasiformis)*
western redcedar/Douglas-fir/Oregon beaked moss (R) *(Thuja plicata/Pseudotsuga menziesii/Kindbergia oregana)*

Rare plants of older forests in the CDFmm

Smith's fairybells (B) (Disporum smithii)

Plants of older forest ecosystems in the CDFmm

Trees	Douglas-fir (*Pseudotsuga menziesii*) western redcedar (*Thuja plicata*) grand fir (*Abies grandis*) western flowering dogwood (*Cornus nuttallii*) arbutus (*Arbutus menziesii*) western hemlock (*Tsuga heterophylla*), occasionally
Shrubs	salal (*Gaultheria shallon*) dull Oregon grape (*Mahonia nervosa*), often dominant oceanspray (*Holodiscus discolor*) baldhip rose (*Rosa gymnocarpa*) snowberry (*Symphoricarpos albus*) purple peavine (*Lathrys nevadensis*) western trumpet honeysuckle (*Lonicera ciliosa*) trailing blackberry (*Rubus ursinus*)
Herbs	vanilla leaf (*Achlys triphylla*) sword fern (*Polystichum munitum*) rattlesnake plantain (*Goodyera oblongifolia*) Alaska oniongrass (*Melica subulata*) fairy slipper (*Calypso bulbosa*) three-leaved foamflower (*Tiarella trifoliata*) Pacific sanicle (*Sanicula crassicaulis*)
Mosses	electrified cat's tail moss (*Rhytidiadelphus triquetrus*)
Ferns	Oregon beaked moss (*Kindbergia oregana*) step moss (*Hylocomium splendens*) bracken fern (*Pteridium aquilinum*)

[81] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) species as of May 2000 are noted; species ranked as infrequent or uncommon (U) are noted in the table. Nationally rare species ranked by COSEWIC, as of May 2000, are noted as endangered (E), threatened (T) or of special concern (SC). See Glossary for further discussion.

Coastal Western Hemlock, very dry maritime subzone (CWHxm1)

The CWHxm1 unit covers the northern portion of the study area and higher elevations in the southern portion and comprises roughly 60% of the study area. This zone is cooler and wetter than the CDF zone and favours western hemlock as the dominant canopy tree on average or zonal sites. Drier sites are still dominated by Douglas-fir.

The floor of older western hemlock forest is commonly a thick mat of needles and small branches that has built up over time. The cool, damp, and acidic forest floor promotes moss development and limits the growth of some plants. Hemlock forests are self-sustaining. Unlike Douglas-fir, which can only regenerate in forest openings that follow disturbance or in very open stands, western hemlock is shade tolerant. Seedlings of western hemlock are common even in the shadiest part of the forest.

Pathfinder *(Adenocaulon bicolor)* (E.J. Stephen)

Plants of older forest ecosystems in the CWHxm1

Trees	Douglas-fir (*Pseudotsuga menziesii*) western hemlock (*Tsuga heterophylla*) western redcedar (*Thuja plicata*) red alder (*Alnus rubra*)
Shrubs	salal (*Gaultheria shallon*) red huckleberry (*Vaccinium parvifolium*) dull Oregon grape (*Mahonia nervosa*) baldhip rose (*Rosa gymnocarpa*) ocean-spray (*Holdiscus discolor*), occasionally
Herbs	vanilla-leaf (*Achlys triphylla*) twinflower (*Linnaea borealis*)
Mosses	step moss (*Hylocomium splendens*)
Ferns	Oregon beaked moss (*Kindbergia oregana*) lanky moss (*Rhytiadelphus loreus*) sword fern (*Polystichum munitum*) bracken fern (*Pteridium aquilinum*)

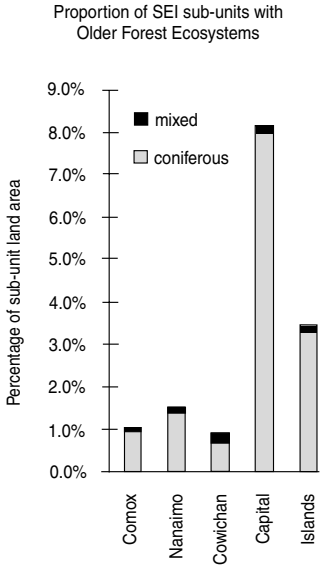
Rare natural plant communities in older forests in the CWHxm1

Douglas-fir/sword fern (R) *(Pseudotsuga menziesii/Polystichum munitum)*

Douglas-fir/western hemlock/salal (B) *(Pseudotsuga menziesii/Tsuga heterophylla/Gaultheria shallon)*

western hemlock/western redcedar/deer fern (B) *(Tsuga heterophylla/Thuja plicata/Blechnum spicant)*

Status



Older forest ecosystems occupy 2.6 % (10,605 hectares) of the entire SEI study area (see Table 10), and account for the largest areal extent of the seven sensitive ecosystems. Ninety-percent of older forest stands are dominated by coniferous forest; the remaining stands are mixed with big-leaf maple, arbutus, or Garry oak that comprise more than 15 percent of canopy trees.

In general, older forests largely consist of numerous small fragments scattered across the landscape with a median size of 6.4 hectares. Many remnant patches were not logged because of difficult access or poorer tree growth than surrounding areas. Through the whole study area, only 15 sites individually exceed 100 ha in size—most of these occur in the Capital Sub-unit and include the largest sensitive ecosystem (1,200 ha) in the study area; two are in the Nanaimo Sub-unit, and two in the Comox Sub-unit.

Almost half of the total area of older forest is found in the Capital Sub-unit. Many of these sites are protected under a variety of tenures including Regional and Provincial Parks, on federal lands, and within the Capital Regional District water supply area.

Much of the older forest outside of the CRD is privately owned, either by forest companies or private landowners. Relatively little of this older forest is protected in parks or ecological reserves. The sub-units of Comox, Nanaimo, and most notably Cowichan have poor representation of older forests. This may reflect the gentle topography of these areas, which afforded good access by logging railroads. In the Cowichan Sub-unit, the most productive area for Douglas-fir, only 0.9% of the land area remains in older stands.

Table 10: Area (ha) of older forest ecosystems by sub-unit

SEI sub-unit	Coniferous	Mixed	Total	No of sites
Comox	1058.2	58.8	1117.	81
Nanaimo	1344.9	118.4	1463.4	77
Cowichan	579.2	150.5	729.7	83
Capital	4925.8	106.0	5031.9	104
Islands	2168.4	94.9	2263.3	125
Total	10076.5	528.6	10605.1	470

*See **Volume 1,** section 4.2.8, page 66, for further discussion of inventory results relating to older forest ecosystems.*

SEI figures suggest that forests older than 100 years[82] now account for just under four percent of the area they occupied 150 years ago.[83]

Table 11 : Area (ha) of older forest greater than 250 years.

SEI sub-unit	Area	No of sites
Comox	135.3	28
Nanaimo	135.2	13
Cowichan	21.0	7
Capital	98.7	5
Islands	542.2	24
Total	932.4	77

Northern Goshawk (R) (M. Hames)

Forests older than 250 years were not distinguished from other older forests on the SEI maps. However, where available, this information was recorded in the database and shows that only 77 (16%) of the 470 older forest sites were dominated by trees older than 250 years (see Table 11); these sites represent less than 9% of the area of older forest in the study area. The age of 12 of these sites was verified either by groundtruthing or personal knowledge, whereas the other 65 sites were identified through air photo interpretation, forest cover or soils maps. Taken as a general indication only, these figures indicate poor representation of forests older than 250 years.

Other research shows that only 1,071 hectares of forest greater than 250 years old is found in the entire Coastal Douglas-fir zone.[84] And of this remaining forest, only 150 hectares (14%) is currently protected in designated parks.

[82] Includes 10,605 ha of SEI older forest ecosystem and 1,610 ha of mature and old growth riparian ecosystem (structural stages 6 and 7).
[83] This is based on the assumption that coniferous forest once covered about 80% of the landscape, or roughly 330,000 hectares of the SEI study area.
[84] MacKinnon and Vold 1998.

Why are they Important?

Ecological attributes and socio-economic values pertaining to older forest ecosystems are listed below. Some of these are common to most SEI ecosystems and are discussed in Chapter 2.

Ecological Attributes

- **Rarity**—As discussed above (page 117), older forests in the SEI study area account for less than four percent of the area they occupied only 150 years ago (see also page 10).
- **High biodiversity**—Older forests generally support a rich community of wildlife, plant, and invertebrate species. Structural complexity and diversity provide the key to much of the richness of organisms, habitat, and processes. Structural diversity includes individual habitat features such as snags, downed logs, and large trees, but also vertical and horizontal structural attributes. Mixed age classes and a multilayered canopy are typical, while patchiness of canopy gaps provides variation in light levels on the forest floor.[85] A number of wildlife and plant species are dependent or associated with specific habitat features only found in older forests.

  Fungi, canopy insects, and lichens are examples of species groups that account for a huge proportion of the biological diversity of older forests. Mycorrhizal fungi live in the litter and soil of the forest floor and contribute to the growth of trees through interactions between tree roots and the soil. Macrofungi, which includes mushrooms, toadstools, bracket fungi, as well as less conspicuous species, are a poorly documented component of biodiversity. Over 1,250 macrofungi species have been documented in British Columbia, but this figure covers only a small percentage of the species actually present.

  Similarly, little is known about the relative abundance, diversity or structure and function of arthropods (spiders, insects, mites, etc.), the most abundant animals in forest habitats. In a recent Vancouver Island study, scientists found that 75% of the 68 arthropod species encountered were previously unknown to science.[86] In addition, some lichens are not found in coastal forests younger than 100 years, which indicates that they are dependent or associated with habitat conditions only found in older forests.

Cup fungus (Cladonia)
(C. Tunnoch)

[85] Franklin 1992.
[86] Humble et al. 1997.

- **High wildlife values**— Older forests support wildlife species that were once common throughout our landscape. Black bears, bats such as the COSEWIC-SC and red-listed Keen's long-eared bat and the blue-listed Townsend's big-eared bat,[87] Pileated Woodpeckers, Bald Eagles, and clouded salamanders are examples of wildlife species that are more common in older forests than in younger stands, or require older forests for portions of their life cycles. Several red and blue-listed animal species also make use of these ecosystems (see sidebar).[88] Blacktailed deer and the Blue-listed Roosevelt elk[89] use older forests in winter to escape deep snows and eat lichens.
- **Specialised habitats**—Species associated with older forests in the SEI study area include the cavity nesting bats, owls, and woodpeckers, as well as amphibians such as clouded salamander. Snags, cavities, rotting logs on the forest floor, thick bark, and large tree stubs all provide niches for many species of wildlife. On the east coast of Vancouver Island, these specialised habitats are found mainly in older forests.

Rare animals of older forests

Keen's long-eared bat (R, COSEWIC-SC)
Townsend's big-eared bat (B)
Northern Goshawk (R)
Western Screech-Owl (B)
Vancouver Island Pygmy-Owl (B)
Hutton's Vireo (B)
Roosevelt elk (B)

Socio-economic Values

- **Spiritual value**— Older forests, and in particular old-growth forests, have intrinsic values that, to many of us, cannot be measured solely in economic terms (see sidebar).
- **Research and nature education**—Considerable research has focused on the ecology of older forests in coastal British Columbia. Older forests provide models of succession and disturbance that are important for the management of second-growth forest. Research on wildlife species, plant communities, and invertebrate diversity in forest canopies is used to census biodiversity in coastal forests. Older forests may also contain genetic resources in the form of local tree adaptations that can be used to improve tree growth or sustain silviculture in British Columbia. Some older forests are used as seed sources to improve the genetics of nursery grown seedlings (see also page 11).
- **Outdoor Recreation** (see page 11)
- **Eco-tourism** (see page 12)
- **Forestry**—Forestry activity does not necessarily have to conflict with the conservation of older forests. Indeed, most of the older forests identified by the SEI have had some forestry activity

When we talk about old-growth forests, we don't simply mean old trees. We mean tall, stately trees, or proud, scarred veterans. We mean intricate ecosystems that provide for, and protect, elk and black bears, bald eagles and ever-flowing salmon streams. We mean the colour green in infinite variety. We mean soft spongy humus and head-high salal. We mean carpets of moss. We mean the profound sense of inner peace as we walk the floor of nature's cathedrals and stare up in silence at such handiwork.

—Cameron Young

[87] Cannings et al. 1999.
[88] Fraser et al. 1999.
[89] Cannings et al. 1999

such as selective logging occur within them. Small scale forestry operations are able to remove trees on a sustainable basis using alternative harvesting and silviculture techniques (see sidebar). Many older forests in the SEI are on relatively shallow soils with low moisture levels that are suitable for alternative logging methods such as small towers or horse logging. Uneven aged stand management has the potential to provide economic benefits and conserve ecological values of older forests.

Eco-forestry

Merv Wilkinson's 55-hectare 'Wildwood' near Ladysmith is an excellent example of selective, sustainable logging. His forest has been cut 9 times over the past 45 years, and this multi-aged stand is still producing high-quality forest products.

- **Other forest products**—A broad range of forest products including wild mushrooms (e.g., pine mushrooms, chantrelles, boletes), floral material (e.g., salal), wildberries, and medicinal products such as Western yew bark and devil's club are harvested from older forests. In 1993, 7,300 kg of pine mushrooms were harvested in Vancouver Island forests, many of them within the SEI study area. The total value was approximately $230,000. Although pine mushrooms are not confined to older forests, dry Douglas-fir dominated areas are the primary area for pine mushroom growth.

Management Recommendations

Unlike the high profile conservation issues in Clayoquot Sound and other areas on the west coast of Vancouver Island, the conservation of remnant older forest in the SEI study area focuses on preventing further fragmentation, ecosystem loss, and incremental degradation.

Forest fragments, not watersheds, are the unit of conservation on eastern Vancouver Island and the Gulf Islands.

Opportunities to protect large areas of contiguous or connected older forest were lost 50 to 75 years ago. Many older forests are highly fragmented by roads, logging, and urban development (see also page 20). None are completely free of human disturbance. Most SEI older forests are less than 10 hectares, which reduces their ability to support some species. Black bears, cougars, and Roosevelt elk will not survive in small, isolated patches of older forests, no matter how well protected.

More detail on specific tools for protecting or maintaining older forests are presented in Section Two.

Conservation efforts should focus on maintaining the largest possible contiguous patches of older forest, as well as retaining interior forest conditions, wildlife and plant species movement. Patches of forest, rather than isolated trees should be retained in urban and rural settings.

When developing a management plan for older forest ecosysems, it is assumed that a local ecosystems plan and protection strategy have been carried out (see pages 28 and 29). The following recommendations will aid in the site management of older forest ecosystems.

Great Blue Heron (B) (L. Friis)

Delineate Buffers around Older Forest Ecosystems

Wherever possible, vegetated buffers should be delineated around each older forest ecosystem as described in Chapter 4 (page 30). In older forest ecosystems, buffers need to be large enough to protect from edge effects, such as increased light and temperature and decreased moisture, noise and windthrow. Windthrow and changes to light levels and humidity are acute around linear corridors such as roads and powerlines (see also page 22).

- Treed buffers should have the least possible amount of edge per unit area (i.e., should be as close to round as practical).
- The windward edge should be smooth and located in areas of deep soils and well rooted trees.
- Edge stabilisation treatments including feathering, sail pruning, topping, and removal of unsound trees should be used in the buffer to ensure a windfirm edge around tree retention areas thus protecting the core ecosystem.

Avoid Direct and Indirect Impacts

Most of the structural features that contribute to the ecological value of older forests originate during disturbance events. One of the indirect impacts of development adjacent to older forests is the loss of wildfire or other disturbances that contribute to the creation of structural diversity. In addition, snags and falling limbs are usually removed next to roads, buildings, and trails because of safety concerns. The following actions will help minimise impacts to relatively undisturbed older forest ecosystems.

- **Discourage development within or adjacent to older forest ecosystems**
- **Manage access**—Use barriers such as fences to prevent vehicular or livestock access, where necessary; where trails are allowed, see Develop Carefully below.
- **Prevent disturbance of nesting or breeding areas**—see also page 23)
- **Control invasive species**–Fragmentation of older forests encourages the introduction of pest or invasive species such as spurge-laurel, English ivy, common laurel, introduced grasses

and English holly; livestock grazing also stimulates alien weed invasion. Use active control methods such as hand clearing, pruning, mowing, excavation, and planting of appropriate native species (see also pages 21 and 30).

- **Allow succession and natural disturbance to occur**—Regardless of aesthetic concerns, allow natural windthrow, tree death, disease, or other processes linked to competition and succession to occur.

Northern Saw-whet Owl
(M. Hames)

Develop Carefully

Where development is allowed in older forest ecosystems, the general development guidelines described in Chapter 4 (page 32) should be followed, namely:

- **Require an ecological inventory conducted by a qualified professional**.
- **Plan, design and implement all land development activities** (including recreational facilities such as trails and access roads, and vegetation management such as danger tree removal and appropriate park maintenance) **in a manner that will minimise impacts to the core older forest ecosystem.**
  - Protect trees, understorey plants, snags, and downed logs, as well as ecosystem processes that influence vegetation composition and structure (i.e., competition, disturbance, regeneration).
  - Locate the development footprint away from existing trees—cluster housing can work in many situations to avoid stands of older forest; or utilise already-disturbed patches where available.
  - Locate infrastructure to avoid trees and their root masses, generally keeping away a distance equal to the height of a tree from its base or 15 metres, whichever is greater.
  - Where linear corridors are unavoidable, they should be narrow (less than 20 m wide) and configured to provide wildlife crossings.
  - Incorporate landscape designs that respect the natural system. Where the loss of mature trees is unavoidable, replace trees with native tree species. Preference should be given to plants salvaged from the land-clearing footprint and transplanted to other sites.
- **Design trails carefully**—Trail construction for passive recreational purposes (e.g., walking, jogging, hiking) may be permitted if the trail does not affect the root systems of trees, understorey vegetation, or soil. This may be achieved by

locating the trails in areas of minimum disturbance to the wildlife using the site, as determined by the ecological inventory. Clearly delineate sensitive areas prior to and during construction and consider the following planning, design, and management guidelines.

- Avoid the root zone of trees, which is generally defined as the drip line. Avoid any shallow subsurface flows.
- Design trails to encourage foot traffic and discourage other types of use (horseback riding, motorised vehicles, mountain bikes).
- Avoid areas with hazardous trees, wherever possible.
- Use barriers such as fences to prevent vehicular or livestock access, where necessary.

Protect endangered, threatened, or vulnerable species and habitat features that were identified during the planning and inventory stages such as:

- Patches of rare plants and natural plant communities, nesting trees, rock outcrops, vernal pools, or seepage areas that are nodes of high biological diversity within the older forest.
- Standing dead and dying trees, such as snags and stubs, which should be retained and fallen trees, limbs, leaf litter and soil should be left in place to provide foraging opportunities and nesting and denning sites.
- Danger trees, which should be allowed to remain standing but topped as high as is possible without posing risk to human safety should they fall. Felled trees should be left on the ground. If unavoidable, removal of hazard trees should be conducted in a manner that considers the protection of the surrounding flora, with due regard to timing so as to minimise disturbance to the native fauna.

Prevent disturbance of nesting and breeding areas. Land disturbance activities should be phased or timed to avoid the breeding season for coastal wildlife; this may range from late March through mid-August depending on the species.

Protect nesting and denning sites that were identified during the planning and inventory stages including:

- Black bear dens, eagle nest or perch trees, owl roost sites, and woodpecker cavities—examples of specific habitat features that may occur in older forests. Eagle trees in particular are associated with older forests because of the prevalence of large live trees or snags that rise above the general forest canopy.

- Buffers may need to be extended or recreational trails relocated to minimise disturbance to these sites.

- **Design and implement appropriate sediment and erosion control measures**.

For suggestions on how to incorporate the above recommendations into Official Community Plans and Development Permit Areas, see Chapter 14

In older second growth forests, stumps, burned snags, remnant (veteran) trees and other structural elements from the original forest, are nodes of higher biological diversity until the forest ages. (Photo: Neil K. Dawe)

Older second growth forests play a central role in connecting habitat patches. For example, northwestern salamanders use these forests for a large portion of their life cycles, but also require access to other habitat patches for feeding, breeding, or migration. (Photo:SEI)

12 Older Second Growth Forest

What are Older Second Growth Forest Ecosystems?

Older second growth forests (SG) are coniferous dominated stands with an average tree age between 60 and 100 years. Two sub-categories of older second growth forest were recognised by the SEI: *coniferous* stands with less than 15% deciduous trees (SG:co); and *mixed* coniferous-deciduous stands in which deciduous trees occupied more than 15% of the canopy (SG:mx). Stands greater than approximately 25 hectares were mapped.[90] The large size is an important component of the biological diversity of these forests and focuses attention on the stands that provide landscape level connectivity and also support species with larger home ranges. The field of conservation biology recognises that larger forest patches generally support more species than smaller forest patches.

Older second growth forests and seasonally flooded agricultural fields are the two *other important ecosystems* recognised by the SEI because of their biodiversity values. They do not constitute *sensitive ecosystems* because of their widespread distribution and history of recent human disturbance. All older second growth forests have been disturbed by logging or other human activity since

Older Second Growth Forest vs. Older Forest

Some older second growth forests are difficult to distinguish from older forests because they may have many of the same structural features. Some of these features begin to develop in stands as young as forty years, however, large snags and downed logs only occur after 80 to 100 years of growth.

Generally, older second growth forests can be differentiated from older forests by the presence of large stumps, which testify to the size of old-growth trees before logging, and the lack of snags and other structural elements.

[90] The original minimum size targeted was 100 hectares. This was changed to 25 hectares during the inventory when it was realized that some significant older second growth stands, particularly on some of the smaller Gulf Islands, could not be included using the 100 hectare minimum (see ***Volume 1***, *Section 2.3.2* for further discussion).

European settlement of Vancouver Island and the Gulf Islands began in the middle of the 19th century.

Red squirrel (L. Friis)

The broad variation in stand age, polygon size, vegetation composition, and other attributes makes it difficult to describe characteristic vegetation or wildlife use in older second growth forests. Some stands are patchy, whereas others are strikingly uniform in age and height.

Most *coniferous* second growth forests are dominated by Douglas-fir or western hemlock, with western redcedar stands on wet sites. Grand fir is less common. Younger forests in this category are characterised by dense, uniform stands of even-aged Douglas-fir and cedar or western hemlock, and lack a well-developed understorey because of lack of sunlight. Low growth of sword fern or salal and dull Oregon grape may predominate and some sites support only moss. Stands greater than 80 years typically support more species than younger stands. Some lichen and invertebrate species may not occur until stand age is greater than 80 years because specific habitat features like large moss covered limbs are not present.

Rare plants of older second growth forests

Phantom orchid (R, COSEWIC-T), *(Cephalanthera austinae)*

Mixed older second growth forest occurs both on moist sites where red alder, big-leaf maple, black cottonwood or bitter cherry is mixed with Douglas-fir, cedar, or hemlock, or dry sites with fir mixed with arbutus or Garry oak. Soil disturbance during logging often results in dense establishment of red alder or maple seedlings. Mixed older second growth forests are generally more structurally diverse and more productive for wildlife species than coniferous stands. The more open canopy contributes to understorey diversity. Greater tree species diversity also makes a multi-layered canopy. Furthermore, snags and downed logs are generated sooner in mixed forests because of the shorter life span of red alder and big-leaf maple. Red alder stands begin to senesce after 50 to 80 years, which often coincides with an increase in the dominance of conifers that have regenerated below the alder canopy. The deciduous component may be evenly distributed or patchy.[91]

[91] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) species as of May 2000 are noted in sidebar above. Nationally rare species ranked by COSEWIC, as of May 2000, are also noted as endangered (E), threatened (T) or of special concern (SC). See Glossary for further discussion.

Status

Older second growth forests are the most common forested ecosystems on the east coast of Vancouver Island and the Gulf Islands. Almost 11 percent (44,890 hectares or 449 square kilometres) of the SEI study area was identified as older second growth forest (see Table 12). This is more than four times the amount of older forest identified (see Table 3, page 16). The relatively large extent of this category is a reflection of extensive logging in the past and the large proportion of the SEI that is privately owned forestland. Because only patches of forest greater than approximately 25 hectares were mapped, these figures likely underestimate the extent of older second growth forest in the study area. The median size of older second growth forests mapped was 32 hectares. Although many stands were below the 25 ha minimum, they were mapped because they were part of an ecosystem complex and provided a buffer to adjacent sensitive ecosystems.

Comparisons between the different sub-units of the SEI study area are difficult to make, as the older second growth forest polygons were not consistently mapped using the same criteria.[92] However, it can be noted that the distribution of older second growth forest is widespread in the five sub-units of the SEI; only the Cowichan Sub-unit contained less than 10 percent cover of older second growth forest. Mixed forests accounted for approximately half of this ecosystem type in both the Cowichan and Islands sub-units. Other sub-units contained smaller proportions of mixed forest (see bar chart).

Table 12: Area (ha) of older second growth forest by sub-unit

SEI sub-unit	Coniferous	Mixed	Total
Comox	5661.3	2932.9	8594.2
Nanaimo	4304.6	3423.9	7728.5
Cowichan	1595.7	1698.5	3294.1
Capital	9897.5	857.3	10754.8
Islands	7415.7	7103.3	14519.0
Total	28874.7	16015.9	44890.6

See Volume 1, section 4.2.9, page 68, for further discussion of inventory results relating to older second growth forest ecosystems.

