DIVERSITY by DESIGN

A Guide to Restoring Habitat for Species at Risk on BC's South Coast

SOUTH COAST CONSERVATION PROGRAM

Protecting and Restoring at Risk species and Ecological Communities on BC's South Coast

South Coast Conservation Program
www.sccp.ca

Established in 2005, the South Coast Conservation Program (SCCP) is a multi-partner, landscape-level conservation program. The SCCP was established to provide a coordinated approach and facilitate implementation of sound conservation and management for species and ecosystems at risk within the South Coast region.

Partners in the SCCP include the provincial and federal governments, municipalities, regional districts, First Nations, non-government conservation organizations and programs, universities, and several private consultants.

For more information on the SCCP, including a full list of organizational partners, visit www.sccp.ca.

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Diversity by Design

A Guide to Restoring Habitat for Species at Risk on BC's South Coast

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South Coast Conservation Program

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FORWARD

Conservation and recovery of species and ecological communities at risk is a shared responsibility for all who live in BC's South Coast including governments, non-governmental organizations, stewardship groups, private landowners, and residents.

This document is the foundation for a multi-part roadmap designed to help those engaging in any type of habitat restoration or management activity on BC's South Coast to effectively plan their project considering the habitat needs and potential for impacts to species and ecological communities at risk. This document, provides guidance to restoration practitioners on conceiving, planning, implementing, and monitoring the effectiveness of habitat restoration projects involving species and ecological communities at risk. Modules 1-3 provide more detailed design criteria and restoration techniques for priority ecological communities on the South Coast, supported by locally relevant case studies.

With continued growth and development in the region and its associated impacts to habitat for species at risk, habitat restoration is an essential part of the recovery efforts for many species. Also, restoration can be expensive and with limiting funding available for restoration projects, there is a need to plan restoration projects which benefit biodiversity broadly, not just a single target species. Whether your project is directly targeting species at risk or not, this guide can help you plan a project that considers the presence of existing species at risk populations, maximizes its potential benefits for species at risk, and minimizes the potential for any negative impacts.

The SCCP hope that readers find Diversity by Design a helpful and informative resource for planning habitat restoration projects that will benefit a range of species.

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TABLE OF CONTENTS

TABLE OF CONTENT - LIST OF TABLES/FIGURES

List of Tables

List of Figures

INTRODUCTION

Western Painted Turtle - Illustration by Carrielynn Victor

Diversity by Design is intended to fulfill an identified need for science-based guidance for stewards, land managers, and practitioners involved in habitat restoration and management activities that either directly target or indirectly affect species and ecological communities at risk on BC's South Coast. Increasingly, it is increasingly recognized that restoration projects should not be only focused on a single species but should employ a "multi-species approach" in order to maximize their conservation impact. Also, conflicts can arise between actions which are aimed at recovering one species but which may adversely impact another species. With the increased stressors on species and habitats, broadening the potential benefits of habitat restoration projects to include both species at risk and biodiversity generally while working to avoid unintentional conflicts with and risks to non-target species is needed. This guide and its accompanying modules present information useful for planning and implementing habitat restoration projects incorporating such an approach.

There are a suite of resources available for habitat restoration and stewardship, many of which cover species at risk. The BC Ministry of Environment's Develop with Care series and Best Management Practices (BMPs) have been developed for individual species. The Stewardship Centre of BC has also developed a number of voluntary stewardship practices for species at risk which include habitat restoration. Diversity by Design is meant to complement these and other resources.

Here are several examples of how restoration projects can benefit:

- A community park association would like to clear invasive plant species in an area adjacent to a wetland which is also home to a rare plant species.
- A government agency or department has developed an invasive plant management plan for a forested area within a park that includes mechanical invasive removal, use of herbicides to control some species, and re-vegetation with native species.
- As part of a highway widening project, 500 m^2 of compensatory fish habitat must be constructed to compensate for habitat lost as a result of the project. The watershed has several known occurrences of a rare fish species.
- An off-channel wetland is being constructed by a local environmental stewardship group to increase available rearing habitat for overwintering coho salmon.
- A development permit for new development in an Environmental Development Permit Area requires the restoration of a riparian buffer zone along a stream. In addition to providing fish habitat, several species at risk are known in the area.

WHAT ARE SPECIES AND ECOSYSTEMS AT RISK?

Diversity by Design can help project proponents take appropriate measures to avoid or mitigate the risks to species and ecological communities at risk; it also highlights how such projects can actually be turned into more broadly beneficial projects, achieving regulatory requirements or management objectives, while also benefiting a broader range of ecological and social needs through careful planning and design.[1]

The primary audience for the guide and modules is practitioners engaged in the restoration and management of habitats for species and ecological communities at risk. Examples include municipal and regional land managers (e.g., parks and urban forestry departments, drainage and watershed planning), conservation organizations, and volunteer-based stewardship and community groups. Although not the primary audience, Diversity by Design may also be useful for developers and their consultants involved in habitat mitigation and restoration design.

This document represents Part 1. It provides the initial roadmap to conceiving, planning, implementing, and monitoring the effectiveness of habitat restoration projects involving species and ecological communities at risk. The modules provide more detailed design criteria and restoration techniques for priority ecosystem types on the South Coast including example case studies.

What are Species and Ecosystems at Risk?

A plant, animal, or ecosystem is said to be "at risk" when it is deemed to be in danger of disappearing from the wild. In Canada, assessments of a species' status are made at both federal and provincial government levels, based on biological factors and standardized assessment criteria.

In British Columbia, the **BC Conservation Data Centre (CDC)** maintains Red and Blue Lists of species and ecological communities that are in danger of disappearing from the wild (Table 1). This process can be considered a higher level screening process: species placed on the provincial Red and Blue lists are flagged as being of conservation concern and requiring investigation. The Red and Blue lists provide a list of species for consideration for more formal provincial designation under the British Columbia Wildlife Act. The lists also provide a method of assigning conservation priorities for species in British Columbia.

At the federal level, the **Committee on the Status of Endangered Wildlife in Canada (COSEWIC)** is a committee of experts that assesses and designates wildlife species that are in some danger of disappearing from Canada. Species are listed by the responsible Minister under the Species at Risk Act (SARA) on the basis of a status report, which summarizes all available information on that species and assesses its status against quantitative biological criteria. Species can be assigned to one of seven categories: Extinct, Extirpated, Endangered, Threatened, Special Concern, Data Deficient, or Not at Risk (Table 2). Species are re-assessed every 10 years.

[1]It is important to recognize that while the SCCP strives to provide as current, and comprehensive information as possible, applying the restoration approaches in the guide and modules does not replace the need for due diligence regarding legislative and regulatory requirements and responsibilities.

WHAT ARE SPECIES AND ECOSYSTEMS AT RISK?

Table 1. Definitions of the provincial Red, Blue, and Yellow Lists.

List Name	Definition
Red List	Includes any ecological community, and indigenous species and subspecies that is extirpated, endangered, or threatened in British Columbia. Extirpated elements no longer exist in the wild in British Columbia, but do occur elsewhere. Endangered elements are facing imminent extirpation or extinction. Threatened elements are likely to become endangered if limiting factors are not reversed.
Blue List	Includes any ecological community, and indigenous species and subspecies considered to be of special concern (formerly vulnerable) in British Columbia. Elements are of special concern because of characteristics that make them particularly sensitive to human activities or natural events. Blue-listed elements are at risk, but are not Extirpated, Endangered or Threatened.
Yellow list	List of ecological communities and indigenous species that are not at risk in British Columbia.

Table 2. COSEWIC status assessment categories.

List Name	Definition
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species that no longer exists in the wild in Canada, but exists elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.
Special Concern (SC)	A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.
Data Deficient (DD)	A category that applies when the available information is insufficient (a) to resolve a wildlife species' eligibility for assessment or (b) to permit an assessment of the wildlife species' risk of extinction.
Not at Risk (NAR)	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

Once a species has been designated "at risk" (one of the first five categories listed above) by COSEWIC, it is considered for addition to the List of Wildlife Species at Risk (Schedule 1) under the federal Species at Risk Act (SARA).

Once a species has been listed under SARA, a recovery strategy must be completed within one year of a species being listed as endangered, and within two years of a species being listed as threatened or extirpated (extinct in Canada).. Recovery strategies identify priority actions to ensure the survival and recovery of species. They can be focused on single species or on multiple species with significant similarities or habitat overlaps. The goal of recovery planning is to help stop or reverse the decline of a species, and/or reduce or remove the threats to its long-term persistence in the wild. Depending on the species, a federal or provincial agency may take the lead in recovery planning. Recovery teams are made up of government biologists, land managers, and other experts that assist in the development of the recovery strategy as well as action plans, which assist in recovery implementation.

Ecological communities at risk in BC are only tracked at the provincial level and are not yet legally-designated at either the federal or provincial level.[2]

For the purposes of this guide, species and ecological communities at risk include:

- Species and ecological communities which have been placed on the provincial Red or Blue lists by the BC Conservation Data Centre.
- Species that have been assessed and recommended for listing under SARA by COSEWIC (but may not yet be listed under SARA); and
- Species that are officially listed as at risk on Schedule 1 of SARA as either Extirpated, Endangered, Threatened, or a Species of Special Concern.

BC's South Coast Region

The South Coast region of BC follows the boundaries of three forest districts – Chilliwack, Squamish, and Sunshine Coast. The region encompasses lands in five regional districts (Fraser Valley, Metro Vancouver, Powell River, Sunshine Coast, and Squamish - Lillooet), 34 municipalities, a number of electoral areas, and 2 ratified treaty areas (Tsawwassen and Sechelt). The traditional territories of 21 First Nations are also found wholly or partly in the region. Figure 1 shows the boundaries of the South Coast region.

BC is Canada's most biologically diverse province. The South Coast in particular, encompasses some of the rarest and most endangered species and ecosystems in BC and Canada and is one of three biodiversity hotspots in the province.[3] On the South Coast, over 300 species are provincially and federally listed as threatened or

[2]There are some exceptions to this e.g. for species associated with Garry Oak ecosystems on Vancouver Island, which have multi-species recovery strategies that reflect ecosystem associations.

BC's SOUTH COAST REGION

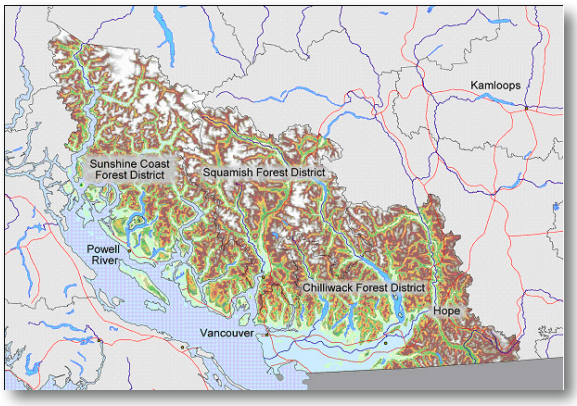


Figure 1. Map showing boundaries of BC's South Coast region.

endangered (Table 3; BC Species and Ecosystems Explorer, 2015). In addition, over 110 ecological communities have been classified "at risk" (Table 4; BC Species and Ecosystems Explorer, 2015).

BC's South Coast region is also home to over two million people and growing. The population is expected to double by 2036 (Transboundary Georgia Basin-Puget Sound Environmental Indicators Working Group, 2002). This level of population growth and development has and will continue to have impacts to biodiversity and species and ecological communities at risk. As a result, most ongoing threats relate to human activity in some way and include:

- Habitat loss or degradation from various forms of development (residential and commercial development, agriculture, energy production and mining, transportation, etc.);
- Wildlife harvesting and consumptive uses (for some species);
- Changes in ecological dynamics and natural processes;
- Invasive and other problematic species;
- Pollution;
- Climate change and extreme weather.

Habitat restoration has an important role to play in reversing, mitigating, or compensating for the impacts from many of these threats.

[3]The South Coast vies as a biodiversity hotspot with Southeast Vancouver Island/Gulf Islands and the South Okanagan/ Similkameen).

Table 3. Numbers of provincially - and federally-listed species at risk by species group within the South Coast region (Source: BC Species & Ecosystems Explorer, 2015).

	Provincial Lists		COSEWIC List				
Species Group	Red List	Blue List	Extinct (X)	Extirpated (XT)	Endangered (E)	Threatened (T)	Special Concern (SC)
Birds	4	17	0	0	1	8	6
Mammals	7	9	0	0	3	0	6
Amphibians	2	3	0	0	1	1	3
Reptiles	4	1	0	2	2	1	2
Fish (fresh water)	5	2	2	0	2	3	2
Invertebrates	20	19	0	1	2	3	4
Vascular Plants	47	80	0	0	6	2	2
Non-vascular Plants	24	41	0	0	3	0	0
Lichens	0	2	0	0	0	0	2
Totals	**113**	**172**	**2**	**3**	**20**	**18**	**26**
	285		**64**				

Table 4. Numbers of red - and blue-listed ecological communities at risk by ecosystem type within the South Coast region (Source: BC Species & Ecosystems Explorer, 2015).

