2010

STATE OF THE ENVIRONMENT

C·V·R·D

ENVIRONMENT COMMISSION

Environment Commission | Cowichan Valley Regional District
June 2010

Front Cover Photo: Chris Junck, Garry Oak Ecosystems Recovery Team

Table of Contents

June 9, 2010

Acknowledgements

This report was prepared by Judith Cullington (Judith Cullington & Associates), Rachel F. Holt (Veridian Ecological Consulting) and Jenny Farkas for the Cowichan Valley Regional District (CVRD) Environment Commission.

Substantial support for the development of this report was provided by the Environment Commission's Subcommittee on the State of the Environment, Kate Miller (Manager, Regional Environmental Policy, CVRD) and numerous individuals (listed below) who assisted either by attending the workshop, providing data and/or reviewing drafts.

Members of the Environment Commission Subcommittee on the State of the Environment for 2009/2010 were:

Justin Straker (Chair)
Rodger Hunter
Roger Wiles
Bruce Fraser
Judy Stafford

These individuals – and especially Justin Straker and Roger Wiles – provided significant and invaluable volunteer time in assisting with the research, direction and vision for this document.

Special thanks to Don Radford of Fisheries and Oceans Canada, who provided staff resources for the fisheries section.

In alphabetical order (and with apologies for any inadvertent omissions):

Lynne Atwood
Bruce Adkins
Glen Anderson
Lynn Bonner
Kim Brunt
Marlene Caskey
Alan Chapman
Don Closson
Linden Collette
Ron Cook
Melissa Daniels
John Deniseger
Brian Dennison
Deborah Epps
Corey Erwin
Tracy Fleming
Dyan Freer
Joe Friesenham
Marilyn Fuchs
Ian Giesbrecht
Ramona de Graaf
Rob Grant
Wayne Haddow
Mary Jo Hamey
Roger Hart
Maggie Henigman
Harmony Huffman
Laura Hunse
Jan Kirkby
Louise Knodel-Joy
Laura Kristiansen
Kathy Lachman
Pat Lapcevic
Nick Leone
Dave Lindsay
Wilf Luedke
John Mackay
Lynne Magee
Asit Mazumder
John Milne
Kathleen Milward
Rachelle Moreau
Peter Murray
Bent Nielsen
Peter Nix
Glen Okrainetz
Mike Pennock
Earle Plain
Brigid Reynolds
Nagi Rizk
Tom Rutherford
John Scull
Chip Seymour
Ted Sheldon
David Slade
Judy Stafford
Mary Storzer
Leon Teubes
Len Thew
Janice Thomas
Jane Thomson
Janice Urquhart
Morne Van Niekerk
Jessica Vanwinden
Sarah Verstegen
Peter de Verteuil
Michelle Vessey
Craig Wightman
Elke Wind
Jason Young

Caroll Taiji, April Shepherd-Trent and Claire Matthews (Taiji Brand Group) were responsible for graphic design, layout and proofing.

A letter from Gerry Giles, Chair of the CVRD Board of Directors

In 2007, the CVRD Board established an Environment Commission to provide it with advice for addressing environmental issues that fall within the Board's jurisdiction.

In a previous major report, the Commission worked with the CVRD to put forward "12 Big Ideas" to indicate where our communities should focus their efforts to have a positive influence on the condition of our regional environment.

During the past year a significant focus of the Commission has been on developing a means to measure the progress that is being made within the regional district to ensure that our environmental assets are healthy and sustainable. This inaugural State of the Environment Report – developed in collaboration with the CVRD – establishes a scientific baseline and a process for measuring and reporting the status of our important environmental values into the future.

The Commission contracted an experienced scientific team to develop sets of measurable indicators for a variety of environmental values. The team then searched for existing information that could be used to tell us where things currently stand. Their task was to use both historic and current data to analyze current conditions and emergent trends, and to suggest what would be needed in the future to fill information gaps that they discovered.

Their report is a sobering one. The team examined the status of water, air, fish, agricultural land, biodiversity, population and growth, the implications of climate change and the management of waste. The story that emerges is that the wonderful environment that has attracted so many of us to the Cowichan region is under stress and most trends are negative. Although we are addressing some of the critical issues, we continue to degrade many of our most precious assets and we need to pay attention.

The Commission believes that we need to re-double our environmental stewardship efforts, both to arrest the negative trends that have been measured and to restore values that are in danger of dipping below recovery thresholds. Fortunately, while the message is extremely cautionary, it is being delivered to a region that is already alive to the issues and organizing to address them. The Commission is aware of many initiatives from federal, provincial, regional district and municipal levels that are leading in the right direction. It is also aware of a host of civic organizations that are actively pursuing programs of conservation, water management, food security, energy efficiency, greenhouse gas reduction, lakeshore management, recycling and estuary health among many others. None of these organizations can solve environmental issues alone. We have in front of us a major task that requires collaboration, cooperation and coordination.

In our collective best interest, the job we have to do is to turn each of the troublesome indicator measurements from negative to positive. Good water, abundant local food, efficient use of energy sources, sustained natural ecosystems, effectively reduced waste, revived salmon populations, well-designed settlements, healthy air quality and strong resilience to climate change are goals worthy of our concentrated effort. This State of the Environment Report starts us on a path of measuring how well we are doing and pointing toward areas that most need our attention.

The Commission intends to use the State of the Environment Report to organize its annual work plan and structure its advisory functions to the CVRD Board. The Commission's 2010/11 work plan will focus on priority environmental values, establish teams to develop suitable public education and other initiatives, and develop recommendations for the CVRD Board where our contribution is relevant and our leadership is required. The Commission will also engage with and support existing community organizations in each relevant sector, and work with federal, provincial, regional and community governments on their programs of managed development, sustainability, conservation and restoration.

On behalf of the Board of Directors, I want to congratulate the Environment Commission on producing this vital and important report.

Gerry Giles, Chair

CVRD Board of Directors

Executive Summary

State of the Environment Report Executive Summary

The Cowichan Valley Regional District (CVRD) Environment Commission prepared this inaugural State of the Environment Report to assess the status of a variety of environmental indicators and issues that signal the health of the environment within the regional district. Using the principle "if you don't measure, you can't manage," this ground-breaking report identifies numerous reliable and repeatable measures of how the environment is doing.

The Report strives to answer questions such as:

- Are our ecosystems and species adequately protected?
- Are we living within natural ecological thresholds?[1]
- Do the biodiversity and related ecological services that sustain the region have the resilience to respond to climate change and population growth?
- Are water resources adequately protected to safely provide for people, plants and animals?
- Is the air quality good?
- Are we making good use of available land and creating smart, flexible, and resilient communities?
- Are we producing enough local food?
- Are we proactively addressing the challenges of climate change?

Overall, this report identifies a number of areas where we face major challenges. We have dramatically changed the natural landscape, and in so doing have compromised natural ecosystems including native plants and animals. Many native species and ecosystems are at risk, and there are too many invasive species. Coho and chinook salmon stocks have crashed. Water is polluted and scarce in some places and at some times of the year. While the region's air quality seems to be good, high hospital admission rates for children with respiratory problems may signal a problem. Climate change already creates challenges with floods and drought, and further stress on native species and ecosystems is imminent.

1 Example of an ecosystem threshold: species diversity of a landscape may decline steadily with increasing habitat degradation to a certain point, and then fall sharply after a critical threshold of degradation is reached.