About half of the mapped older second growth forest areas occurred in combination with other ecosystem types, mainly older forest and terrestrial herbaceous units.

[92] See note on page 127.

Why are they Important?

Ecological attributes and socio-economic values pertaining to older second growth forest ecosystems are listed below. Some of these are common to other SEI ecosystems and are discussed in Chapter 2.

Ecological Attributes

- **Biodiversity**—Older second growth forest can support a broad range of forest-dependent wildlife species depending on stand size, vegetation structure and connectivity. Plant species diversity is generally lower in coniferous stands compared to mixed stands, but increases with age and stand **heterogeneity**.

  Although wildlife values are generally lower in the younger, more uniform coniferous stands, stumps, burned snags, remnant (veteran) trees and other remnant structural elements from the previous forest, are nodes of higher diversity. Small mammals such as bats, shrews, and voles, depend on these features for habitat until the second growth forest ages. Wildlife diversity is higher in mixed stands with red alder or big-leaf maple or in older stands with some of the characteristics of older forests.

  Biologically, the richest older second growth forests contain deciduous and coniferous trees, are large polygons or are connected to other natural ecosystems, and are over 80 years old. The presence of snags and downed logs in particular, is closely associated with wildlife species such as small mammals and cavity nesting birds such as woodpeckers. Species that require large home ranges (e.g., black bears) may rely on the relatively large size of some older second growth forest polygons.

  Furthermore, populations in large connected patches are more capable of surviving large scale disturbance events (e.g., fire, drought, blowdown) because the population is larger and spread between different areas.

Mountain sweet-cicely *(Osmorhiza berteroi)* (D. Gunn)

- **Landscape connectivity**—As the most common forested ecosystem in the study area, older second growth forests play a central role in connecting habitat patches. Species as varied as blacktailed deer, black bears and northwestern salamanders use older second growth forests for a large portion of their life cycles, but also require access to other habitat patches for feeding, breeding, or migration. Wildlife populations in remnant ecosystems adjacent to large patches of older second growth forest may be maintained by frequent immigration from the forest patch. As well, smaller patches may be recognised

following disturbance events by individuals that survived in the larger and more stable older second growth forest (see also page 20).

- **Buffers**—Older second growth forests make ideal buffers, because of their broader distribution. Where they border or surround wetlands, patches of older forest or other sensitive ecosystems, older second growth areas serve an important role in minimising disturbance to the adjacent sensitive areas.
- **Future older forests**—Within 20 - 30 years, many of the older second growth forests that were logged in the early 1900s will become older forests. Disturbance and competition will increase the number of structural forest features such as snags and downed logs, and wildlife species associated with older forest will increase. The biodiversity values of older second growth forests generally become higher with age.

Socio-economic Values

- **Forestry**—More than any other area of coastal B.C., forestry on the east coast of Vancouver Island and the Gulf Islands depends on older second growth forest for its timber supply. The logs carried on any logging truck on the Island Highway today are most likely to be Douglas-fir, cedar, or hemlock between 60 and 100 years old.

  Logging began in the 1880s on Vancouver Island. Logging railroads and A-frames from the water, allowed rapid logging of the productive and gentle terrain of the east side of Vancouver Island. Those forests logged before 1900 are now mature second growth forest. Many sites in the SEI study areas are very productive and a 75 year old Douglas-fir could be almost 40 metres tall and one metre in diameter. Current forestry is concentrated on low elevation second growth stands in the Comox, Islands, and Nanaimo sub-units.

- **Other forest products**—Like older forests, older second growth forests provide a broad range of forest products other than timber. Wild mushrooms (e.g., pine mushrooms, chanterelles, boletes), salal for floral material, wildberries such as huckleberries, and medicinal products such as Devil's club are harvested from older second growth forests. Many of these products can be harvested sustainably, and their importance to local economies is expected to grow in the next decade.
- **Green space**—Although much of this report focuses on the importance of ecosystems that are limited in occurrence or sensitive because of ecosystem loss, second growth forest forms the primary network of green space in the region. It surrounds

Morel (C. Tunnoch)

many of the towns and cities and dominates the lower slopes of the Insular Mountains that divide the east and west coasts of Vancouver Island. Most provincial or regional parks contain large areas of second growth forests. In urban areas, where older second growth forests account for a large proportion of the remnant natural areas, they often link parks.

Management Recommendations

Management goals for older second growth forest ecosystems:

Maintain the resource use values of older second growth forests while minimising the loss of ecosystem functions.

Conservation priority should be given to older second growth forests surrounding or adjacent to sensitive ecosystems.

Compared to the recommendations for the seven *sensitive ecosystem* types (*Chapters 5-11*), the emphasis on the two other important ecosystems—*older second growth forest and seasonally flooded agricultural fields*—is less on protection and more on recommending careful management by landowners, local and senior governments and others in order to increase or maintain biodiversity values, while having the ecosystems provide goods and services for humans.

Where possible, local governments and landowners should encourage the concepts of ecosystem management[93] be applied to older second growth forest ecosystems. Rather than managing for specific goods or services, the ecosystem is managed for the structures and processes that are necessary to deliver the goods and services, with sustainability as a precondition.

In many cases, older second growth forest ecosystems will serve as important buffers to adjacent sensitive ecosystems. Where they occur in isolation from other ecosystems, efforts should be made to retain the largest patches possible. Larger older second growth areas are the best candidates for long-term protection because there is larger area of interior habitat. Larger habitat patches support more species and larger populations than smaller ones and protect species with large home ranges. Smaller populations are more prone to **extirpation** caused by predation, or other factors. Large habitat patches with more robust populations can serve as a source to repopulate smaller patches in highly fragmented landscapes.

When developing a management plan for older second growth forest ecosysems, it is assumed that a local ecosystems plan and protection strategy have been carried out (see pages 28 and 29). The following recommendations will aid in the site management of older second growth forest ecosystems.

[93] Christensen et al. 1996.

Avoid Direct and Indirect Impacts

The following actions will minimise impacts to older second growth forest ecosystems.

- **Discourage development within or adjacent to older second growth forest ecosystems** which can result in increased predation or disturbance of bird, small mammal, and reptile species by domestic cats and the introduction of invasive species.
- **Minimise edge effects**—Even changes to wind severity and light levels can cause damage to trees or understorey species (see also page 22).
  - Patches of forest, rather than the retention of isolated trees, is the preferred option in isolated urban settings.
  - Treed areas should have the least possible amount of edge per unit area (i.e., should be as close to round as practical).
  - The windward edge should be smooth and in areas of deep soils and well rooted trees.
  - Edge stabilisation treatments including feathering, sail pruning, topping, and removal of unsound trees should be used to ensure a windfirm edge.
- **Manage recreational and livestock access** to avoid damage to vegetation, soils and wildlife.
- **Prevent disturbance of nesting or breeding areas** (see page 23).
- **Control the introduction or spread of invasive plant species**—A broad invasive species management zone can be designated and active control methods used, such as hand clearing, pruning, mowing, and excavation. Species of concern from nearby gardens or landscaped areas include spurge-laurel, English ivy, Himalayan blackberry, Scotch broom and English holly (see also pages 21 and 30).
- **Allow natural disturbances and successional functions and processes to occur** (see page 31).

Deer Mouse (L. Friis)

Develop Carefully

Where development is allowed in older second growth forest ecosystems, the general development guidelines described in Chapter 4 (page 32) should be followed, including:

- **Require an ecological inventory conducted by a qualified professional**.
- **Plan, design and implement all land development activities**, including recreational facilities such as trails and access roads, in a manner that will minimise impacts to the older second growth forest ecosystem.
- **Locate developments away from sensitive areas** such as groups of snags or large live trees, areas of significantly wetter or drier soils, small populations of locally rare plants, or riparian areas as determined by the ecological inventory. This may be achieved by considering the following:
  - Cluster housing can work in many situations to avoid important stands of trees.
  - Roads and clearcuts should be located within existing disturbed areas to minimise fragmentation.
  - Infrastructure should avoid trees and their root masses that are to be conserved. Generally, staying back the distance equal to the height of a tree from its base or 15 metres, whichever is greater, will achieve this.
- **Schedule land disturbance activities to avoid the spring nesting and breeding season for coastal wildlife**.[94]
- **Protect endangered, threatened, or vulnerable species and habitat features identified during the planning and inventory stages**:
  - Patches of rare plants, nesting trees, snags, vernal pools, or seepage areas that are nodes of biological diversity within the forest landscape.
  - Standing dead and dying trees that should be retained, and fallen trees, limbs, leaf litter and soil that should be left in place to provide foraging opportunities and nesting and denning sites.
  - Removal of hazard trees should be conducted in a manner that considers both the protection of the surrounding flora and reasonable costs, and with due regard to timing to minimise disturbance to native fauna. Danger trees should

[94] Contact resource agencies for further information (see Appendix B).

be allowed to remain standing but topped as high as is possible without posing risk to human safety should they fall. Felled trees should be left on the ground.

- **Design and implement appropriate sediment and erosion control measures**.
- **Allow succession and natural disturbance to occur**, regardless of aesthetic concerns, namely, natural windthrow, tree death, disease, or other processes linked to competition and succession. Many of these processes are the building blocks of biologically and structurally diverse forests. Older second growth forests will be older forests in 10 to 40 years.

Brown Creeper (M. Hames)

For suggestions on how to incorporate the above recommendations into Official Community Plans and Development Permit Areas, see Chapter 14

With the historical loss of natural wetland ecosystems, seasonally flooded agricultural field ecosystems are playing an increasingly important role by providing surrogate wetland habitat for wildlife, especially waterfowl. (Photo: Mark Kaarremaa)

13 Seasonally Flooded Agricultural Field

What are Seasonally Flooded Agricultural Field Ecosystems?

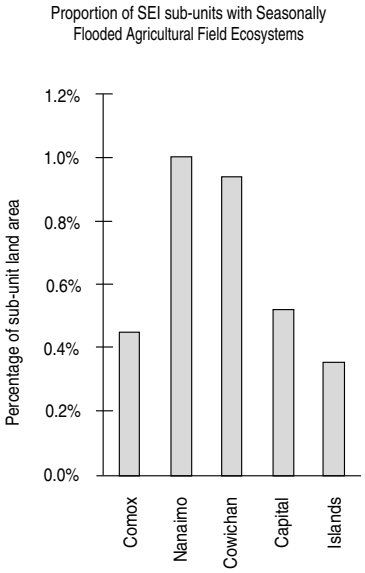
Seasonally flooded agricultural fields (FS) are lands that have been modified for agricultural use but have important wildlife habitat values for many species of waterfowl, shorebirds and birds of prey during specific times of the year. These fields are located primarily in low-lying areas that are often associated with, and form complexes with wetlands such as freshwater and estuarine marshes, swamps, and wet meadows. In such cases, other environmental factors such as poor drainage, or a high water table contribute to flooding during the autumn and winter rainy season. Where the fields are located next to riparian ecosystems, flooding can also occur during peak river discharge periods, or raised lake levels. In these cases, the flooding season can be extended into spring and early summer.

Seasonally flooded agricultural fields are predominantly in private ownership and are managed primarily for agriculture. Agricultural uses vary from farm to farm, but can include dairy pasture, hay meadows, and cultivated fields (corn, flower bulbs, and various vegetable crops). Following harvest, topography and weather contribute to flooding of the fields, creating an ideal mixture of shallow water, stubble, waste grain and produce, weed seeds, and invertebrates, all of which attract wintering waterfowl. Changes in agricultural use or abandonment may alter the habitat potential, and ultimately the species mix attracted to these fields.

Beyond the areas of active farming, seasonally flooded fields can include remnant patches of wetland ecosystems and the occasional small pond. Where the fields border riparian ecosystems, the field edges are often allowed to form a scrub-shrub zone that provides a transition to the riparian ecosystem. Typical native species of this transition zone include: salmonberry, red-osier dogwood, willow species, hardhack, red elderberry, thimbleberry, Pacific crab apple, Pacific ninebark, and Nootka rose. Along with the native shrubs can be a wide range of agronomic weeds and other opportunistic species that are tolerant of fluctuating water levels: timothy, fescues, reed canary grass, orchard grass and giant knotweed.

Status

Seasonally flooded agricultural fields are widespread, but generally uncommon in the SEI study area. They occur on valley bottoms that are prone to flooding and on former wetlands that have been dyked and drained. In the Nanaimo, Cowichan and Comox sub-units, many seasonally flooded agricultural field ecosystems are associated with the floodplains and deltas of large, alluvial rivers and creeks such as the Chemainus, Puntledge, Nanaimo, Cowichan, Little Qualicum, French, Courtenay, and Millstone. Conversion to other land uses has been slower in these places than in the Capital Sub-unit, hence their greater areal extent.



In the Comox Sub-unit a small number of large fields accounted for most of the land occupied by this ecosystem type (see Table 13). The Nanaimo and Cowichan sub-units also contained a large percentage of the total land occupied by this ecosystem. However, the total area values were comprised of a large number of smaller fields, which may indicate the greater extent of farmland fragmentation, smaller field systems, or the occurrence of more wetlands or creek, stream and river systems prone to flooding.

Table 13: Area (ha) of seasonally flooded agricultural fields by sub-unit

SEI sub-unit	Seasonally Flooded Agricultural Field	No of sites
Comox	491.4	12
Nanaimo	956.8	101
Cowichan	772.5	83
Capital	325.3	26
Islands	232.9	52
Total	2778.9	274

*See **Volume 1**, section 4.2.10, page 68, for further discussion of inventory results relating to seasonally flooded agricultural field ecosystems*

In the Capital Sub-unit, many small seasonally flooded agricultural fields are found on moisture-receiving sites on the Saanich Peninsula, such as the farming areas around Martindale Flats and Island View Beach. Occasionally, the fields are associated with wetland complexes such as those found around Swan Lake and Fizzle Lake. In the Islands Sub-unit, small seasonally flooded agricultural fields are found on moisture-receiving sites, usually in association with lake shores, or lowlands adjacent to coastal bays. The lesser areal extent of seasonally flooded agricultural field ecosystems in the Islands and Capital sub-units can be attributed to the absence of relatively large rivers and their floodplains, to differences in topography and geology that are not conducive to agriculture, and to the loss of agricultural fields due to urban expansion and changing land uses.

Some birds of seasonally flooded agricultural fields[95]

Waterfowl
Canada Goose
Greater White-fronted Goose
Trumpeter Swan (B)
Tundra Swan (Y)
Gadwall
Eurasian Wigeon
American Wigeon
Mallard
Northern Shoveler
Northern Pintail
Green-winged Teal

Shorebirds
Killdeer
Common Snipe
Dunlin
Black-bellied Plover
Dowitcher
Great Blue Heron (B, COSEWIC-SC)

Birds of Prey
Bald Eagle (Y)
Gyrfalcon (B)
Red-tailed Hawk
Cooper's Hawk
'Anatum' Peregrine Falcon (R, COSEWIC-T)
Merlin
American Kestrel
Short-eared Owl (B, COSEWIC-SC)
Long-eared Owl
Snowy Owl (Y)

Why are they Important?

Ecological Attributes

High wildlife use—The SEI area is located on the Pacific Flyway, which is a migratory path for bird species travelling between their southern wintering areas and their northern breeding grounds. Favourable climatic conditions and available habitat make the SEI area an important wintering area for many species of waterbirds. Wetlands such as swamps, freshwater and estuarine marshes, and riparian areas such as river deltas and sloughs are examples of the natural wintering habitats available for waterfowl and other birds.

These natural habitats are supplemented by seasonally flooded agricultural fields, which add to the total amount of wintering habitat area available. Over the past century, natural wetland destruction has occurred to the extent that artificial wetlands such as seasonally flooded fields have become increasingly important because of their wildlife habitat qualities. These lands can support high numbers of different bird species for the areas they occupy, depending on the previous season's agricultural use and the weather.

Throughout the year, the number of bird species in agricultural areas containing seasonally flooded fields is higher than in

[95] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) species as of May 2000 are noted; species ranked as infrequent or uncommon (U) are noted in the table. Nationally rare species ranked by COSEWIC, as of May 2000, are noted as endangered (E), threatened (T) or of special concern (SC). See Glossary for further discussion.

other altered land use areas. With winter flooding, fields in the SEI study area provide valuable habitat for many bird species. Waterfowl depend on the varied diet available in seasonally flooded fields during the winter, and many species can be frequently seen foraging (see sidebar). Shorebirds often use seasonally flooded fields and the concentration of waterfowl and shorebirds attracts hawks and other birds of prey. Suitable grassy edge and ditch habitats attract Short-eared, Long-eared, and Snowy owls, Northern Harriers, Western Meadowlarks, and Northern Shrikes.

Fields in the Somenos Marsh area near Duncan receive more summer use by songbirds because of their linkage to other habitats.

By comparison, the Martindale Flats in Saanich lack substantial adjacent woodlands that provide the necessary habitat for nesting songbirds during the spring and summer months, and bird activity is subsequently low during these months.

During spring migration, still-wet fields can attract open-field species such as swallows and Band-tailed Pigeons. If ponds and ditches are part of this habitat, or the late winter **freshet** extends the flooding period, various ducks and geese remain near the fields, occasionally nesting near permanent water. The fields also supply seeds, invertebrates and other nutrients that increase egg-laying capacity and provide calcium necessary for strong eggshells.

During the summer breeding season, fields are under intensive cultivation and are of little use to songbirds and waterfowl. Small mammal use of the fields increases, and owls and raptors return for productive hunting forays after nightfall. The Great Blue Heron (blue-listed and COSEWIC-SC) and Barn Owl (COSEWIC-SC) supplement their diets with Townsend's voles that make their homes in wet meadows and fields. In autumn, the fields are busy stopover points for birds migrating south. Species encountered will vary from field to field, depending on the surrounding habitat, and individual species requirements.

- **Water storage**–Like wetlands and riparian ecosystems, seasonally flooded field ecosystems can reduce peak flows by slowing or storing runoff, and stabilising water flows throughout the year.
- **Important component of ecosystem complexes**—When a seasonally flooded field is adjacent or connected to the larger mosaic of woodlands, wetlands, and riparian corridors, wildlife use will extend to other seasons (see sidebar). Many species depend on one ecosystem for part of their life cycle, and surrounding areas for another. For example, seasonally flooded fields may be vital for winter survival, and riparian woodlands for breeding and nesting.

Sandhill Crane (B)
(R. Savannah)

Seasonally flooded fields and agricultural landscapes that are linked to riparian ecosystems have the additional quality of being part of a linear corridor that allows non-flying species to disperse and move between other suitable habitat patches (see also page 20).

The edge between a woodland or forest and a seasonally flooded field ecosystem is also an ecologically important landscape component. The primary function of the edge is to provide a structural transition from a non-forested ecosystem to a forested one. The result is a flow of energy, nutrients and species between these ecosystems. Both lengthwise and transverse movements of species along and through these edges makes them places of intense species interactions (e.g. breeding, predation), thus moulding the composition of plant and animal communities within both ecosystems. Forest/field edges, given room to generate and expand, provide a gradual transition between the ecosystems, resulting in species richness and habitat diversity.

Socio-economic Values

- **Agricultural benefits—**The primary benefit from agriculture is to the farmer and society who benefit from a source of local food. An additional benefit of these seasonally flooded agricultural fields is bird use, which benefits society as a whole. Programs such as Greenfields, Comox Valley Waterfowl Management Program and the Delta Farmland and Wildlife Trust Farmscape Program can mitigate the impact of birds on agriculture.

If a [region] accepts sustainable self-sufficiency as its primary goal, it will give first attention to agriculture. Food is a more basic need than industrial products.

— Daly and Cobb Jr.

- **Outdoor recreation—**The seasonal ebb and flow of waterfowl and other birds is an important part of nature. Wintering areas now attract thousands of visitors to view wintering and migrating waterfowl. During the winter months, seasonally flooded fields can become ‘hot spots’ for recreational activities such as birdwatching and wildlife viewing. Fields in the Martindale Valley Flats and Island View Beach on the Saanich Peninsula have received national and international media attention[96] because of the vast numbers of bird species (170)[97] recorded there throughout the year, many of which are red- or blue-listed. Farmers in these areas have been working with naturalists to create a code of ethics for wildlife viewing which is mutually acceptable.

(R. Savannah)

- **Eco-tourism—**Bird watching opportunities can have a positive local economic impact. In the Comox area, the Trumpeter Swan Festival, held the first week of February, is beginning to receive international attention. This event attracts birdwatchers from other countries, and provides a boost to the local economy during a traditionally slow time.

[96] Great Outdoors Recreation Pages, see web site: *www.gorp.com*

[97] See web site: *http://birding.bc.ca*, local hotspots.

Management Recommendations

The long-term preservation of agricultural lands and agricultural activities in the SEI region is of paramount importance.

Compared to the recommendations for the seven *sensitive ecosystem* types (*Chapters 5-11*), the emphasis on the two other important ecosystems—*older second growth forest and seasonally flooded agricultural fields*—is less on protection and more on recommending careful management in order to increase or maintain biodiversity values, while having the ecosystems provide goods and services for humans.

Where possible, local governments and landowners should encourage that the concept of ecosystem management[98] be applied to seasonally flooded agricultural field ecosystems. Rather than managing for specific goods or services, the ecosystem is managed for the structures and processes that are necessary to deliver the goods and services, with sustainability as a precondition.

Conservation Stewardship Models

*In the **Cowichan Valley** Canadian Wildlife Service, BC Ministry of Agriculture and Food, Ducks Unlimited Canada, The Nature Trust of B. C., local land trusts and farmers are co-operating on the development of individual seasonally flooded agricultural field management plans.*

*In the **Comox Valley,** the above agencies are co-operating with local farmers to develop a comprehensive regional Trumpeter Swan Management Plan and Ducks Unlimited recently purchased the Farquharson Farms on the Courtenay River floodplain in order to conserve both agriculture and waterfowl habitat.*

Urban encroachment onto farmland is the biggest threat to this ecosystem type. As agricultural practices change, and agriculture is replaced by other land uses, seasonally flooded agricultural fields may become threatened habitats themselves.

No incentive is presently offered to farmers to maintain seasonally flooded agricultural fields, or to conserve and increase all types of wildlife habitat on farmlands such as leaving hedgerows for their wildlife values. If conservation of these fields is ecologically and societally important, farmers alone cannot be expected to bear the financial burden of implementing conservation management plans. This is an important consideration, particularly if economic opportunities are lost in the process.

In highly fragmented landscapes such as the east side of Vancouver Island, wildlife species depend on a series of inter-connected habitat patches. With the historical loss of natural wetland ecosystems, seasonally flooded agricultural field ecosystems are playing an increasingly important role by providing surrogate wetland habitat for wildlife. The value of these ecosystems in the landscape mosaic has been recognised by several levels of government and non-government agencies as a conservation issue (see also page 20).

When developing a management plan for seasonally flooded agricultural field ecosystems, it is assumed that a local ecosystems

[98] Christensen et al. 1996.

plan and protection strategy have been carried out (see page 28). The following recommendations will aid in the site management of seasonally flooded agricultural field ecosystems.

- **Maintain linkages to adjacent natural ecosystems**—Fields that are adjacent to natural riparian and wetland ecosystems create expanded linkage opportunities, and increase habitat diversity within the larger landscape mosaic. Hedgerows that have developed along fence lines forming the boundaries between land holdings or fields create other linkages and travel corridors. Habitat diversity attracts a greater variety of species, each with a unique suite of habitat needs.
- **Reduce landscape fragmentation**—Locate farm development away from riparian ecosystems in order to maintain the linear and continuous nature of riparian ecosystems and ensure that riparian ecosystems are not severed from adjacent upland ecosystems (see also page 20).

Use Conservation-oriented Management Practices

Because seasonally flooded field habitats are the product of land management and drainage practices, ongoing site management is an important aspect of their conservation. A number of guidelines and management techniques that are common to every seasonally flooded agricultural field are presented below.

*See **Section Two** for discussion of available Conservation Tools.*

Hazards of Pesticide Use

In October 1975, 1,000 Green-winged Teal died in agricultural fields in Ladner from a probable cause of pesticide poisoning (Carbofuran G) after a farmer applied the pesticide at up to 4-times the registered application rate.

In another instance, 1060 Savannah Sparrows died in Richmond in September 1986 with the same probable cause.

- **Create vegetation buffers between high-use areas and fields**—Vegetation buffers may be required if the fields are located next to high-traffic roads (e.g., the Pat Bay Highway) that can alter habitat use because of vehicular movement or associated noise. Vegetation buffers also can serve as windbreaks, define field boundaries, provide visual screens, and serve as movement corridors into adjacent ecosystems.
- **Plant winter cover crops**—Winter cover crops are planted on harvested fields to protect the soil surface from erosion, provide weed control, enhance soil organic matters, and reduce wildlife damage to vulnerable fields that are managed as permanent pasture or hay meadows. Winter cover crops such as fall rye can lure waterfowl away from vulnerable lands, such as more valuable perennial grass pastures.
- **Plant and maintain boundary hedgerows**—Boundary hedges are important “living fence” features in farmlands because in addition to separating land uses, they have the capacity to buffer fields for various reasons, provide structural diversity, food and cover for wildlife, and create linkages to other habitats.