Ecosystem Type	Red List	Blue List
Forest	34	33
Grassland	2	3
Subalpine/Alpine	2	0
Flood	6	5
Beach	2	0
Wetland	9	19
Estuarine	9	0
Totals	64	60

What is Restoration?

Ecological restoration is "the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed" (Society for Ecological Restoration, 2004). It is an intentional activity that seeks to initiate, accelerate, or alter the trajectory of an ecosystem and increase its ecological integrity.[4] Put simply, restoration aims to restore an ecosystem or landscape that has been disturbed by human activity to something which resembles a more "natural" state.

Ecological restoration is "the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed" (Society for Ecological Restoration, 2004).

At its most basic level, species at risk recovery is a form of restoration. Along with habitat protection and mitigating threats, restoration is integral to species recovery. The primary goal of a recovery strategy is to move a particular species or ecological community with small or declining numbers to a distribution or population size that is more likely to persist in the long-term. As the Species at Risk Act focuses on single species, many of the historic recovery actions in BC have been designed to meet a single species' needs – for example, Spotted Owl and Vancouver Island Marmot. Although species do often require individually targeted conservation efforts, each species is ultimately dependent on a web of relationships form the basis for healthy, functioning natural ecosystems. Over the long-term, ecosystems and landscapes with existing high levels of biodiversity and ecological integrity are more likely to sustain and support the recovery of populations of species and ecological communities at risk.

Effective restoration must also recognize why a habitat or ecosystem is degraded in the first place. Understanding the roles of biophysical features, limiting factors, disturbance, and key ecological processes are essential to determining what restorative actions should be taken. Furthermore, restoration must also recognize the significant role of First Nations cultural practices (e.g., prescribed burning, soil disturbance) to which some ecosystems are adapted. For some ecosystems, re-establishing such practices can be an important part of effective restoration.

Diversity by Design uses the term "restoration" broadly to include any activity undertaken to improve the ecological integrity of a particular species, habitat, ecosystem, or landscape. Restoration is possible across a wide variety of ecosystem types, at various scales and is related to several overlapping approaches aimed at improving the condition of degraded ecosystems including mitigation, compensation, reclamation, and enhancement (Table 5). Ecological restoration, in its broadest sense can be seen to embrace all of these activities.

[4]Parks Canada defines ecological integrity as "a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes" (Parks Canada, 2000). In plain language, ecosystems have integrity when they have their native components intact, including: abiotic components (the physical elements, e.g. water, rocks), biodiversity (the composition and abundance of species and communities in an ecosystem) and ecosystem processes (the engines that makes ecosystem work; e.g. fire, flooding, predation).

WHAT IS RESTORATION?

Table 5. Definition of important terms related to restoration (modified from Gayton, 2001 except where noted).

Term	Definition
Restoration	Process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed (Society for Ecological Restoration, 2004).
Reclamation	As the term is used in British Columbia, seeking to stabilize soil and water on lands that have been damaged by industrial activity, and to return the land to some useful purpose.
Mitigation	Reducing environmental damage from a specific source of damage or pollution, such as reducing industrial phosphate emissions into a river system. Mitigation includes the concept of environmental credits, in which a producer of pollution will undertake reclamation, a land purchase, or other work to offset their negative ecological effects.
Compensation	Replacement of natural habitat, increase in the productivity of existing habitat, or maintenance of habitat by artificial means in circumstances where mitigation techniques and other measures are not adequate to maintain habitat values (adapted from DFO, 1986).
Enhancement	Manipulating habitat to allow a selected species to exceed its historical population levels in a particular area, generally for socio-economic reasons.
Conservation	General term for the protection of existing species, landscapes, or ecosystems.
Stewardship	A general term for maintaining or protecting a natural area or natural resource.
Ecological integrity	An ecosystem has ecological integrity when: (1) it is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes" (Panel on the Ecological Integrity of Canada's National Parks, 2000). (2) the structure, composition and function of the ecosystem are unimpaired by stresses from human activity; natural ecological processes are intact and self-sustaining, the ecosystem evolves naturally and it's capacity for self-renewal is maintained; and the ecosystem's biodiversity is ensured (BC Parks Legacy Panel, 1999).

Some Guiding Principles

Diversity by Design has been developed with a series of overarching principles that, if followed, will increase the likelihood of successful restoration projects. We encourage anyone undertaking restoration on the South Coast to understand and adopt them in their project planning and design. Many of these principles have been borrowed from the recently published Restoring British Columbia's Garry Oak Ecosystems: Principles and Practices guide (GOERT, 2011):

1. Put protection before restoration. For some ecosystem types (e.g. wetlands, coastal sand ecosystems), over 85% of their historic footprint on the South Coast has already been lost or degraded by human activity. Protection of remaining intact habitats and ecosystems and associated processes is a key component of preserving and recovering species and ecological communities at risk. The reality though is that even the best restoration projects will never recreate entirely what has been damaged, degraded, or destroyed. The potential values that restoration can provide should not be used as a rationale or justification for destroying remaining habitats or ecosystems.
2. Take a long-term view. Is your site secure as a natural habitat area in the long-term before you begin a project? If a restoration site has the potential for future development, the benefits may only be short-term and your investment of time and money may be in vain. Many restoration projects will also require additional management or regular maintenance and monitoring in the future to be successful. It is important that you take a long-term view to avoid making investments in projects that cannot be sustained.
3. Design for diversity. It may seem to go without saying, but whenever possible, seek to design projects which benefit multiple species and biodiversity broadly, not just a single species. Avoid creating habitat for one species at the expense of another, especially if that species is a species at risk.
4. Adopt a socio-ecological approach. With seven billion people on the planet very few ecosystems exist that are not affected or managed within a human context. Successful restoration efforts often require changing human behavior and working with landowners and decisions makers. Projects that integrate local land use interests with ecological knowledge and up to date science have a higher likelihood of success and will are more likely to endure. Lack of consultation and involvement with necessary stakeholders at the start can doom restoration projects. Another key aspect often overlooked is investing in long-term education resources for community partners and interests (Sauer 1998). As an example the SCCP has developed a number of complementary education tools that assist in its work with local landholders, municipal governments and schools.[5]
5. Apply the best available knowledge. This can include scientific research, as well as local and indigenous knowledge. Ecological restoration techniques and methods are continually improving as we learn more about how ecosystems function. Users of this guide should view the content as a complementary starting point for their project that includes integrating other resources and expertise.

[5]Examples include Species at Risk in the Classroom and Local Government Tools Supporting Species and Ecosystems at Risk: A Resource Guide for the South Coast of British Columbia.

6. Set clear objectives. At the outset of any project, it is important to set clear attainable objectives. Project objectives drive the actions of a project, set criteria for evaluating success, and directly shape budgets. A project with unclear objectives may generate confusion among the participants, can lead to selecting incorrect methods, and may lead to conflicts when making decisions. It is hard to communicate to the public and to project supporters if the project's desired outcomes and targets are vague. Goals should be S.M.A.R.T. – that is, specific, measurable, achievable, relevant, and time-based (i.e., both timely and time-bound). The importance of establishing clear, shared objectives cannot be overstated, it can determine the success or failure of a restoration project.
7. Apply adaptive management. Adaptive management is the systematic process of continually improving policies and practices by learning from the outcomes of management "experiments". The concept of adaptive management arose from the realization that land management activities, including ecological restoration, are often experimental because their outcomes cannot be predicted with certainty; their results will be known only after ecosystems have responded to treatments. Uncertainty is a common feature of restoration projects. To learn as much as possible from management experiments, adaptive management practitioners use a continuous cycle to plan, conduct, and learn from their activities that includes problem assessment, project design, implementation, monitoring, evaluation, and the adjustment of future decisions.
8. Document your results. Although this principle may seem obvious, many projects keep only brief or scattered records of what was attempted and what actually happened. Ecological restoration is a relatively new area of practice. Even the most basic observations are critical to advancing our understanding, and it is especially important to document failures so that unsuccessful approaches are not repeated. All new knowledge needs to be compiled and passed on to future restoration projects and practitioners.

Priority Ecosystems for Restoration

To aid in ecosystem restoration efforts on the South Coast, an ecosystem classification scheme has been developed (Table 6; see also Appendix 1). This classification is used throughout this publication to provide restoration practitioners with information (e.g., species-ecosystem associations) that can be used during project planning and design. It includes all major natural and human-modified ecosystems found in the region.

The classification generally follows the standards for Sensitive Ecosystem Inventories (or SEIs) that has been developed in partnership with Environment Canada for use in BC (BC Ministry of Environment, 2006). Sensitive Ecosystem Inventories have recently been completed on the South Coast, including Metro Vancouver and the City of Abbotsford (2013), Sumas Mountain (2012), Harrison (2010), and Sunshine Coast and Howe Sound (2005) area. Sensitive Ecosystem Inventories provide highly useful spatial information that is helpful as a planning tool for restoration. The classification used in this guide complements and is intended to be used with the SEI data and maps which were developed through the federal/provincial partnership.
As the classification generally follows the standards for Sensitive Ecosystem Inventories (or SEIs) methodology

has been developed within the context of the provincial Terrestrial Ecosystem Mapping (TEM) standards, this classification also connects well to TEM data, which is frequently used for ecosystem mapping as part of environmental assessments and resource development planning. Finally, the classification also maps well onto classifications used by other species at risk information sources including the BC Conservation Data Centre's BC Species & Ecosystems Explorer (BC Ministry of Environment, 2013) and the Stewardship Centre of BC's Species at Risk & Local Government: A Primer for British Columbia website (Pearson and Healey, 2013).

A sensitive ecosystem is one that is considered fragile and/or rare (Ward et al., 1998). Rare ecosystems often support rare species, including species at risk.

Higher priority ecosystems for restoration have been identified (shown starred and in italics in Table 6) based on their sensitivity, current threats, importance for species at risk, and potential for successful restoration.

Table 6. Classification of major natural and human-modified ecosystems found on the South Coast. Priority ecosystems for restoration are noted by stars and italicized.

Forests and Woodlands	
Old Forest (OF)	"Old-growth" forests greater than 250 years old. Generally conifer-dominated with complex vertical structure but may include older mixed coniferous stands.
Mature Forest (MF)	Forests between 80 and 250 years old. Usually older second-growth forests on the South Coast. Not as structurally complex as old forests.
Young (Immature) Forest (YF)	Forests between 15 and 80 years old. May be coniferous, broadleaf, or mixed. Includes early regenerating stands and young woodlands.
Woodland (WD)	Open forests (10-30% tree cover) as a result of site conditions; found on dry sites, mostly on south facing slopes of rocky knolls and bedrock-dominated areas, e.g., Garry oak or Arbutus woodlands.
Freshwater Ecosystems	
Large River (RV)	Major navigable rivers with large open channels, e.g., Fraser River, Pitt River.
Lowland Stream / River (LS)	Low-gradient coastal streams and rivers. May have some headwater areas in mountains but fed primarily by surface water (rainfall) and groundwater for most of the year. Frequently dyked to prevent flooding.
Mountain Stream (MS)	High-gradient streams originating from mountain lakes or high elevation headwater areas. Seasonally fed by snowmelt.

Table 6. Continued.

Riparian (RI)	Areas associated with and influenced by freshwater. Includes floodplain benches, riparian fringe, gullies, canyons, gravel bars, and mudflats.
Wetland (WN)	Areas that are saturated or inundated with water for long enough periods of time to influence vegetation and soil. Includes bogs, fens, marshes, swamps, shallow water, and wet meadows.
Lake, Pond, and Reservoir (FW)	Areas of water that lack emergent or floating vegetation.
Tidal and Marine Ecosystems	
Estuarine (ES)	Confluence of rivers with the ocean. Influenced occasionally or diurnally by tidal inundation and brackish water. Includes estuary swamps, meadows, marshes, and tidal flats.
Intertidal and Shallow sub-tidal (IT)	Coastal areas influenced by diurnal tidal cycles with little to no freshwater input (primarily through rainfall runoff). Includes mudflats, beaches, rocky shorelines, and eelgrass.
Other Natural Ecosystems	
Herbaceous (HB)	Non-forested ecosystems with less than 10% tree cover. Includes coastal bluffs, vegetated shorelines, and shrubs.
Sparsely Vegetated (SV)	Areas of low vascular vegetation cover, generally 5 – 10%, but may be greater in some patches; may have high cover of mosses, liverworts and lichens. Includes cliffs, rock outcrops, talus slopes, sand dunes, and spits.
Alpine (AP)	Ecosystems above or near tree-line – mostly non-forested but includes treed islands and windblown, Includes herbaceous, shrubby treed patches (krummholz), parkland forest, dwarf shrub, tall shrub, and avalanche tracks.
Human-modified Ecosystems	
Seasonally-flooded Agricultural Field (FS)	Annually flooded cultivated fields or hay fields; important migrating and wintering waterfowl habitat.
Old Field (OF)	Lands formerly cultivated or grazed but later abandoned; in an intermediate stage of succession; will eventually become forest without management.
Agricultural Field (AG)	Includes agricultural areas in active agricultural use and rotation including vegetable and grain crops, berry fields, vineyards, orchards, pasture lands, etc.
Urban / Disturbed (UR)	Includes highly disturbed and modified areas.