Low-density development (sprawl) has fragmented ecosystems, negatively impacted watersheds and created car-dependent communities that contribute to climate change through use of fossil fuels. Continued population growth in the region will place further stress on the natural environment and human use of its resources.

Much is unknown. Many residents rely on wells for water – but there are few data on how much water is being withdrawn and whether withdrawal rates are sustainable for the long term. While data for sensitive ecosystems exist for the eastern part of the region (i.e., the Coastal Douglas-fir forest), there are few studies of the ecology of the equally sensitive Coastal Western Hemlock forests to the west. There is no water quality information for many lakes and streams. Furthermore, data on populations of iconic species such as Roosevelt elk are limited, and data for less well-known species – including "species-at-risk" – are frequently sparse.

But the news is not all bad. Agriculture is a thriving industry in the Cowichan Region, providing the opportunity for the region to move towards self-sufficiency in food production. Chum salmon returns are the highest in 60 years. Rates of recycling are soaring. And although data are somewhat lacking, there appears to be reasonably good quality water within most of the region most of the time.

Simply by starting to report out on the State of the Environment, the CVRD, associated municipalities, non-government organizations, businesses and individuals have an opportunity to better understand the natural environment and human impacts, and gain a competitive advantage over areas that have not had the foresight to take this initial step. Indeed, this report is an important first step in "measuring so we can manage".

As well, it is clear that many steps are being taken to address some of the problems. Reports such as the Cowichan Basin Water Management Plan have identified steps to address some of the water issues in the area, and a Cowichan Watershed Board has now been established to undertake this work. The municipalities of Ladysmith, Duncan and Lake Cowichan have installed (or plan to install) meters so that they can track drinking water consumption. The CVRD is bringing small sewage treatment plants up to standard to avoid water quality issues. The Regional District and several municipalities have undertaken energy and emissions assessments and have begun work to reduce their carbon footprints. Regional residents are knowledgeable and passionate about environmental issues, and are working in many ways to make and keep this region a healthy and desirable place to live.

Regular updates to this State of the Environment Report can help residents of the region stay informed and aware, and help governments and others set priorities for action.

A summary of the key findings from the report are listed below.

The Landbase

- The human footprint (including development and logging) now covers over 75% of the total landbase and affects its ability to supply and maintain ecological values and services.
- On the east coast, 50% of the landbase is no longer forested and little or no older forests remain. Despite being regarded as unique and sensitive, very few areas of Coastal Douglas-fir ecosystems have protected area status. Less than 20% of the historic Garry oak ecosystems remain, and less than 5% of those are in a "natural" condition.
- At higher elevations, and towards the west coast, there are more forested lands. However, the total amount protected (<8%) within the CVRD is well below standards (~50%) set for maintaining ecological values into the future.
- On-going development along shorelines is resulting in continued loss and degradation of those habitats.

Biodiversity

- The proportion of animals, plants and ecological communities at risk in the CVRD is high compared to many other areas of the province. Ecological communities at risk, such as the massive riparian Sitka-spruce forests in the western part of the region, are not legally protected from harvesting.
- The CVRD has a large and growing number of invasive plant and animal species, especially in the drier east-side areas of the region. The negative impacts of invasive species are particularly evident in Garry oak ecosystems, riparian areas and wetlands.
- In the last five years, the number of returning salmon spawners for two of the Cowichan River's primary salmon runs – fall coho and chinook – have been reduced to roughly 10% of numbers documented during the last 80 years. At the same time, chum salmon returns are at some of the highest levels seen in the last 60 years. Chinook salmon in particular are often considered to be indicators of broader ecosystem health, since their survival and reproductive success are affected by a wide range of factors.

Water

- Measuring, monitoring and understanding patterns and trends for water are complex and difficult. However, there is a general sense that water is abundant and water quality is reasonably good throughout most of the CVRD, most of the time.
- Some of the key aquifers in the Cowichan Region are naturally vulnerable and are increasingly becoming heavily developed.
- At critical periods and particularly in dry years, the conflict for water can become acute – leading to the potential for significant impacts to crucial aquatic resources such as fish spawning, or to industrial processes. Climate change is expected to exacerbate this situation.

> Pollutant levels are typically low, but waters of major rivers are no longer fit to drink, and cumulative downstream impacts have led to closure of shellfish fisheries since the 1970s.

> Naturally vulnerable lakes – such as Quamichan – already show significant impacts of pollution from a variety of sources. Cowichan Lake is buffered by its large size and depth. Unfortunately, cumulative effects can be difficult to detect and may not observed until significant events such as "fish kills" occur.

> Most areas lack the ability to track volumes of drinking water consumption. However, the Town of Ladysmith has introduced water meters to homes, and has seen a significant reduction in water consumption as a result. North Cowichan has also been quite progressive and the municipalities of Duncan and Lake Cowichan are in the process of introducing water meters.

Air Quality

> Air quality in the Cowichan Region is generally good, and pollution levels are well within provincial standards. However, hospital admission rates for children with respiratory problems in the region are consistently more than 20% higher than the provincial average, and at times twice the average.

> Air quality diminishes significantly in the fall and winter months, due to increases in seasonal combustion (open burning and woodstove use). Sources of low-level air pollution throughout the year include vehicle exhaust and commercial/industrial emissions.

Population and Growth

> The Cowichan Valley Regional District has a population of about 77,000, and its population continues to grow. While some of the population is concentrated in higher density areas (such as Duncan), there are fewer than 200 people/km^2 in most parts of the region. This makes "smart growth" development very hard to achieve.

> About three-quarters of the population live in communities where they are dependent on cars for most daily needs and errands. About 90% of commuters travel to work by personal vehicle – the vast majority as single occupant drivers.

> If maximum build-out under current zoning were to occur, two-thirds of the region's watersheds would have 10–30% impervious surface coverage, with consequent significant ecological impacts on local waterways.

Agriculture

> Agriculture is a thriving and valuable industry in the Cowichan Region, and achievement of regional food security objectives is possible. However, current rates of reported productivity fall short of food security targets.

> Key barriers to achieving these targets include access to irrigation water (and natural constraints on available water volumes), lack of skilled labour, an absence of processing and distribution facilities, high land prices, and restrictive production quotas.

Climate Change Mitigation and Adaptation

> The CVRD and its member municipalities, together with many groups and individual citizens, have recognized climate change as an issue that needs to be addressed. Major region-wide strategic and sectoral approaches have yet to occur.

Waste Management

> The CVRD has set a long-term goal of Zero Waste, with a more immediate goal to achieve a 50% per capita reduction in the disposal of solid waste (over 1990 levels), and has an extensive recycling program to support this.

> The volume of recyclables has risen significantly in the past ten years, both in terms of total volume and per capita volumes. At the same time, however, total and per capita volumes of solid waste (garbage) have also increased, indicating that while people are recycling more, they are also buying (and disposing of) more "stuff".

> The CVRD is taking over and bringing up to standard many smaller liquid or sewage treatment plants, thus addressing some of the issues related to leaking septic fields. However, many septic fields remain and continue to contribute to water quality issues in the region.

12 big ideas for a strong, resilient Cowichan

Here are our 12 big ideas on which to build a sustainability plan for the Cowichan region, and some examples of what our big ideas would look like 'on the ground'. Some of these things you could do personally, and some we could do together as a community and through local government. Are we on the right track? How would you prioritize our big ideas? Are you ready to do your part, and to support local government to do theirs?