Redtailed Hawk (M. Hames)

- **Establish grass leave strips along field margins**—Grass leave strips are uncultivated field margin strips of native grasses and forbs. They provide a transition zone between agricultural fields and boundary hedges or edges, provide habitat for beneficial insects (pollinators and predators), and cover for small mammals and song birds.
- **Mimic naturally occurring edges by developing "soft" edges between fields and adjacent forested areas**—The edges of forests and woodlands can be the most important habitat for many wildlife species, but can increase the vulnerability of the forest or woodland to interference from other land use activities. "Hard" edges are managed for convenience to provide an abrupt break between two ecosystem types. They are of little use to wildlife and can help undesired species invade the woodland or forest. "Soft" edges provide a seamless transition between the grass leave strips at the farm field margin and the woodland or forest. Soft edges are composed of a wide variety of smaller shrubs that grade into larger shrubs and small trees towards the woodland or forest. Soft edges can be managed to create a fairly impenetrable border to the woodland or forest, which can help control public access, and protect the forest interior (see also page 22).

Avoid Direct and Indirect Impacts

The Victoria Natural History Society and a group of local farmers have developed a code of ethics for birders using the Martindale Flats.

- **Manage recreational access**—Undisciplined wildlife viewing and birdwatching can cause negative impacts such as trespassing, crop damage, and trampling of farmlands. Proactive communication between farmers, wildlife managers, recreation or park planners, and the general public is important to ensure that the concerns of the various interest groups are understood by all, and workable solutions are developed (see sidebar). Signage, fencing, and designated official viewing areas are a few techniques that have been used successfully elsewhere.[99]
- **Control invasive plant species**—Canada thistle, annual sow thistle, perennial sow thistle, common burdock, leafy spurge, and ox-eye daisy are some of the unwanted introduced species that can threaten seasonally flooded fields because they are difficult to reduce in abundance, have minimal value for wetland wildlife, or out-compete agronomic and native plants with greater habitat value. Himalayan blackberry is often the most invasive shrub species found in the scrub-shrub zone at

[99] VanderPol 1998.

field edges. Where this occurs adjacent to a riparian ecosystem it can be problematic due to the displacement of native species (see also page 21).

- **Control pets during active wildlife season** (see pages 21 and 23).
- Maintain hydrological regime—To provide wildlife habitat on seasonally flooded agricultural fields, winter flooding could be allowed to occur naturally and other critical habitat elements (food, water and cover) could also be allowed to develop undisturbed over the winter months. This would ensure that water levels rise gradually, providing waterfowl accessibility to seeds, tubers, browse and invertebrates (see sidebar).

Some farmers work co-operatively with Ducks Unlimited Canada to maintain adequate winter water levels on their lands through the installation of water control structures. Wintering waterfowl benefit from the higher water levels on the fields and the farmers benefit because water levels can be quickly lowered in spring allowing them earlier access to the fields than would otherwise be possible.

Section Two

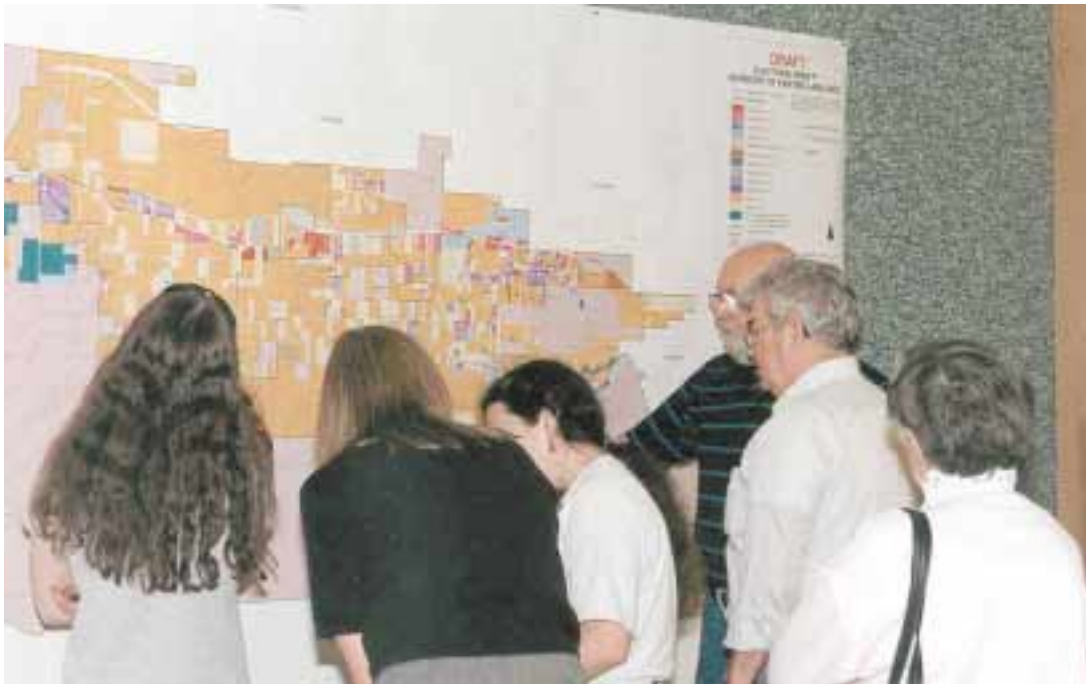
Conservation Tools for

Local Governments

Landowners and other Citizens

Senior Governments

(D. Gunn)



Local governments can use the SEI information to designate Environmentally Sensitive Areas and Development Permit Areas. (Photo: Roy Ostling)

14 What Local Governments Can Do

This section of the manual provides general guidance to local governments, landowners and other citizens and senior governments for conserving and protecting ecosystems. Although the focus of the manual is on the seven sensitive ecosystems and two other important ecosystems (see sidebar), the tools can also be used for conserving other environmentally sensitive areas (ESAs).

Planning

Local governments have numerous planning tools available to assist them in protecting and conserving sensitive and other important ecosystems. Various considerations enter into decisions as to which tools to use in a particular situation. In many cases, innovative development plans can allow compatible development to take place, while conserving sensitive ecosystems and respecting the legal rights of landowners. In some cases, existing environmental problems may have resulted from ongoing land uses that conflict with environmental objectives or do not conform to bylaws.

The tools below provide many options for developing environmentally compatible development plans within the local government's jurisdiction.

Sensitive ecosystems

Coastal Bluff
Sparsely Vegetated
Terrestrial Herbaceous
Wetland
Riparian
Woodland
Older Forest

Other important ecosystems

Older Second Growth Forest
Seasonally Flooded Agricultural Field

Primary Goals

The primary goals of the policies and regulations described in this chapter reflect the differences between the seven *sensitive ecosystems* and the two *other important ecosystems.*

- **Sensitive ecosystems**—the policies and regulations suggested below seek to conserve these areas in a relatively natural state.
- **Other important ecosystems**—the policies and regulations suggested below seek to maintain the resource use values of the two other important ecosystems while minimising the loss of ecosystem functions.

Information Requirements

Other Sources of Information

Canadian WildlifeService, Environment Canada
Ministry of Environment, Lands and Parks
B.C. Conservation Data Centre[100]
Local naturalists
Environmental groups
Universities
First Nations

Sound information is needed to establish a policy and legal basis for protecting sensitive and other important ecosystems. Three types of information are considered in this chapter:

- **SEI ecosystems** are the nine ecosystems defined by the Sensitive Ecosystems Inventory (SEI). Information gathered by the SEI project is at an overview level. Site-specific development proposals will require further refinement and confirmation by detailed inventories, field studies, and groundtruthing to ensure that all habitat patches have been identified.

  SEI information can be used by local governments to 'red flag' areas for designation as Environmentally Sensitive Areas and Development Permit Areas. The detailed ecological information that was collected during the SEI field checking of selected sites[101] can be used on special features and/or ecosystem processes, and the management recommendations in this manual can be used for Development Approval Information. Developers can also use the manual's information to incorporate conservation objectives into initial development design to streamline approvals.

- **Development Approval Information (DAI)** may be required from developers to provide more detailed information as part of the development approval process.

- **Environmentally Sensitive Areas (ESA)** are areas formally designated as environmentally sensitive by the local government. ESAs are usually identified spatially on a map. Local governments may, in co-operation with other government agencies, assemble databases for identifying and managing ESAs within their boundaries. Sensitivity may be due to ecological concerns or existence of natural hazards. ESAs may be mapped either at an overview scale or in considerable detail, depending on the local government jurisdiction. ESAs are not applicable to Managed Forest Land subject to the *Private Land Forest Practices Regulation* or to "agricultural reserve lands" under the jurisdiction of the Agricultural Land Commission.

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[100] The B.C. Conservation Data Centre (CDC) tracks rare plants, animals, and natural plant communities throughout the province. Please check the CDC website (see Appendix H) for current tracking lists.

[101] Approximately 30% or 2,279 of the sites were visited to verify air photo interpretation and collect ecological data to support assigned classifications (see Volume 1, page 15, for details); this information is available upon request (see Appendix H).

Information Verification

Local governments may do the following to ensure adequate information for managing sensitive ecosystems.

- **Establish procedures for verification** and groundtruthing of candidate areas for inclusion in ESAs, as part of planning updates and development approvals, in co-operation with other government agencies.
- **Review, refine, and confirm** areas identified by the Sensitive Ecosystems Inventory Project as candidates for inclusion in ESA inventories or maps.
- **Enact appropriate bylaws** to require *Development Approval Information* for all Sensitive Ecosystem ESAs pursuant to the *Municipal Act*, sections 879.1 and 920.1.
  - Establish procedures and policies for provision of such information. In co-operation with other government agencies, provide criteria for the types of information to be provided, and its sources, quality, and reliability.
  - Use the Sensitive Ecosystems Inventory and information in this manual as a basis for defining the circumstances and rationale for this designation.
- **Involve the public, non-government organisations; environmental, fish, and wildlife agencies; and qualified professional consultants** in co-operative efforts to assemble and evaluate ESA studies and review Development Approval Information. This can involve workshops, open houses, advisory groups, or other participation approaches to gather local knowledge and information.

Official Community Plans

*See **Municipal Act**, sections 875 - 885 for more information*

The Official Community Plan (OCP) provides overall policy direction for the local government and establishes the basis for its regulations and development approvals. OCPs may include goals and policies that define the local government's intention to protect and conserve sensitive ecosystems. A Rural Land Use Bylaw gives, to regional districts, powers similar to an OCP for planning of areas outside a municipality that do not have official community plans. Rural Land Use Bylaws may be less restrictive than OCPs and are primarily used by regional districts in less developed areas as an alternative to an OCP.

Using suggested policies in developing Official Community Plans

Actual legal documents would need to be customised to reflect local practices and conditions. Readers should seek legal advice when preparing new legal documents or bylaws, or when interpreting existing ones.

For local governments who intend to conserve and protect sensitive ecosystems, the following policies are suggested as models (see sidebar) that could be incorporated in OCPs. The common policies suggested below are relevant to all sensitive ecosystems unless otherwise noted. Additional policies specific to individual ecosystems are also presented.

Suggested Policies for all Sensitive Ecosystems

- Recognise the importance of sensitive ecosystems as a part of the natural environment and biological diversity of the community, and an important component of the open green space and natural features of the community.
- Promote preservation of sensitive ecosystem areas and their living resources in a natural condition and maintain these areas free of development and human activity to the maximum extent possible.
- Promote priority acquisition and preservation of sensitive ecosystem sites as protected areas, where possible, with strict 'no access' and 'no disturbance' bylaws for especially sensitive zones.
- Develop a local government-led ecosystems plan, with the assistance of government, non-government environmental agencies and the public, that:
  - utilises ecosystem, habitat, and environmental inventories developed by environmental agencies such as the Ministry of Environment, Lands and Parks; Canadian Wildlife Service; and Fisheries and Oceans Canada.
  - identifies a network of ecosystems that exist within the larger landscape.

Great Horned Owl
(R. Savannah)

- identifies isolated ecosystems and establishes or enhances corridors, connections, and linkages with larger ecosystem networks.
- promotes connectivity between, and discourages fragmentation of, contiguous ecosystems and ecosystem components to preserve landscape diversity, and allow wildlife use, movement, and dispersal.

- Establish goals, objectives, and policies related to the preservation, protection, restoration, and enhancement of: sensitive ecosystems and their natural environments and biological diversity.

*See **Municipal Act**, sections 878 and 879.*

- Develop policies, bylaws, plans, and procedures for preserving, protecting, restoring, and enhancing these ecosystems, while not rendering private parcels as unusable and subject to compensation.
- Designate ESAs identified for sensitive ecosystems as Development Permit Areas (DPAs) in the OCP using information in this manual and provide guidelines for development or land use changes in these areas.

*See **Municipal Act**, sections 879 and 920.*

- Discourage development and other activities that are not compatible with the preservation, protection, restoration, and enhancement of sensitive ecosystems in DPAs, including land uses and the location of roads and utility corridors.
- Designate sensitive and other important ecosystem DPAs as areas for which *Development Approval Information* may be required.

*See **Municipal Act**, sections 879.1 and 920.1.*

- Provide technical assistance to landowners to become involved in stewardship initiatives such as appropriate restoration and enhancement, and registering conservation covenants.
- Maintain appropriate buffers, determined by suitably qualified professionals, around sensitive ecosystem areas that take into account processes of natural erosion, deposition and movement of natural boundaries (see sidebar).

See Environmental Objectives, Best Management Practices and Requirements for Land Development.[102]

- Protect SEI ecosystems from invasion of introduced species.
- Manage recreational access into ecosystems to minimise impacts especially during wildlife nesting seasons.

[102] Ministry of Environment, Lands and Parks 2000.

Entire-leaved gumweed
(Grindelia integrifolia)
(E.J. Stephen)

Additional Policy Suggestions for Coastal Bluff Ecosystems

- Recognise the extremely sensitive and vulnerable nature of this ecosystem to almost any human disturbance, especially during bird nesting periods and early growing season for plants.
- Restrict construction of boat access (docks and wharves), shore protection, and other marine and shoreline structures near coastal bluffs.
- Restrict water uses that may adversely affect coastal bluff sites. This may include working with other government agencies to limit or restrict the development of upslope septic fields, inappropriate drainage systems and garden watering.
- Working with other government agencies, limit or restrict mariculture operations on sites near coastal bluffs, that may adversely affect or have impacts on sensitive coastal bluff shore and marine areas, based on marine environmental impact assessments prepared by qualified professionals.

Additional Policy Suggestions for Sparsely Vegetated Ecosystems

- Recognise the extremely sensitive and vulnerable nature of this ecosystem to almost any human disturbance.
- Working with other government agencies, limit or restrict any construction or development activities near coastal sand dune and sand spit areas that might disrupt or alter coastal processes, isturb sand movement processes, alter natural wind and current flows, cause instability of dunes or spits, or disturb natural landscape, terrain features, or associated vegetation. Restricted activities could include boat access facilities, shore protection, engineering works, beach groins, or other marine structures on coastal sand dunes and coastal spits and adjacent areas.
- Working with other government agencies, limit or restrict water uses that may adversely affect sparsely vegetated sites, including the development of upslope septic fields, inappropriate drainage systems and garden watering.
- Working with other government agencies, limit or restrict mariculture operations on sites near sensitive sparsely vegetated ecosystems that may adversely affect or have impacts on sensitive dune and spit areas, based on marine environmental impact assessments prepared by qualified professionals.

Additional Policy Suggestions for Terrestrial Herbaceous Ecosystems

- Recognise the extremely sensitive and vulnerable nature of this ecosystem to almost any human disturbance.
- Working with other government agencies, limit or restrict water uses that may adversely affect terrestrial herbaceous sites, including the development of upslope septic fields, inappropriate drainage systems and garden watering.

White hawkweed
(Hieracium albiflorum)
(E.J. Stephen)

Additional Policy Suggestions for Wetland Ecosystems

- Investigate and consider the overall hydrology affecting the ecology of wetland ecosystems, and ensure local government land use plans maintain natural surface, groundwater and nutrient regimes to support existing wetland hydrology and ecological processes.
- Protect water quality from pollutants, sedimentation or altered nutrient loading.

Additional Policy Suggestions for Riparian Ecosystems

- Protect water quality from pollutants, sedimentation or altered nutrient loading.
- Maintain continuous riparian corridors of sufficient width to protect fish and wildlife habitat and accommodate the dynamic nature of the hydrologic system, and reduce the need for channel stabilisation and flood controls.
- Avoid locating road and utility corridors along, parallel to, or across riparian ecosystems in order to maintain unconstrained natural connections for wildlife to surrounding upland ecosystems. Where crossings are necessary, design crossing corridors that are narrow and perpendicular to riparian areas, and elevated to maintain wildlife connections.

Additional Policy Suggestions for Woodland Ecosystems

- Work with landowners to retain patches of natural forest in addition to open meadow areas with isolated trees.

Long-eared bat (L. Friis)

Additional Policy Suggestions for Older Forest Ecosystems

- Work with private forest landowners to encourage the development of appropriate forest management plans for logging activities which identify, where possible, approaches that sustain the structure and composition of older forest ecosystems. This suggestion and the following suggestions are not applicable to Managed Forest Land identified under the *Assessment Act* subject to the *Private Land Forest Practices Regulation*.
- Work with private forest landowners to conserve forest patches of sufficient size to support interior forest conditions.
- Work with private forest landowners to maintain natural disturbance regimes of older forest and related ecosystems to sustain successional processes and maintain diversity, where practicable.
- Work with private forest landowners to provide adequate buffers between older forests and developed areas to avoid demands to remove or top “hazard” trees.
- Work with private forest landowners to discourage site clearing, urban development, and road and utility construction within older forest ecosystem areas, especially where such development fragments forest areas into smaller patches.
- Seek to acquire and conserve important older forest ecosystems as open green space and parkland.

Development Permits

Development Permits may be used by local governments to establish special requirements that apply to development or redevelopment, including the preservation, protection, restoration and enhancement of the natural environment, its ecosystems, and biological diversity. Development permits are one of the most important tools available to a local government for protecting sensitive ecosystems.

*See **Municipal Act**, sections 879, 920, 925 for more information.*

The following guidelines are suggested as models (see sidebar) for inclusion in Development Permits and, unless noted, apply to most sensitive ecosystem categories. Additional provisions are suggested for specific ecosystems.

Using suggested guidelines in creating Development Permits

Actual legal documents would need to be customised to reflect local practices and conditions. Readers should seek legal advice when preparing new legal documents or bylaws, or when interpreting existing ones.

Development permits are not generally developed for application to, nor are applicable to, Managed Forest Land as identified under the *Assessment Act* and subject to the *Private Land Forest Practices Regulation* or to lands within the Agricultural Land Reserve. Therefore ecosystems such as older forest, seasonally flooded agricultural field and older second growth forest within Managed Forest Land are not managed or protected using development permits.

Suggested Guidelines for all Sensitive Ecosystems

- Designate sensitive ecosystems ESAs as *Development Permit Areas* (DPA).
- Require that a Development Permit be obtained ***prior to*** subdivision, construction, alteration of land, disturbance of vegetation, soil deposit or removal, or any other development or activity that would disturb sensitive ecosystems within DPAs.
- Require, as a condition of development permit approval, that development in less sensitive portions of the DPA be planned, designed, and implemented in a manner that will not adversely affect or disturb the sensitive ecosystems. This should be tailored to site-specific conditions, including
  - vegetation, trees, snags, and root systems.
  - rare and uncommon species and plant communities.
  - soils and soil conditions.
  - terrain features such as rock.
  - birds and other wildlife and their habitats, such as nesting and breeding areas.

- Avoid creating access such as trails to sensitive ecosystems that could be adversely impacted by human activity.
- Encourage application of density bonusing, cluster housing, relaxation of servicing requirements (such as street widths), density transfers, or other innovative planning tools to achieve attractive development designs while protecting sensitive ecosystems.
- Require that Development Approval Information be prepared by qualified environmental professionals, to include as a minimum:
  - a topographic survey with an appropriate contour interval.
  - an inventory of natural biophysical features including soils, trees, vegetation, water bodies, watercourses, wetlands, wildlife species, ecological processes, and other ecosystem components (see sidebar).
  - identification of populations, habitats, or natural features supporting rare, threatened, and endangered species.
  - identification and confirmation of the boundaries of sensitive and other important ecosystem ESAs.
  - description of site development plans and operations.
  - assessment of the potential environmental effects of activities and developments proposed for the site on sensitive and important ecosystems and watercourses.
- Require that an environmental site plan be prepared by qualified environmental professionals, as an integral part of a Development Permit for any Development Permit Area that includes or abuts a sensitive ecosystem, to ensure that the development does not create offsite effects that adversely affect that ecosystem. The site plan should
  - include details of specific provisions that will be implemented to preserve, protect, restore, and enhance the natural environment, ecosystems, and biological diversity of sensitive ecosystems within the DPA.
  - specify terms and conditions regulating any activities that may potentially adversely affect or disturb species, vegetation, soils, watercourses, natural features, or ecological processes of sensitive ecosystems within the DPA, where such disturbance is unavoidable.
  - define measures for professional environmental supervision, inspection, and monitoring of development activities and related environmental effects on sensitive ecosystems occurring during and after development, including the environmental consequences of any contravention of a condition of the Development Permit

The Ministry of Environment, Lands and Parks has prepared general terms of reference for these types of studies (see Appendix B).

and proposed measures for mitigation of these consequences.

- conform to all municipal bylaws, federal and provincial legislation, regulations, and standards.

- Require that all areas within sensitive ecosystems DPAs remain free of development, except for areas identified as suitable for development in an approved Development Permit and associated environmental site plan.

- Promote and maintain natural buffers adjacent to sensitive ecosystem areas, where possible, that
  - recognise natural processes and changing natural boundaries.
  - insulate the ecosystem from uses that would cause adverse effects.
  - avoid disturbance and removal of native vegetation by people.
  - emphasise native vegetation species compatible with the ecosystem.
  - deter spreading invasive non-native species into the ecosystem.
  - deter grazing by livestock or feral animals in sensitive ecosystem areas.
  - deter predation and disturbance of wildlife by pets and domestic animals in sensitive and other important ecosystem areas.
  - maintain wildlife corridors between the ecosystem and nearby wildlife habitat patches.

- Maintain connectivity and linkages with adjacent sensitive ecosystems and other habitat areas through the use of corridors and greenways to minimise fragmentation.

- Where the development site contains or is adjacent to a natural watercourse, require that the developer
  - dedicate, where possible, the watercourse and continuous riparian corridors of sufficient width to protect fish and wildlife habitat and accommodate the dynamic nature of the hydrologic system, to reduce the need for channel stabilisation and flood controls.
  - prevent access to the watercourse by construction activities, except as approved by appropriate government agencies.

See Environmental Objectives, Best Management Practices and Requirements for Land Development.[103]

Chanterelle
(C. Tunnoch)

[103] Ministry of Environment, Lands and Parks 2000.

- ensure that the flow of the watercourse is not polluted by sediment or toxic materials, or obstructed or impeded, whether or not the watercourse is located on private property.
- preserve and restore the watercourse to natural condition, including the planting and retaining of vegetation and trees, in order to preserve, protect, restore, or enhance fish habitat or riparian areas, control drainage, or control erosion or protect banks.
- comply with provisions of the B.C. *Water Act,* Canada *Fisheries Act* and B.C. *Fish Protection Act.*

- Design and implement appropriate sediment and erosion control measures to protect sensitive ecosystems from silt smothering low plant growth where land disturbance is planned or likely.
- Where utilities, servicing, and infrastructure are required near sensitive ecosystems,
  - avoid locating these works within ESAs and associated buffers.
  - permit their location within ESAs and associated buffers only where the installation is necessary, such as essential public roads, utilities, public works, pathways and creek or ecosystem restoration or protection measures or there is no other physical alternative, in the determination of the local government, except to locate within an ESA.
  - require construction to be managed to avoid adverse effects on sensitive and important ecosystem functions and condition.
  - require installations to be located and designed so that sensitive and important ecosystems can be maintained when adjacent lands are developed.
  - require that any disturbed sensitive ecosystems be restored and enhanced to maintain at least the previously existing natural conditions and functions of the sensitive ecosystem.
- Encourage the use of only native plant species where development occurs within or adjacent to a sensitive ecosystem and discourage use of invasive plant species that could supplant native species.
- Create and implement a plan, where necessary, to control the introduction or spread of invasive plant species. This plan may include, where appropriate, removal of invasive species by hand clearing, pruning, mowing, or excavation. Disturbed sites should be planted with appropriate native species. Herbicides

may be used carefully in special situations with advice of an appropriate environmental professional.

- Require that development activities not be implemented in areas that would disturb wildlife during spring nesting and breeding seasons. Ensure that wildlife agencies are consulted as necessary to determine the best times and practices for development.
- Minimise human activities within sensitive and important ecosystems that disturb wildlife, compact or expose soils, or damage native vegetation, such as intensive recreation and livestock grazing. Where such activities are unavoidable
  - favour designs that minimise road and other public access to sensitive and important ecosystems.
  - develop and implement Best Management Practices or guidelines[104] to mitigate impacts, including prescriptions for managing human activities and uses.
  - provide information to landowners on the sensitivity of the ecosystems and the types of activities that adversely affect these ecosystems.
  - develop and provide opportunities for public education.
  - install appropriately-designed fencing, rails, pathways, elevated boardwalks, signage, and access controls, where necessary and ensure that they do not impede wildlife access between the sensitive ecosystem and adjacent habitat areas
- Trails and other crossings are not recommended within ESAs or sensitive ecosystems. Where appropriate, they should be designed and constructed consistent with the *Access near Aquatic Areas* Stewardship Guidebook,[105] these should be aligned to:
  - provide the least intrusive and disruptive route to viewing areas.
  - avoid areas with high soil compaction or erosion potential.
  - avoid sensitive or rare vegetation.
  - prevent intrusion into wet areas including seepage sites and wetlands.