PROJECT PLANNING and IMPLEMENTATION

Common Nighthawk- Illustration by Carrielynn Victor

Whether you are planning a project involving restoration for fish, amphibians, a coastal sand ecosystem, or undertaking invasive species management, it is important to ensure that your project will not impact non-target species and will have long-term ecological viability and integrity. Successful multi-species habitat restoration requires a careful and systematic approach to planning, design, and implementation.

The recommended guidelines for habitat restoration incorporating species at risk are provided in the form of a planning and implementation approach that includes six phases:

1. Pre-project Considerations
2. Ecological Inventory
3. Assessing Opportunities, Constraints, and Risks
4. Project Planning and Consultation
5. Implementation Monitoring and Adaptive Management

Figure 2 illustrates the recommended project approach as well as some of the inputs and outputs from each phase. As a project proceeds from phase to phase, decision-making points exist about whether a project can proceed, should be modified, or should be stopped because of unacceptable risks or sensitivities. The following sections provide more detailed guidelines for each phase of the approach.

Bearded Sedge- Illustration by Carrielynn Victor

PROJECT PLANNING and IMPLEMENTATION

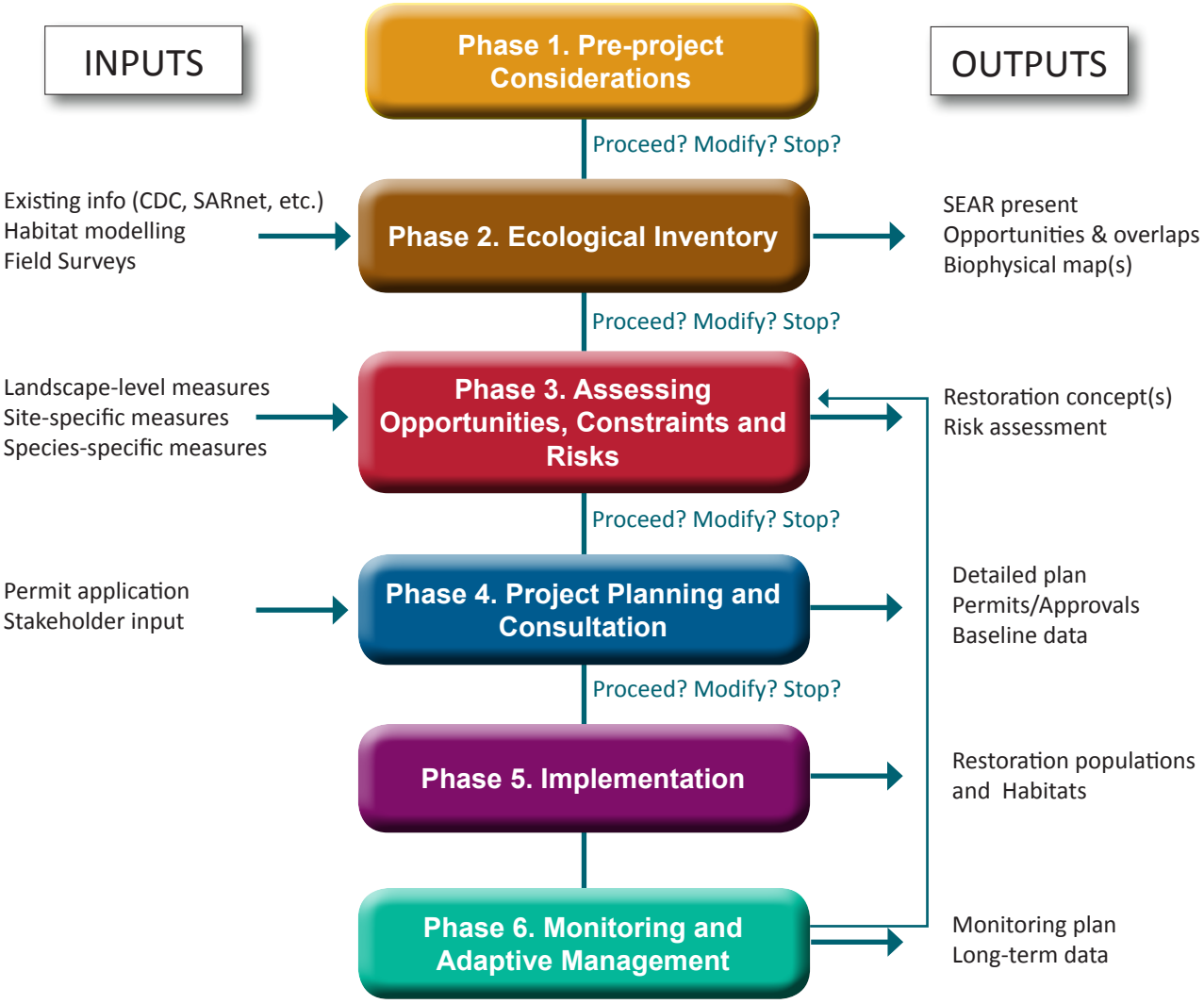


Figure 2. Recommended project approach for habitat restoration planning, design, and implementation, including inputs and outputs at each phase. As each phase is completed, a decision point exists as to whether to proceed, modify the project, or stop entirely because of unacceptable risks or sensitivities.

Phase 1 – Pre-project Considerations

Before you get too far into conceiving and planning a habitat restoration project, it is worth doing some initial consultation and thinking to help shape your planning. Important considerations include project and site selection, organizational capacity, and partnerships.

1.1. Initial Consultation

If you are part of an agency or group that wants to get involved in species at risk restoration but does not have a lot of experience, getting some initial advice is important, even before you choose a project or site. For many species there are often recovery teams, experts, or consultants whom are noted for their expertise. Often, these individuals can be contacted for an initial injection of advice. An initial conversation may help you assess which species and sites are in need of habitat restoration in your area and how complex a potential project may be. If you have a specific project in mind, they may be able to comment on how viable it is. The bottom line – those without experience and expertise should seek guidance.

A list of the recovery team chairs and their contact information can be found on the SARA website (http://www.sararegistry.gc.ca).[6] The SCCP can also provide recommendations as to who may be the best contact to approach depending on your group's interests and project area.

1.2. Choosing Your Site – Remember that Long-term View

If you already have a potential project or site in mind, it is important to know whether or not a site is protected from future development. This is especially important when undertaking restoration on private lands, but is also relevant on public lands as well. Landowners may be excited about restoration on their lands but land does change hands and new owners can have a different perspective. Parkland dedication, conservation covenants, and stewardship agreements are all potential options for securing a site in the long-term. The Stewardship Series guide Stewardship Options for Private Landowners in British Columbia[7] (Penn, 1996) provides good information on the range of options available. If there is a high likelihood that a site will be developed in the future, it may be better to focus your efforts on a site with a higher level of long-term protection.

1.3. Knowing your Organizational Capacity

It is also important to understand your group or agency's capacity. Restoration projects involving species at risk almost always require a multi-year commitment and ongoing maintenance and monitoring. Do you have the appropriate funding and people power to carry out the project? Will these resources be available for the

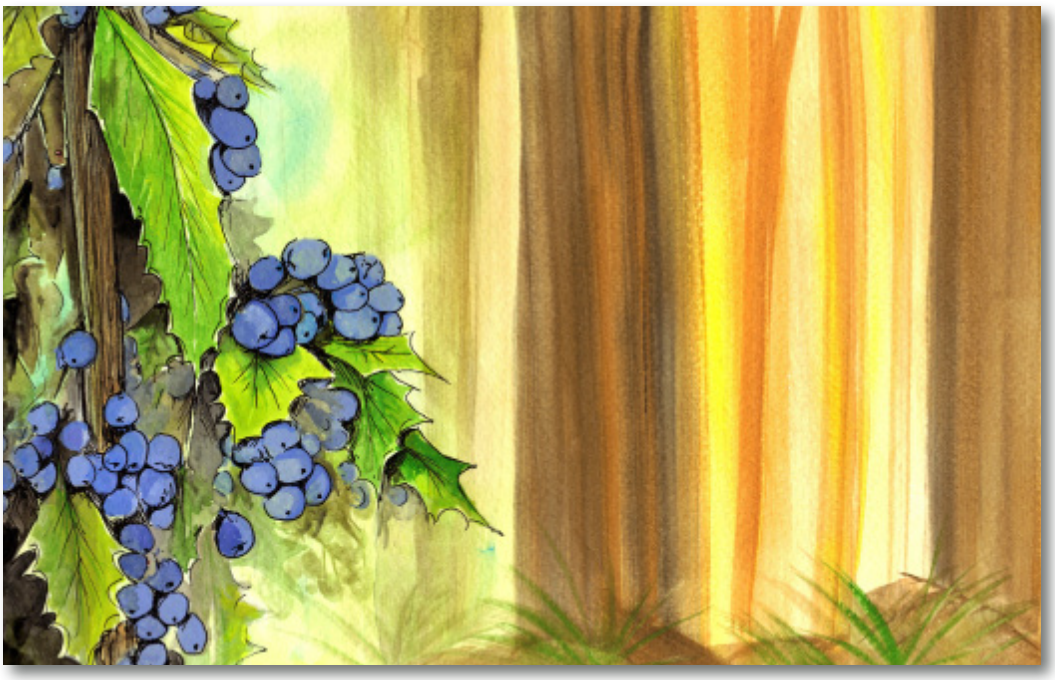
[6]http://www.sararegistry.gc.ca/sar/recovery/team_ch_e.cfm. Note contact information may not be up to date for all teams.
[7]Available for free download from www.stewardshipcentrebc.ca.

duration of the project? If you are volunteer-based, how many volunteers are you likely to have over the life of the project and what contribution will they be able to provide? A chronic challenge with habitat restoration projects is the lack of follow-up evaluations, maintenance, or monitoring. Therefore, it is important to choose projects that fit with your organizational capacity over the full life of the project.

1..4. Partnerships

If your group does not have the capacity to undertake a project on its own, collaborations and partnerships can be a great way to develop the necessary capacity. Some of the strongest partnerships for habitat restoration have been between local governments and community-based stewardships groups because they can bring a diversity of strengths to a project. Species at risk recovery teams may also be looking for assistance with projects they are wishing to undertake, such as restoring key occupied sites, or even re-introducing species at risk to new locations.

If you do choose to enter into a partnership for a project, it is important to clearly define who will lead different aspects of the project and how decisions will be made.



Dull Oregon Grape- Illustration by Carrielynn Victor

Phase 2 – Ecological Inventory

Once a potential restoration site has been identified, conducting an ecological inventory should be undertaken as the next phase in project development. This includes obtaining existing information, conducting a field inventory, as well as understanding the role of different ecosystem processes and factors that may influence a site.

2.1. Gathering Existing Information

One of the first tasks when embarking on a restoration project is to gather existing information about species and ecosystems at risk that may be known or have the potential to occur within your restoration site.

Known Occurrence Records

It is important to obtain information on any known occurrence[8] records of species at risk in your restoration area. There are several sources for information on known occurrences (Table 7):

- The BC Conservation Centre should be contacted to obtain occurrence records for any red- or blue-listed species found within your study area. Data can currently be accessed in three ways: (1) via the BC Species and Ecosystems Explorer, which provides simplified maps and information on occurrences for each species; (2) via the DataBC portal, which provides more detailed downloadable record information and spatial data (GIS shapefiles), or (3) or by contacting the Conservation Data Centre directly (see Table 7). Even if data is accessible online, it is worth contacting the Conservation Data Centre directly by email or phone. Data available online only includes records for non-sensitive species. Accessing information on sensitive species requires special permission. The CDC can help determine whether any sensitive species may be found in your area of interest and who to contact to obtain those records. Often, CDC staff are aware of either very recent or older historical records which may not yet be in their database.
- Recovery teams for species that have them should also be contacted. Because of their detailed work on particular species, recovery teams often have access to additional known occurrence information not held with the CDC.
- Recently created by the SCCP, SARnet (the "Species at Risk Network") is a data hub designed to provide up-to-date information and improve communication and collaboration between researchers, practitioners and the public around species at risk conservation. SARnet is an additional source for researchers or groups who may have records relevant to your project.

[8]Occurrence records (also known as element occurrences (EOs)) are detailed records that document the presence of a species or ecological community at risk at a particular site at a particular time. Records can represent visual sightings of a species, live captures (such as in a trap or net), or collections of dead voucher specimens for deposition in a museum collection.