Thank you for photo contributions to the Town of Ladysmith EDC, Nik West, Andrew Leong, Wayne Taiji and Riley Taiji.

1.0 Cowichan Region State of the Environment

1.1 Introduction

Working with the principle of "if you don't measure, you can't manage," this State of the Environment Report endeavours to establish some reliable and repeatable ways of measuring the condition or health of the environment of the Cowichan Region. This report is the first of its kind for the Cowichan Region, and provides a snapshot of the wide and complex environmental issues facing this area. It has been developed by a partnership between the Cowichan Valley Regional District's Environmental Policy Division and the Region's volunteer Environment Commission.

The development of this report by the regional government marks a shift in responsibility for environmental management; local government has not traditionally been engaged in environmental monitoring and protection. In the past, natural resource stewardship was primarily a federal and provincial responsibility. However, as senior government resources are directed to these areas less and less, the job increasingly falls to local governments. Accompanying this shift have been growing public concerns about the health of the natural environment, and increasing community expectation that all levels of government do a better job of managing the environment.

This report relies on existing data from a number of sources, including local, regional, provincial, federal and First Nations governments, as well as information from community organizations. Unfortunately, due to data inconsistencies and access challenges, many data gaps exist which future State of the Environment reports will hopefully be able to fill. Nonetheless, this report provides an important first step to understanding more about the region's environment, and begins to paint a picture of some of the area's successes and challenges.

This State of the Environment Report builds on the Sustainable Cowichan framework developed by the Cowichan Valley Regional District (CVRD) Environment Commission in 2008. This framework contains four goals[2], and suggests 12 strategic actions to achieving sustainability.

For more information, visit **www.12things.ca**

2 The CVRD Environment Commission's four goals are: (1) To protect the environment from harm; (2) To restore, rehabilitate and enhance the natural environment; (3) To encourage economic and social development compatible with environmental stewardship; and (4) To lead by example.

Key Questions

This inaugural State of the Environment Report strives to answer questions such as:

Is the natural environment healthy?

> Are our ecosystems and species being adequately protected?

> Is our biodiversity resilient in the face of change – in particular climate change and population growth?

> Are we approaching, or crossing, the region's natural thresholds?[3]

> Is the water safe? Is there enough for people, plants and animals?

> Is the air quality good?

Are we living within the "natural" capital'?

> Are we effectively balancing the needs of ecological functions and economic activity?

> Is our natural capital[4] (e.g., fisheries and forests) being managed in a sustainable way? Will it be at least as abundant and productive for future generations?

> Are we making good use of available land, and creating smart, flexible, and resilient communities?

> Are we producing enough local food?

> Are we addressing the challenges of climate change?

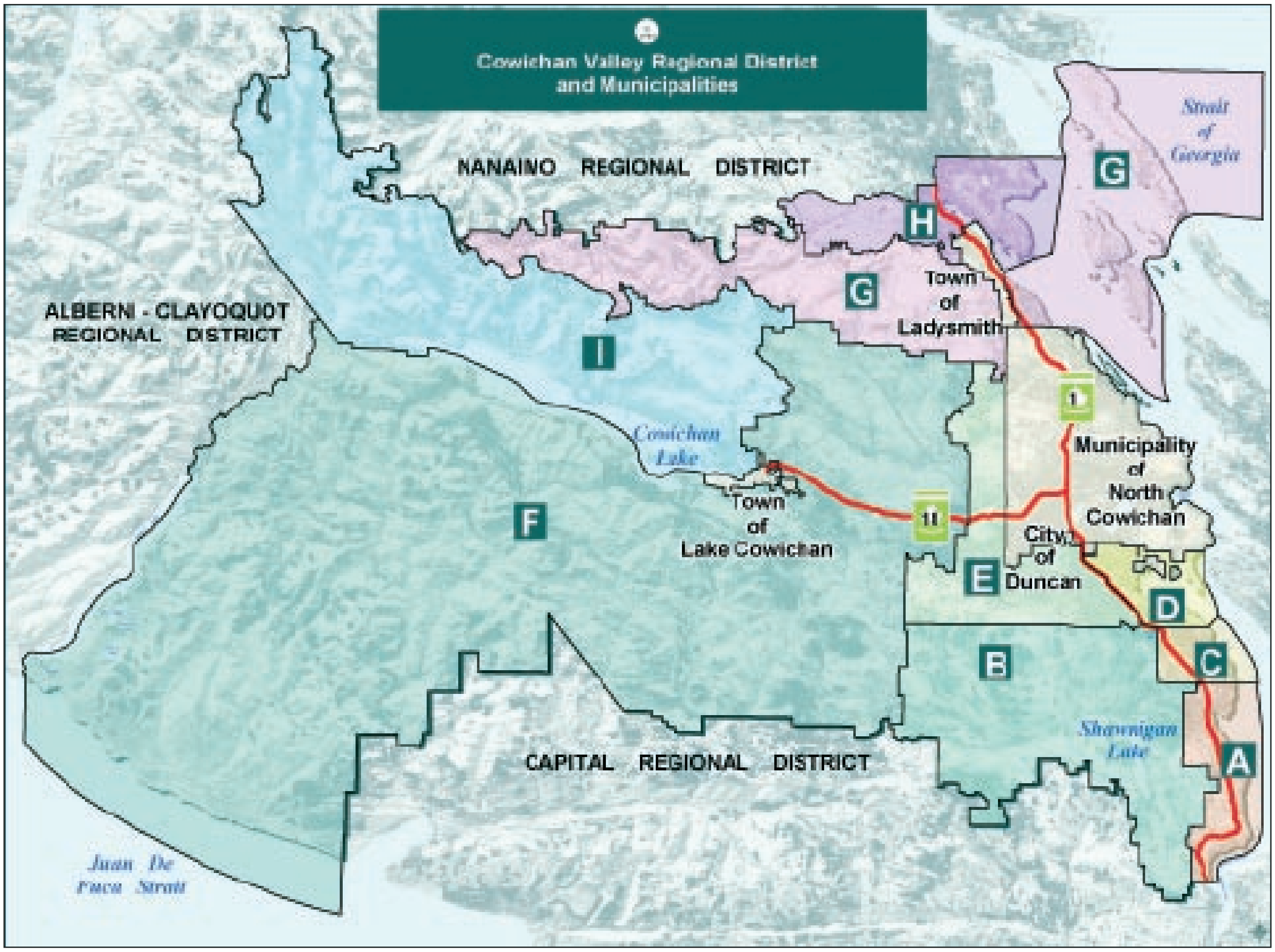
3 Example of an ecosystem threshold: the species diversity of a landscape may decline steadily with increasing habitat degradation to a certain point, and then fall sharply after a critical threshold of degradation is reached.

4 Natural capital is all of the elements that sustain all forms of life, such as water and oil, the land, and the ecosystems that maintain clean water, air and a stable climate. Most of these elements are irreplaceable and not renewable.

The Cowichan Region

The Cowichan Valley Regional District (CVRD) is located on southern Vancouver Island in British Columbia. It covers an area of more than 3,473 square kilometres stretching from the Pacific Coast to the Strait of Georgia, and includes the southern Gulf Islands of Kuper, Thetis and Valdes. The CVRD is made up of four municipalities – City of Duncan, Town of Lake Cowichan, District of North Cowichan and Town of Ladysmith – and nine electoral areas (Figure 1.1).