Hairy Woodpecker
(M. Hames)

[104] See sidebar, page 159.
[105] See Appendix A: *Stewardship Series*

Yarrow *(Achillea millefolium)*
(E.J. Stephen)

Additional Guideline Suggestions for Coastal Bluff Ecosystems

- Require that land development activities be planned, designed, and implemented in a manner that will not adversely affect or disturb vegetated rocky islets, rocky shorelines with grasslands or mosses, and coastal cliffs, including:
  - vegetation, trees, snags, and root systems.
  - rare and uncommon species and communities.
  - terrain features such as rock and especially soils.
  - adjacent foreshore and marine areas.
  - birds and other wildlife and their habitats, such as nesting and breeding areas, microhabitats and habitat niches characteristic of this ecosystem.
- Working with other government agencies, discourage or restrict the disturbance of natural coastal and shoreline processes, and natural ecological and successional processes, from the construction of groins, breakwaters, seawalls, docks, or other landings or protection structures, excavation, blasting, or other alteration of land form, deposition of materials, or the location and operation of mariculture operations.
- Working with other government agencies, prohibit the dumping of wastes or release of pollutants on land or adjacent marine areas, including boat sewage, garbage, garden wastes, or soils from neighbouring areas.
- Require a marine and geotechnical investigation by qualified professionals to identify areas subject to landslide, rock fall, erosion, marine or other hazards.

Additional Guideline Suggestions for Sparsely Vegetated Ecosystems

- Require that land development activities be planned, designed, and implemented in a manner that will not adversely affect or disturb sparsely vegetated inland bluffs, coastal sand dunes, and coastal sand spits, including
  - vegetation, trees, snags, and root systems.
  - rare and uncommon species and plant communities.
  - terrain features such as rock and especially soils.
  - adjacent foreshore and marine areas, including natural sand features and vegetation that supports them.

- birds and other wildlife and their habitats, such as nesting and breeding areas, microhabitats and habitat niches characteristic of this ecosystem.

- Working with other government agencies, discourage, limit or restrict inappropriate sand replenishment or sand control works implemented to create or maintain beaches.
- Working with other government agencies, restrict or limit excessive vessel movement near dunes and spits.
- Working with other government agencies, discourage, limit or restrict disturbance of natural coastal and shoreline processes, and natural ecological and successional processes, from the construction of groins, breakwaters, seawalls, docks, or other landings or protection structures, excavation, blasting, or other alteration of land form, deposition of materials, or the location and operation of aquaculture operations.
- Working with other government agencies, prohibit the dumping of wastes or release of pollutants on land or adjacent marine areas, including boat sewage, garbage, garden wastes, or soils from neighbouring areas.
- Require a marine and geotechnical investigation by qualified professionals to identify areas subject to landslide, rock fall, erosion, marine or other hazards.

Additional Guideline Suggestions for Terrestrial Herbaceous Ecosystems

- Require that land development activities be planned, designed, and implemented in a manner that will not adversely affect or disturb terrestrial herbaceous open wildflower meadows and grassy balds, including
  - grasses, forbs, shrubs, bryophytes, trees, snags, and root systems.
  - rare and uncommon species and communities.
  - terrain features such as rock and especially soils and soil conditions.
  - adjacent foreshore and marine areas.
  - birds and other wildlife and their habitats, such as nesting and breeding areas, microhabitats and habitat niches characteristic of this ecosystem.
- Require a geo-technical investigation by qualified professionals to identify areas subject to landslide, rock fall, erosion and other hazards.

Additional Guideline Suggestions for Wetland Ecosystems

- Require that land development activities be planned, designed, and implemented in a manner that will not adversely affect or disturb bogs, fens, marshes, swamps, shallow water areas, or wet meadows, including:
  - wetland vegetation and structure.
  - rare or uncommon animals, wetland plants or plant communities.
  - wildlife habitats such as breeding and nesting sites.
  - soils and soil conditions.
- Require proponents to enlist the assistance of suitably qualified professionals to calculate baseline flow regimes, where possible, as part of an integrated stormwater management strategy to determine optimum water levels.
- Avoid trail, fencing, or landscape materials that would adversely affect wetlands, such as limestone, bark mulch, and preserved wood.
- Maintain the natural groundwater and surface water hydrologic systems that supports the wetland's ecological processes by
  - retaining professional biological and hydrologic services to advise on treatment of hydrology in the environmental site plan.
  - maintaining existing volumes, flows, and timing of stormwater drainage, except where alterations restore or enhance natural regimes.
  - maintaining existing volumes, timing, and rates of stormwater infiltration or recharge to groundwater systems, except where alterations restore or enhance natural regimes.
  - minimising the extent of impervious area covering groundwater infiltration areas and storm runoff associated with the wetland, and use effective porous pavements such as "grasscrete", exfiltration galleries, or other techniques to compensate for loss of pervious surfaces.
  - maintaining natural ecological processes that support the wetlands including winter flooding, seasonal drawdown, beaver activity, sediment accretion, tidal activity, and groundwater recharge and discharge.
  - protecting water quality from pollutants and sedimentation, including nutrient rich urban stormwater, agricultural runoff, and septic field drainage.

- avoiding ditching and drainage works within the hydrologic zone of the wetland.

- Ensure that trees in the wetland ecosystem and associated buffer areas are given stabilisation treatments as necessary, under the supervision of a suitably qualified professional, to ensure a windfirm edge, such as feathering, sail pruning, topping, and removal of unsound trees. Ensure, where possible, that trees in windward edge are located in deep soils and well rooted.

Beaver (L. Friis)

Additional Guideline Suggestions for Riparian Ecosystems

- All tributaries and channels within riparian ecosystems should be carefully identified so that protection of these systems is possible.
- Require that land development activities be planned, designed, and implemented in a manner that will not adversely affect or disturb riparian ecosystems, including
  - natural processes related to disturbance events and ecological succession, such as natural flow regimes of streams, seasonal flooding, stream channel movement, senescence of seral species, windthrow or blow-down of trees, and natural slope failures.
  - trees, understorey plants, and other vegetation within the riparian ecosystem area.
  - nesting and denning sites.
  - standing dead and dying trees, snags, fallen trees, downed logs, and similar forest features within riparian ecosystem area.
  - natural corridors and connectivity of riparian species and habitats with important upland ecosystems.
- Minimise windthrow, susceptibility to invasive species, and loss of interior, non-edge habitats by maintaining
  - riparian corridors as wide as practical with buffers of trees well rooted in deep soil.
  - wildlife corridors between the riparian and nearby upland ecosystem patches.
- Ensure that trees in the buffer areas are given stabilisation treatments as necessary, under the supervision of a suitably qualified professional, to ensure a windfirm edge, such as feathering, sail pruning, topping, and removal of unsound trees. Ensure that trees in windward edge are located in deep soils and well-rooted, where possible.

- Avoid removal of snags and downed logs for fire wood, cedar shake production or any other purpose.

Additional Guideline Suggestions for Woodland Ecosystems

- Require that land development activities be planned, designed, and implemented in a manner that will not adversely affect or disturb Garry oak, arbutus, or trembling aspen ecosystems, including:
  - the root systems of trees, tree density, tree canopy, tree health, or stand age structure.
  - shrub, herb, grass, moss, and lichen understorey species.
  - standing dead and dying trees, fallen trees, snags and downed logs.
  - fallen limbs, leaf litter, and other natural detritus.
  - soil conditions.
  - ground or surface water drainage regimes.
  - nesting and denning sites.
- Require that a tree management plan be prepared by a suitably qualified professional as part of the environmental site plan that would
  - locate and design windward edges of forest stands to minimise windthrow potential.
  - remove unsound trees only where these are a hazard to the public.
  - replace trees or other significant vegetation that are unavoidably or accidentally lost as part of land development with plants appropriate to the ecosystem, with preference for replacement by plants salvaged from disturbed areas of the site.
  - provide for appropriate management to sustain these ecosystems and deter invasive non-native species in consultation with biologists or environmental management agencies.
  - consider approaches for maintaining natural disturbance regimes, and implement such approaches where feasible and appropriate.
- Encourage site plans that locate buildings, infrastructure, other development an adequate distance away from core woodland areas in order to maintain tree and forest health.

Shooting star *(Dodecatheon)*
(B. Penn)

Additional Guideline Suggestions for Older Forest Ecosystems

The following guidelines apply where a local government has authority for the forest area and the land is not Managed Forest Land designated under the *Assessment Act* subject to the *Private Land Forest Practices Regulation*, portions of the ecosystem have been included within a Development Permit Area, and land development is proposed for this area.

- Require that land development activities be planned, designed, and implemented in a manner that will not adversely affect or disturb older forest ecosystems, including
  - trees, understorey plants, and other vegetation within the older forest ecosystem area.
  - standing dead and dying trees, snags, fallen trees, downed logs, and similar forest features within the older forest ecosystem area.
  - interior forest conditions and habitats, i.e., provide for as large an area as practical.
  - natural corridors and connectivity of older forest species and habitats with important adjacent ecosystems.
  - natural processes related to disturbance events and ecological succession.
- Require that an environmental site plan be prepared by a suitably qualified professional to minimise adverse effects on older forest ecosystems, that would
  - limit access by humans in order to minimise disturbance.
  - maintain appropriate vegetation buffers to insulate the older forest ecosystem from uses that would adversely affect its ecology.
  - maintain connectivity and linkages with adjacent sensitive ecosystems and other habitat areas through the use of corridors and greenways to minimise fragmentation.
  - locate and design windward edges of forest stands to minimise windthrow potential.
  - implement edge stabilisation treatments to ensure a windfirm edge, such as feathering, sail pruning, and topping of unsound trees.
  - remove unsound trees only where these are a hazard to the public.
  - replace trees or other significant vegetation that are unavoidably or accidentally lost as part of land

Lungwort *(Lobaria pulmonaria)*
(C. Tunnoch)

Bald Eagle (Y) (J.Grundle)

development with plants appropriate to the ecosystem, with preference for replacement by plants salvaged from disturbed areas of the site.

- deter the spread of invasive non-native species into the ecosystem.
- consider approaches for maintaining natural disturbance regimes and implement such approaches where feasible and appropriate.

Recommendations for Other Important Ecosystems

Older Second Growth Forest Ecosystems

Older second growth forest ecosystems are most effective as buffers around sensitive ecosystems. They also provide green space and wildlife habitat in urban areas and contribute to biodiversity. Local governments who intend to conserve and protect this ecosystem on land within their authority and on non Managed Forest Land subject to the *Private Land Forest Practices Regulation* should, where practical, and in co-operation with landowners

- Encourage the maintenance of older second growth forest cover and ecological functions.
- Promote the retention of older second growth forests as feathered buffers around sensitive ecosystems.
- Encourage measures to minimise fragmentation of older second growth forests by large-scale developments, roads, and other linear developments, and large-scale clearcutting.
- Require where practical, Development Approval Information that
  - provides an evaluation of the forest condition and forestry and wildlife habitat potential of older second growth forest ecosystem areas.
  - identifies rare, threatened, and endangered species and their populations.
  - identifies the habitats and natural features supporting rare, threatened, and endangered species and their populations, such as patches of rare plants, nesting trees or snags, treed swamps, vernal pools, and seepage areas.

  Require, where practical, as a component of the environmental site plan, development of a forestry management plan that
  - sustains the older second growth forest ecosystem through appropriate conservation-oriented forest management practices after development, where feasible.

- protects rare, threatened, and endangered species and their populations, including their supporting species, habitats, or natural features.
- conserves standing dead and dying trees, fallen trees, limbs, leaf litter, and soil to provide foraging opportunities and nesting and denning sites.

Seasonally Flooded Agricultural Field Ecosystems

With the historical loss of natural wetland ecosystems, seasonally flooded agricultural field ecosystems are playing an increasingly important role by providing surrogate wetland habitat for wildlife. Local governments who intend to conserve and protect these fields should, where practical, and in co-operation with landowners

- Support the maintenance of seasonally flooded field ecosystems, including related hydrological processes and associated adjacent habitats when preparing drainage plans.
- Support availability of this agricultural land for wildlife.
- Support agricultural value and continued active farm use of fields as farmlands while conserving wildlife values.
- Participate in the review of changes in the use of agricultural land, such as greenhouses, that affect the wildlife potential and alter hydraulic regimes on farmland.
- Support the retention of fields in the Agricultural Land Reserve, emphasize through agricultural zoning and by restricting urban encroachment.
- Encourage, where practical and in co-operation with the landowner, as a component of the environmental site plan, an agricultural management plan that would achieve the following after development, where possible
  - conserves the agricultural value and active use of these fields as farmlands.
  - maintains the seasonally flooded field ecosystem and associated wildlife habitat.
  - maintains, where possible, existing hydrological conditions and related hydrologic processes that affect seasonal flooding, using local control structures.
  - avoids grading, dyking, field levelling, ditching, channelling, other drainage improvements, soil removal, and soil deposition that will reduce or disturb seasonal flooding processes.

Sandhill Cranes (R. Savannah)

- minimises erosion and soil degradation potentials.
- minimises or avoids use of chemical fertilisers and pesticides.
- encourages innovative conservation agriculture practices and voluntary stewardship programs for maintaining productive farmland and farming operations while conserving valuable bird and wildlife habitat and minimising wildlife nuisances and crop damage.
- conserves adjacent supporting habitats, such as adjacent wetlands, riparian areas, woodlands, hedgerows, and other habitats.
- maintains connectivity between seasonally flooded fields and adjacent supporting habitats.
- minimises intrusion of people into farm and wildlife habitat areas.

Zoning

*See **Municipal Act**, sections 903-904*

Zoning bylaws[106] regulate how land is developed and used (see sidebar). Innovative zoning provisions can provide significant protection to environmentally sensitive resources. A Rural Land Use Bylaw gives zoning powers to regional districts for areas outside a municipality (see sidebar). Where appropriate, local governments can:

*See **Municipal Act**, sections 886-889*

- Establish setback provisions that require buildings, structures, or other uses to remain a certain distance from a specified boundary, such as a property line.
  - Zoning can also define a specified boundary to be a "siting circumstance" such as the "high water mark" of a water body or other legally definable boundary. Setback provisions can be used to protect stream corridors or other natural features from development.
  - A siting circumstance could include definition of a distance from a specified tree, however, the tree itself would need protection under development permit, tree cutting bylaw, or landscaping requirements.
- Ensure that zoning categories allow parcel sizes and dimensions that will enable the establishment of appropriate setbacks and leave areas in the event of future rezoning or subdivision.

*See **Municipal Act**, sections 903 and 904.*

- Create density bonusing zones for residential areas adjacent to ESAs to allow developers to apply for an increase in density in exchange for the conservation of a specified amenity, such as the preservation of substantial area of a development site as a protected ESA. This allows developers to preserve sensitive ecosystems in return for designs that increase density in non-sensitive portions of the site.
- Create cluster housing zones for residential areas adjacent to ESAs to allow a tighter grouping of houses or multiple-unit buildings on the most buildable portions of a building site in exchange for retaining a large portion of the land, such as an ESA, in a natural state.
- Encourage the use of bare land strata subdivisions for residential areas adjacent to ESAs to promote cluster housing with protection of sensitive site areas as common open space.

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[106] Stream stewardship guides are an excellent resource for language that can be used in regulatory bylaws, particularly zoning bylaws.

- Ensure sensitive areas are protected from future development by conservation covenants in the name of the regional district, municipality, Islands Trust Fund and/or non-government environmental or conservation organisations (see sidebar).
- Use comprehensive development zones for complex sites in urban development areas to enable careful site planning for conservation of sensitive ecosystems.
- Continue to implement the flood plain setbacks and regulations under Section 910 of the *Municipal Act.*

See Conservation Covenants, page 188 for more information.

Subdivision Approvals

Subdivisions are examined under the *Land Title Act* by a *subdivision approving officer,* appointed by the Attorney General. Approving officers within municipalities are municipal employees. Outside municipalities, approving officers may be employees of a regional district, or of the Ministry of Highways and Transportation where regional districts have not been granted subdivision approval authority. Subdivision approval provisions require an approving officer to ensure that subdivisions conform to local government bylaws such as zoning and subdivision servicing bylaws. However, approving officers have substantial independent authority to determine the public interest and specify requirements for subdivisions. The *Land Title Act* enables the approving officer to

- Use the "protecting the public interest" provisions in the *Land Title Act* to conserve sensitive and important ecosystems within the subdivision approval process. In this situation, a subdivision approving officer may refuse to approve a subdivision if s/he considers it to be against the public interest. Case law is extensive with regard to 'public interests' which helps define the scope of this authority. The Ministry of Environment, Lands and Parks may review subdivision referrals and develop general or site specific environmental or conservation recommendations to subdivision approving authorities.
- Make provision, where possible, for retention of sensitive ecosystems in public ownership as part of neighbourhood and subdivision designs.
    - Seek a dedication during subdivision for park or public open space in order to acquire lands within ESAs, where possible, and in accordance with section 941 of the *Municipal Act.*
    - Seek a five percent school site dedication provision of the Municipal Act to provide for school sites, in accordance with section 942 of the *Municipal Act,* while recognising

opportunities to protect ESAs on school grounds, where possible, as outdoor classrooms for raising conservation awareness.

- Consider, where appropriate, the use of road and water body access dedication requirements for provision of stream and wildlife corridors.

- Where acquisition or dedication is not appropriate or possible, seek the registration of a covenant on land titles to preserve ESAs. Covenants can be used to require environmental protection measures such as retaining vegetation, keeping sensitive areas free of development and in a natural condition, and installing fencing to restrict access. Covenants can be in favour of the local government, senior government agency, land trust and/or a conservation organisation. Covenants must be enforced to be effective.

Subdivision Servicing Bylaws

Subdivision servicing bylaws are established under sections 938-946 of the *Municipal Act*. These bylaws set standards and make requirements for the provision of services, such as access (roads, sidewalks, trails, transit stops), water, sewer, and storm drainage systems. To protect sensitive and other important ecosystems, subdivision servicing bylaws may:

- Develop Best Management Practices and guidelines, and incorporate these into engineering, servicing, construction standards and requirements, as well as operational procedures to ensure these are compatible with the preservation, protection, restoration, and enhancement of sensitive and important ecosystems. Important functions include stormwater management, stream protection, vegetation management, and erosion and sedimentation control.

- Require that all public works, including road, utility and park construction be conducted in a manner that is consistent with environmental protection of ESAs.

Stream and Drainage Policies and Bylaws

The *Municipal Act* provides significant powers to local governments to enact stream and drainage policies and bylaws that may assist in the protection of environmentally sensitive and important ecosystems. A liquid waste management plan under the *Waste Management Act* may also be used to implement some stormwater management policies and proposed management practices. Some of these drainage system powers may require additional authority within electoral areas of regional districts. Some proposals are subject to the BC *Water Act* and Canada *Fisheries Act* regulations. Local governments can and are encouraged to

- Establish integrated stormwater drainage policies for drainage facilities and land development activities that
  - maintain the natural hydrology and natural environment of watersheds, groundwater, streams, and other water bodies, including provisions that would help ensure maintenance of minimum base stream flows.
  - regulate development work within stream corridors.
- Enact or amend a watercourse protection bylaw pursuant to section 551 of the *Municipal Act* that restricts anyone from polluting or obstructing or impeding the flow of a stream, creek, waterway, watercourse, waterworks, ditch, drain, or sewer, and imposes penalties for contravention of the prohibition.
- Adopt an open streams policy that will
  - limit the crossing, confinement, covering, or piping of watercourses.
  - identify and establish a program to remove obstacles impeding movement of fish such as inappropriately designed culverts and stream crossings.
  - identify "lost streams" that have been covered by culverts or other covers, and consider "day-lighting" these lost streams where practical and feasible.
- Enact or amend a runoff control bylaw for areas abutting or adjacent to ESAs, pursuant to section 907 of the *Municipal Act*, to:
  - establish a maximum percentage of area that can be covered by impermeable material.

(D. Gunn)

- establish standards for drainage works for the ongoing disposal of surface runoff and stormwater from paved areas and roof areas during and after construction.

- Enact or amend a parking bylaw to discourage location of parking areas in ESAs, and regulate surface treatments to mitigate runoff impacts on sensitive and important ecosystems. See *Municipal Act*, section 906.

Tree and Landscaping Policies and Bylaws

The *Municipal Act* provides significant powers to local governments to enact tree and landscaping policies and bylaws that may assist in the protection of environmentally sensitive ecosystems. Local governments can and are encouraged to

- Enact or amend a Tree Bylaw, pursuant to sections 708-715 of the *Municipal Act* (municipalities only), in order to:
  - designate ESAs as areas for special tree cutting regulations, as contemplated in section 708.
  - within these areas, require permits for cutting or removing of trees, and restrict activities that may damage trees, and where appropriate, require replacement of trees for trees that are cut, removed, or damaged as a result of a permit.
  - define appropriate trees within ESAs as Significant Trees under the meaning of section 710, and require tree cutting permits for removal or pruning of these trees.
  - where removal of a hazardous tree (see *Municipal Act*, section 711) is essential within an ESA, require special care to be exercised to minimise disturbance to surrounding vegetation, and wildlife and their habitat.
- Enact or amend a landscaping bylaw under section 909 of the *Municipal Act* in order to
  - set standards for screening and landscaping for preserving, protecting, restoring, and enhancing the natural environment of sensitive and important ecosystems.
  - regulate the provision of landscaping including the planting of vegetation where necessary to conserve sensitive and important ecosystems.

  (This bylaw may be a substitute for a tree bylaw in areas outside of municipalities where tree bylaws cannot be established except in relation to hazardous conditions.)

Soils Bylaws

The *Municipal Act* provides significant powers to local governments to enact soils policies and bylaws that may assist in the protection of environmentally sensitive ecosystems. Local governments can and are encouraged to

- Enact or amend a soils bylaw pursuant to section 723 of the *Municipal Act* that
  - regulates soil removal and deposition, including site grading, in order to ensure that ESAs are protected and conserved during and after land development and redevelopment.
  - ensures that development plans near ESAs include and implement appropriate designs and procedures for control of erosion and sedimentation.
  - where soil movement is approved within or near an ESA, require special care to be exercised to minimise disturbance to surrounding vegetation, wildlife and wildlife habitat.

Animal Control Bylaws

Sections 703-707 of the *Municipal Act* empower local governments to enact bylaws for the regulation of animals. These bylaws may be used to control pets and livestock that could endanger wildlife or damage vegetation in ESAs and sensitive ecosystems. The local government may

- Regulate or restrict the keeping of dogs, horses, cattle, sheep, goats, swine, rabbits, or other animals and define areas where they may or may not be kept. Defined areas could include ESAs and DPAs.
- Require dog owners to keep dogs on leash or under the control of a competent person while on a highway or public place. Public place could include publicly owned ESAs and sensitive areas of public parks, stream corridors, and roadsides.
- Regulate or restrict the running of cattle on a highway or public place; the straying of or trespassing by cattle on a highway or public place or private property; or grazing of cattle on unfenced land, unless securely tethered. Private property could include sensitive areas such as ESAs and stream corridors.

Partnerships

Stewardship of the environment is everyone's responsibility. Local governments can build partnerships with other governments, non-government organisations, and the public by

- Providing leadership for the development of a long term strategy to acquire priority ESAs, including
  - acquiring and preserving ESAs as part of local parks programs.
  - identifying acquisition priorities in co-operation with non-government and government conservation organisations.
  - identifying priorities for protection through development permit, rezoning, subdivision, and other regulations.
- Adopting a bylaw under section 343 of the *Municipal Act* to exempt eligible riparian property from property taxes where a property is subject to a conservation covenant under section 219 of the *Land Title Act.* Providing information on property tax incentives for protecting riparian land through conservation covenants where this bylaw has been adopted.
- Directing landowners to sources of advice about federal tax benefits for ecological gifts.
- Implementing stewardship awareness programs, in co-operation with senior governments, local conservation organisations, and schools, to increase public awareness and support for conservation of sensitive and important ecosystems and existing ESAs, and to promote active stewardship and restoration activities.
- Encouraging individuals and community organisations to be involved in managing sensitive ecosystems, restoring and enhancing native habitats, planting native vegetation and appropriate trees, preventing erosion, establishing conservation covenants, promoting proper use and disposal of polluting chemicals, installing signs to inform and educate the public, monitoring misuse of sensitive ecosystems, and advocating conservation and protection of sensitive ecosystems. Initiating a landowner contact program, in concert with conservation organisations, can be an effective way of educating property owners about the ecological functions and sensitivity of their land.
- Encouraging land developers to use environmentally sensitive site designs, construction procedures, and landscaping methods that avoid or minimise impacts on the functions and conditions of sensitive and important ecosystems.

- Endorsing and supporting the efforts of community organisations, landowners, and others to identify, acquire, and protect sensitive and important ecosystems. Encouraging restoration and enhancement measures that are carried out under appropriate authority and guidelines.
- Encouraging and educating pet owners to control pets that prey on or disturb birds, small mammals, or other species.
- Co-operating with provincial and federal government programs to protect sensitive and important ecosystems, and fish and wildlife habitat. Consider supplementing municipal environmental policies with environmental and sustainable development guidelines of federal, provincial, and regional government agencies.