Table 7. Potential sources of information on known and potential occurrences of species and ecological communities at risk on the South Coast.

Source	Description
BC Species and Ecosystems Explorer http://www.env.gov.bc.ca/atrisk/toolintro.html	Provides simple maps of the CDC occurrence records for most red- and blue-listed species in the province. As well, can search by regional district, municipality, habitat type and subtype.
Species at Risk A Primer for BC http://www.speciesatrisk.bc.ca/	Provides an easy to use database and summaries of species at risk in BC searchable by location, species, and habitat type. Useful for creating a list of potential species that could be found within your restoration area. Also useful for species information to share as part of any education and outreach included in your project.
BC Conservation Data Centre http://www.env.gov.bc.ca/cdc/	Contact by email or phone to request additional information. Often, additional records exist that have not yet been databased, such as very recent records or older historical records may exist.
Recovery Planning in BC website http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm	Recovery teams may have additional occurrence records not listed with the CDC. For privacy or other reasons, some records are never submitted to the Conservation Data Centre. A list of recovery team chairs can be found on this website.
SARnet http://www.sccp.ca/about-sarnet	Created by the SCCP to provide up-to-date information and improve communication and collaboration between researchers, practitioners and the public around species at risk conservation. You can register your project and search for similar projects by location or species.

Critical Habitat Polygons

It is also important to check whether any critical habitat[9] has been designated within your restoration area for any species at risk. Critical habitat polygons are often based on recent occurrence records but are extended to include adjacent suitable habitats as well. Critical habitat maps can be found in some of the newly published recovery strategies. Recovery teams should also be contacted as critical habitat maps may exist in draft form but not yet be published. Restoration within any designated critical habitat should not be undertaken without consulting the recovery team for that species.

Developing a List of Potential Species

Although some species may not yet be documented in your area of interest, they may still occur in the area

[9]SARA describes critical habitat as: "...the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in a recovery strategy or in an action plan for the species."

if suitable habitat exists. Many sites have not yet been adequately surveyed for a wide range of species and some species are simply difficult to detect, even if surveys have been undertaken.[10] To help target your field inventory, a list of potential species at risk which may be found in your site should be developed.

If you know the types of habitats found on your site, the BC Species and Ecosystems Explorer[11] can be used to develop a list of potential species based on your location and site characteristics. The Advanced Search function allows you to filter the database by regional district or municipality as well as different habitat types/subtypes. The Species at Risk A Primer for BC website can provide list of potential species based on the regional district, municipality and habitat type. Maps of existing occurrences, such as those found on the BC Species and Ecosystems Explorer can also be used to look at which species have known occurrences adjacent to your site in similar habitats. Appendix 2 shows the habitat associations of selected species at risk found on the South Coast based on the ecosystem classification presented previously and can also be used to help develop a list of species with the potential to be found in your restoration area.

Once you have a broad list of potential species, the list can be refined based on local and site specific knowledge. Local experts and naturalists[12] can also help suggest which species may be present given the types of habitats found in your area of interest or can help you refine a list you may have developed through the databases of information suggested above.

2.2. Conducting a Field Inventory

A field inventory should be conducted for both known and potential species at risk within your study area. The purpose of a field inventory is three-fold: (1) to confirm the ongoing presence of known species and document their distribution in your area of interest, (2) to establish whether any potential species you have identified for your site are actually found there, and (3) to better understand the relationship between distribution of particular species and habitat characteristics within your study area by understanding baseline conditions.

Survey Methodologies

All surveys undertaken for species at risk should follow previously developed inventory methods. These inventory methods have been developed to be effective, to minimize the risk of affecting the fitness or mortality species being targeted, and to avoid impacts to non-target species. Protocols typically detail both survey methods as well as appropriate levels of effort.

For many species at risk, species-specific protocols have been developed that are based on the best available scientific information and incorporate the collective experience of species experts. Some of these methods are summarized in the provincial Best Management Practices documents for particular species.[13]

[10]Remember the sage advice “absence of evidence is not evidence of absence”.
[11]http://www.env.gov.bc.ca/atrisk/toolintro.html go to “Launch BC Species and Ecosystems Explorer”.
[12]Organizations like BC Nature http://www.bcnature.ca/ have a number of local chapters that may be able to connect you to local experts or specialists.

BioBlitzes – Citizen Science Field Inventory

A BioBlitz is an intense period of biological surveying in an attempt to record all the living species within a designated area. Groups of scientists, naturalists and volunteers conduct an intensive field study over a short, usually a 24- or 48-hour, time. There is a public component to many BioBlitzes, with the goal of getting the public interested in biodiversity. To encourage more public participation, BioBlitzes are often held in urban parks or nature reserves close to cities.

In the absence of species-specific survey protocols, general standards for different forms of biodiversity (e.g., grassland birds, large mammals, amphibians, arthropods, etc.) have been developed by the province's Resource Inventory Standards Committee (RISC).[14]

It is important to ensure elusive species are not overlooked, such as difficult to survey for plant and animal species (e.g., Pacific Water Shrew, Phantom Orchid, Oregon Forestsnail).

If you think you have found a new occurrence of a species at risk, it is worth reporting that sighting for verification.[15] At a minimum, all new occurrence records for species at risk should include five pieces of information: (1) the species name, (2) date of the observation or capture, (3) name(s) of the observer(s) or collector(s), (4) number observed, and (5) detailed location information. For most species at risk, usually collecting a specimen is not appropriate, unless an accidental mortality has occurred. However, photographs are a helpful way to document and confirm the presence of a particular species within your site. Collecting habitat information can also be helpful to conservation and recovery efforts for that species.

Survey Timing

An important consideration in conducting targeted surveys for species at risk is what time of year the surveys will be conducted. Surveys for most species will be effective only at certain times of the year. Depending on

[13]A number of these BMP documents are available on the SCCP's website under the Guidelines or Resources tab. However, recovery teams should always be contacted for the most up-to-date and appropriate methods.
[14]RISC standards are available online at http://www.ilmb.gov.bc.ca/risc/pubs/tebiodiv/index.htm.
[15]The SCCP can be contacted at info@sccp.ca to help with species ID and channel inquiries to local specialists and government biologists. Occurrence information should be submitted to the CDC to ensure such information is properly warehoused. For many species groups, standardized observation forms have been developed by the BC Conservation Data Centre. These can be downloaded from the BC Conservation Data Centre website at http://www.env.gov.bc.ca/cdc/contribute.html.

the species, appropriate timing can vary widely. Site with potential or known multiple species occurrences may need to be surveyed at different times of the year to capture observations in the appropriate timing windows.

A future resource envisioned by the SCCP is a table outlining the best survey times for a suite of species at risk commonly surveyed for on the South Coast.

Survey Permits

Appropriate permits and in most instances professional or credible inventory and handling skills are required for conducting surveys involving wildlife (including at risk and aquatic, i.e. fish species):

- SARA Permits: Where a species is protected under SARA, a permit or agreement is required for any "activity affecting a listed wildlife species, any part of its critical habitat or the residences of its individuals" (Environment Canada, 2009). This includes work such as habitat restoration where "the activity benefits the species or is required to enhance its chance of survival in the wild." A SARA Permit is also required for introduction or re-introduction of species listed on Schedule 1.[16]
- BC Wildlife Act Permits: The BC Wildlife Act forbids the "capture, possession, shipping, and import of a vertebrate species without a permit" (BC Ministry of Environment, 1996). Activities such as trapping or moving individuals require a permit through the BC Permit and Authorizations Service Bureau (PASB).[17] Also, for species where (e.g., an Animal Care component of the Wildlife Act permit application is required. Specialized training or handling requirements may also be required for some species to prevent the transmission of disease (e.g., amphibians).
- Fish Sampling/Collection Permits: Under Section 51 of the Fisheries Act, "no person shall fish for experimental, scientific, educational or public display purposes unless authorized to do so under a license." Therefore, a permit is required for surveys involving trapping of fish under federal jurisdiction such as salmonids (http://www.pac.dfo-mpo.gc.ca/habitat/permits-permis-eng.htm). A permit is also required for freshwater fish under provincial jurisdiction and can be obtained through the PASB.
- Park Use Permits: A permit is also required for any survey or research undertaken within a provincial park or ecological reserve and can be obtained through the PASB.

For many species, more than one permit may be required. Depending on the permit, permits can take between 10 business days and 3 months to be processed, depending on the issuing agency. It is recommended that you apply for permits well in advance (3-4 months) of when they will be required. This is also where partnerships with specialists, the private sector or academia can be highly beneficial.

Use of Qualified Professionals

For some elusive or difficult to survey for species, it may be preferable to retain the services of a qualified

[16]See the SARA public registry for further details on permits and agreements (http://www.sararegistry.gc.ca/sar/permit/permits_e.cfm).

[17]More details regarding Wildlife Act, scientific collection and Park permits can be found on the BC Permit and Authorizations Service Bureau (PASB) website of the BC Ministry of Forests, Lands, and Natural Resource Operations http://www.env.gov.bc.ca/pasb/.

professional. A qualified professional is a person, such as a biologist, that is specifically trained or has a suitable level of experience to undertake a specific task.[18] Undertaking surveys for some species without adequate training or expertise can result in an inadequate survey. It can result in risk of injury or accidental mortality of either target or non-target species, particularly those where species capture is involved (either by trap or net). As well, habitat can sometimes be damaged.

Species for which specialized training or involvement from qualified professionals is recommended are:

- Small mammal trapping;
- Amphibian, reptile, or turtle surveys involving trapping or handling; or
- Some types of fish trapping.

Reporting Requirements

As per permit requirements, it is expected that any new species at risk occurrences will be reported without delay to the regional Species at Risk Biologist with BC Ministry of Forests, Lands, and Natural Resource Operations.

Submission to the BC Conservation Data Centre is also encouraged. The SCCP is also encouraging groups undertaking habitat restoration for species at risk to register their group on SARnet so that information from these projects can be networked and shared with others.

Identify Characteristics of Your Site

As part of your surveys, it is also important to conduct a baseline survey to document different characteristics of the restoration area, including important ecosystem types, biophysical features, and limiting factors.

Ecosystem mapping involves subdividing the restoration area into component ecosystems that are generally uniform (i.e., have similar ecological attributes) within themselves but differ from others. Identifying ecosystems present on a site is often straightforward because the differences among them are obvious, even to the "untrained" eye. The ecosystem classification suggested in the introduction represents a suitable standard for ecosystem mapping.

In addition to ecosystem mapping, other features to be documented are those that may be essential to sustaining different species or ecosystems present. Examples of important features to be noted include:

- Critical habitat features, such as nesting sites, roosting sites, foraging sites, and hibernation sites;
- Hydrological features, including the locations of watercourses, wetlands, seepage sites, and seasonally wet areas.

[18]The College of Applied Biology is the provincially legislated body governing Registered Biology Professionals in BC. See their website https://www.cab-bc.org/members-list/partial for a list of practitioners and their area of expertise relevant to your geographic area.

- Ecological boundaries, such as transitions between different habitat types and edges.

Important features should be photographed and locations clearly marked on a printed or hand-drawn site map.

2.3. Habitat Suitability/Capability Mapping

For some species, field surveys are likely to be inconclusive because the probability of detection or capture during surveys is low. In those cases, habitat suitability mapping[19] may be a better approach than inventory. Habitat suitability models have been developed for some species in order to predict the likelihood of species to be present in particular areas.

Two species which have habitat suitability models on the South Coast are Pacific Water Shrew and Oregon Forestsnail. Pacific Water Shrew, in particular, is a difficult species to confirm presence by inventory and lack of detection during inventory does not necessary confirm that they do not occur within the surveyed area. Best Management Practices for this species suggest the use of modeling in addition to surveys. Models have been developed for Pacific Water Shrew for use with both Terrestrial Ecosystem Mapping (TEM) and Sensitive Habitat Inventory and Mapping (SHIM) data.[20]

Developing these models is a complex task that requires specific ecological and statistical expertise. Models are typically developed for use with habitat mapping that is more commonly available, such as TEM or SHIM data. Although their application has been limited to date, it is likely that additional models will be developed for a wider range of species in the future.

2.4. Understanding the Role of Ecosystem Processes

As part of a baseline survey of your site, it is also important to understand the role of different ecosystem processes that may contribute to the maintenance of habitat or change over time. Understanding historical composition, structure, and processes is an important step to restoring a degraded site to a functional, resilient ecosystem.

Natural Processes (e.g., Succession)

Successful restoration involves understanding how an ecosystem is currently functioning and how these functions will be affected by different restoration approaches and actions.

There are four natural processes that govern ecosystem functioning: water cycling, nutrient cycling, energy

[19]Habitat suitability/capability modeling is a tool for predicting the suitability (or capability) of habitat for a given species based on known affinities with particular environmental parameters or habitat conditions.