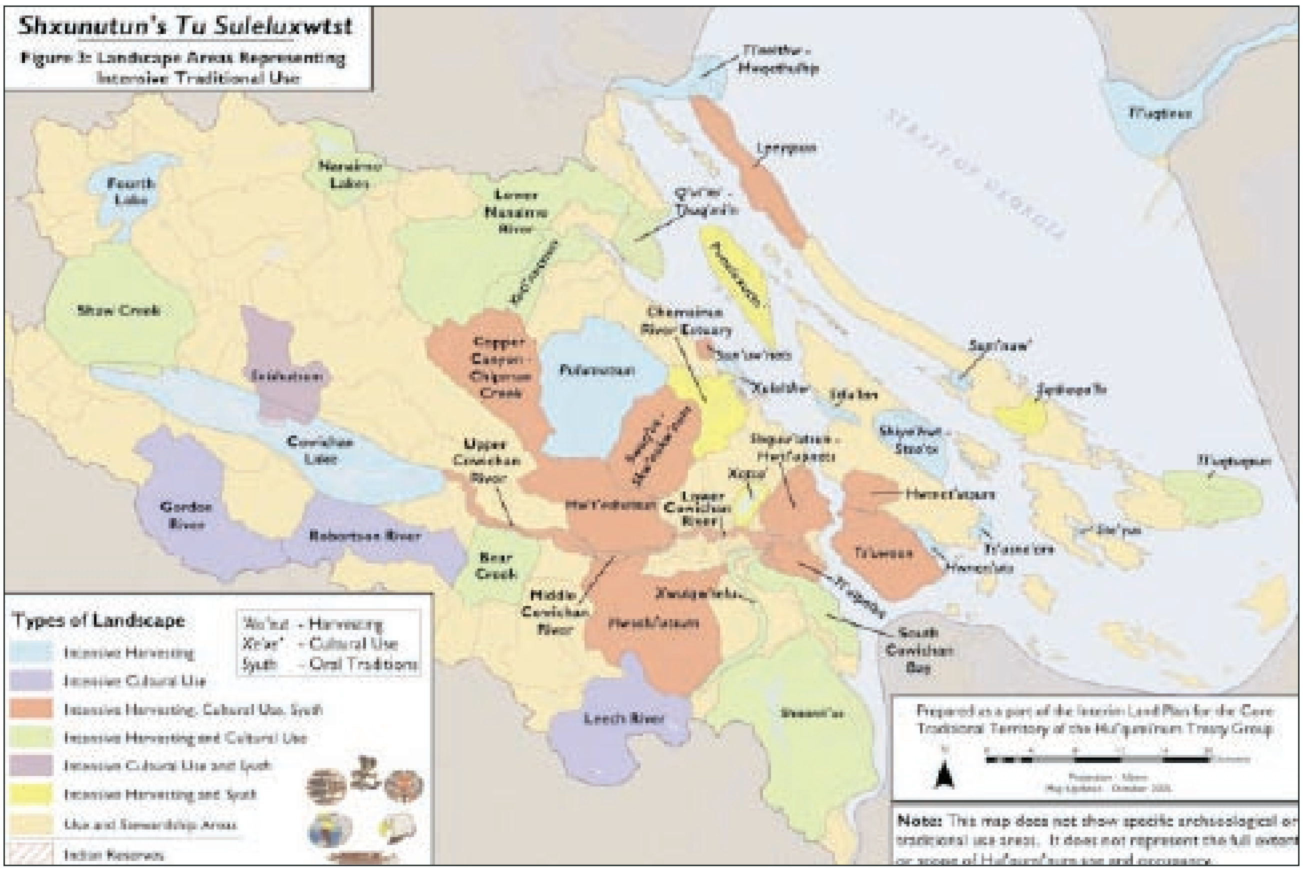
FIGURE 1.1: Cowichan Valley Regional District



Source: CVRD website www.cvrd.bc.ca

The CVRD land is part of the traditional territories of several First Nations, including the Cowichan people (the largest First Nation in the province), Chemainus, Penelakut, Lyackson, Halalt, Lake Cowichan and Ditidaht First Nations. Today, these First Nations make up the Hul'qumi'num Treaty Group – with the exception of the Ditidaht on the west coast. Traditionally, these First Nations occupied overlapping, ecologically based territories that included the Salish Sea and the Fraser River (Figure 1.2). The landscape was a source of both spiritual and physical nourishment.

FIGURE 1.2: Partial representation of the scope of use and occupancy of the Hul'qumi'num Treaty Group's traditional territories



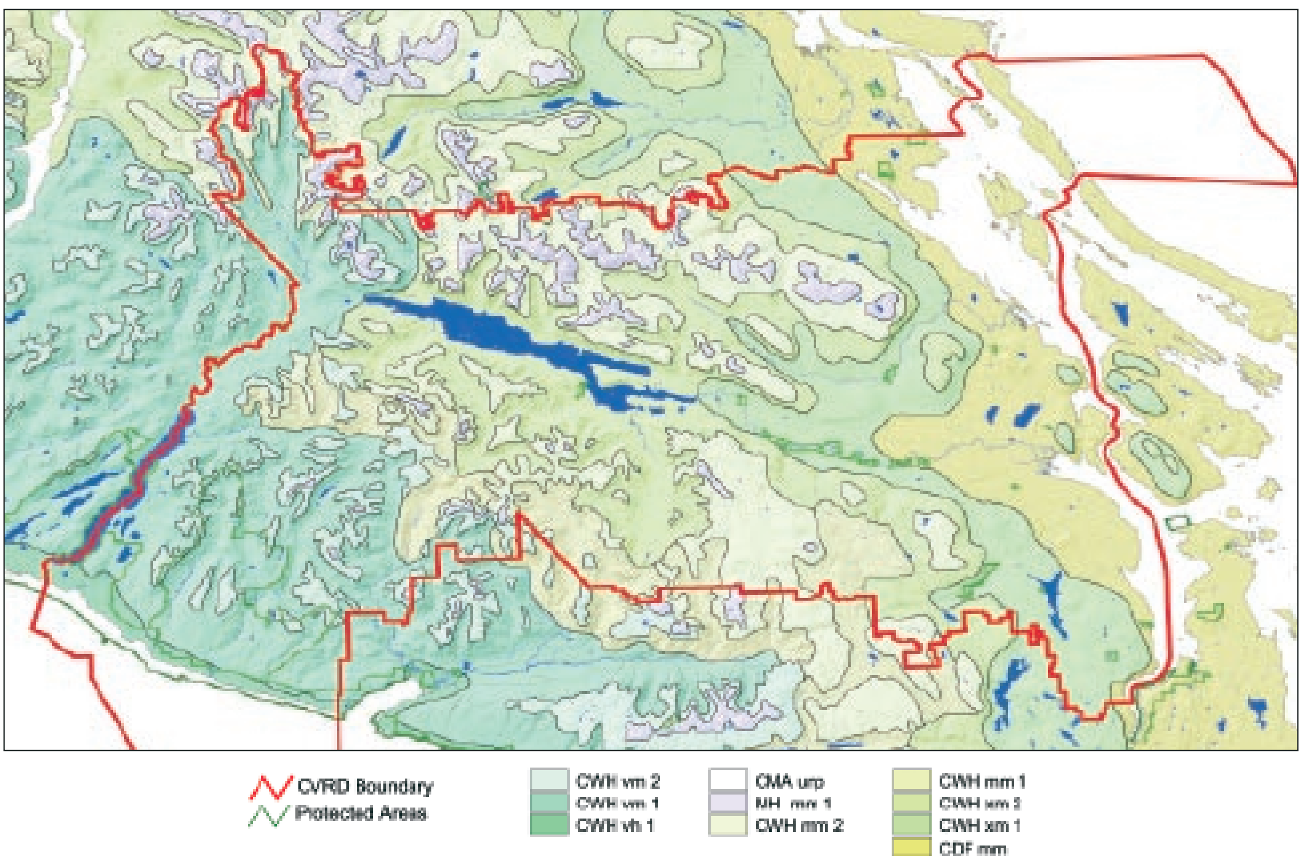
Source: Hul'qumi'num Treaty Group. 2005. Shxunutun's Tu Suleluxwtst. In the footsteps of our Ancestors. Summary of the Interim Strategic Land Plan for the Hul'qumi'num Core Traditional Territory.