Typically, stewardship organisations are involved in hands-on management, protection, rehabilitation or enhancement of habitat. They also raise public interest and awareness about significant local sensitive ecosystems and are seen as potential "eyes and ears" of government for reporting threats to habitat. (Photo: Faye Smith)

15 What Landowners and Citizens Can Do

Local and senior government policies, legislation and their enforcement are just part of the equation when conserving sensitive ecosystems on eastern Vancouver Island and the Gulf Islands. Implementing all the measures necessary to secure environmentally sensitive areas (ESA) protection is limited by the availability of public financial assistance and concerns by private property owners over regulation of their land. The voluntary efforts of landowners and citizens are therefore essential to the conservation and enhancement of sensitive and other important ecosystems. Described below are several conservation related initiatives that landowners and other citizens can undertake.

The real substance of conservation lies not in the physical projects of government, but in the mental processes of its citizens.

– Aldo Leopold[107]

Learn about the Natural Environment

The value of education about environmentally sensitive areas cannot be emphasised strongly enough, as it is the foundation of all private land protection tools. For some sensitive ecosystems, education about its importance and conservation methods may be the only available means to secure some measure of its protection. Education also helps generate a constituency of concerned citizens and landowners who may then be motivated to secure the protection of a sensitive ecosystem through purchase or other legal mechanisms. Finally, education about the ESA is necessary for its successful long-term protection, as protection through a legal mechanism is only useful if it is respected. If it is not respected, then the legal tool may only be useful in determining the liability and damages to be awarded for the destruction of the ESA.

At the end of this manual there are a number of references, such as the publications in the Stewardship Series, which are useful for expanding the understanding of ESAs.

[107] Aldo Leopold, father of the land ethic.

Join or Create a Stewardship Organisation, Land Trust or Advocacy Group

People may first learn about sensitive ecosystems or through the activities of a stewardship organisation in their neighbourhood. Generally, stewardship organisations and land trusts are non-profit and frequently non-political organisations dedicated to protecting specific sites, specific species or habitat types, or sensitive environmental areas in general. Advocacy groups are non-profit organisations generally established to raise awareness within government, industry and the public on conservation issues. All of these types of groups may range from very loose-knit "Friends of...." clubs to formal, registered charitable organisations.

Great Horned Owl
(R. Savannah)

Stewardship Organisations

Stewardship organisations include a broad spectrum of groups both charitable and non-charitable as well as formal and informal. Typically, stewardship organisations are involved in hands-on management, protection, rehabilitation or enhancement of habitat. Some stewardship organisations, such as the Garry Oak Meadow Preservation Society, may also qualify as holders of conservation covenants on land. A conservation covenant is a voluntary, written legal agreement in which a landowner promises to protect his/her land in specified ways pursuant to Section 219 of the *Land Title Act*. Further discussion regarding conservation covenants is found later in this chapter.

Stewardship organisations raise public interest and awareness about significant local ESAs through a number of means: establishing festivals, e.g. the Brant Festival, Camas Flower Day and Salmon Days; distributing native plants; holding public information and educational forums; and conducting broom bashes, among other activities.

Senior governments have long recognised the important contribution of non-government stewardship organisations undertaking activities to enhance the environment. There are now federal, provincial and some local government grants to help support these organisations. Stewardship organisations are also seen

as potential "eyes and ears" of government for reporting threats to habitat.[108]

Appendix B provides a list of government and non-government organisations active in the conservation of lands in the SEI study area. If there is not already a suitable organisation in your area, a helpful publication from the Stewardship Series is *Community Stewardship: A Guide to Establishing Your Own Group*.[109]

Land Trusts

See Appendix B for a list of land trusts and conservancies active in the SEI study area.

Land Trusts are not "trusts" in the legal sense but they fulfil a form of public trust by holding an interest in land, or owning land and preserving it for future generations. Land trusts have been active in Great Britain and the United States for more than 100 years. In Canada, they are a more recent phenomenon, but have been growing rapidly, particularly in British Columbia.[110]

To raise funds through charitable donations and become registered landowners, land trusts are required to meet more formal requirements than typical stewardship organisations. Nevertheless, how they achieve their objectives may vary depending on the resources, culture and experience of the land trust. The spectrum of activities of land trusts can be characterised by three active land trusts in British Columbia: *The Nature Trust of British Columbia*, the *Islands Trust Fund* and the *Cowichan Community Land Trust Society.*

- **The Nature Trust of British Columbia** was established by the federal government in 1971 as a charitable federal corporation with an endowment of $4.5 million to mark the centenary of British Columbia's entry into Confederation. Since that date, The Nature Trust has purchased or formed partnerships to purchase more than $26 million in protected land in British Columbia including a number of parcels and significant estuary lands, in the SEI study area. The Nature Trust leases most of its holdings in the SEI area to the British Columbia Ministry of Environment, Lands and Parks on long-term leases. The provincial government is responsible for the day-to-day management of most Nature Trust properties.
- **The Islands Trust Fund Board** is a conservation land trust created by the *Islands Trust Act,* whose mandate is to preserve and protect the Islands Trust Area and its significant features and environment for the benefit of the island residents and the Province generally. The Islands Trust Fund works with

[108] Dovetail Consultants Ltd. 1996.
[109] Fraser Basin Management Program 1995.
[110] See Appendix B for a list of land trusts.

interested landowners, local groups, non-government organisations and the government to facilitate and achieve conservation of key sites within the Islands Trust Area. This is done, in part, through land acquisitions and conservation covenants. The Islands Trust Fund currently owns seven nature reserves, and holds a number of conservation covenants, protecting approximately 400 acres (160 hectares) for their natural, historic, recreational and/or scenic values. Examples of acquisitions and other initiatives include

- In partnership with the *Nanaimo and Area Land Trust* and *The Land Conservancy of BC*, the *Islands Trust Fund* negotiated an agreement to purchase an entire SEI site, South Winchelsea Island, a 10.4 hectare island located north of Nanaimo.
- The McFadden Creek Heronry project on Salt Spring Island now protects a 5 hectare (12 acre) SEI site with 118 nests, the largest protected heronry in both the Georgia Basin and SEI study area. Three groups actively worked to secure this heronry for conservation purposes - the *Islands Trust Fund*, the *Wild Bird Trust of BC* and the Salt Spring Island *Waterbird Watch Collective.*
- A third initiative involved the partnership of the *Islands Trust Fund*, the *Friends of Brooks Point, Capital Regional District Parks, The Nature Conservancy of Canada, Pender Islands Conservancy Association* and several other partners to acquire Brooks Point on South Pender Island. This 4 hectare (10 acre) SEI site is a coastal headland containing old forest, grasslands, and coastal bluffs that provide habitat for rare plants and over 100 species of birds.

In addition to its own land trust work, the *Islands Trust Fund* assists local conservancies and land trusts working in the Islands Trust Area in furthering their conservation objectives by providing information, partnering, and where possible helping with organisational and technical assistance.

CCLT landowner contact program

CCLT provides landowners with maps showing the location of SEI sites on their land and invites owners to discuss the range of options available to them for conservation of the sensitive ecosystems on their land.

The Cowichan Community Land Trust Society (CCLT) grew out of a concern for the rapid development in the Cowichan Valley during the 1990s. CCLT does not hold land and is only just beginning to secure interests in land through conservation covenants. To date its primary purpose has been to promote land stewardship through education and public incentives such as “Land Steward” awards and designations (see sidebar). *Caring for Our Shores: A Handbook for Coastal Landowners in the Strait of Georgia*[111] is a recent publication

[111] Cowan et al. 1998.

that exemplifies the approach of this land trust in securing the preservation of the Cowichan Valley's natural heritage. Memberships, private donations and grants provide funding for CCLT.

The rapidly expanding number of land trusts as well as the growing number of stewardship organisations engaged in land trust activities, has prompted the establishment of an umbrella organisation to share expertise and information to assist the activities of these organisations. The ***Land Trust Alliance of British Columbia*** had its formal inaugural convention in March 1998 and as part of the event provided a forum for a number of US and Canadian land trust and stewardship experts to make presentations.

Varied Thrush (M. Hames)

The tools that land trusts use (see below for a discussion of tools) to protect ESAs vary according to the resources and culture of the organisation. They also vary according to

- the circumstances of the ESA: the type of landowner, e. g., institutional, private land or corporate ownership.
- the type of ESA values: pristine wilderness, older second growth forest.
- the location of the ESA: near high density urban development, low density agricultural land, etc.
- the ESA land's current use (open space, farm, industrial surplus, etc.).
- the potential for donor interest in the land.

Advocacy Groups

Stewardship organisations and land trusts are advocates for their causes but advocacy groups do not typically own land for conservation or carry out stewardship activities. Their focus is on raising awareness, raising funds and creating public opinion to encourage the protection of sensitive environmental areas.

Advocacy groups can raise concerns and argue the case for protection of environmentally sensitive areas where a senior or local government has the authority to protect the area on private land but has made a decision not to do so.

Advocacy groups fill an important niche in sensitive environmental area protection by allowing stewardship organisations and land trusts to pursue their activities, unaligned with one position or another in a contested land use debate. Traditionally, support for advocacy groups comes from a smaller spectrum of committed

members and donors that support the mission and strategies adopted by the organisation.

Participate in your Local Government

Making the significant commitment of running for a position in the local government may be a step very few people are willing to take. There are, however, many ways for landowners and citizens to participate in local government land use decision-making.

Speaking at Council meetings or public hearings, volunteering for appointment to a local government Environmental Advisory Committee or an Advisory Planning Commission, or offering expertise on an informal basis to these agencies, allow landowners and citizens to provide informed recommendations to Council on matters that are referred to the Committee or Commission.

Be a Good Steward of Your Own Land

Red-legged frog (B. Penn)

Landowners can help protect ESAs by learning about the natural values of their own land, rehabilitating the landscape and protecting its natural values. Information on stewardship is available from groups and sources in Appendix A. A significant publication to assist landowners is the *Naturescape Series: Caring for Wildlife Habitat at Home*.[112] This publication includes ways to enhance wildlife habitat on small properties and even apartment balconies.

[112] Naturescape British Columbia 1995.

Consider Legal Tools for the Long-term Protection of ESAs

Land trust or stewardship organisations may be able to help landowners establish longer term and more secure means of protecting environmentally sensitive areas on their land. Some examples of private legal tools for ESA protection include:

Handshake Agreements

Handshake agreements are verbal undertakings by landowners with a land trust or stewardship organisation to carry out activities on their land so that ESAs are not harmed and/or the wildlife attracted to the land is accommodated.

One example of such an arrangement is that between the *Delta Farmland and Wildlife Trust* (DFWT) and some Lower Fraser River Delta farmers. Through funding from Environment Canada, Delta Agricultural Society, Ducks Unlimited Canada and the B.C. Waterfowl Society, the DFWT is able to provide financial incentives to farmers to establish hedgerows, plant natural grasses, and grow winter cover crops for food for over-wintering wildlife. There is not only the benefit to the farmers and society at large in controlling soil erosion but a significant advantage to wildlife.

The Cowichan Community Land Trust Society, as mentioned above, has encouraged handshake agreements with riparian habitat owners and others in the Cowichan Valley through public incentives such as “Land Steward” awards and designations.

Land Management Agreements

Swan Lake Christmas Hill Sanctuary Society does not hold title or covenants to land but has operated a 58-hectare nature sanctuary in the midst of the rapidly expanding area around Greater Victoria under a land management agreement with the primary owner, the Municipality of Saanich. The municipality also provides a baseline operating budget for staff and a Nature House, supplemented by private donations, native plant sales and other fund-raising activities.

The mission of the Society is to "foster an understanding and appreciation of nature through direct experiences that will develop personal responsibility for the care and protection of the natural environment" and it has pursued that mission with greatsuccess.

Land management agreements are not just for publicly owned land. They may also be arranged for private lands where the landowner is prepared to allow the encouragement of wildlife and native vegetation but is not yet prepared to adopt more protective measures, such as a **conservation covenant**, that will restrict the uses of that land.

Conservation Covenants

For a more detailed discussion of conservation covenants, see "Leaving a Living Legacy: Using Conservation Covenants in BC".[113]

A conservation covenant is a voluntary, written agreement between a landowner and another person, or more typically, an organisation, where the landowner undertakes to protect certain natural values of the land.[114] It provides stronger protection for an ESA than land management agreements because they give the organisation an interest in the land that is registered in the Land Title Office and is binding on anyone who may own the land in the future.

Conservation covenants, known in the United States as conservation easements, have been used for more than a century to protect environmentally sensitive areas. Their chief advantage is that conservation objectives can be achieved, at significantly less cost, by limiting the use of land without eliminating all use of the land.

A conservation covenant may provide tax advantages to the landowner. If it can be shown that registration of a conservation covenant has reduced the property value through the restrictions on its use (under the provisions of the *B.C. Assessment Act*), then the covenanting organisation (if it is a registered charitable organisation) may provide the landowner with a charitable receipt for the difference in the land value. The landowner has, in effect, made a charitable donation that provides a tax credit to reduce the income tax payable by the landowner. This tax credit can be carried over tax years to prolong the impact of the gift.[115]

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[113] Andrews and Loukidelis 1996 (See Appendix A: *Stewardship Publications)*.

[114] *Land Title Act*, RSBC 1996 c. 250, section 219. Under the terms of the conservation covenant, the interest granted may allow public access or it may limit access to the organization for the sole purpose of monitoring of the covenant.

[115] The tax considerations and the structuring of charitable gifts of land and interests in land can be complex depending on the circumstances of the landowner and on the nature of the gift. Competent tax advice is essential in order for the landowner to see the greatest benefit from their generosity.

Similarly, property taxes in British Columbia are based on the "actual value", typically the market value, of a parcel of land. If it can be demonstrated that the property value is reduced by the restrictions of a registered conservation covenant then the landowner will also have the benefit of reduced property taxes after the registration of the conservation covenant.

Under revisions to the *Municipal Act* adopted in 1997,[116] there is also specific provision for the reduction of property taxes by councils and regional district boards for covenants established in eligible riparian areas. This, however, is at the discretion of local governments.

Perhaps the sole disadvantage of conservation covenants is their continued enforcement. A landowner that initiates a conservation covenant may dispose of the land to family members or sell to others who may have different views about the land's intended use. Threats to the ESA may require more frequent monitoring of the conservation covenant area to ensure the ESAs protection. A program of landowner contact and education is an important means of ensuring compliance with the objectives of the covenant without the organisation having to resort to a costly court action for enforcement of the conservation covenant.

Land trusts and stewardship organisations (if designated by the Minister of Environment, Lands and Parks) are entitled to hold conservation covenants.[117] Holding covenants is less costly to the organisations than holding land but there are costs: surveying the land, drafting the covenant, registering it on title and monitoring the covenanted area to ensure compliance. Land trusts and stewardship organisations usually have priorities for habitats they want to protect.[118]

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[116] *Municipal Act*, RSBC 1996, c.323, s.343.1 and s.845.1, effective October 31, 1997. The council or regional district board must also be a covenantee of the conservation covenant.
[117] *Land Title Act*, c. 250, section 219(3).
[118] In the United States, it is not uncommon for land trusts to require that the landowner undertake the survey and legal expenses for the establishment of a conservation covenant and provide a donation for monitoring the covenant.

Other Interests in Land

Land ownership in British Columbia is akin to owning a bundle of rights to use and occupy land. As a human invention, there are consequently many creative methods of granting rights that may also provide protection for an ESA.

Land law can be a complex area. Landowners may receive valuable information and assistance from land trusts, stewardship organisations or advocacy groups in sorting through the options available to them, but ultimately landowners must assume the responsibility for protecting their interests and realising their wishes by seeking the advice of legal counsel. The intent in this section is therefore merely to alert the reader to the existence of other types of interests that may be granted by a landowner, short of granting land outright or providing a conservation covenant.

For example, a landowner may grant a life estate in the land to his or her children with the remainder given to a conservation organisation. This means that the landowner gives the right to use and occupy the land to his or her children until their death. During their lifetime, the children are responsible for looking after the land and are restricted from diminishing the value of the land.[119] After the children's death, the conservation organisation becomes the landowner.

Another illustration is the ability of a landowner to grant an interest to someone to enter the land and remove something from it. This right, called a ***profit à prendre***, was used in earlier times to provide security to someone to remove hay or harvest trees on a property. For conservation purposes, however, a landowner could grant a *profit à prendre* to a conservation organization so that the conservation organization has the sole right to remove the trees—something it will never exercise. The landowner and any subsequent landowners would nevertheless be restricted from removing the trees.

[119] It would be prudent for the grant of a life estate to explain the specific rights and obligations of the life tenant and to allow for the remainderman to monitor the land.

Donate Land

Landowners may take the greatest step of securing the legal protection of an ESA by donating that land to a land trust, stewardship organisation or government by deed or by will. To ensure the continued protection of the land if the organisation ceases to exist or the government does not honour the intent of the gift, the landowner may provide that another larger land trust or other organisation hold a conservation covenant on the land or that the other organisation assume ownership of the land should certain conditions occur.[120]

Tax Advantages

There are, of course, tax advantages to landowners donating land to a registered charitable organisation or to government. Like land law, however, the tax issues surrounding donations of land can be complex. Issues such as capital gains, gifts of "ecologically significant lands" and other issues require landowners to seek the advice of a tax expert to pursue the best options for their particular circumstances (see sidebar).[121]

See Giving it Away: Tax Implications of Gifts to Protect Private Land.

For general information on legal tools available to a landowner, a very helpful publication from the Stewardship Series[122] is *Stewardship Options For Private Landowners in British Columbia*.[123] For greater detail on the options available to landowners, see *Here Today, Here Tomorrow: Legal Tools for the Voluntary Protection of Private Land in British Columbia*.[124]

Make a Charitable Donation

In addition to donating land or an interest in land such as a conservation covenant, landowners and citizens may donate cash, goods, services or leave money in a will to an organization dedicated to protecting ESAs. Most land trusts, stewardship organisations and advocacy groups are dependent upon the support of private donations and the volunteer services of their members. From the point of view of these organisations, there is no gift too small. Every contribution makes a difference to the protection of ESAs.

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[120] This is also often done in the case of conservation covenants. A local land trust or stewardship organization may hold the covenant but an alternative land trust or other organization is specified should the local group fail. This often referred to as "cross-covenanting".
[121] Hillier and Atkins, 2000.
[122] See Appendix A: *Stewardship Publications*.
[123] Ministry of Environment Lands and Parks 1996. (See Appendix A)
[124] findlay and Hillyer 1994 (see Appendix A).

16 What Senior Governments Can Do

Whereas this manual focuses on the tools available to local governments and private landowners, the following section provides an introduction to the range of provincial and federal legislation that may be used to protect sensitive and other important ecosystems in the SEI study area. The Government of Canada and the Province of British Columbia have a responsibility to protect and manage the environment using a broad range of legislated powers. Some are directed at specific resources such as the federal *Fisheries Act* and the provincial *Fish Protection, Wildlife* and *Water Acts*, whereas others address broader environmental issues through assessment or process requirements.

In general, wetlands and riparian ecosystems are most effectively protected under federal or provincial laws (e.g., *Federal Fisheries Act, B.C. Water Act, B.C. Fish Protection Act*). Forested ecosystems on provincial Crown land are also afforded considerable management emphasis under the *Forest Practices Code of B.C. Act* and those on Managed Forest Lands are subject to the *Private Land Forest Practices Regulation*. However, there are few provisions aimed specifically at maintaining or protecting forested ecosystems elsewhere. Other SEI ecosystem types including sparsely vegetated, coastal bluff, and seasonally flooded agricultural field ecosystems have fewer legislative policies or laws available for their protection, although the *Wildlife Act* and the *Fisheries Act* can be used for some of these ecosystems in certain circumstances.

Because of the paramountcy principle under the Canadian Constitution, which gives more senior levels of government powers over lower levels of government, the Parliament of Canada has and uses powers that supersede provincial and local government powers. Provincial powers that override local powers are usually stated as such in legislation. Another principle—'occupied field'—means that where a higher order of government does not use its powers and the lower level chooses to do so under its legislation, it may do so even if primary jurisdiction rests at a higher level.

Some of the strongest legislation for environmental protection is the responsibility of the Government of Canada and Province of British Columbia. However, the provincial government has primary jurisdiction over land use decisions. As well, Fisheries and Oceans Canada, Environment Canada, B.C. Ministry of Environment, Lands and Parks, and B.C. Ministry of Forests have expertise, information and other resources that may be useful in identifying and conserving sensitive ecosystems.

Federal Legislation

Fisheries Act

Fish habitat is defined as: *"spawning grounds and nursery, rearing, food supply and migration areas on which fish depend either directly or indirectly in order to carry out their life processes."* Canada Fisheries Act Sec 34(1)

The Federal government has a legislated responsibility for Canada's fisheries. A key component of this responsibility is the protection of fish and fish habitat (see sidebar). This definition is applied to streams, rivers, intertidal areas, estuarine marshes, wetlands, and riparian areas. All of these habitats may be found in SEI ecosystem types. The *Fisheries Act* allows for protected or restorative management to maintain the productive capacity of fish habitat. This entails review and authorisation of development proposals that have the potential to affect fish habitat, as well as requirements for compensatory mechanisms to off-set the unavoidable destruction of fish habitat. To do so requires authorisation under the *Fisheries Act*.

Canadian Environmental Assessment Act (CEAA)

The *Canadian Environmental Assessment Act (CEAA)* is designed to ensure thorough assessment of large scale projects that have the potential to affect the environment prior to approval. Only projects requiring certain federal approvals or authorisations, granting an interest in federal land, receiving federal funding, or proposed by a federal department or agency are addressed by *CEAA*. The Province of B.C. has a provincially based environmental assessment act with much the same purpose, and there is currently a harmonisation agreement in place to reduce overlap between the two processes. If both *CEAA* and the *B.C. Environmental Assessment Act (BCEAA)* are triggered, then the *BCEAA* process is used to address *CEAA* requirements with the addition of outstanding issues only addressed by *CEAA*.

The SEI is a tool that is used in the *CEAA* process to identify areas of concern that *CEAA* must address. For example, the Canadian Wildlife Service will provide expert advice to a responsible

authority under *CEAA* recommending that impacts to SEI sites due to a project, be avoided or minimised.

CEAA screenings are triggered irrespective of scale. The depth of the review varies with scale, but the legislative process is the same. Not all projects under the federal mandate are subject to *CEAA*. *CEAA* uses a screening process to identify projects for which environmental impacts are likely. Routine activities such as channel dredging may not require a full assessment. Many urban fish habitat issues are encompassed by *CEAA*, but are addressed at a local or regional level under provisions of the *Fisheries Act* which allow for review and comment prior to approval.

Because of federal responsibility under the *Fisheries Act*, wetland and riparian ecosystems are the most likely ecosystem types to be affected by *CEAA*. The *Fisheries Act* will be the most significant trigger for the *CEAA* in the SEI study area. Large scale projects on military bases would also be screened. Failure of the Department of Fisheries to utilise its powers under the *Fisheries Act* can trigger a challenge under *CEAA*.

Canada Wildlife Act

The *Canada Wildlife Act* enables the federal government to do wildlife research and interpretation and to designate National Wildlife Areas (NWA) for conservation purposes. One of the five NWAs in British Columbia is in the SEI study area—the Qualicum National Wildlife Area—which comprises three distinct geographical units:

- Nanoose Bay Unit—34 hectares (ha) of estuarine and upland habitats at the head of Nanoose Harbour;
- Marshall-Stevenson Unit—66 ha of prime estuarine and mature riparian habitats at the mouth of the Little Qualicum River; and
- Rosewall Creek Unit—54 ha of sheltered marine bay and estuary at Mud Bay on Baynes Sound.

Barred Owl (M. Hames)

Migratory Birds Convention Act

This Act is primarily concerned with regulating the hunting and use of migratory birds in Canada. Regulations pursuant to the Act restrict the disturbance or destruction of nests, eggs and shelters of migratory birds, except in accordance with a permit. Three of the seven Migratory Bird Sanctuaries in British Columbia are located in the SEI study area:

- Esquimalt Lagoon—130 ha of tidal lagoon, marine spit and coastal forest;

- Victoria Harbour—1700 ha of foreshore and tidal channels; and
- Shoal Harbour—150 ha of shallow marine bay and tidal mudflats.

Provincial Legislation

Municipal Act

The Municipal Act *in its own right and in relation to other statutes is a complex legal area, which cannot be addressed effectively in this manual.*

Black bear (R. Savannah)

Under the *Municipal Act*, local governments[125] have extensive powers over the use, development, and servicing of private land as well as those provincial Crown lands which are subject to private tenures under the *B.C. Land Act*, for example, foreshore and water lot leases for moorage and aquaculture (see *Section 4.1*). However, these powers have limited application in the Agricultural or the Forest Land Reserves, and no application (except with respect to servicing under special agreements) to areas under federal legislative jurisdiction, such as National Wildlife Areas, Indian Reserves and Department of National Defence lands.

The following should be considered when looking to local governments to protect environmentally sensitive areas.

- Although local governments do not have primary mandates for natural resource management, their land use, development approval and servicing (e.g., water supply, liquid and solid waste disposal) decisions can be used to protect, restore, maintain and enhance ecosystems and resource productivity. Or, by not considering and acting on these interests, local governments can be party to their loss.
- Local governments cannot restrict the use of land to a public use without triggering compensation claims. Thus local governments cannot be expected to use their regulatory tools on behalf of provincial or federal interests to the extent that this would trigger compensation claims.