[20]Habitat suitability modeling guidelines for Pacific Water Shrew are available on the SCCP's website under the Guidelines (South Coast and BC) tab, page 2. For other species such as Oregon Forest Snail or Western Painted Turtle contact the recovery team chair or regional provincial species at risk biologist at the Ministry of Forest Lands and Natural Resource Operations in Surrey.

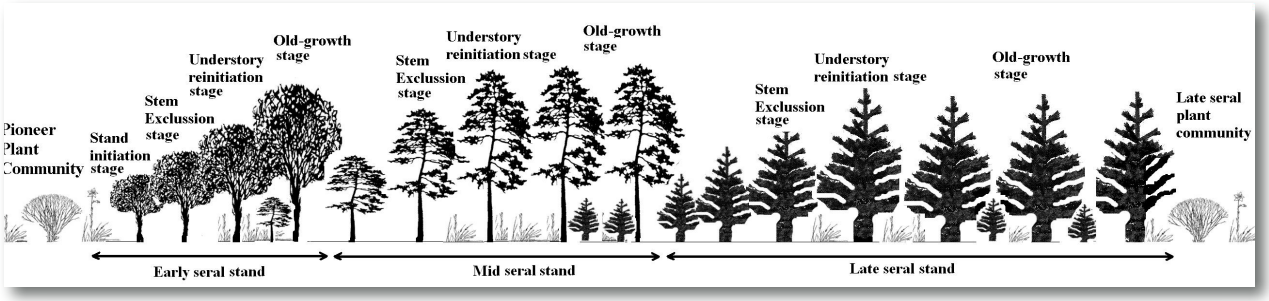


Figure 3. Succession in typical coastal BC forested landscapes

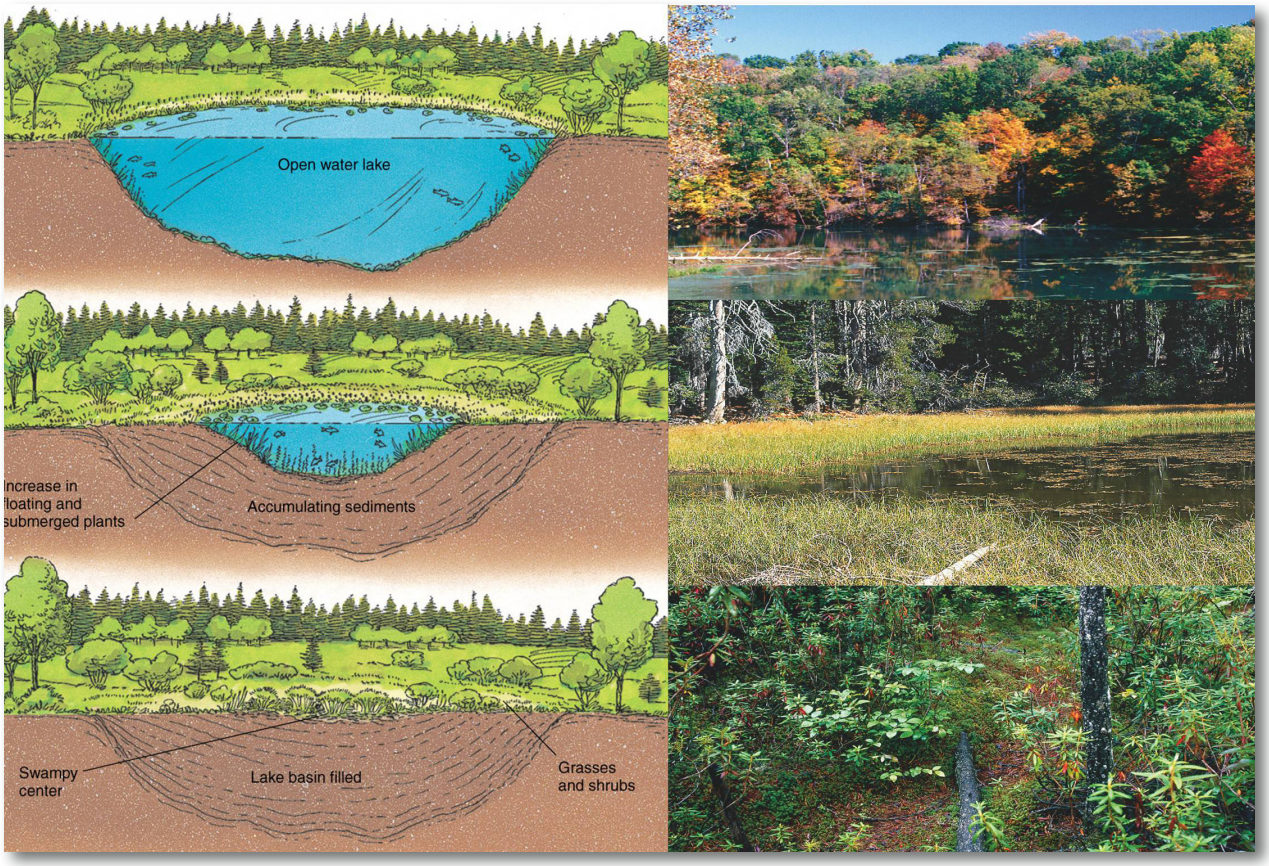


Figure 4. Succession occurs in wetlands too!

flow, and succession (GOERT, 2011). Plans for restoration should consider how each action will affect these processes. For example, changes in vegetation structure, such as establishing a tree canopy on an open site, can increase rainfall interception and water uptake from the soil, and thus reduce the availability of water to other species. Planting nitrogen-fixing species may increase available soil nitrogen to other species.

Succession is the sequence of changes a biotic community passes through before reaching its maximum possible development, or potential natural community (Gayton, 2001). The successional trajectory of an ecosystem is influenced by a variety of factors, including various site conditions (e.g., soil type, topography, moisture), climate and weather, seed dispersal, as well as chance events. Restoration often seeks to move a community, site, or ecosystem along a successional sequence towards a desired future condition.
Succession occurs in wetlands too!

Disturbance

Most ecosystems are impacted by disturbance to some degree, although the role that disturbance plays depend on the ecosystem type, location, and adjacent land use type.

Ecological disturbance can be defined broadly as "any relatively discrete event in time that disrupts ecosystem, community or population structure and changes resource, substrate availability, or the physical environment" (White and Pickett, 1985). Examples of disturbance can include fire, flooding, windthrow, avalanches, insect outbreaks, and even volcanic eruptions. These disturbances interact with other ecosystem-level processes such as production, biomass accumulation, energetics, and nutrient cycling, and change the structure and dynamics of natural communities. The suppression of historical disturbance patterns has also led to changes that enable alien invasive species dominance (MacDougall and Turkington, 2005).

Human disturbance plays an obvious role in degrading ecosystems but can also play a role in restoration efforts by re-establishing or mimicking natural disturbance processes that are no longer occurring. However, if conditions have changed, disturbance may not have the same effect on an ecosystem as it did historically. Therefore, it is important to consider disturbance in light of your restoration goals, the current state of your restoration site, and potential effects of disturbance given the changed conditions. Using disturbance as an ecosystem restoration tool can also be costly and controversial.

2.5. Identifying Multi-species Restoration Opportunities

When multiple species at risk or ecological communities are found on a site, overlaps in their habitat use and needs should be identified as an initial step in determining what restoration measures may be appropriate and what risks to species may be present if certain restoration actions are taken.

Appendix 2 can be used as a first step to help identify species which overlap in their habitat requirements. This reference groups selected species at risk by the ecosystem types described in the introduction of this document and in Appendix 1.

Using Air Photos to Document A Site's HistoryAir photos are one way to document a site's history of succession and disturbance. Air photos can be used to look at changes in vegetation communities, evidence of natural or human disturbance, such as exposed soil, changes in topography, or changes in the location of watercourses. By examining different series of air photos of the same site through time, trends can be observed which help us to understand how the site arrived at its present-day conditions. Historical air photos are available through some libraries. UBC's Geographic Information Centre (GIC) has a large library of air photos that cover much of the South Coast region over time. These photos can be viewed at the GIC or borrowed for short periods of time via mail. Air photos can also be ordered through the National Air Photo Library in Ottawa. Municipalities and regional districts sometimes have historical air photos in their files which they may be willing to make available for a specific project.

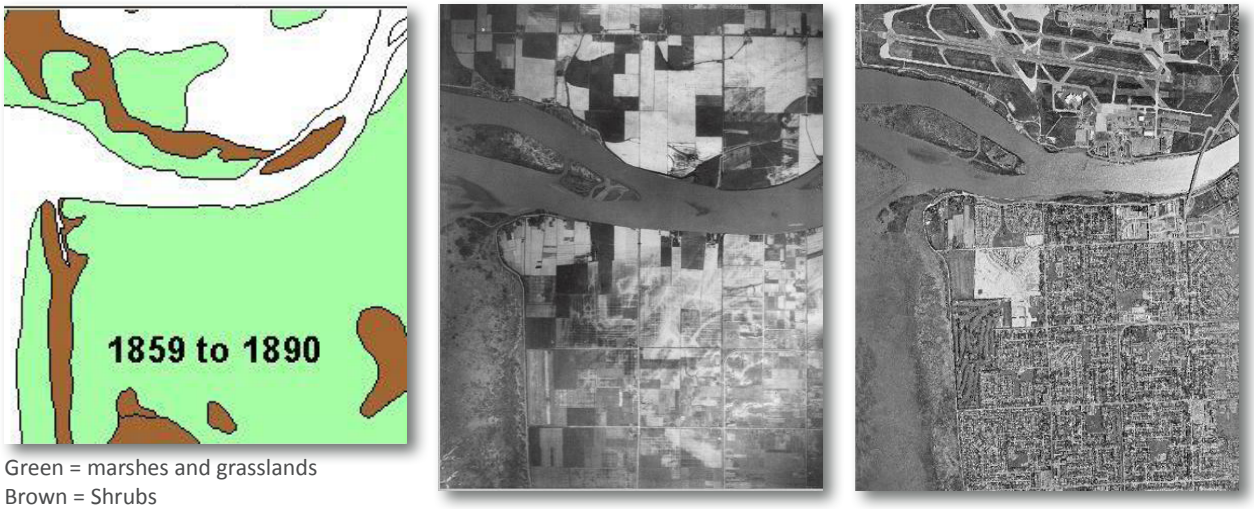


Figure 5. West Richmond 1859, 1930 and 1995. Example of how air photos can be used to assess land cover (habitat) changes over time. Interpretive maps and aerial photos of the Fraser Estuary over a 100 year time span. (Source: Environment Canada – Canadian Wildlife Service)

Use of more detailed habitat information for species is found on the SCCP website and other sources is available to further refine your groupings. Table 8 shows some common association of species on the South Coast. Habitat requirements can change at different times of year and for different parts of a species' life cycle (e.g., breeding, rearing, nesting) so it is important to consider a species' full range of habitat needs as part of identifying overlaps.

Maps

To help document these species overlaps, creating a map can be very helpful. By marking areas known to be utilized by different species on the same map, one can begin to get a picture of how species may use similar habitats in different ways and where restoration actions could come into conflict without proper considerations of the needs of all species. Maps can also be powerful communication tools when applying for permits or requesting funding. Maps don't need to be complicated. Often a simple hand-drawn schematic or map is enough to document opportunities and identify overlaps. Free software like Google Earth is one of the best ways to create simple overlays using current satellite imagery (often with good detail) that can be saved as files readable in GIS software.

Table 8. Examples of groups of species at risk with overlapping habitat requirements found on the South Coast of BC. Note: Species at risk are denoted in bold. Species not at risk but often a significant target for habitat restoration are denoted with asterisk (*).

Shallow water wetlands	Lowland streams and riparian areas
Oregon Spotted Frog **Red-legged Frog** **Western Toad**	Coho Salmon* Salish Sucker Nooksack Dace Pacific Water Shrew Trowbridge's Shrew Red-legged Frog Western Toad
Mountain streams and riparian areas	**Mature forests**
Coastal Giant Salamander **Coastal Tailed Frog**	Olive-sided Flycatcher Pacific Water Shrew Red-legged Frog Western Toad Oregon Forestsnail Pacific Sideband
Intertidal and shallow sub-tidal	**Old fields**
Salmon sp.* **Eelgrass*** **Great Blue Heron, *fannini ssp*.** **Peregrine Falcon** **Olympia Oyster**	Barn Owl Short-eared Owl Great Blue Heron, *fannini ssp.* Townsend's Mole

Phase 3 – Assessing Opportunities, Constraints, and Risks

Once the values and sensitivities present on a site are known, potential restoration opportunities can be identified, assessed, and evaluated. This includes identifying appropriate restoration actions for the species and ecosystems present, understanding possible constraints to implementing those actions, and evaluating the environmental risks involved, particularly to species at risk.