Local Ecology

Vancouver Island is classified into four ecosections, and the ecosystems within them are divided into a large number of biogeoclimatic zones (Figure 1.3)[5]. The eastern side of the Island – the Nanaimo Lowland and Leeward Island Mountains – are characterized by dry forests dominated historically by Coastal Douglas-fir (CDF) and Garry oak, which historically burned relatively frequently by both "natural" and First Nation-driven fires.

In contrast, the forests on the west side of Vancouver Island are some of the wettest in the province, and so burn very infrequently – some forests here have escaped any large disturbance for 4,000 years or more. As a result, they are characterized by huge statured and often old or ancient western red-cedar, yellow-cedar, coastal western hemlock (CWH) and Sitka spruce forests. These multi-storied canopy forests (forests with many layers) provide a home to a large diversity of plants and animals and perform many natural functions, including the long-term storage of carbon.

FIGURE 1.3: Vancouver Island biogeoclimatic zones



CWH = Coastal Western Hemlock zone; CMA = Coastal Mountain-heather Alpine Zone; MH = Mountain Hemlock Zone; CDF = Coastal Douglas-fir zone. The letters (e.g., vm2) following these zone titles describe moisture and temperature variability within each broader area.

See Footnote 5 for additional information about these zones.

5 A description of these zones can be found on the Ministry of Forest's Biogeoclimatic Ecosystem Classification (BEC) website: www.for.gov.bc.ca/HRE/becweb/resources/classificationreports/subzones/index.html

The diversity of ecosystems – unique combinations of plants, animals and their physical environment – defines the beauty and richness of the natural world. The CVRD contains a range of rare, sensitive and keystone ecosystems that have very high ecological and social values. For example, the region's Garry oak woodlands are among the most endangered ecosystems in Canada, and provide a home for a wide diversity of species – including seven species of reptiles, seven species of amphibians, 33 species of mammals, 104 species of birds, 694 species of plants and more than 800 species of insects and spiders.[6]

Other sensitive ecosystems in the region include wetlands and riparian[7] habitats, older forests, terrestrial herbaceous areas (rocky outcrops and grassy knolls), coastal bluffs, and coastal dunes and spits, as well as many shoreline ecosystems. Shoreline ecosystems are the interface between terrestrial and marine environments, and allow land species access to the historical abundance of the ocean, as well as providing critical habitats for many marine and intertidal species.

6 Garry Oak Ecosystems Recovery Team, www.goert.ca

7 A riparian habitat or zone is the interface between land and a flowing surface water body such as a river. Riparian zones play a significant role in soil conservation, and influence biodiversity and aquatic ecosystem health.

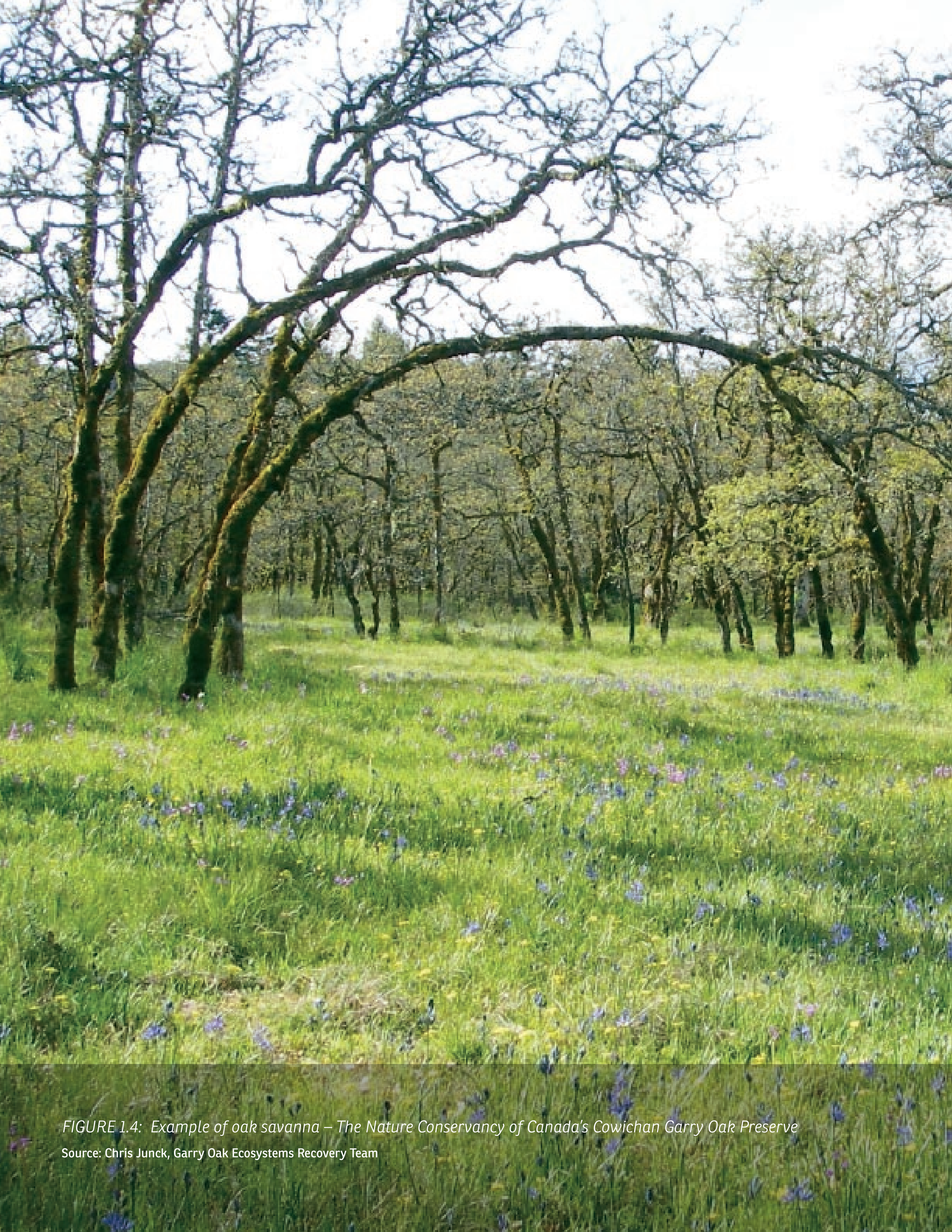


FIGURE 1.4: Example of oak savanna – The Nature Conservancy of Canada's Cowichan Garry Oak Preserve

Source: Chris Junck, Garry Oak Ecosystems Recovery Team

1.2 Cowichan Region – A Changing Landscape

"You can never step into the same river twice, for it is not the same river and you are not the same person." [8]

Landscapes are constantly changing, and the Cowichan Region is no exception. All sorts of natural and human forces affect change – including climate, geology and biology. Below is a brief timeline that highlights some major changes that have already taken place in the region.