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[125] There are several types of local government in the study area and official community plans for some of these require provincial approval: *municipalities* - which may be cities, towns, district municipalities and villages (official community plans do not require provincial approval); *regional districts* - which are comprised of municipalities and unincorporated electoral areas (electoral area official community plans require provincial approval); *Islands Trust* - which is established by the Islands Trust Act, and cross-referenced to the Municipal Act with respect to land use and development control powers (official community plans require provincial approval).

- Local governments are comprised of locally elected representatives who have, with the exceptions noted above, autonomous authority to give priority to community interests. In this regard, environmental interests are among a range of diverse and competing priorities such as housing, commercial and industrial development, and transportation. The priority each of these receives is related to a variety of factors—a primary one being community based values—in other words, the importance residents place on these values.

Regional Growth Strategies

Part 25 of the *Municipal Act* contains provisions for the preparation of regional growth strategies by Regional Districts. Growth strategies are optional. A regional growth strategy is a regional vision that commits affected municipalities and regional districts to a course of action to meet common social, economic and environmental objectives. It must also contain population and employment projections. Section 849 of the *Municipal Act* sets out the purposes and goals of a regional growth strategy. One of these goals is to protect environmentally sensitive areas. The strategy is initiated by a regional district and prepared through a broad consultative process specified in legislation. Prior to enactment it is referred to all affected local governments for acceptance. Section 850 of the Act outlines the content of a regional growth strategy. A regional growth strategy is not mandatory, but should a regional district decide to prepare one, it must have a planning horizon of at least 20 years.

A Regional Context Statement forms part of a municipality's Official Community Plan that sets out the relationship between the Regional Growth Strategy and the municipality's OCP. An OCP for electoral areas must be consistent with the Regional Growth Strategy. The statement is prepared by the municipality and referred to the regional district for acceptance. An Implementation Agreement is a partnership agreement between a regional district and its member municipalities and/or other orders of government, their agencies or other bodies. These agreements spell out the details of how certain aspects of a Regional Growth Strategy will be carried out. For example, an agreement may relate to the construction and funding of new or upgraded highways, sewers, regional parks or hospitals.

River otter (L. Friis)

Water Act

The *Water Act* regulates the use of surface water and for changes in and about streams. Licences or approvals are required from the Regional Water Manager, Ministry of Environment, Lands and Parks (MELP) or alternatively the Comptroller of Water Rights. The *Water Act* provides for regulations to require Notification for many routine works constructed in or around streams.

Wildlife Act

The *Wildlife Act* is intended to address the protection and management of wildlife species in B.C. However, in reality it focuses on a relatively small group of designated endangered species, Wildlife Management Areas (WMA) , and the management of recreational hunting. In addition, it provides a mechanism through which land acquisition can be funded and administered. Designated endangered species under the *Wildlife Act* include the Vancouver Island marmot, burrowing owl, and white pelican; none of which reside in the SEI study area. The only WMA in the SEI study is:

- Parksville - Qualicum Beach WMA - 873 ha stretching along 17km of intertidal foreshore.

The *Wildlife Act* also specifies no disturbance of beaver dams and muskrat dens without approval, except where drainage is threatened. Bird nests are also protected. The nests of eagle, peregrine falcon, gyrfalcon, osprey, heron and burrowing owl are protected throughout the year; all other birds' nests are protected when occupied by a bird or egg (i.e., during the spring or early summer in coastal B.C.).

Protection or management of SEI ecosystem types through the *Wildlife Act* would occur if it were in a WMA, or contained the nest of a raptor or heron. However, if there is sufficient scientific justification and public support for acquisition of a sensitive ecosystem for wildlife values, then the *Wildlife Act* should be considered as a means of acquiring and protecting important ecosystems.

Land Act

The *Land Act* enables the province to manage, regulate, or dispose of Crown lands. All lands that are sold, leased, occupied, or granted an easement for, through the British Columbia Assets and Land Corporation (BCAL) may be referred to other agencies for review and comment. The B.C. Ministry of Environment, Lands and Parks and the Department of Federal Fisheries and Oceans routinely review and make recommendations on the proposed terms of land disposition. However, the final land use decision rests with BCAL.

In the SEI area, land is primarily privately owned and therefore is not subject to this Act. However, coastal inter-tidal areas and water surfaces are subject to the *Land Act*. Therefore, many foreshore structures such as wharves, docks, piers, seawalls, etc. require approval by BCAL and could be subject to SEI conservation guidelines.

Environmental Assessment Act (BCEAA)

The purpose of the *B.C. Environmental Assessment Act* is to assess the potential environmental, economic, heritage, health, and social effects arising from a broad range of large scale projects. *BCEAA* only addresses projects under provincial responsibility. Forestry related projects are not generally included as they are addressed by the *Forest Practices Code.* Where both *BCEAA* and *CEAA* interests may apply, a joint assessment process can be initiated.

BCEAA covers major projects including mines, waste disposal, energy projects such as power generation plants, pipelines, transmission lines, tourism projects, and transportation related projects (e.g., public highways). Large scale urban developments may also be subject to *BCEAA* review. Project size or ‘threshold’ is an important factor; the *BCEAA* is intended to address large scale projects with significant potential to affect the environment.

BCEAA has the potential to increase protection of all SEI ecosystem types if they are threatened by a large scale project such as a new highway. However, much of the ecosystem loss in the SEI is due to the incremental damage caused by many small developments and activities that are not encompassed by *BCEAA.*

Agricultural Land Reserve Act

The *Agricultural Land Reserve (ALR) Act* protects farmland from conversion to non-agricultural use. ALR lands are regulated by the Agricultural Land Commission.

The ALR ensures that farmland is maintained as large parcels that are economically viable for food production. The *Municipal Act* contains provisions which affect local governments' jurisdiction with respect to farm practises in the ALR.

The primary use of the *ALR Act* in terms of SEI ecosystem types is to maintain seasonally flooded agricultural fields by encouraging active farming and discouraging or preventing conversion to other land uses such as housing. The ALR does allow for compatible uses including wildlife habitat and nature reserves.

Forest Land Reserve Act

The *Forest Land Reserve (FLR) Act* protects privately owned "managed" or Crown forest land from conversion to non-forestry use.

Owl feather (R. Savannah)

The Forest Land Reserve consists of Crown Land and private land, other than agricultural reserve land that is classified under the *Assessment Act* as Managed Forest Land.

The land is regulated by the Forest Land Commission. The objective of the legislation is to "protect the integrity of the working forest land base by minimising the impact of urban development and rural area settlement on forest reserve land, encourage responsible forest practices on forest land and to promote conditions favourable for investment in private land forest management."

The FLR restricts the use of land to certain purposes, namely forestry, forage production, recreation, water management, fish, wildlife and biodiversity management and mineral exploration or development.

Fish Protection Act

The *Fish Protection Act*, passed in 1997, is designed to increase the protection and management of fisheries by the Provincial Government. However, at time of writing, only some powers are enacted. The legislation addresses improving water allocation policy and procedures to ensure adequate flows are maintained for fish, improving riparian protection on private land and promoting enhanced watershed planning. The specifics for many of these actions are still being developed. The *Fish Protection Act* has several objectives:

Chinook salmon (R. Savannah)

- **To ensure adequate water for fish**. This entails better licensing of withdrawals, and allowing stewardship groups to hold water licenses for maintaining flows for fish.
- **To protect and restore fish habitat**. These provisions include developing recovery plans for sensitive streams and offering incentives for conservation covenants on private land. Seven streams have recently (March 2000) been designated as "sensitive streams" within the SEI study area. These streams are Black Creek, Englishman River, French Creek, Fulford Creek, Goldstream River, Little Qualicum River and Little River.
- **Riparian protection**, particularly in urban areas (The *Forest Practices Code* is the analogue on Crown forest lands). The Streamside Stewardship Directive is controversial and remains under development. It should specify conditions for enhancing riparian protection along streams and wetlands. This directive may provide the most useful tool for the conservation of some types of SEI ecosystems under the *Fish Protection Act*.
- **Enhanced Watershed Planning**. The Act also provides for enhanced watershed planning in "sensitive stream" watersheds, which should be of assistance to the wetland and riparian ecosystems. At time of writing, Black Creek has been selected as a pilot for the "sensitive stream" recovery plan process.
- **To strengthen environmental protection by local governments**. Local governments, through their management of land use and development, have a critical role to play in protecting streams, lakes, wetlands and other fish habitats. The *Fish Protection Act* amends sections in several acts including the *Municipal Act* and the *Water Act.*

Private Land Forest Practices Regulation

The *Private Land Forest Practices Regulation (PLFPR)* was enacted April 1, 2000. The regulation is applicable to Managed Forest Land under the *Assessment Act*. The *PLFPR* prescribes a number of management requirements including soil conservation, stream and fish habitat protection, water supply protection, protection of critical wildlife habitats and reforestation.

The Ministry of Environment, Lands and Parks has staff that are designated environmental officials under the regulation and the Forest Land Commission has staff that are designated as officers under the new regulation. These people work as team to ensure the regulation is applied to Managed Forest Lands.

A large portion of the SEI study area is designated Managed Forest Land and therefore subject to this regulation. Older forest and older second growth forest SEI polygons are delineated on these lands. The primary land use on these lands is forestry. It can be expected that the older forest sensitive ecosystems and other important older second growth forest ecosystems will be converted over time.

Farm Practices Protection (Right to Farm) Act

This *Farm Practices Protection Act (FPPA)* legislation supports farmers who farm responsibly, establishes a process to address public concerns about farm practices and helps local governments support farming in community plans and by-laws.

Definition of Normal Farming Practices

An activity that is conducted by a farm business in a manner consistent with proper and accepted customs and standards as established and followed by similar farm businesses under similar circumstances.

The fundamental policy of the legislation is that farmers have a right to farm in B.C.'s important farming areas, particularly in the Agricultural Land Reserve, provided they use "normal farming practices" (see sidebar) and are in compliance with related legislation (the *Waste Management Act, Water Act, Pesticide Control Act, Health Act*).

The legislation establishes an improved complaint resolution process for people who live near farms and have concerns about farm practices that create dust, odor, noise or other disturbances. The FPPA also amends the *Municipal* and *Land Title Acts* to encourage local governments to support farming by ensuring local by-laws reflect provincial standards for farming.

Conclusion

It is clear that senior levels of government have a vital role to play in the conservation of sensitive ecosystems within the SEI study area. However, no one level of government or agency has overall responsibility for conservation. Although there is no explicit sensitive ecosystems legislation per se within British Columbia or at the federal level, legislation exists that can set aside sensitive areas for conservation purposes—usually as part of a Wildlife Management Area or a National Wildlife Area, Ecological Reserve, provincial or national park, etc. The majority of legislation is generally directed towards protecting specific resources (e.g. fish, wildlife or habitat) and regulating human activities that could impact on the resource.

In recent years there has been an effort to take more of an ecosystem approach to land use planning and management, with the introduction of the *Fish Protection Act* and amendments to the *Municipal Act*. There is recognition that watershed planning and management is an essential step towards conserving sensitive ecosystems. The identification, designation and mapping of ESAs by local governments, land trusts, conservancy groups, and special interest groups is an important tool in conserving sensitive ecosystems.

However, long-term conservation of biodiversity depends on public support—the development of a 'conservation ethic' that acknowledges and affirms the link between a healthy environment and human prosperity. Development of such an ethic requires education in conservation and natural values, which in turn helps to develop a love of home and place, and an appreciation of and protective attitude toward non-human life forms everywhere. We hope that this manual will assist governments, landowners, developers, and others to find ways to live productively and sustainably while conserving our rich biological heritage.

Let us leave a splendid legacy for our children...let us turn to them and say, 'this you inherit: guard it well, for it is far more precious than money, and once destroyed, nature's beauty cannot be repurchased at any price.'

— Ansel Adams

Glossary[126]

Accretion: The increase in size or amount of inorganic materials in an area due to the addition (accretion) of particles arriving in the area from elsewhere.

Alluvial: See **Fluvial**.

Aspect: The compass direction of a slope or surface relative to the sun (e.g. a slope on the south side of a hill has a southerly aspect).

Blue-listed (B): those indigenous species or subspecies considered provincially vulnerable. See **Vulnerable/sensitive species**.

Breakwater: A barrier constructed to protect a harbour or beach from the force of waves.

Bryophyte: Primitive plant in the plant phylum Bryophyta, lacking a vascular system and typically growing in moist habitats (e.g., mosses, hornworts, and liverworts).

Canadian Biodiversity Strategy: In 1992, Canada ratified the United Nations Convention on Biological Diversity, developed to promote the conservation and sustainable use of living organisms and the biological complexes of which they are a part. By 1996, representatives of the federal, provincial and territorial governments had developed, through broad-based consultations, the Canadian Biodiversity Strategy as a guide to implementing the Convention. The Strategy outlines comprehensive steps for the conservation and sustainable use of biological resources through science, ecosystem management, legislation and regulation, education and awareness and international cooperation.

Climax: The culminating self-replacing seral stage in plant succession that is relatively stable and persists for long periods relative to other seral stages.

Community: A group of living organisms connected by ecological processes to a particular ecosystem. Often named after the dominant vegetation. For example the red-listed Western redcedar - Indian plum plant community. Within this community are other associated plant species, and other dependent species (animals, birds, reptiles, amphibians, invertebrates and micro-organisms).

Conservation covenant: A conservation covenant is a voluntary, written legal agreement in which a landowner promises to

[126] Extracted from Dunster and Dunster 1996.

protect his/her land in specified ways. It can cover all or just part of the landowner's property. Such a covenant offers a way of protecting land for a variety of uses such as wildlife habitat, watershed protection, scenic values and historic preservation. The agreement is between the landowner and an organization, such as the Islands Trust Fund or a local conservancy, or any other group or government agency recognised or designated by the Minister of Environment, Lands and Parks. Conservation covenants protect the land by giving the covenant holder the authority to assume the long-term responsibility for monitoring and enforcing the agreement. The covenant is attached to the title of the land, is registered in the Land Title Office, and binds future owners of the land to the terms established by the first landowner.

COSEWIC: The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild Canadian species, subspecies and separate populations suspected of being at risk. All native mammals, birds, reptiles, amphibians, fish, molluscs, lepidopterans (butterflies and moths), vascular plants, mosses and lichens are included in its current mandate. Three categories of risk are used in this manual. Endangered (E) denotes a species facing imminent extirpation or extinction. Threatened (T) denotes a species likely to become endangered if limiting factors are not reversed. (SC) denotes a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.

Direct effect (impact): A condition caused by an action or inaction without an intermediary agent which can be linked directly back to the action/inaction.

Disjunct population: Populations of the same species that are geographically separated from each other by large distances.

Dispersal: The passive or active movement, on any time scale, of organisms from their point of origin to another location where they may subsequently produce offspring.

Disturbance: A discrete force that causes significant change in structure of composition through natural events such as fire, flood, wind, or earthquake; mortality caused by insect or disease outbreaks, or by human-caused events such as the harvesting of a forest or draining of a wetland. In forests, larger disturbances generally favour colonising species, whereas smaller disturbances favour the competitive species. Typically, diversity in the landscape is greater with large disturbances at infrequent intervals. Small but frequent

disturbances create high diversity at the stand or ecosystem level. A **chronic disturbance** is recurrent, or continues for a long period of time. An **episodic disturbance** event occurs within a completely distinct time period.

Dominant: A plant or group of plants which, by their collective size, mass, or number, exert the most influence on other components of the ecosystem.

Ecological processes: The actions or events that link organisms (including humans) and their environment, such as disturbance, successional development, nutrient cycling, productivity, and decay.

Ecosystem: A system of living organisms interacting with the soil, land, water and nutrients that make up their environment. An ecosystem is the home place of living things, including humans.

Edge effect: The penetration of wind, light, and humidity creating differences in microclimate (air and soil temperature, wind, light, humidity), as well as sound, predation, and visibility, beyond and into vegetation bordering a zone of disturbance. The distance of edge effect penetration varies with the vegetation conditions of the forest and the adjacent opening, as well as aspect and topography. Edge effects can drastically reduce the area of a vegetated "island" that can function as "interior" forest.

Environmentally Sensitive Area (ESA): A term often used loosely to mean a site or area that has environmental attributes worthy of retention or special care. ESAs are important in the management of all landscapes and require tight definitions to be defensible. A more exacting definition is: An environmentally sensitive area is any parcel of land, large or small, under public or private control, that already has, or with remedial action could achieve, desirable environmental attributes. These attributes contribute to the retention and/or creation of wildlife habitat, soils stability, water retention or recharge, vegetative cover, and similar vital ecological functions.

Environmentally sensitive areas range in size from small patches to extensive landscape features. They can include rare or common habitats, plants and animals. Taken together, a well-defined and protected network of environmentally sensitive areas performs necessary ecological functions within urban and rural landscapes. This network makes a very important contribution to the overall quality of life for all species living in and around the area, and plays a particularly important role in

maintaining or enhancing the health and livability of city and urban landscapes.

Evapotranspiration: The movement of water from the soil, an individual plant, or plant communities to the atmosphere by evaporation of water from the soil and transpiration of water by plants.

Extinction: The termination of a species caused by failure to reproduce and death of all remaining members of that species. Can be natural or human-induced.

Extirpation: The elimination of a species or subspecies from a particular area, but not from its entire range.

Feral: An animal that has escaped from domestication and returned to a wild state.

Fluvial: A comprehensive term for several stream or river processes, involving the transport and deposition of materials by water.

Forb: An herbaceous plant with broad leaves, excluding the grasses and grass-like plants.

Fragmentation: is the breaking up of continuous areas of habitat into smaller parcels. For example, a forest becomes fragmented when sections are cleared for highway widening.

Freshet: A sudden and rapid rise in the level of a stream or river due to heavy rains or rapid snowmelt.

Grass: Plants in the family Gramineae, whose characteristics include stems that are jointed at nodes, are hollow, have sheathing leaves, and flowers (inflorescences) surrounded by bracts (glumes).

Greenway: A system of protected linear corridors of open space, managed for conservation and recreation purposes.

Groin: A breakwater structure that extends seaward at a right angle to the shoreline, in order to alter or inhibit the drift of sediments along the shoreline.

Habitat: Those parts of the environment (aquatic, terrestrial, atmospheric), often typified by a dominant plant form or physical characteristic, on which an organism depends, directly or indirectly, in order to carry out its life processes.

Habitat heterogeneity: A mix of different habitats within an ecosystem, landscape, or area. **Habitat diversity** is the number of different types of habitats within a given area.

Hibernacula: Sheltered places where overwintering animals rest, or dens where snakes hibernate.

Impact: Or, "effect". Describes a positive or negative change in the environment through space or time as a result of human, non-human (natural), or abiotic activity. Impacts can be **additive** (the outcome equals the sum of the individual impacts), **subtractive** (the outcome is less than the sum of individual impacts because some have cancelled each other out), or **synergistic** (the final impact is greater than the sum of the individual impacts). See also **Direct effect** and **Indirect effect**.

Important ecosystems: Modified or non-natural sites functioning as important wildlife habitats, as buffers between developed lands and the more fragile ecosystems, and as reservoirs for biodiversity in otherwise highly developed and urbanised landscapes. For the SEI project the two *other important ecosystems* are *older second growth forest* and *seasonally flooded agricultural field ecosystems*.

Indirect effect (impact): A condition caused by an action or inaction through intermediary causal agents. An effect for which the causal linkages to the action or inaction are not clearly apparent.

Jetty: A structure of wooden pilings, rocks, or other materials extending out into a body of water to divert a current, or to protect a harbour, shoreline or a wharf.

Krummholtz: A twisted, dwarfed or prostrate growth habit of trees that is the result of severe environmental conditions such as strong prevailing winds.

Micro-habitat: 1) A specific combination of habitat elements in the place occupied by an organism. 2) A restricted set of distinctive environmental conditions that constitute habitat on a small scale, such as the area under a log.

Natural disturbance: An event that causes a change in the composition or structure of the ecosystem with minimal influence from human activity.

Niche: The unique suite of environmental factors required by an organism for survival. An **ecological niche** is an organism's actual place within a community, including its tolerances for the physical environment, its interactions with other organisms, and the manner in which the organism utilises the component parts of its habitat.

Non-point source pollution: A source of atmospheric, aquatic, or terrestrial pollution in which naturally occurring or human-induced pollutants are discharged over a widespread area or from a number of small inputs, rather than from one distinct identifiable source (point source).

Obligate: Organisms that are restricted to one or very few narrowly defined environments, roles, modes of life, or processes, for survival. For example, an obligate cavity dweller only uses tree cavities for nesting or denning.

Patch: A habitat patch is a spatially distinct unit of a particular habitat.

Peak flow: The highest amount of stream or river flow occurring in a year or from a single storm event.

Peripheral population: An assemblage of individuals of one species at the edge of its geographic range.

Polygon: A series of points that are joined to form an unbroken line delineating the perimeter of an area (e.g. ecosystem) on a map. A polygon is used to graphically delineate and sort the features of an area by various attributes and represents a unique site in the SEI inventory.

Population: Is a group of individuals of the same species that inhabit an area in which they can interact and potentially breed with one another.

Profits à prendre: A right to take a part of the soil or produce of the land, or to take from the soil such as by logging or mining. The taking (profit) distinguishes this right from an easement, which is a right of use over the property of another.

Recharge: The addition of water to an aquifer that occurs naturally from infiltration of rainfall and from water flowing over earth materials that allow water to infiltrate below the land surface.

Red-listed (R): Those indigenous species or subspecies considered provincially rare. See **Threatened and endangered species**.

Riparian: Terrestrial areas where the vegetation complex and microclimate conditions are products of the combined presence and influence of perennial and/or intermittent water, associated high water tables, and soils that exhibit some wetness characteristics.

Runoff: The part of precipitation and snowmelt that reaches streams and rivers by flowing over or through the ground. **Surface runoff** flows away without penetrating the soils. **Groundwater runoff** enters streams by seeping through soils.

Scarified: Seeds that have undergone physical or chemical modification to make their hard coats permeable to water and air in order to initiate germination.

Senescence: The process of aging in mature individuals, typically toward the end of an organism's life.

Sensitive ecosystem: Those remaining natural terrestrial ecosystems which are considered fragile and/or rare in the SEI study area: coastal bluff, sparsely vegetated, terrestrial herbaceous, wetland, riparian, woodland and older forest ecosystems.

Seral: The successional stage of plant communities that succeed one another.

Snag: Any standing dead, partially dead, or defective tree at least 3 metres tall.

Succession: A series of dynamic changes in ecosystem structure, function, and species composition over time as a result of which one group of organisms succeeds another through stages leading to a potential natural community or climax stage. For example, the series of plant communities (seral stages) following a major disturbance. **Primary succession** occurs when organisms colonise a previously sterile area (i.e. it has no biological legacy to pass on). **Secondary succession** occurs on sites that have previously been colonised and subsequently disturbed in some manner or the natural replacement of seral stage ecosystem with a later or climax ecosystem.

Talus: Angular rock fragments accumulated at the foot of a steep rock slope and being the product of successive rock falls; a type of colluvium.

Threatened and endangered species: An indigenous species of flora or fauna that is likely to become endangered if the factors affecting its vulnerability do not become reversed. Threatened and endangered species are referred to as "red-listed" by the B.C. Conservation Data Centre.

Till: Material deposited by glaciers and ice sheets without modification by any other agent of transportation. Till materials typically consist of unsorted mixtures of clay, silt, sand, gravel and boulders of varying sizes and shapes.

Tilth: The structure, character, and quality of soil resulting from the combined factors of parent material and biological activity within the soil, and the effects of land use management practices on the soil. Soil in good tilth is well aerated, and rich in humus and organic matter that allows moisture to be retained.

Vernal pool: A temporary body of freshwater that is filled by spring rains and snowmelt, only to dry up during the hot, dry summer months. Many vernal pools are filled again by autumn rains, and may persist throughout the winter.

pools are typically small and shallow, and provide crucial breeding habitat for amphibians and invertebrates.

Vulnerable/sensitive species: Indigenous species that are not threatened but are particularly at risk because of low or declining numbers. These species are identified as "blue listed" by the B.C. Conservation Data Centre.

Wildlife: Any wild organism, including: wild mammals, birds, reptiles, amphibians, fishes, invertebrates, plants, fungi, algae, and bacteria.

Windthrow: A tree uprooted by the wind.

Yellow-listed (Y): Any indigenous species or subspecies (taxa) that is not at risk in British Columbia but may be vulnerable during times of seasonal concentration (e.g., breeding colonies). These species are identified as "yellow-listed" by the B.C. Conservation Data Centre.

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Appendix A: Stewardship Publications

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The Stewardship Series

The Stewardship Series is a group of publications describing stewardship activities for various audiences. The series is funded by federal and provincial governments in partnership with non-government organisations on a project by project basis. Current publications include:

Department of Fisheries and Oceans (Fraser River Action Plan) and Ministry of Environment, Lands and Parks. 1997. *Watershed Stewardship: A Guide For Agriculture.* Vancouver, B.C.

———.1997. *Stewardship By-laws: A Guide for Local Government.* Vancouver, B.C.

———.1996. *Community Greenways: Linking Communities to Country, and People to Nature.* Vancouver, B.C.