3.1. The 'Doing Nothing' Option

At various points in conceiving a restoration project, it is worth asking: "Is restoration the best approach?" Sometimes existing high levels of ecological integrity, the sensitivity of a particular habitat, or the presence of a very rare species means that restoration can be risky. In this situation, the best approach may actually involve avoidance or only minor intervention. This is why it is important to weigh the costs and benefits of restoration. The decision of whether to proceed with restoration or whether to leave "as-is" should always be given careful consideration.

3.2. Understanding the Capacity of your Site

When planning a restoration project, the site capacity should always be taken into account when deciding which restoration measures will be used. Restoration, by definition, is recovering an ecosystem to something which resembles its original condition or "natural state". Understanding a site's "natural state" is related to the ecological concepts of natural succession and climax vegetation. Factors such as terrain, soils, and hydrology naturally limit what ecosystem types and features can be supported by a site. Developing a restoration plan that aligns with what your site can naturally support will be easier to achieve. For example, it will likely be very difficult to construct a wetland in very well-drained soils without changing the soil composition. The ongoing maintenance cost required to ensure the longevity of a restoration project that moves away from the site's natural capacity to support is not a worthwhile or sustainable investment.

3.3. Picking a Reference Site

As part of planning your restoration project, it can be helpful to identify a reference site on which to model your restoration efforts. A reference site is usually a site with similar underlying characteristics that has a high level of existing ecological integrity. Having a reference site can help you understand what you are trying to achieve once your restoration effort is complete. When restoring habitat specifically for species at risk, a suitable reference site will likely be a site that already supports your species of interest. If it is not possible to find such a reference site, visiting and examining the conditions of different reference sites can help you understand what needs to be changed or re-established at your restoration site in order to achieve the desired conditions.[21]

[21]Finding relatively undisturbed reference or control sites is not an easy task in places like the highly populated South Coast. But they do exist. Many examples of relatively intact ecological communities such as swamps and freshwater marshes, riparian areas and even remaining old-growth or mature forest communities can be found in local provincial or regional parks.

3.4. Taking Action at Different Scales

Restoration actions are usually aimed at restoring particular components of disturbed or degraded sites, including ecosystem-forming elements, ecosystem processes, or micro-habitat features. Depending on the species, restoration of species' populations may be needed directly, through augmentation or translocation. Addressing the root causes of degradation by addressing threats is also often a high priority. Table 9 provides some examples of restoration actions from each category. As previously advised, before undertaking actions it is important to consult with experts, recovery teams and local interests who will be affected by your activities.

Table 9. Categories of restoration opportunities and example actions.

Category	Example Actions
Restore ecosystem-forming elements	Re-establish or increase foundation (habitat-forming) species, e.g., trees, emergent aquatic vegetation. Increase number of large trees. Restore specific structures or features such as large trees, dead standing trees (wildlife trees), coarse woody debris, or other features. Restore understory vegetation diversity. Restore canopy gaps and vertical structure. Create floodplain function and areas of open and flowing water, including watercourses and wetlands.
Restore ecosystem processes	Re-introduce or mimic natural disturbance regimes, e.g., prescribed burning, soil disturbance. Re-establish former hydrologic regime. Initiate or accelerate succession through planting or thinning.
Restore micro-habitat features	Create or augment nesting sites. Increase food plant abundance. Increase topographic heterogeneity. Alter substrate or substrate heterogeneity.
Restore species	Re-introduction of extirpated species (e.g., translocation, captive rearing and release). Stabilizing or augmenting decreasing populations. Restore keystone species (e.g., salmon, major tree species).
Address threats	Secure land for conservation in perpetuity. Alter access through signage and fencing. Reduce harvesting or incidental take. Control introduced or problematic predators. Control competing invasive species. Reduce exposure to pollution.

Habitat restoration for species at risk can also take place at different scales. Actions can be targeted at the landscape level (such as a city or neighhourhood), the site level (single parcel of land or development site), and at individual species with very specific and unique needs (Table 10). It is important to determine the appropriate scale at which to restore your site. In many cases, projects may seek to simultaneously address restoration needs at multiple scales. Priority actions should be those which:

- Directly address the habitat requirements of the target species, group of species, or ecological community within the site
- Directly improve ecological integrity within a site, and
- Increase the resilience of the site (i.e., the site is better able to adapt and withstand future stress or change).

Targeting such actions will lead to more effective and sustainable restoration projects.

3.5. Avoiding Inter-species Restoration Conflicts

One of the key reasons for a multi-species restoration approach is to avoid conflicts between ecosystem restoration and species at risk. This approach is also used to avoid conflicts between the habitat needs of different species at risk.

Table 10. Examples of restoration measures for species and ecosystems at risk.

Scale	Example of Measures
Landscape-level	Re-establish or increase foundation (habitat-forming) species, e.g., trees, emergent aquatic vegetation. Increase number of large trees. Restore specific structures or features such as large trees, dead standing trees (wildlife trees), coarse woody debris, or other features. Restore understory vegetation diversity. Restore canopy gaps and vertical structure. Create floodplain function and areas of open and flowing water, including watercourses and wetlands.
Site-specific	Re-introduce or mimic natural disturbance regimes, e.g., prescribed burning, soil disturbance. Re-establish former hydrologic regime. Initiate or accelerate succession through planting or thinning.
Species-specific	Create or augment nesting sites. Increase food plant abundance. Increase topographic heterogeneity. Alter substrate or substrate heterogeneity.

PHASE 3. ASSESSING OPPORTUNITIES, CONSTRAINTS, AND RISKS

Many conflicts arise simply because of a lack of knowledge about the species present on a site. As mentioned, one of the best ways to avoid these conflicts is to know as much as possible about the species that occur or are expected to occur within your site. Conducting a risk assessment is the best way to evaluate and avoid inter-species conflicts when species or ecosystems at risk do occur on your site.

3.6. Conducting a Risk Assessment

An environmental risk assessment (ERA) is a process that evaluates the likelihood or probability that adverse effects may occur to environmental values as a result of human activities (MELP, 2000). ERA can be used as a decision making tool when determining whether and how to proceed with a variety of projects and when evaluating the associated risks. Basic environmental risk assessment involves four key steps:

- Identify the hazards;
- Identify the potential impacts to the ecosystem;
- Identify what ecosystem components (e.g., species) are at risk and level of risk;
- Identify available measures to reduce and mitigate risks

The purpose of an ERA is to determine whether enough has been done to control the risks, whether further control measures need to be put in place, or whether a project should not proceed because risks cannot be avoided or mitigated.

Conducting a basic risk assessment, even an informal one, for a restoration project can ensure that potential impacts and risks are not missed, and that appropriate measures to avoid or mitigate potential impacts are taken.

3.7. Cumulative Effects

Cumulative effects are the combined impacts of all past, present and foreseeable human activities, over time, on a particular location. Always consider the impact of a proposed restoration project within its overall context rather than in isolation. Example, if a degraded stream is proposed for restoration, how might future upstream development affect the provision of flows or water quality, could restoration measures could unintentionally have adverse impacts? Similarly, restoring a site that is a source population of a particular species at risk may not be effective on its own if future land use change in the area is projected to turn it into a sink population.[22] Also, because restoration often leads to some habitat disturbance, at least initially, the combined effects of multiple restoration projects within a site could also result in more cumulative disturbance than populations of certain species may be able to handle.

[22]Source populations or patches are a net exporter of individuals. In contrast, in a sink patch, death rates are greater than birth rates, resulting in a population decline toward extinction unless enough individuals emigrated from the source patch. From Pulliam, H. R. 1988. Sources, sinks, and population regulation. American Naturalist 132:652-661.

4. Phase 4 – Planning Your Project

Once you have determined a series of appropriate restoration actions for your site, a more detailed restoration plan needs to be developed. As part of planning for your project, permits, approvals, and insurance may also be necessary, funding may need to be secured, and stakeholders should be appropriately consulted.

4.1. Developing a Restoration Plan

Restoration projects can vary in their scope and complexity. When a restoration project is more complex, developing a restoration plan can help projects to stay on time and budget and achieve the desired outcome. Effective restoration plans should have several key elements:

Restoration Goals and Objectives

Goals are one or more broad statements about the purpose of your project and what you want to achieve. Goals are typically longer-term and more abstract; they may or may not be measurable. Objectives are more focused, specific, and easy-to-measure. Each objective supports attaining the overall goal(s). Projects typically have one or two goals and several objectives. Each objective will likely require a series of tasks to achieve them.

Objectives as identified at the beginning should be S.M.A.R.T. – that is, Specific, Measurable, Achievable, relevant, and Time-based (i.e., both timely and time-bound). This will make it more likely that the goal can be attained. Habitat restoration projects, in particular, often suffer from unclear or unrealistic goals.

For restoration projects, goals may be focused on species at risk directly (e.g., maintain the current population, expand the current population, re-introduce or introduce a new population or sub-population) while objectives may be related to the supporting ecosystem condition or processes (e.g., increase nesting sites, increase coarse woody debris). Species at risk restoration goals must fit with the long-term recovery goals for that species as identified in its recovery strategy.

Work Plan / Maps / Design Drawings

Completing a project will require working through a series of tasks. A work plan is an outline of ordered tasks or processes aimed of achieving the goals and objectives. In addition to a work plan, maps and/or detailed design drawings can help to illustrate how tasks will be carried out within the site.

Schedule

Developing a schedule can assist with carrying out a project in a timely fashion. Permits need to be secured and restoration activities often need to be timed to take place during appropriate windows. Stream restoration projects should take placed during the instream works window when risks to fish are low (typically August 1 – September 15 for watercourses with salmon and trout). If tree clearing or shrub removal is part of the project (e.g., removal of invasive trees or shrubs), then clearing should be timed to avoid the bird nesting season (generally from March 15 – August 15) as required by the BC Wildlife Act.

Measures to Mitigate Impacts/Avoid Harm

Mitigation measures may include conducting a pre-construction wildlife salvage, diverting water around a work area, monitoring water quality to make sure that parameters stay within acceptable levels, and erosion and sediment control. In some cases, formal mitigation or construction monitoring plans may be required to gain project approval from a regulatory authority (see Section 1.4.2).

Maintenance and Monitoring Plan

A restoration plan should always include a plan for long-term maintenance and monitoring. Further details on monitoring and adaptive management are found in Section 1.6.

Budget

Finally, developing a project budget can help identify the required financial support and track costs as a project is being carried out.

4.2. Permits and Approvals

Approvals and permits are required to undertake many restoration projects. If your project is located within 30 m of a stream, depending on the nature of the project, you may be required to notify or get approval from regulatory authorities:

- As per Section 35 of the federal Fisheries Act, works in and around water may have certain legal requirements. For common types of low risk projects, this can involve a simple notification or adhering to an Operational Statement for that particular activity. For higher risk projects or where fish habitat will be damaged and will require compensation, a Fisheries Act authorization is required.[23]
- As per Section 9 of the BC Water Act, notifications or approvals are required for work "in and about a stream". Approvals are written authorization for changes in and about a stream that are of a complex nature. Notifications (made at least 45 days in advance of the scheduled start date) are typically used for works that do not involve any diversion of water, may be completed within a short period of time and will have minimal impact on the environment or third parties.[24]

Similar to the requirement for permits when conducting surveys, if your project requires the capture or handling of any SARA-listed species or wildlife, a SARA permit and/or a BC Wildlife Act permit may be required (see Section 1.2.2).

Permits may also be required from your regional district or municipality if a project involves tree cutting, vegetation clearing, has the potential to create erosion and sediment that could impact water quality, or is taking place in an Environmental Development Permit Area. It is recommended that you contact your local municipality or regional district to determine what approvals (if any) may be required.

[23]For more information on Federal Fisheries Act notifications and authorizations, consult the Working Near Water in BC and the Yukon website (http://www.pac.dfo-mpo.gc.ca/habitat/index-eng.htm).

[24]For more information on BC Water Act notifications and approvals, consult the BC Ministry of Forests, Lands and Natural Resource Operations Resource Stewardship webpage (http://www.env.gov.bc.ca/wsd/water_rights/ See the SCCP's Landowner Stewardship

As with survey permits, it is recommended that you apply for any approvals well in advance (i.e. 2-4 months) of when they will be required.

4.3. Landowner Permission

Permission must be obtained from the landowner of any land on which a restoration project is proposed. If landowners are municipalities or other government agencies, additional permits may be required. The South Coast Conservation Program has a well-developed landowner contact program and can provide expertise and advice in this area.[25]

4.4. Insurance

Because of the liabilities involved in undertaking restoration projects, it is also recommended that you have insurance. Liability insurance will project you in the event that the work you are doing causes accidental or unintended damage or if someone is injured while working on your project. For simple projects, umbrella organizations, such as the Pacific Streamkeepers Federation, offer insurance policies that cover volunteer group members while they are involved in restoration activities.