Ice Age

The term "ice age" is generally used to refer to the period of extreme cold that began roughly 30,000 years ago and resulted in extensive ice sheets covering large parts of North America. During this glacial period the ice was hundreds of metres thick, and so heavy that Vancouver Island was depressed by more than 150 m.

Around 15,000 years ago the climate began to warm, and the ice sheets slowly melted and retreated. The release of the weight of ice eventually caused the land to rebound, evidence of which can be seen in the iconic shapes of Mt Tzouhalem near Maple Bay, and Mt Maxwell and Mt Tuam on Saltspring Island. Moving and melting ice cut major features into the landscape, including the U-shaped Cowichan Valley, the deep depression of Lake Cowichan, and the channels of the Cowichan River.

In place of the ice sheets, large deposits of glacial till (a mixture of soil, clay, sand and gravel) were left behind. Rivers transported this material to the lowlands, forming fertile pockets such as the Cowichan and Chemainus Estuaries. Soon, pioneering species, such as pine, and oak savannas and alpine meadows re-colonized the landscape, aided by a mild, coastal climate, and sufficiently watered by winter rains and snow to be able to withstand summer droughts (Figure 1.4).

---

8 Paraphrase of Heraclitus, Greek philosopher.

FIGURE 1.5: Example of Coastal Douglas-fir ecosystem – Koksilah River Ancient Forest

Source: Warrick Whitehead

Later, forests of conifers, mostly made up of Douglas-fir, colonized the landscape. Other trees that eventually flourished include western hemlock, arbutus, western flowering dogwood, bigleaf maple, grand fir and western red-cedar. These coniferous forests are accompanied by a varied understorey, including Indian plum, salmonberry, western snowberry, Oregon grape, honeysuckle, and salal (Figure 1.5).

Animals, including insects, ducks, eagles, bears and elk, gradually began to fill the ecological niches of the region, Salmon returned to spawn in the gravels deposited in the rivers, and other fish found excellent rearing habitat in the lakes and channels of the area. The web of life in the Cowichan Region became complex and resilient.[9]

First Nations Settlement

Aboriginal people reached the Cowichan Region not long after the glaciers receded (8,000 to 10,000 years ago). The people adapted themselves to the seasonal patterns of weather, fish, and plants – moving throughout the region according to the natural cycles (e.g., spawning salmon, or migrating elk and deer). The area's rivers, tributaries and estuaries provided ready access to a plentiful supply of food: the rivers supported abundant salmon and trout populations, the sea was rich in shellfish, marine plants and marine mammals, and the land supported healthy wildlife populations and a variety of edible and medicinal plants and construction materials such as western red-cedar. Garry oak meadows were once very common in this area, and were important food-gathering sites (e.g., for camas bulbs).

This abundance was accessed carefully; First Nations made only minor adjustments to the landscape (e.g., temporary fish weirs, camas "farms", or controlled burns), in recognition of the connectedness to all things and their role as caretakers of the land, animals and resources – and in order to ensure a sustainable supply of these resources for their people.

> *"Our ancestors touched the lands, rivers, and oceans in our territory lightly and with respect. We used only what nature provided, and only what we needed."* [10] *Cowichan Tribes*

9 See Westland Resource Group's 2005 Water Issues report, and the Capital Regional District's website about the geological history of Vancouver Island (www.crd.bc.ca/watersheds/protection/geology-processes/geologicalhistoryVI.htm)

10 Quote from Cowichan Tribes website: www.cowichantribes.com

European Settlement

In the 1800s, European settlers arrived, bringing a different view of the region's landscape. Europeans imported the notion of private ownership and control ("taming of the wild"), and perceived apparently "unused" land as land simply waiting to be made useful. Oliver Wells, the first non-native person to conduct a detailed land survey of the Cowichan Valley (in 1859) described the landscape as: "45,000 acres of superior agricultural land that could be parceled into farms for 500 to 600 settler families." [11]

By the 1860s, logging and land clearing were well underway, and the low-lying areas of the region were being settled by farmers. In 1913, Canadian Pacific extended a rail line to Lake Cowichan. By 1920, 18 logging companies employed 1,200 men in the harvesting of the Cowichan Basin's forests (Figure 1.6).

FIGURE 1.6: Early logging camp in Rounds, BC (near Lake Cowichan)

Source: Kaatza Station Museum and Archives, accession number P983.28.60.

11 Cited in Arnett 1999, 61, on the History of the Hul'qumi'num page of the Hul'qumi'num People website people.www.hulquminum.bc.ca/hulquminum_people/cowichan?print=1

The new residents of the region made substantial modifications to many ecological systems . For example, the hydrologic system[12] was permanently altered, and not only by logging. The mighty Cowichan River was once made up of a series of rapids and waterfalls. Most of these falls were blown up with dynamite and/or removed, to facilitate greater access to and movement for harvesting. Eventually, log jams caused huge losses to logging operations and helped expedite the construction of a railway. The significant ecological impacts of these modifications are still felt today.

Winter floods threatened investments in roads and railroads throughout the Cowichan Basin and the growing settlement at Duncan. Dykes were the answer, and served to greatly narrow the Cowichan River's flood plain. Farmers capitalized on the rich soils that were a gift from the water in the Cowichan Basin; they straightened and deepened streams to hasten drainage, and drilled wells to extract water for irrigation.

With settlements came pavement, storm drains, septic fields, and sewage treatment plants, all of which affected the region's natural water cycles, as well as water quantity and quality. Industry, too, needed water, and soon extensive water licenses were being issued to support growing industries. For example, in the mid-twentieth century, the government agreed that the new pulp mill at Crofton could divert substantial quantities of water from the Cowichan River. A permanent weir was built at the outlet of Cowichan Lake to increase the capacity of the lake in order to store water for the mill.

During a period of roughly 30 years, beginning in the 1860s, virtually all land previously occupied by First Nations peoples came under the control of the region's new European settlers. In the 1860s and 1870s, about 60,000 ha of Hul'qumi'num land on Vancouver Island and the Gulf Islands were claimed and occupied by these settlers, including prime oceanfront and riverfront lands, and areas of the Cowichan and Chemainus valleys. The newcomers were settled among the long-established Hul'qumi'num villages, occupying and inhabiting many of the domestic and resource places previously occupied by Hul'qumi'num peoples. These newcomers brought smallpox, which decimated First Nations populations on the Island. (The estimated population before European contact and smallpox is between 5,000 and 10,000 people.)

In the 1880s, the bulk of Hul'qumi'num land was given to politician and businessman Robert Dunsmuir, in exchange for Dunsmuir's promise to build a railroad between Esquimalt and Nanaimo (E&N railroad). For the Hul'qumi'num peoples, this deal represented a loss of almost 85% of their traditional land and resources, and an almost complete erosion of their way of life (Figure 1.7).[13]

12 Hydrology encompasses the occurrence, distribution, movement, and properties of the waters of the earth. It involves the interaction of water with the physical and biological environment. A hydrologic system is a system of interrelated components, including the processes of precipitation, evaporation, transpiration, infiltration, groundwater flow, streamflow, etc., in addition to those structures and devices that are used to manage the system. A hydrologic system is subject to different kinds of weather pattern and spatial complexity, and is dynamic and random in nature.