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Appendix B: Organisations and Resources

Federal Government

Environment Canada
Canadian Wildlife Service
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Qualicum Beach, B.C., V9K 2B7
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fax: (250) 752-9611

Environment Canada
Canadian Wildlife Service
Pacific and Yukon Region
RR 1, 5421 Robertson Road
Delta, B.C.,V4K 3N2
tel: (604) 940-4700
fax: (604) 946-7022

Agriculture and Agri-food Canada
Coastal Areas Branch
Box 2527
103-620 Royal Avenue
New Westminster, B.C.
V3L 5A8
tel: (604) 666-9283

Fisheries and Oceans Canada
South Coast Division
3225 Stephenson Point Road
Nanaimo, B.C.
V9T 1K3
tel: (250) 756-7270
fax: (250) 756-7160

Provincial Government

Ministry of Environment, Land and Parks
Conservation Data Centre
Resources Inventory Branch
Box 9344 Stn. Prov. Govt.
Victoria, B.C.
V8W 9M1
tel: (250) 387-0732
fax: (250) 387-2733
email: elpcdcdata@victoria1.gov.bc.ca
web site: http://www.elp.gov.bc.ca/rib/wis/cdc

Ministry of Agriculture and Food
Agriculture Division
808 Douglas Street
Victoria, B.C.
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Ministry of Environment, Land and Parks
Vancouver Island Regional Headquarters
2080A Labieux Road
Nanaimo, B.C.
V9T 6J9
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fax: (250) 751-3103

British Columbia Land Reserve Commission
Room 133, 4940 Canada Way
Burnaby, B.C. V5G 4K6
tel: (604) 660-7000
fax: (604) 660-7033
web site: www.landcommission.gov.bc.ca

Ministry of Municipal Affairs
Growth Strategies Office
P.O. Box 9490, Provincial Government Station
3rd Floor, 800 Johnson Street
Victoria, B.C.
V8W 9N7
tel: (250) 387-4040
fax: (250) 356-9019

Regional Government

Capital Regional District
Box 1000, 524 Yates Street
Victoria, B.C.
V8W 2S6
tel: (250) 360-3000
fax: (250) 360-3130

Regional District of Comox-Strathcona
Box 3370
Courtenay, B.C.
V9N 5N5
tel: (250) 334-6000
fax: (250) 334-4358

Powell River Regional District (Lasqueti Island)
5776 Marine Avenue
Powell River, B.C.
V8A 2M4
tel: (250) 483-3231
fax: (250) 483-2229

Cowichan Valley Regional District
137 Evans Street
Duncan, B.C.
V9L 1P5
tel: (250) 746-2500
fax: (250) 746-5612
email: cvrdds@island.net

Regional District of Nanaimo
Box 40
Lantzville, B.C.
tel: (250) 390-4111
fax: (250) 390-4163

Local Government

Islands Trust
2nd Floor, 1627 Fort Street
Victoria, B.C.
V8R 1H8
tel: (250) 405-5151
fax: (250) 405-5155
web site: www.islandstrust.bc.ca/

District of Campbell River
301 St. Ann's Road,
Campbell River V9W 4C7
tel: (250) 286-5700
fax: (250) 286-5761

Islands Trust Fund
2nd Floor, 1627 Fort Street
Victoria, B.C.
V8R 1H8
tel: (250) 405-5174
fax: (250) 405-5155
web site: www.islandstrustfund.bc.ca

Town of Comox
1809 Beaufort Avenue
Comox V9M 1R9
tel: (250) 339-2202
fax: (250) 339-7110

City of Courtenay
830 Cliffe Avenue,
Courtenay V9N 2J7
tel: (250) 334-4061
fax: (250) 334-4241

Town of Qualicum Beach
PO Box 130,
Qualicum Beach V9K 1S7
tel: (250) 752-6921
fax: (250) 752-1243

City of Nanaimo
455 Wallace St
Naniamo V9R 5J6
tel: (250) 755-4428
fax: (250) 755-4436

District of North Cowichan
PO Box 278
Duncan V9L 3X4
tel: (250) 746-3100
fax: (250) 746-3154

Town of Ladysmith
Town Hall, PO Box 220
Ladysmith V0R 2E0
tel: (250) 245-6400
fax: (250) 245-6411

Town of Sidney
2440 Sidney Avenue
Sidney V8L 1Y7
tel: (250) 656-1184
fax: (250) 655-4508

District of North Saanich
PO Box 2639
Sidney V8L 4C1
tel: (250) 656-0781
fax: (250) 656-3155

District of Central Saanich
1903 Mount Newton Cross Road
Saanichton V0S 1M0
tel: (250) 652-4444
fax: (250) 652-0315

Village of Cumberland
PO Box 340
Cumberland V0R 1S0
tel: (250) 336-2291
fax: (250) 336-2321

City of Parksville
PO Box 1390
Parksville V9P 2H3
tel: (250) 954-4660
fax: (250) 248-6650

City of Duncan
PO Box 820,
Duncan V9L 3Y2
tel: (250) 746-6126
fax: (250) 746-6129

Village of Lake Cowichan
PO Box 860
Lake Cowichan V0R 2G0
tel: (250) 749-6681
fax: (250) 749-3900

District of Highlands
1564 Millstream Road
Victoria V9B 4T9
tel: (250) 474-1773
fax: (250) 474-3677

District of Langford
2805 Carlow Road
Victoria V9B 5V9
tel: (250) 478-7882
fax: (250) 478-7864

City of Colwood
3300 Wishart Road
Victoria V9C 1R1
tel: (250) 478-5541
fax: (250) 478-7516

District of Saanich
770 Vernon Avenue
Victoria V8X 2W7
tel: (250) 475-1775
fax: (250) 475-5450

District of Oak Bay
2167 Oak Bay Avenue
Victoria V8R 1G2
tel: (250) 598-3311
fax: (250) 598-9108

City of Victoria
1 Centennial Square
Victoria V8W 1P6
tel: (250) 385-5711
fax: (250) 385-1128

Town of View Royal
45 View Royal Avenue
Victoria V9B 1A6
tel: (250) 479-6800
fax: (250) 727-9551

District of Metchosin
4450 Happy Valley Road
RR #4 Victoria V9C 3Z3
tel: (250) 474-3167
fax: (250) 474-6298

District of Esquimalt
1229 Esquimalt Road
Victoria V9A 3P1
tel: (250) 385-2461
fax: (250) 385-6668

Non-Government Organisations

*Note: this list has been compiled to provide the reader with some sources of further information. This is **not** intended to be a complete listing of all conservation organisations in the SEI study area.*

B.C. Federation of Agriculture
846 Broughton Street
Victoria, B.C.
V8W 1E4
tel: (250) 383-7171
fax: (250) 383-5031
email: bcfa@bcfa.bc.ca
web site: http://vvv.com/home/bcfa/index.html

Cowichan Community Land Trust Society
#6 - 55 Station Street
Duncan, B.C.
V9L 1M2
tel: (250) 746-0227
fax: (250) 746-9608
email: cclt@island.net

Denman Island Conservancy Association
P.O. Box 60
Denman Island, B.C.
V0R 1T0
tel: (250) 335-2151
fax: (250) 335-2151

Coast Islands Conservancy
RR1
Mayne Island, B.C.
V0N 2J0
tel: (250) 539-2034
email: rpither@gulfislands.com

Comox Valley Land Trust
Box 3462
Courtenay, B.C.
V9N 5N5
tel: (250) 337-1929

Discovery Coast Greenways Land Trust
158 Coronation Crescent
Campbell River, B.C. V9W 3T6
tel: (250) 287-8565
email: mar@online.bc.ca

Ducks Unlimited Canada - Coastal Office
Unit 1 – 3033 King George Highway
Surrey, B.C. V4P 1B8
tel: (604) 531-5933
fax: (604) 531-43890

Friends of Ecological Reserves
Box 8477
Victoria, B.C.
V8W 3S1
tel: (250) 595-4813

Galiano Conservancy Association
RR#1, Sturdies Bay Road
Galiano Island, B.C.
V0N 1P0
tel: (250) 539-2424
email: galiano_conservancy@gulfislands.com

Georgia Strait Alliance
#201 - 195 Commercial Street
Nanaimo, B.C.
V9R 5G5
tel: (250) 753-3459
fax: (250) 753-2567
email: gsa@island.net
web site: http://www.island.net/~gsa/

Hornby Island Conservancy
Box 55
Hornby Island, B.C.
V0R 1Z0
tel: (250) 335-2603
fax: (250) 335-2807

Native Plant Society of B.C.
2012 William Street
Vancouver, B.C.
V5L 2X6
tel: (604) 255-5719
fax: (604) 258-0201
email: npsbc@hotmail.com

Federation of BC Naturalists
#425 - 1367 West Broadway
Vancouver, B.C., V6H 4A9
tel: (604) 737-3057
fax: (604) 738-7173
email: fbcn@intergate.bc.ca

Gabriola Island Conservancy
General Delivery
Gabriola Island, B.C.
V0R 1X0
tel: (250) 247-8691
fax: (250) 247-8691

Garry Oak Meadow Preservation Society
3873 Swan Lake Road
Victoria, B.C.
V8X 3W1
(250) 386-4792

Heartlands Conservancy
RR#2, Site 52
Gabriola Island, B.C.
V0R 1X0
tel: (250) 247-8436
fax: (250) 247-8492

Nanaimo and Area Land Trust Society
2648 Hammond Bay Road
Nanaimo, B.C. V9T 1T0
tel: (250) 758-5490
fax: (250) 754-2386
hourston@island.net

Pender Islands Conservancy Association
P.O. Box 52
Pender Island, B.C.
V0N 2M0
tel: (250) 629-6416
fax: (250) 629-6432
email: pica@gulfislands.com

Rosewall to Bonnell Land Trust Society
3681 Tralee Road
Qualicum Beach, B.C.
V9K 1V52
tel: (250) 752-3087
email: bharany@macn.bc.ca

Swan Lake and Christmas Hill Nature Sanctuary Society
3873 Swan Lake
Victoria, B.C.
tel: (250) 479-0211
fax: (250) 479-0132

The Land Conservancy of British Columbia
5793 Old West Saanich Road
Victoria, B.C. V9E 2H2
tel: (250) 361-7693
fax: (250) 744-2251
email: admin@conservancy.bc.ca
web site: www.conservancy.bc.ca

Trumpeter Swan Sentinel Society
#3 - 2401 Cliffe Avenue, Box 169
Courtenay, B.C. V9N 2L5
tel: (250) 335-1419
fax: (250) 338-5565

Habitat Acquisition Trust
Victoria Natural History Society
PO Box 8552
Victoria, B.C., V8W 3S2
tel: (250) 995-2428
email: hatmail@home.com
website: www.hat.bc.ca

Wild Bird Trust of BC
124 - 1489 Marine Drive
West Vancouver, B.C.
V7T 1B8
tel: (604) 922-1550
fax: (604) 922-8407

Gambier Island Conservancy
RR#3
Gambier Island, B.C.
V0N 1V0
tel: (604) 886-8901
fax: (604) 886-8901

Salt Spring Island Conservancy
Box 722, Ganges P.O.
Saltspring Island, B.C., V8K 2W3
tel/fax: (250) 538-0012
email: ssiconservancy@saltspring.com
website: www.salt-spring.bc.ca/conservancy

The Evergreen Foundation
Learning Grounds Project
106-163 West Hastings Street
Vancouver, B.C.
V6B 1H5

The Nature Trust of B.C.
808-100 Park Royal South
West Vancouver, B.C. V7T 1A2
tel: (604) 925-1128
fax: (604) 926-3482

Victoria Natural History Society
Box 5220, Station B
Victoria, B.C.
V8R 2J1
tel: (250) 479-2054

Waterbird Watch Collective
272 Beddis Road
Saltspring Island, B.C.
V8K 2J1
tel: (250) 537-4515
fax: (250) 537-5115

Land Trust Alliance of B.C.
204-338 Lower Ganges Road
Salt Spring Island, B.C.
V8K 2V3
Email: ltabc@saltspring.com
web site: www.island.net/~ltabc/

Thetis Island Conservancy
Box 5 - 8
Thetis Island, B.C.
V0R 2X0
tel: (250) 246-2184

Mount Tolmie Conservancy Association
3503 Camcrest Place
Victoria, B.C.
V8P 4V6
web site: www.geocities.com/RainForest/1234

West Coast Environmental Law Association
1001 - 207 West Hastings Street
Vancouver, B.C.
V6B 1H7
tel: (604) 684-7378
fax: (604) 684-1312
email: admin@wcel.org

Bowen Island Heritage Preservation Association
PO Box 78
Bowen Island, B. C.
V0N 1G0
tel: (604) 947-9146
fax: (640) 947-2687

Bowen Island Conservancy
P.O. Box 301
Bowen Island, B.C.
V0N 1G0
tel: (604) 947-0483
fax: (604) 947-0483

Nature Conservancy of Canada
202-26 Bastion Square
Victoria, B. C.
V8W 1H9
tel: (250) 479-3191

Appendix C: Ecosystem Key

Following is a key to the nine SEI ecosystems of the eastern coastal lowland of Vancouver Island and the Gulf Islands. It is designed to assist users in identifying the ecosystem type(s) of a particular site in question.

To use the key, carefully select one of the two possible choices at each level of the key, i.e., start at **1a** and see if the statement applies to your site. If it does, continue to **2a**, otherwise go to **1b**. In choosing which statement applies, keep in mind that this key pertains only to areas larger than 0.5 ha. In other words, *do not* use the key without having walked through a large portion of the site.

Key

1a. Site usually open with less than 10% trees–go to **2**

2a. Site dominated by non-agricultural land–go to **3**

3a. Site not associated with a floodplain or gully or immediately adjacent to a lake, stream or river–go to **4**

4a. Site without water at or above the surface of the land; soils relatively dry–go to **5**

5a. Site with highly visible, exposed bedrock–**6**

6a. Site at marine shoreline, but above high water–**7**

7a. Site with less than 30% slope dominated by grasses or mosses: COASTAL BLUFF–Vegetated rocky islets and shorelines (CB)

7b. Site steep, with at least a 30% slope: COASTAL BLUFF–Vegetated coastal cliffs and bluffs (CB:cl)

6b. Site not at marine shoreline–**8**

8a. Site with generally less than 30% slope, but vegetation more than slope a factor: TERRESTRIAL HERBACEOUS–Rock outcrops often a dominant feature (HT:ro)

8b. Site with at least 30% slope: SPARSELY VEGETATED–Inland cliffs and bluffs (SV:cl)

5b. Site without highly visible, exposed bedrock–**9**

9a. Site at the shoreline consisting of exposed sands or gravels–**10**

10a. Site created by wind-blown sand forming a ridge or hill: SPARSELY VEGETATED–Coastal sand dunes (SV:sd)

10b. Site consisting of gravels or sands deposited by long-shore drifting: SPARSELY VEGETATED–Coastal gravel and sand spits (SV:sp)

9b. Site may or may not be at the shoreline but not consisting of exposed sands or gravels–**11**

11a. Site saturated periodically and dominated by grasses, sedges, rushes and forbs: WET MEADOW (WN:wm)

11b. Site never saturated and dominated by grasses and mosses: TERRESTRIAL HERBACEOUS–Natural grasslands and moss-dominated (HT)

4b. Site with water at or above or regularly inundating the surface of the land; soils obviously wet–**12**

12a. Site with trees or shrubs present–**13**

13a. Site with moss species common and often abundant, tree cover generally absent or stunted–**14**

14a. Site receiving water from surface runoff or groundwater, dominated by sedges and brown mosses and non-Ericaceous shrubs: WETLAND–Fen (WN:fn)

14b. Site generally isolated from groundwater or surface runoff, dominated by Sphagnum moss and Ericaceous shrubs with shore pine the dominant tree: WETLAND–Bog (WN:bg)

13b. Site with moss species uncommon except on the flood-tolerant trees (e.g. western redcedar, Pacific crabapple, black cottonwood, willow); dominated by shrubs (e.g. hardhack); skunk cabbage or sedges common: WETLAND–Swamp (WN:sp)

12b. Site without trees or shrubs–**15**

15a. Site with less than 5% rooted vegetation; most vegetation submerged or floating; water depth less than 2m: WETLAND–Shallow water (WN:sw)

15b. Site with more than 5% rooted vegetation; dominated by emergent vegetation including sedges, grasses and rushes: WETLAND–Marsh (WN:ms)

3b. Site associated with a floodplain or gully or immediately adjacent to a lake, stream or river–go to **16**

16a. Site associated with a gully: RIPARIAN–Gullies (RI:g)

16b. Site not associated with a gully–**17**

17a. Site with less than 20% shrubs–**18**

18a. Site dominated by mosses and lichens: RIPARIAN–Sparse/bryoid (RI:1)

18b. Site dominated by herbs: RIPARIAN–Herb (RI:2)

17b. Site with at least 20% shrubs: RIPARIAN–Shrub/herb (RI:3)

2b. Site dominated by agricultural land and flooded at certain times of year: SEASONALLY FLOODED AGRICULTURAL FIELD (FS)

1b. Site somewhat to completely closed with at least 10% trees–go to **19**

19a. Site not associated with a floodplain or gully or immediately adjacent to a lake, stream or river–go to **20**

20a. Site without visible water at or above the surface of the land–go to **21**

21a. Site dominated by non-coniferous tree species–**22**

22a. Dominant trees other than Garry oak–**23**

23a. Trees predominately arbutus; Douglas-fir and Garry oak may also be present: WOODLAND–Arbutus–Douglas-fir woodlands

23b. Trees predominately trembling aspen: WOODLAND–Trembling Aspen woodlands

22b. Trees predominately Garry oak; Douglas-fir and arbutus may also be present: WOODLAND–Garry oak woodlands

21b. Site dominated by coniferous tree species–**24**

24a. Coniferous-dominated forest with average tree age of at least 100 years–**25**

25a. Site dominated by coniferous trees with deciduous species, if any, occupying less than 15% of canopy: CONIFEROUS OLDER FOREST (OF:co)

25b. Site dominated by coniferous trees with deciduous trees occupying at least 15% of the canopy: OLDER FOREST–Mixed Older Forest (OF:mx)

24b. Coniferous-dominated forest with average tree age between 60 and 100 years–**26**

26a. Site dominated by coniferous trees with deciduous species, if any, occupying less than 15% of canopy: OLDER SECOND GROWTH FOREST–Coniferous Older Second Growth Forest (SG:co)

26b. Site dominated by coniferous trees with deciduous trees occupying at least 15% of the canopy: OLDER SECOND GROWTH FOREST–Mixed Older Second Growth Forest (SG:mx)

20b. Site with water at or above the surface of the land–**27**

27a. Site dominated by (at least 25% cover) flood-tolerant trees (western redcedar, Pacific crabapple, black cottonwood, willow) or shrubs (hardhack): WETLAND–Swamp (WN:sp).

27b. Site dominated by *Sphagnum* moss and Ericaceous shrubs with shore pine, occasionally with western hemlock: WETLAND–Bog (WN:bg)

19b. Site associated with a floodplain or gully or immediately adjacent to a lake, stream or river–go to **28**

28a. Site associated with a gully: RIPARIAN–Gullies (RI:g)

28b. Site not associated with a gully–**29**

29a. Site with trees less than 80 years old–**30**

30a. Site dominated by densely stocked trees less than 40 years old: RIPARIAN–Pole/sapling (RI:4)

30b. Site dominated by young forest where self-thinning is evident; trees 40 to 80 years old: RIPARIAN–Young forest (RI:5)

29b. Site with trees at least 80 years old–**31**

31a. Site with trees 80 to 250 years old: RIPARIAN–Mature forest (RI:6)

31b. Site with trees at least 250 years old: RIPARIAN–Older forest (RI:7)

Appendix D: Plants of the SEI Study Area

Note: This is not a complete list of all plant species of the SEI study area. It is an index of species mentioned in the SEI Technical Report and/or the Conservation Manual. * denotes introduced species, R – red-listed species, B – blue-listed species, U – uncommon species as of May 2000. Please check the BC Conservation Data Centre web site for current status of plant species: http://www.elp.gov.bc.ca/rib/wis/cdc. COSEWIC listed species as of May 2000 are also noted: E (Endangered) denotes a species facing imminent extirpation or extinction; T (Threatened) denotes a species likely to become endangered if limiting factors are not reversed; SC denotes a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events (see also Glossary).

Common Name	**Scientific Name**
Alaska bentgrass	*Agrostis aequivalis*
Alaska brome	*Bromus sitchensis*
Alaska oniongrass	*Melica subulata*
alkaligrass	*Puccinellia* spp.
American glasswort	*Salicornia virginica*
American searocket	*Cakile edentula*
apple moss (R, COSEWIC-E)	*Bartramia stricta*
arbutus	*Arbutus menziesii*
arctic rush	*Juncus arcticus* ssp.*sitchensis*
awned haircap moss	*Polytrichum piliferum*
badge moss	*Plagiomnium insigne*
baldhip rose	*Rosa gymnocarpa*
baneberry	*Actaea rubra*
barren brome *	*Bromus sterilis*
beach bindweed (U)	*Convolvulus soldanella*
beach bluegrass (U)	*Poa confinis*
beach pea	*Lathyrus japonicus*
beach sand-spurry (B)	*Spergularia macrotheca*
beaked sedge	*Carex utriculata*
bigleaf maple	*Acer macrophyllum*
bitter cherry	*Prunus emarginata*
black cottonwood	*Populus balsamifera* ssp. *trichocarpa*
black hawthorn	*Crataegus douglasii*
bleeding heart	*Dicentra formosa*
blue wildrye	*Elymus glaucus*
blue-eyed grass (U)	*Sisyrinchium idahoense* var. *macounii*
blue-eyed Mary	*Collinsia parviflora*
bog cranberry	*Oxycoccus oxycoccos*
bog-orchid	*Platanehera* spp.
bog-rosemary	*Andromeda polifolia*
bracken fern	*Pteridium aquilinum*
brittle prickly-pear cactus	*Opuntia fragilis*

Common Name	Scientific Name
broad-leaved shooting star	*Dodecatheon hendersonii*
broad-leaved stonecrop	*Sedum spathulifolium*
broom moss	*Dicranum scoparium*
buckbean	*Menyanthes trifoliata*
bull thistle*	*Cirsium vulgare*
California brome	*Bromus carinatus*
California oatgrass	*Danthonia californica*
California poppy*	*Eschscholtzia californica*
caloplaca lichen	*Caloplaca* sp.
Canada thistle*	*Cirsium arvense*
Carolina meadow-foxtail (R)	*Alopecurus carolinianus*
cascara	*Rhamnus purshiana*
cattail	*Typha latifolia*
Chamisso's cotton-grass	*Eriophorum chamissonis*
chickweed monkey-flower (U)	*Mimulus alsinoides*
chocolate lily	*Fritillaria affinis*
cleavers*	*Galium aparine*
cloudberry	*Rubus chamaemorus*
coast microseris (R)	*Microseris bigelovii*
coastal reindeer lichen	*Cladina portentosa*
coastal strawberry	*Fragaria chiloensis*
Columbia brome	*Bromus vulgaris*
common camas	*Camassia quamash*
common mare's tail	*Hippuris vulgaris*
common rush	*Juncus effusus*
common spike-rush	*Eleocharis palustris*
common vetch *	*Vicia sativa*
common water moss	*Fontinalis antipyretica*
contorted-pod evening-primrose (R)	*Camissonia contorta*
cow-parsnip	*Heracleum maximum*
creeping bentgrass*	*Agrostis stolonifera*
creeping buttercup*	*Ranunculus repens*
crowberry	*Empetrum nigrum*
death camas	*Zygadenus venenosus*
deer fern	*Blechnum spicant*
deltoid balsamroot (R, COSEWIC-E)	*Balsamorhiza deltoidea*
devil's club	*Oplopanax horridus*
Douglas' aster	*Aster subspicatus*
Douglas-fir	*Pseudotsuga menziesii*
dulichium	*Dulichium arundinaceum*
dull Oregon-grape	*Mahonia nervosa*
dune bentgrass (B)	*Agrostis pallens*
dunegrass	*Elymus mollis*
dwarf owl-clover	*Triphysaria pusilla*
early blue violet	*Viola adunca*
early hairgrass*	*Aira praecox*

Common Name	**Scientific Name**
electrified cat's tail moss	*Rhytidiadelphus triquetrus*
English holly*	*Ilex aquifolium*
English ivy*	*Hedera helix*
entire-leaved gumweed	*Grindelia integrifolia*
erect pigmyweed (R)	*Crassula connata* var. *connata*
Eurasian water-milfoil*	*Myriophyllum spicatum*
European bittersweet*	*Solanum duleamara*
European glasswort*	*Salicornia europaea*
European gorse*	*Ulex europaeus*
fairyslipper	*Calypso bulbosa*
false lily-of-the-valley	*Maianthemum dilatatum*
falsebox	*Paxistima myrsinites*
farewell-to-spring (U)	*Clarkia amoena*
fat bog moss	*Sphagnun papillosum*
fawn lily	*Erythronium* spp.
few-flowered shooting star	*Dodecatheon pulchellum*
field chickweed	*Cerastium arvense*
fleshy jaumea (B)	*Jaumea carnosa*
floating-leaved pondweed	*Potamogeton natans*
fool's onion	*Triteleia hyacinthina*
Gairdner's yampah (U)	*Perideridia gairdneri*
Garry oak	*Quercus garryana*
Geyer's onion (R)	*Allium geyeri* var. *tenerum*
giant chain fern (U)	*Woodwardia fimbriata*
giant knotweed*	*Polygonum sachalinense*
gold star (U)	*Crocidium multicaule*
goldenback fern (U)	*Pentagramma triangularis*
graceful arrow-grass (R)	*Triglochin concinnum*
grand fir	*Abies grandis*
grass-leaved pondweed	*Potamogeton gramineus*
great burnet	*Sanguisorba officinalis*
great camas	*Camassia leichtlinii*
greater bladderwort	*Utricularia vulgaris*
green sedge	*Carex viridula*
green-sheathed sedge (B)	*Carex feta*
hairy honeysuckle	*Lonicera hispidula*
hairy manzanita (U)	*Arctostaphylos columbiana*
hairy screw moss	*Tortula ruralis*
hairy vetch*	*Vicia hirsuta*
hardhack	*Spiraea douglasii*
hard-stemmed bulrush	*Scirpus lacustris*
harvest brodiaea (U)	*Brodiaea coronaria*
hedgehog dogtail*	*Cynosurus echinatus*
Henderson's checkermallow (B)	*Sidalcea hendersonii*
herb robert*	*Geranium robertianum*
Himalyan blackberry*	*Rubus discolor*