4.5. Funding Sources

More complex restoration projects can have significant costs. Grant funding is available to help encourage restoration activities for species at risk in Canada. Four federal funds can provide funding for projects depending on the group or ownership of the land involved:

- The Habitat Stewardship Program for Species at Risk (HSP) provides funding for projects that "contribute to the recovery of endangered, threatened, and other species at risk, and to prevent other species from becoming a conservation concern, by engaging Canadians from all walks of life in conservation actions to benefit wildlife." See the HSP website for more information (https://www.ec.gc.ca/hsp-pih/).
- The Aboriginal Funds for Species at Risk (AFSAR) program (http://www.recovery.gc.ca/AFSAR-FAEP/) funds which increase the capacity of First Nations to implement recovery actions for species at risk, including on reserves.
- The Interdepartmental Recovery Fund (IRF) supports projects aimed at the recovery of species at risk involving departments or on lands administered by departments other than Environment Canada, Fisheries and Oceans Canada, and Parks Canada (http://www.sararegistry.gc.ca/involved/funding/irf_fir/program_e.cfm).

[25]Program at http://sccp.ca/projects/south-coast-environmental-stewardship-program licence_application/section9/).

- Environment Canada's EcoAction Community Funding Program provides financial support to community-based, non-profit organizations for projects that have measurable, positive impacts on the environment , including projects involving habitat restoration (http://www.ec.gc.ca/ecoaction/.

Provincially, the Habitat Conservation Trust Foundation (HCTF) also awards funding to projects which may benefit species at risk either directly or indirectly. See the HCTF website for more information (http://www.hctf.ca/).

There are also numerous businesses and private foundations that provide grant funds to groups interested in habitat restoration, with or without the species at risk focus. Some municipalities also supply small grants to community groups that can be used for projects such as habitat restoration. The SCCP can recommend sources of funding to pursue based on the nature and scope of your project.

4.6. Consulting with Stakeholders

Consultation is a two-way process in which the project lead provide an overview of the project and collaborate with stakeholders to further develop and implement the project ensuring all views are heard and needs are met. Depending on the project, possible stakeholders could include:

- Local governments
- Private landowners
- Industry
- Stewards
- First Nations
- Local residents

Building community support for a project should not be overlooked. Without it, many projects may not be received well or may not be able to proceed. Ideally, consultation should occur at multiple stages during project development to allow for as much input as possible. As with landowner stewardship the SCCP is evolving long-term resources for working with stakeholders including local governments.[26]

4.7. Public Education and Outreach

Including public education and outreach components in your restoration project is also a great way to engage the public in protecting species and ecosystems at risk, and encourage them to become involved. Common

[26]See the SCCP's Conservation Planning for Land Use Decision Makers http://sccp.ca/programs/conservation_planning.

education elements include public field trips to the site, volunteer work days, and the development of brochures or signage. The SCCP has developed a South Coast/BC based curriculum resource, Species at Risk in the Classroom, Provincially Wild BC has a range of educational resources and the Stewardship Centre of BC is working on species at risk based curriculum for secondary grades in BC. These are just a sample of the education and extension resources and toolkits available, many with a specific focus on species at risk.[27]

Skunk Cabbadge. Illustration by Carrielynn Victor.

[27]See: http://sccp.ca/resources/species-risk-classroom-resource-educators, http://wildbc.org/, http://www.stewardshipcentrebc.ca/, http://northwestwildlife.com/educational-programs.

Phase 5 – Implementing Your Project

Once you have planned your project, you are ready to move to the implementation phase.

5.1. Pre-construction Monitoring

Prior to beginning restoration work on any site, it is strongly recommended that pre-construction monitoring be undertaken. Monitoring provides a way to measure whether the desired outcomes have been achieved and the goals and objectives met and how or if conditions are changing over time. Section 1.6 talks more about monitoring.

5.2. Implementation

Once baseline data has been collected, you are ready to implement your project. Typical implementation tasks include:

- Notifying the stakeholders, participants, and authorities that work is commencing;
- Initiating construction monitoring;
- Implementing mitigation measures, such as erosion and sediment control;
- Preparing the underlying site, such as soil, water, and topography; and
- Carrying out planting of native species and/or removal of invasive species.

It is important to remain flexible while implementing a project. Unexpected site conditions, bad weather, or new information can result in a need to change the original plan. Don't hesitate to seek out advice or assistance as you implement your project.

As mentioned earlier, you should document all aspects of your project including costs and techniques used. Taking regular photos can help document progress. Preparing a project report can help both you and other restoration practitioners learn from your project and share results.

If possible, during your project, invite stakeholders and the interested public to view the progress. Also, if appropriate, consider a celebration or opening to show off what you have achieved.

Phase 6 – Monitoring and Adaptive Management

Monitoring is an important and sometimes overlooked part of any restoration project. It serves to evaluate a project's effectiveness, to ensure environmental mitigation and management is functioning as planned, and to inform adaptive management. Monitoring can also be used to help ensure the protection of the restoration and ongoing stakeholder engagement; especially if the project team provides periodic updates.

6.1. Types of Monitoring

Monitoring is the collection of information at set locations and times. This information is collected in order to provide the data needed to define current conditions and establish trends over time. Monitoring is a way of seeing how restoration actions taken have influenced a site now and into the future. There are several types of monitoring that may be relevant to habitat restoration:

- Species at risk population monitoring can be used to help determine the responses of species at risk populations to restoration actions. As restoration may take several years to achieve the desired outcomes, monitoring may need to occur over a long period of time to detect an influence on population trends.
- Long-term ecosystem process monitoring can be used to look at the long-term impacts of restoration on ecosystem processes. Potential aspects of an ecosystem which could be monitored include: soil, vegetation, water cycling, and nutrient cycling.
- Flow and water quality monitoring can be used to look at the impacts of restoration on aquatic habitats, such as streams and rivers.
- Photo-point monitoring can be used to document changes in vegetation and soil through repeat photography over time from the same location. Photographs are also a great way to demonstrate progress to stakeholders.

6.2. Monitoring Plan – Pre-, During, and Post-construction

Effective monitoring requires a commitment to monitor before, during, and after the project. Prior to beginning restoration work on any site, it is strongly recommended that pre-construction monitoring be undertaken. Restoration can often be set up as an experiment where different factors (e.g., species abundance or density, vegetation, soil, water flows, water quality, microclimate conditions) are compared in a before-after control-impact (BACI) design. In a BACI design, the impact site is the restoration area. The control site is an area with similar characteristics where restoration work will not occur. Monitoring may be at points, along transects, or in plots. To ensure accuracy, it is important than monitoring sites be properly marked and protected during the life of a project.

PHASE 6. MONITORING AND ADAPTIVE MANAGEMENT

6.3. Adaptive Management

As mentioned above, adaptive management is the systematic process of continually improving policies and practices by learning from the outcomes of management "experiments" (BC Ministry of Forests and Range, 2008). The concept of adaptive management arose from the realization that land management activities, including ecological restoration, are often experimental because their outcomes cannot be predicted with certainty. A typical adaptive management cycle has six steps (BC Ministry of Forests and Range, 2008):

- Step 1: Assess and define the problem;
- Step 2: Design;
- Step 3: Implementation;
- Step 4: Monitoring;
- Step 5: Evaluation of results; and
- Step 6: Adjustment/ Revision of Hypotheses & Management.

Uncertainty is a common feature of restoration projects. Therefore, using a cycle of "learning by doing", as adaptive management is sometimes called, is crucial to effective and sustainable restoration. Some ways adaptive management can be useful to restoration include:

- Informing changes to mitigation measures if they are found to be unsuccessful at mitigating harm;
- Informing changes to restoration techniques if they do not achieve the desired ecosystem conditions;
- Informing changes to translocation techniques if populations do not re-establish or successfully reproduce; and
- Determining appropriate efforts needed to control invasive species.

Additional Considerations

With such an extensive checklist of requirements and to-do's there are additional considerations that are often relevant to restoration projects involving species at risk. Most will seem to be a no-brainer, some will definitely require specialized expertise, permitting and resources. These include species translocation, managing alien invasive species, and sourcing materials (physical supplies but information and expertise as well). Talking to stewardship groups such as the SCCP can be helpful for identifying considerations, specific to your project, which should be addressed during the planning phase.

7.1. Species Translocations, Captive Breeding, and Propagation

Species translocations are the deliberate moving of individual animal or plants (including propagules) from one location, either a natural population in the wild or off-site collections, to another location in the wild in order to assist in the recovery of the species (Maslovat, 2009). Translocations may include augmentation of an existing population, introduction of a species to a new site, and re-introduction to a historically occupied site where the species was once present but has been extirpated. Captive breeding or propagation can be used as an intermediate step to create a captive population from which to release individuals over time.

Currently, only a handful of species at risk on the South Coast are actively being translocated, captively bred, or propagated (i.e. Oregon Spotted Frog and Western Painted Turtle). One of the more frequent reasons for translocation is salvage from a site prior to development. Species translocation from a site should always be used as a last resort once all possible opportunities for in-situ conservation have been exhausted.

Specific guidelines have been developed to guide translocation, captive breeding, and propagation programs and should always be followed (e.g., Maslovat, 2009, IUCN 2012). Because the use of translocation is relatively new for most species, it is important that all attempts be carefully planned, implemented, and documented. A high degree of translocation are not successful so it is important that we learn as much as possible each time a translocation is attempted to increase the likelihood of success with future attempts .

A SARA Permit is required for introduction or re-introduction of species listed on Schedule 1. You should contact recovery teams and regulatory authorities to discuss whether translocation is appropriate for your project.[28]

7.2. Managing Alien Invasive Species

Managing the impacts of alien invasive species is a reality of almost any restoration project undertaken on the South Coast of BC. Both the number of invasive species and their distributions are projected to increase over

[28]Two recent documents include: IUCN Guidelines for Reintroductions and Conservation Translocations (2012) and A Summary of native bat, reptile, amphibian and terrestrial invertebrate translocations in New Zealand.

time. Management of invasive plants is likely the most common restoration activity undertaken on the South Coast. However, other invasive species are increasingly being targeted, including fish, bullfrogs, and some insects.

To control invasive plants, a range of options are available, including physical and chemical methods. Before any alien invasive species are removed, the impact of their removal should be evaluated and a strategy developed to minimize potential negative impacts.

Several important considerations when controlling invasive plants include:

- Choosing control methods appropriate to the sensitivities of the site;
- Minimizing soil disturbance as alien plant species are adapted to thrive in disturbed environments;
- Actively revegetate any areas of bare or disturbed soils to limit opportunities for alien invasive plants to establish;
- Conducting regular maintenance to remove and control re-establishing seedlings;
- Using appropriate safety precautions to minimize risks to human health;
- Using appropriate handling techniques for removed plant material to minimize the risk of spreading unwanted seeds and other propagules.

It is important to be fully informed about the appropriate techniques and precautions. Information on the most effective methods for managing different invasive species can be obtained from many sources. The Invasive Species Council of BC (http://www.bcinvasives.ca) provides a variety of useful resources. As well, several regional invasive species societies on the South Coast may be able to provide more regional and site-specific information:

- Invasive Species Council of Metro Vancouver (http://www.iscmv.ca)
- Fraser Valley Invasive Plant Council (http://www.fraservalleyweeds.com)
- Sea to Sky Invasive Species Council (http://www.ssisc.info)
- Coastal Invasive Species Committee (http://www.coastalisc.com/)

7.3. Sourcing Materials

It is often possible to source materials for restoration projects locally, avoiding the need to purchase these supplies. It is particularly beneficial to source plant material locally as this material is more likely to be adapted to local climate and soil conditions. Examples of local plant material sourcing include: requesting access from property developers to salvage native plants prior to clearing and selectively harvesting native plants where impact to the source site is minimal (e.g. willow whips).

Items like rocks, root wads, and coarse wood debris can sometimes be obtained from developers, farmers,

and municipal work crews who have removed them from a site and have no use for them. In some cases there may be synergies between different projects (e.g., beaver dam removal can provide coarse wood for another restoration project).

Finally...The Road Ahead

Diversity by Design provides an extensive and comprehensive checklist for approaching restoration for species and ecological communities at risk. Still this resource is not exhaustive. As you review the accompanying modules and evolve your plan from concept to implementation there will be many issues, needs and wants that will have to be addressed.

In summary it will be critical for the success of your project and the intended beneficiaries that you do your homework and recognize your limitations and capacity. Do not be afraid to seek out specialists and integrate innovative approaches and solutions. But also recognize that there are regulatory requirements you have a responsibility to adhere to.

Where Do You Go From Here? There are a many resources referred to in this guide that are readily available, plus a number of organizations that can be tapped into for help. Your roles and responsibilities may extend for a lengthy period. Invasive plants, wildlife damage, natural processes and unforeseen events can impact a project's success. However having an effective and adaptive plan in place will ensure you are better able to deal with contingencies and unexpected results or situations. This also provides an opportunity for timely mitigation which will ultimately increase the success of your restoration activities.