13 Hul'qumi'num Treaty Group, The Great Land Grab in Hul'qumi'num Territory, www.hulquminum.bc.ca/pubs/HTGRailwayBookSpreads.pdf

FIGURE 1.7: Portion of E&N Railway land grant in traditional Hul'qumi'num territory

Source: Robert Morales. 2007. The Great Land Grab.

Ongoing Change

In the past 150 years, the face of the Cowichan Region has changed more than in the preceding 5,000 years. And the rate of change is accelerating. East-side old growth forests are nearly gone, replaced by young trees that are cut as soon as they become marketable – and long before they replace the functionality of a natural forest and the rich biological system it supports.

More and more water is being diverted from rivers and streams and pumped from aquifers, and natural green infrastructure (e.g., wetlands and watercourses that help recharge underground aquifers) are being filled or paved over. About 77,000 people call this region home, many times the number of people that lived here 100 years ago.

And growth is continuing – the region's population grew by almost 7% between 2001 and 2006,[14] Official Community Plans throughout the region predict more growth, and hundreds of thousands of visitors come for recreation and tourism each year.[15] Figures 1.8 and 1.9 provide a visual image of some of the change in the region between 1974 and 2009. The extensive areas of yellow/brown are newly logged areas in 1974, and the bright green areas evident in Figure 1.8 represent areas logged in the 1950s. This pattern of extensive harvesting of entire drainage areas has resulted in the current condition of the landbase, with very little older forest remaining anywhere except on the West Coast.

14 Census 2006.

15 431,483 parties visited Tourism Visitor Centres on Vancouver Island in 2006 (Source: Cowichan Region Accommodation Study http://bc-cowichanvalley.civicplus.com/documents/EDC/Pdf/Accommodation%20Study.PDF)

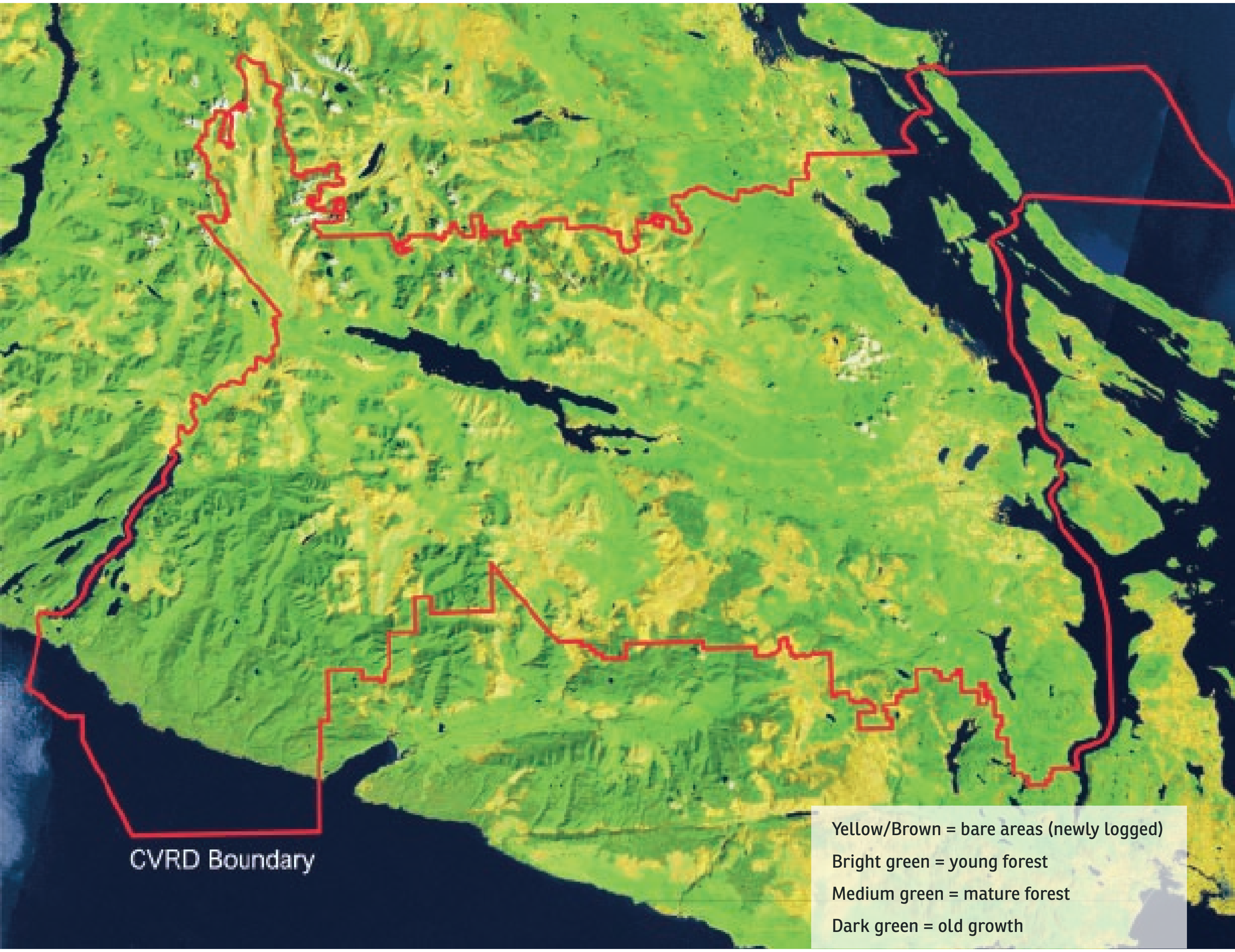


FIGURE 1.8: CVRD 1974, satellite image

Source: www.glovis.usgs.gov

What is less clear from these satellite images, but equally telling, is that the Cowichan Region is unusual compared to many other areas of the Province. Here, a significant proportion of the landscape (with the exception of the outer west coast) has been harvested once or twice already – the image from 1974 shows extensive areas of progressive clearcutting in all the valleys around Cowichan Lake and through to the east coast plain present at that time. In 2009 there is