Common Name	Scientific Name
hoary rock moss	*Racomitrium lanuginosum*
Hooker's onion (U)	*Allium acuminatum*
Hooker's willow	*Salix hookeriana*
Howell's montia (U)	*Montia howellii*
Howell's triteleia (R)	*Triteleia howellii*
huckleberry	*Vaccinium* spp.
humped bladderwort (U)	*Utricularia gibba*
Idaho fescue	*Festuca idahoensis*
Indian hellebore	*Veratrum viride*
Indian plum	*Oemleria cerasiformis*
Indian's-dream fern (U)	*Aspidotis densa*
inflated sedge	*Carex exsiccata*
junegrass	*Koeleria macrantha*
juniper haircap moss	*Polytrichum juniperinum*
Kentucky bluegrass*	*Poa pratensis*
king gentian	*Gentiana sceptrum*
kinnikinnick	*Arctostaphylos uva-ursi*
Labrador tea	*Ledum groenlandicum*
lady fern	*Athryrium filix-femina*
lanky moss	*Rhytidiadelphus loreus*
large leafy moss	*Rhizomnium glabrescens*
large-headed sedge (U)	*Carex macrocephala*
large-leaved avens	*Geum macrophyllum*
Lemmon's needlegrass (U)	*Stipa lemmonii*
lettuce lung lichen	*Lobaria oregana*
licorice fern	*Polypodium glycyrrhiza*
lodgepole pine	*Pinus contorta* var. *latifolia*
long-stoloned sedge (U)	*Carex inops*
low birch	*Betula pumila* var. *glandulifera*
Lyngby's sedge	*Carex lyngbyei*
Macoun's meadowfoam (B, COSEWIC-SC)	*Limnanthes macounii*
Menzies' larkspur	*Delphinium menziesii*
Menzies' tree moss	*Leucolepis acanthoneuron*
miner's lettuce	*Claytonia perfoliata*
mountain sweet-cicely	*Osmorhiza berteroi*
narrow-leaved cotton-grass	*Eriophorum angustifolium*
nodding onion	*Allium cernuum*
Nootka rose	*Rosa nutkana*
northern adder's tongue (R)	*Ophioglossum pusillum*
northern starflower	*Trientalis europaea* ssp. *artica*
Nuttall's quillwort (U)	*Isoetes nuttallii*
oceanspray	*Holodiscus discolor*
orache*	*Atriplex patula*
orchard grass*	*Dactylis glomerata*
Oregon beaked moss	*Kindbergia oregana*
Pacific crab apple	*Malus fusca*

Common Name	**Scientific Name**
Pacific ninebark	*Physocarpus capitatus*
Pacific sanicle	*Sanicula crassicaulis*
Pacific water-parsley	*Oenanthe sarmentosa*
Pacific willow	*Salix lucida* ssp. *lasiandra*
palmate coltsfoot	*Petasites frigidus* var. *palmatus*
pathfinder	*Adenocaulon bicolor*
pearly everlasting	*Anaphalis maragaritacea*
phantom orchid (R)	*Cephalanthera austinae*
poison oak (B)	*Rhus diversiloba*
poverty clover (U)	*Trifolium depauperatum*
purple loosestrife*	*Lythrum salicaria*
purple peavine	*Lathyrus nevadensis*
purple-leaved willowherb	*Ebilobium ciliatum*
rattlesnake plantain	*Goodyera oblongifolia*
red alder	*Alnus rubra*
red elderberry	*Sambucus racemosa*
red fescue	*Festuca rubra*
red huckleberry	*Vaccinium parvifolium*
red-osier dogwood	*Cornus stolonifera*
reed canary grass	*Phalaris arundinacea*
ribbed bog moss	*Aulacomnium palustre*
rip-gut brome*	*Bromus rigidus*
roadside rock moss	*Racomitrium canescens*
Rocky Mountain juniper (U)	*Juniperus scopulorum*
rose campion*	*Lychnis coronaria*
round-leaved sundew	*Drosera rotundifolia*
rusty-haired saxifrage	*Saxifraga rufidula*
salal	*Gaultheria shallon*
salmonberry	*Rubus spectabilis*
sand-dune sedge (B)	*Carex pansa*
Saskatoon	*Amelanchier alnifolia*
satin-flower	*Olsynium douglasii* var. *douglasii*
saxifrage	*Saxifraga* spp.
scalepod (R)	*Idahoa scapigera*
Scotch broom*	*Cytisus scoparius*
Scouler's corydalis (R)	*Corydalis scouleri*
Scouler's hairbell	*Campanula scouleri*
Scouler's willow	*Salix scouleriana*
sea arrow-grass	*Triglochin maritimum*
sea blush	*Plectritis congesta*
sea tar lichen	*Verrucaria maura*
seabeach sandwort	*Honckenya peploides*
seacoast bulrush	*Scirpus maritimus*
seashore bluegrass (U)	*Poa macrantha*
seashore lupine (U)	*Lupinus littoralis*
seashore saltgrass	*Distichlis spicata*

Common Name	Scientific Name
seaside birdsfoot trefoil (R)	*Lotus formosissimus*
seaside kidney lichen	*Nephroma laevigatum*
seaside plantain	*Plantago maritima* ssp. *juncoides*
seaside rein orchid (U)	*Pipera maritima*
self-heal	*Prunella vulgaris*
semaphore grass (B)	*Pleuropogon refractus*
shooting star	*Dodecatheon* spp.
shore pine	*Pinus contorta* var. *contorta*
short-stemmed sedge	*Carex brevicaulis*
sickle moss	*Drepanocladus uncinatus*
silver burweed	*Ambrosia chamissonis*
silver hairgrass*	*Aira caryophyllea*
silverweed	*Potentilla anserina*
Sitka sedge	*Carex sitchensis*
Sitka spruce	*Picea sitchensis*
Sitka willow	*Salix sitchensis*
skunk cabbage	*Lysichiton americanum*
slender beaked moss	*Kindbergia praelonga*
slender plantain	*Plantago elongata*
slender wooly-heads (R)	*Psilocarphus tenellus*
slimleaf onion (U)	*Allium amplectens*
slough sedge	*Carex obnupta*
small red peat moss	*Sphagnum capillifolium*
small-flowered alumroot	*Heuchera micrantha*
small-flowered forget-me-not	*Myosotis laxa*
small-flowered wood rush	*Luzula parviflora*
Smith's fairybells (B)	*Disporum smithii*
snake-root (R)	*Sanicula arctopoides*
snowberry	*Symphoricarpos albus*
soft brome*	*Bromus hordeaceus*
spreading stonecrop	*Sedum divergens*
spring-gold	*Lomatium utriculatum*
spurge-laurel*	*Daphne laureola*
step moss	*Hylocomium splendens*
stinging nettle*	*Urtica dioica* ssp. *dioica*
stink currant	*Ribes bracteosum*
strawberry	*Fragaria* spp.
sundew	*Drosera* spp.
swamp gentian	*Gentiana douglasiana*
sweet vernalgrass*	*Anthoxanthum odoratum*
sword fern	*Polystichum munitum*
tall mannagrass	*Glyceria elata*
tall Oregon grape	*Mahonia aquifolium*
tapered rush	*Juncus acuminatus*
thimbleberry	*Rubus parviflorus*
three-leaved foamflower	*Tiarella trifoliata*

Common Name	Scientific Name
thrift (U)	*Armeria maritima*
tiger lily	*Lilium columbianum*
timothy*	*Phleum pratense*
tiny mousetail	*Myosurus minimus*
tomcat clover	*Trifolium tridentatum*
Tracy's romanzoffia (B)	*Romanzoffia tracyi*
trailing blackberry	*Rubus ursinus*
trembling aspen	*Populus tremuloides*
trillium	*Trillium ovatum*
tufted hairgrass	*Deschampsia cespitosa* ssp. *beringensis*
twinflower	*Linnaea borealis*
two-coloured lupine (U)	*Lupinus bicolor*
Vancouver Island beggarticks (U)	*Bidens amplissima*
vanilla leaf	*Achlys triphylla*
wall lettuce*	*Lactuca muralis*
Wallace's selaginella	*Selaginella wallacei*
water sedge	*Carex aquatilis*
water smartweed	*Polygonum amphibium*
water-pepper (B)	*Polygonum hydropiperoides*
water-plantain	*Alisma triviale*
water-plantain buttercup (R, COSEWIC-E)	*Ranunculus alismifolius*
watershield	*Brasenia schreberi*
western bog-laurel	*Kalmia microphylla* ssp. *occidentalis*
western buttercup	*Ranunculus occidentalis*
western fescue	*Festuca occidentalis*
western flowering dogwood	*Cornus nuttallii*
western hemlock	*Tsuga heterophylla*
western redcedar	*Thuja plicata*
western trumpet honeysuckle	*Lonicera ciliosa*
western white pine	*Pinus monticola*
western yew	*Taxus brevifolia*
white beak-rush	*Rhynchospora alba*
white bog-orchid	*Platanthera dilatata* var. *dilatata*
white fawn lily	*Erythronium oregonum*
white hawkweed	*Hieracium albiflorum*
white-topped aster (R, COSEWIC-T)	*Aster curtus*
Willow	*Salix* spp.
woolly eriophyllum	*Eriophyllum lanatum* var. *lanatum*
yarrow	*Achillea millefolium*
yellow montane violet (R, COSEWIC-T)	*Viola praemorsa*
yellow pond-lily	*Nuphar polysepalum*
yellow sand verbena (U)	*Abronia latifolia*
yellow-flag iris*	*Iris pseudacorus*
yerba buena	*Satureja douglasii*

Appendix E: SEI Site Nomination Form

This form is designed to allow individuals, organisations, or municipal governments to nominate sensitive ecosystem sites that are not currently included in the SEI maps or database. The form and location map should be forwarded to the Conservation Data Centre at Ministry of Environment, Land and Parks, PO Box 9344, Stn. Prov. Govt., Victoria, B.C.V8T 9M1 tel: (250) 387-0732; fax: (250) 387-2733.

The nominating individual should be familiar with the nine ecosystem type definitions for the SEI. Conservation Data Centre staff can be contacted for more information on ecosystem type definitions.

Name of Nominator: _____

Address and Contact Numbers of Nominator: _____

_____

_____

Site Location (please provide a description of the site location and include a photocopy of map location at 1:20,000; air photos are also useful):

Regional District / Municipality: _____

Description of Site Location: _____

_____

_____

_____

Proposed Ecosystem Type(s): _____ **Code:** _____

Vegetation Description: _____

_____

_____

_____

Wildlife Observations: _____

_____

Adjacent land uses: _____

Known threats: _____

_____

Land status / Ownership: _____

Comments: _____

_____

_____

Appendix F: SEI Update Form

SENSITIVE ECOSYSTEMS INVENTORY
EAST VANCOUVER ISLAND AND GULF ISLANDS

INFORMATION CHANGE

This form is intended to provide updated information on areas and polygons that may have changed since the original survey in 1993. Please state whether change is due to disturbance, change in vegetation cover, development, elimination of sensitive ecosystem or other cause. **Date**: _____

Source of Information **Name** _____

Address_____

Phone _____

Study Area _____ Capital Region District (CRD), Cowichan Valley (CVRD), Regional District of Nanaimo (RDN), Comox/Strathcona (CSRD), Islands Trust (IT)

Check one: Addition of Polygon __ Modification of Existing Polygon__ Elimination of Polygon__
N.B. *If change involves addition of new polygon(s), please contact Conservation Data Centre for additional field forms*

General Location _____

_____

Polygon # _____

Change _____

_____

_____

Provide sketch map of change (attach additional sheet)

Ground photos_____ Aerial photos_____ Maps _____ are included with this form

Send information to:
Sensitive Ecosystems Inventory Coordinator
Conservation Data Centre
Ministry of Environment Lands and Parks
Resource Inventory Branch, Wildlife Inventory Section
Box 9344 Station Provincial Government
Victoria, B.C. V8W 9M1
Fax: (250) 387-2733 Phone: (250) 387-0732

Appendix G: Groundtruthing Forms

GROUNDTRUTHING FORM - UPLANDS

I.D. NO. (prelim):	MAP SHEET:	FINAL I.D. NO.
ECOSYSTEM CODE:	LOCATION:	
AIR PHOTO(S):	GROUND PHOTO(S):	
SOIL UNIT:		
SURVEY DATE:	SURVEYORS:	

Landscape condition:

___ Unfragmented (< 5% of landscape fragmented)
___ Partly fragmented (5-25% landscape fragmentation)
___ Highly fragmented (> 25% landscape fragmentation)

POLYGON DESCRIPTION:

Uniformity:

Degree of environmental uniformity: _____High _____Medium _____Low
Degree of vegetation uniformity: _____High _____Medium _____Low

Environmental characteristics:

_____%Slope _____Aspect _____Elevation _____Mesoslope
_____Moisture Regime _____Nutrient Regime _____Drainage

Ecosystem type(s):

Forested Site Association(s): _____

Non-forested Ecosystem(s): _____

Ecological Plot No. (where applicable):_____

Disturbance History (natural):

____Fire ____Windthrow ____Disease ____Animal Use ____Erosion ____Other

Disturbance History (anthropogenic):

____Logging ____Grazing ____Agriculture ____Construction ____Recreation ____Other

Adjacent land uses: _____

Known threats: _____

Comments: _____

_____

Wildlife Observation: _____

SKETCH:

VEGETATION DESCRIPTION - UPLANDS

Vegetation Type (% total layer) | Dominant Species (% each)

_____ Coniferous trees (core, dbh of dominant age class) _____

_____

_____

_____ Hardwood trees _____

_____

_____

_____ Tall shrub _____

_____

_____

_____ Low shrub _____

_____

_____

_____ Forb _____

_____

_____

_____ Grass _____

_____

_____

_____ Moss/Lichen _____

_____

_____

_____ Non-vegetated _____

_____

_____

_____ Introduced spp. _____

_____

_____

Voucher specimens: _____

_____

GROUNDTRUTHING FORM - WETLANDS

I.D. NO. (prelim):	MAP SHEET:	FINAL I.D. NO.
ECOSYSTEM CODE:	LOCATION:	
AIR PHOTO(S):	GROUND PHOTO(S):	
SOIL UNIT:		
SURVEY DATE:	SURVEYORS:	

Landscape condition:

___ Unfragmented (< 5% of landscape fragmented)
___ Partly fragmented (5-25% landscape fragmentation)
___ Highly fragmented (> 25% landscape fragmentation)

POLYGON DESCRIPTION:

Uniformity:

Degree of environmental uniformity: _____High _____Medium _____Low
Degree of vegetation uniformity: _____High _____Medium _____Low

Environmental characteristics:

_____Elevation _____Mineral Soil _____Organic Soil

Disturbance History (natural):

_____Fire _____Flooding _____Animal Use _____Erosion _____Other

Disturbance History (anthropogenic):

_____Water Level Control _____Grazing _____Agriculture _____Dyking
_____Dredging _____Pollutants (Dump) _____Recreation _____Other

Adjacent land uses: _____

Known threats: _____

Comments: _____

_____

Wildlife Observation:_____

Fish Present:_____ **Fish Not Detected**:_____

CLASSIFICATION OF WETLAND: **Ecoplot No**.:

Hydrology: _____

Wetland class (%): _____

Inflow/Outflow: _____Photo-interpreted _____Fieldchecked _____Not verified

SKETCH:

VEGETATION DESCRIPTION - WETLANDS

Vegetation Type (% total layer) Dominant Species (% each)

_____ Coniferous trees (core, dbh of dominant age class) _____

_____

_____ Hardwood trees _____

_____

_____ Tall shrub _____

_____

_____ Low shrub _____

_____

_____ Forb _____

_____

_____ Grass _____

_____

_____ Rushes _____

_____

_____ Sedges _____

_____

_____ Mosses _____

_____

_____ Lichens _____

_____

_____ Floating aquatic _____

_____

_____ Submerged aquatic _____

_____

_____ Non-vegetated _____

_____

_____ Introduced spp. _____

_____

Voucher specimens: _____

_____

INSTRUCTIONS FOR COMPLETING SEI GROUNDTRUTHING FORMS

ID NO (prelim): Fill in Polygon ID number assigned at the air photo interpretation stage.

MAP SHEET: Fill in corresponding mapsheet number

FINAL ID NO: Leave blank; to be filled in after editing stage.

ECOSYSTEM: Fill in the ecosystem code(s) assigned during air photo interpretation.

LOCATION: Use the location name assigned during air photo interpretation.

AIR PHOTO(S): Fill in the air photo number(s) on which the polygon is delineated.

GROUND PHOTO(S): Fill in slide photo roll and numbers taken on site.

SOIL UNIT: Fill in the soil unit as noted in DEIF [Describing Ecosystems in the Field (Luttmerding *et al*. 1990)]; this will help with the site interpretation.

SURVEY DATE: Fill in date of groundtruthing.

SURVEYORS: Enter the name (or initials) of the crew members filling out the forms.

Landscape condition: Describe the 500 ha surrounding the polygon being visited (basically the size of one photo). Fragmentation refers to separation of the landscape by significant anthropogenic influences, roads, hydro lines, developments, etc.

POLYGON DESCRIPTION:
Uniformity: Summarize the environmental characteristics of the polygon. For example: is this polygon a complex of slope positions and land forms or a complex of vegetation patterns? Can it be further divided into distinct polygons based on variability? Is the entire polygon on a steep south facing slope or is there a transition from steep to gentle? Refer to DEIF. If there is a wide range of mesoslope position, %slope or aspect, and these can be distinctly separated on the ground, then consider breaking up the polygon. However, if any variability is distributed throughout the polygon, then consider noting as a complex of 2 or more types (e.g. Forested ecosystems, CDFmm/01 and CDFmm/04 in a mosaic, or a mosaic of Garry oak - Oceanspray and *Carex inops - Racomitrium* community in the openings).

Disturbance History (natural): This field is designed to provide information on disturbances that significantly impact the vegetation patterns within the polygon. Root rot centres, several blowdowns, deer severely grazing on shrubs, slides, regular flooding, etc. all influence the vegetation development and history. It is Important to distinguish between natural and introduced disturbances. Use category “other” if nothing else fits and explain.

Disturbance History (anthropogenic): Use “other” and explain if not included here. Again, this information can indicate artificial causes of changes in vegetation patterns and consequently ecosystem structure and function.

Environmental characteristics:
This data will support ecosystem descriptions. Record Slope in percentage, Aspect in degrees, Elevation in metres. For Mesoslope, Moisture, Nutrient and Drainage, refer to the definitions from DEIF.

The coding format to be used on the groundtruthing forms follows Mesoslope position; use **CR**-crest, **UP**-upper slope, **MD**-midslope, **LW**-lower slope, **TO**-toe, **DP**-depression, **LV**-level, indicate range if necessary. For Drainage use R-rapidly drained, **W**-well drained, **M**-moderately well drained, **I**-imperfectly drained, **P**-poorly drained, **VP**-very poorly drained.

For Moisture and Nutrient Regime use the numbers and terms from the Ministry of Forests Site Interpretation manuals for your region.
e.g. 2-3(SD) Moisture VP(A) Nutrient
Use indicator species to support your site interpretation.

For wetlands, assess the first 50 cm of the soils using a soil auger, and tick mineral or organic on the form.

Ecosystem type(s): Some polygons may contain both primary and secondary ecosystem components which cannot be delineated separately (review the 'uniformity' assessment). If this is the case, list separately on this line and indicate the % of the polygon each occupies. Describe the vegetation for each ecosystem type separately. Indicate the distribution of ecosystems in the sketch. If other ecosystems are represented only as minor inclusions, note in the comments field. Forested site associations should be listed according to the Biogeoclimatic Ecosystem Classification (e.g. CWHxm1/02, CWHxm1/00).

If a full ecological plot is conducted, assign an number corresponding to DEIF plots that have been completed for the polygon.

Adjacent land uses: Briefly describe land uses surrounding the polygon, farming, logging, sewage treatment, etc.

Known threats: Briefly document any current knowledge or observations related to continued or further threats to the continued existence of the ecosystem(s) in that polygon.

CLASSIFICATION OF WETLAND (use an approved classification system):
Hydrology: Use the classes as set out in the wetland classification system. If there is more than one type of wetland in the polygon, list them separately.

Wetland class (%): Use the classes as set out in the classification system. If there is more than one type of wetland in the polygon, list them separately and indicate % each occupies of the total polygon. If there is more than one wetland vegetation type for the class indicated, note this information. E.g. Marsh veg type A 20% and Marsh veg type B 80%. These two different marsh vegetation types should be described in separate vegetation lists and their orientation indicated on the sketch.

Inflow/Outflow: Indicate on the sketch and on the air photo (with a small arrow) the direction of water flow in and out of the wetland(s) or polygon. If this is not visible on the photos and cannot be determined on the ground use the "Not verified" checkoff.

SKETCH: Quickly sketch the polygon with the distribution of ecosystem association(s), landforms, water flow, etc. Mark the point where a plot was completed or from which most notes were taken. Mark North on the sketch and other features for orientation.

VEGETATION DESCRIPTION (of sample plot):

Filling out this part of the Uplands groundtruthing form in not required if a DEIF vegetation plot (ecoplot or reci plot) has been completed. Since the DEIF forms do not separate out wetland vegetation layers, this part of the wetlands groundtruthing form should be filled out, in addition to the DEIF (or reci) forms.

Vegetation Type: In the first column indicate the % cover of all species combined within the Layer or vegetation category. e.g., Coniferous species present in the overstorey tree layer is 60% cover.

Dominant Species: An example could be as follows: the dominant species is *Pseudotsuga menziesii* at 45% cover, *Tsuga heterophylla* is 30% and *Thuja plicata* another 25%. This percentage cover is to be based on the 100% cover for the vegetation unit (sample plot) being described. For coniferous species record the diameter at breast height and cored age of the most common age class. Indicate which canopy layer this age class is in e.g. veterans, A1, A2 or A3 as in DEIF. If tree species reappear in shrub, herb, grass or moss/lichen layers record their occurrence.

Use Latin names for all species, and use the 8 letter codes (first 4 letters of genus followed by first 3 letters of species, and one letter of subspecies if applicable, *e.g.* Vaccpar is *Vaccinium parvifolium*). For tree species use the 2 letter codes as listed used by the Ministry of Forests. Use **Qg** for Garry oak and **Ra** for arbutus, **Mb** for big leaf maple, **At** for trembling aspen.

Introduced vascular plants species must be recorded. Refer to Commonly Encountered Introduced Plant Species of British Columbia (Appendix 3).

Voucher specimens: Prepare one collection sheet for each vascular plant in flower or in fruit encountered in their study area. If specimens are collected in the polygon being checked record the species collected (or the potential identification) and the collection number attached to the specimen.

Appendix H: SEI Contacts

Environment Canada
Canadian Wildlife Service
Vancouver Island

3567 Island Highway West
Qualicum Beach, B.C.
V9K 2B7
Tel/fax: (250) 752-9611
Contact: Peggy Ward
web site: www.pyr.ec.gc.ca/wildlife/

Environment Canada
Canadian Wildlife Service,
Pacific and Yukon Region

RR 1, 5421 Robertson Road
Delta, B.C.
V4K 3N2
Tel: (604) 940-4700; Fax: (604) 946-7022
Contacts: Ken Brock, Trish Hayes.
web site: www.pyr.ec.gc.ca/wildlife/

Ministry of Environment, Lands and Parks
Vancouver Island Regional Headquarters

2080A Labieux Road
Nanaimo, B.C., V9T 6E9
Tel: (250) 751-3100; Fax: (250) 751-3103
Contacts: Marlene Caskey, Bill Hubbard,
Trudy Chatwin

Ministry of Environment, Land and Parks
Conservation Data Centre

PO Box 9344, Stn. Prov. Govt.
Victoria, B.C., V8T 9M1
Tel: (250) 387-0732; Fax: (250) 387-2733
email: elpcdcdata@victoria1.gov.bc.ca
web site: http://www.elp.gov.bc.ca/rib/wis/cdc/
Contacts: Jan Kirkby, Andrew Harcombe

To order maps:

Clover Point Cartographics
202 - 919 Fort Street
Victoria, B.C. g140
V8V 3K3
Tel: (250) 384-3537; Fax: (250) 384-2679
e-mail: cloverpoint@pinc.com

To obtain field data:

Jan.Kirkby@gems9.gov.bc.ca
(250) 387-0732
or
Bill.Hubbard@gems2.gov.bc.ca
(250) 751-3236

SEI Web Site:

www.pyr.ec.gc.ca/wildlife/sei

OR

www.elp.gov.bc.ca/rib/wis/cdc/sei

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