Ideally the SCCP envisions that resources like Diversity by Design will support the growing body of projects and case studies that inform other groups while demonstrating to agencies, the public and decision makers that recovering, protecting and restoring at risk species and their habitat is a natural and worthwhile investment for the South Coast and beyond.

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APPENDICES

Oregon Forestsnail- Illustration by Carrielynn Victor

Appendix 1 – Classification of Natural and Human-modified Ecosystems for the South Coast of BC.

Class	Code	Description	Structural stage(s)	Subclasses	Example(s)
Forests and Woodlands					
Old Forest	OF	Forests > 250 years old; generally conifer-dominated with complex vertical structure; may include older mixed coniferous stands.	7	Conifer-dominated (co) Mixed conifer and broadleaf (mx) Very old (vo)	Old-growth forest
Mature Forest	MF	Forests 80-250 years old; not as structurally complex as old forests.	6	Conifer-dominated (co) Mixed conifer and broadleaf (mx)	Second-growth forest
Young Forest	YF	Forest generally greater than 30 and less 80 years old; includes young woodlands.	5	Conifer-dominated (co) Mixed conifer and broadleaf (mx) Broadleaf-dominated (bd)	Young alder stands
Woodland	WD	Open forests (10-30% tree cover) as a result of site conditions; found on dry sites, mostly on south facing slopes of rocky knolls and bedrock-dominated areas.	6-7	Conifer-dominated (co) Mixed conifer and broadleaf (mx)	Garry Oak woodlands Arbutus bluffs Dry Douglas-fir sites
Freshwater					
Large River	RV	Navigable rivers.	n/a		Fraser River, Pitt River
Lowland Stream/ River	LS		n/a		Byrne Creek, Little Campbell River
Mountain Stream	MS		n/a		Lynn Creek

APPENDIX 1

Appendix 1 - Continued

Class	Code	Description	Structural stage(s)	Subclasses	Example(s)
Riparian	RI	Areas associated with and influenced by freshwater; generally along rivers, streams, and creeks, but also fringes around lakes; influenced by factors such as erosion, sedimentation, flooding, and/or subterranean irrigation due to proximity to the water body.	1-7	Low bench floodplain (fl) Medium bench floodplain (fm) High bench floodplain (fh) Fringe (ff) Gully (gu) Canyon (ca) River (ri) Mudflat (mf)	
Wetland	WN	Areas that are saturated or inundated with water for long enough periods of time to influence vegetation and soil; may result from flooding, fluctuating water tables, tidal influences or poor drainage conditions.	n/a	Bog (bg) Fen (fn) Marsh (ms) Swamp (sp) Shallow water (sw) Wet meadow (wm)	
Lake, Pond, and Reservoir	FW	Bodies of water that usually lack floating vegetation.	n/a	Lake (la) Pond (pd) Reservoir (rs)	
Tidal and Marine					
Estuarine	ES	Estuarine ecosystems are found at the confluence of rivers with the sea where they are influenced by occasional or diurnal tidal inundation and brackish water; distinguished from intertidal ecosystems by freshwater input.	n/a	Estuary swamp (sp) Estuary meadow (md) Estuary marsh (ms) Estuary tidal flat (tf)	
Intertidal and Sub-tidal	IT	Mudflats, beaches and rocky shorelines influenced by diurnal tidal cycles with little to no freshwater input (primarily through rainfall runoff).	n/a	Mudflats (mf) Beaches (bs) Eelgrass (el)	

APPENDIX 1

Appendix 1 - Continued

Class	Code	Description	Structural stage(s)	Subclasses	Example(s)
Other					
Herbaceous	HB	Non-forested ecosystems (less than 10% tree cover), generally with shallow soils and often with bedrock outcroppings, coarse-textured soils, or natural disturbances (wind or wave action); includes a variety of natural ecosystems such as large, bedrock-controlled openings within forested areas, coastal headlands, shorelines vegetated with grasses and herbs, sometimes low shrubs, and moss and lichen communities on rock outcrops.	2-3	Herbaceous (hb) Coastal herbaceous (cs) Vegetated shoreline (vs) Shrub (sh)	
Sparsely Vegetated	SV	Areas of low vascular vegetation cover, generally 5 – 10%, but may be greater in some patches; may have high cover of mosses, liverworts and lichens.	1	Cliff (cl) Rock outcrop (ro) Talus (ta) Sand dune (sd) Spit (st)	
Alpine	AP	Ecosystems above or near tree-line – mostly non-forested but includes treed islands and windblown, shrubby treed patches (krummholz).	1-5	Herbaceous (hb) Krummolz (kr) Parkland forest (pf) Dwarf shrub (ds) Tall shrub (ts) Avalanche track (av)	
Human-modified					
Seasonally-Flooded Agricultural Field	FS	Annually flooded cultivated fields or hay fields; important migrating and wintering waterfowl habitat.	n/a	None	
Old Field	OF	Lands formerly cultivated or grazed but later abandoned; in an intermediate stage of succession; will eventually become forest without management.	2	None	
Agricultural Field	AG	Active agricultural areas including vegetable and grain crops, berry fields, vineyards, orchards, pasture lands, etc.	n/a	None	
Urban/ Disturbed	UR	Highly disturbed and modified areas, such as those in urban areas.	n/a	None	

APPENDIX 2

Appendix 2 – Groupings of Selected Species at Risk by Ecosystem Type on the South Coast of BC.

Note: For a description of the subclass codes used within the table, see Appendix 1.

MAMMALS

	Forests and Woodlands				Freshwater						Tidal and Marine		Other			Human-modified			
Class	Old Forest	Mature Forest	Young (Immature) Forest	Woodland	Large River	Lowland Stream / River	Mountain Stream	Riparian	Wetland	Lake, Pond, and Reservoir	Estuarine	Intertidal and Shallow Sub-tidal	Herbaceous	Sparsely vegetated	Alpine	Seasonally-flooded Agricultural Field	Old Field	Agricultural Field	Urban / Disturbed
Code	OF	MF	YF	WD	RV	LS	MS	RI	WN	FW	ES	IT	HB	SV	AP	FS	OF	AG	UR
Long-tailed Weasel				X				X	X				X				X	X	X
Mountain Beaver, *rufa subsp.*	X	X	X	X				X											
Snowshoe Hare, *washingtonii subsp.*		X	X						X				X						
Keen's Myotis	X	X						X											
Townsend's Big-eared Bat	X	X	X	X															
Pacific Water Shrew	X	X				X		X	X										
Townsend's Mole													X				X		X

BIRDS

	Forests and Woodlands				Freshwater						Tidal and Marine		Other			Human-modified			
Class	Old Forest	Mature Forest	Young (Immature) Forest	Woodland	Large River	Lowland Stream / River	Mountain Stream	Riparian	Wetland	Lake, Pond, and Reservoir	Estuarine	Intertidal and Shallow Sub-tidal	Herbaceous	Sparsely vegetated	Alpine	Seasonally-flooded Agricultural Field	Old Field	Agricultural Field	Urban / Disturbed
Code	OF	MF	YF	WD	RV	LS	MS	RI	WN	FW	ES	IT	HB	SV	AP	FS	OF	AG	UR
Great Blue Heron, *fannini subsp.*	X	X			X	X		X	X	X									
Horned Lark											X	X		sd, st		X	X	X	X
Barn Owl									X		X		X	X			X	X	X
Northern Goshawk	X	X									X		X			X	X	X	X
Peregrine Falcon				X					X										
Short-eared Owl				X				X	X		X	X	X	cl	X				
Spotted Owl	X	X									X		X						
Western Screech-Owl, *kennicottii subsp.*	X	X	X	X				X											
Barn Swallow				X	X	X		X	X	X									
Olive-sided Flycatcher	X	X		X				X	X				X	X			X	X	

AMPHIBIANS

	Forests and Woodlands				Freshwater						Tidal and Marine		Other			Human-modified			
Class	Old Forest	Mature Forest	Young (Immature) Forest	Woodland	Large River	Lowland Stream / River	Mountain Stream	Riparian	Wetland	Lake, Pond, and Reservoir	Estuarine	Intertidal and Shallow Sub-tidal	Herbaceous	Sparsely vegetated	Alpine	Seasonally-flooded Agricultural Field	Old Field	Agricultural Field	Urban / Disturbed
Code	OF	MF	YF	WD	RV	LS	MS	RI	WN	FW	ES	IT	HB	SV	AP	FS	OF	AG	UR
Pacific Giant Salamander	X	X					X	X						ta					
Pacific Tailed Frog	X	X					X	X											
Oregon Spotted Frog						X		X	X										
Northern Red-legged Frog	X	X				X		X	X	X									
Western Toad	X	X	X	X	X	X	X	X	X	X			X	ta	X				X

TURTLES

	Forests and Woodlands				Freshwater						Tidal and Marine		Other			Human-modified			
Class	Old Forest	Mature Forest	Young (Immature) Forest	Woodland	Large River	Lowland Stream / River	Mountain Stream	Riparian	Wetland	Lake, Pond, and Reservoir	Estuarine	Intertidal and Shallow Sub-tidal	Herbaceous	Sparsely vegetated	Alpine	Seasonally-flooded Agricultural Field	Old Field	Agricultural Field	Urban / Disturbed
Code	OF	MF	YF	WD	RV	LS	MS	RI	WN	FW	ES	IT	HB	SV	AP	FS	OF	AG	UR
Western Painted Turtle, Pacific Coast pop.						X		X	X	X									

FISH

	Forests and Woodlands				Freshwater						Tidal and Marine		Other			Human-modified			
Class	Old Forest	Mature Forest	Young (Immature) Forest	Woodland	Large River	Lowland Stream / River	Mountain Stream	Riparian	Wetland	Lake, Pond, and Reservoir	Estuarine	Intertidal and Shallow Sub-tidal	Herbaceous	Sparsely vegetated	Alpine	Seasonally-flooded Agricultural Field	Old Field	Agricultural Field	Urban / Disturbed
Code	OF	MF	YF	WD	RV	LS	MS	RI	WN	FW	ES	IT	HB	SV	AP	FS	OF	AG	UR
Nooksack Dace						X		X											
Salish Sucker						X		X	X										

INVERTEBRATES

	Forests and Woodlands				Freshwater						Tidal and Marine		Other			Human-modified			
Class	Old Forest	Mature Forest	Young (Immature) Forest	Woodland	Large River	Lowland Stream / River	Mountain Stream	Riparian	Wetland	Lake, Pond, and Reservoir	Estuarine	Intertidal and Shallow Sub-tidal	Herbaceous	Sparsely vegetated	Alpine	Seasonally-flooded Agricultural Field	Old Field	Agricultural Field	Urban / Disturbed
Code	OF	MF	YF	WD	RV	LS	MS	RI	WN	FW	ES	IT	HB	SV	AP	FS	OF	AG	UR
Oregon Forestsnail	X	X	X					X	X										X
Dun Skipper								X	X				X						
Monarch				X					X				X						X
Grappletail						X	X?	X											
Olympia Oyster											X	X							

VASCULAR PLANTS

	Forests and Woodlands				Freshwater						Tidal and Marine		Other			Human-modified			
Class	Old Forest	Mature Forest	Young (Immature) Forest	Woodland	Large River	Lowland Stream / River	Mountain Stream	Riparian	Wetland	Lake, Pond, and Reservoir	Estuarine	Intertidal and Shallow Sub-tidal	Herbaceous	Sparsely vegetated	Alpine	Seasonally-flooded Agricultural Field	Old Field	Agricultural Field	Urban / Disturbed
Code	OF	MF	YF	WD	RV	LS	MS	RI	WN	FW	ES	IT	HB	SV	AP	FS	OF	AG	UR
cliff paintbrush														cl	X				
phantom orchid	X	X																	
streambank lupine								X					vs						
tall bugbane	X	X						X											
Vancouver Island beggarticks						X		X	X		X	X							
contorted-pod evening-primrose													cs	sd, st					
whitebark pine				X?											X?				

NON-VASCULAR PLANTS

	Forests and Woodlands				Freshwater						Tidal and Marine		Other			Human-modified			
Class	Old Forest	Mature Forest	Young (Immature) Forest	Woodland	Large River	Lowland Stream / River	Mountain Stream	Riparian	Wetland	Lake, Pond, and Reservoir	Estuarine	Intertidal and Shallow Sub-tidal	Herbaceous	Sparsely vegetated	Alpine	Seasonally-flooded Agricultural Field	Old Field	Agricultural Field	Urban / Disturbed
Code	OF	MF	YF	WD	RV	LS	MS	RI	WN	FW	ES	IT	HB	SV	AP	FS	OF	AG	UR
silver hair moss				X										cl, ro					
poor pocket moss	X	X						X											


South Coast Conservation
Program