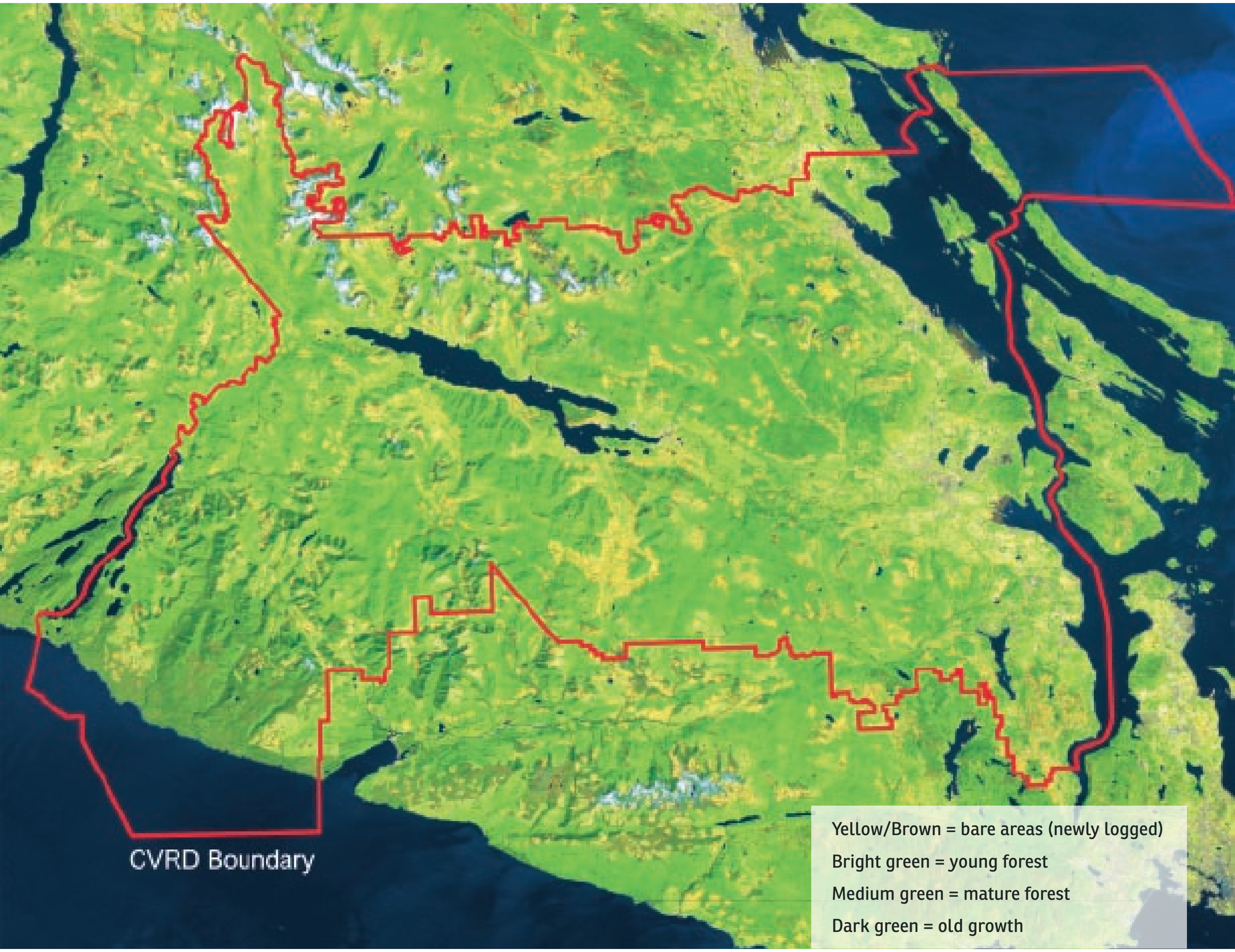


FIGURE 1.9: CVRD 2009, satellite image

Source: www.glovis.usgs.gov

actually more mature forest than was present in the mid-1970s, as these harvested forests have regrown. However, a second or third pass of harvesting is beginning in many of these areas today. There are no intact watersheds remaining, and the area is fully roaded; there are no core protected areas to help maintain ecological systems in this region.

Ecosystems in the east and central part of the region have significantly less than 30% of their historic natural levels of old forest remaining. Drawing down the natural capital so far has a significant impact on ecological resources, including the ability of the landscape to produce clean water and the biodiversity values that are so unique to this region.

Climate Change

Global climate change will significantly affect the Cowichan Valley. The Ministry of Environment notes that many changes are already affecting this region's climate:

> "The average air temperature has become higher in many areas. Air temperature on the coast has been less affected than in the interior and northeast of the province.

> The sea surface temperature has risen along the coast, and deep-water temperatures have increased in some inlets on the South Coast.

> Relative sea level has risen along the BC coast, except in those areas being pushed upward by geological processes."[16]

In general, climate change in the Cowichan Valley is expected to create milder and wetter winters and drier summers, with some local and regional variation. The sea level is expected to rise by at least 1 m by the end of the century – and more recent science predicts that sea level rise will be greater than this.[17] Storm surges – both windstorms and rainstorms – are expected to be more frequent and more intense.

Recent flooding in the Lower Cowichan Basin has certainly raised awareness of the social and economic costs of such events. Changes in surface water temperatures and flow rates (less snow means less storage, more drought means less rain) will have major impacts on the habitat and recharge of lakes and rivers, resulting in cascading systems collapse. For example, during the summer of 2009, the water temperature as it was released into the river from the warm lake[18] measured 26° Celsius (due to low flow, warmer weather and increased evaporation) – roughly the same temperature that results in "fish kills."

16 Ministry of Environment, State of Environment Reporting, www.env.gov.bc.ca/soe/bcce/03_climate_change/overview.html accessed January 29, 2010.

17 The Copenhagen Climate Science Update identifies significant feedback loops that make the 2007 projections of sea-level and temperature rise very conservative: see www.climatecongress.ku.dk/pdf/synthesisreport

The Ministry of Environment provides some additional, and now conservative, predictions for the future:

> "A reduced snow pack in southern BC and at mid-elevations in the mountains

> An earlier spring freshet[19] and reduced water flow in the summer particularly on river systems that depend on snow melt as a source of water

> Warmer water in lakes and rivers

> Changes in ocean temperature, salinity, and density, which, in turn, may affect productivity [and species diversity – especially at the freshwater/saltwater interface]

> Lower soil moisture in the summer

> Increased frequency and severity of natural disturbances, such as fire, and pest outbreaks, such as mountain pine beetle

> Large-scale shifts in ecosystems and loss of ecosystems, such as some wetland and alpine areas

> An increase in number of growing days each season for crops." [20]

Change – For Better or For Worse

Change will continue in the Cowichan Valley, driven by changing climates, growing population, and changing human values and land uses. This State of the Environment report provides a reference point and a way to view these changes – are we maintaining the quality of the natural environment as well as the quality of human life? Are there aspects of our lifestyles that we need to manage differently to ensure that this happens? Overall, are we happy with the trends outlined in this report – and if not, how should we respond?

18 BC Conservation Federation data, provided to Kate Miller by Craig Wightman, Senior Fisheries Biologist, BC Conservation Foundation.

19 A freshet is a sudden rise in the level of a stream, or a flood, caused by heavy rains or the rapid melting of snow and ice.

20 Ministry of Environment, State of Environment Reporting, www.env.gov.bc.ca/soe/bcce/03_climate_change/overview.html accessed January 29, 2010

2.0 State of the Natural Environment

2.1 Landbase

Introduction

Forested landscapes define British Columbia. The Cowichan Valley Regional District (CVRD) is located in the coastal temperate rainforest – a globally unique ecosystem. The CVRD's forest-dominated ecosystems are very diverse, and range from some of the driest to some of the wettest in the province.

Measuring trends for the thousands of individual living species is impossible, and broader indicators are typically used to understand ecological health. A broad "state of the landbase" indicator is useful because it reflects population trends for many other species. The closer a landscape is to its "natural" condition, the more likely that the associated biodiversity values are maintained and that natural processes such as hydrologic cycles continue to function.

Forest harvesting and land clearing have historically been the major agents of change for forested ecosystems on Vancouver Island and within the Cowichan Valley Regional District. Significant harvesting of easily accessible stands started in the 1800s and has continued to the present day, with changes in harvest pattern and profile over time.

Accessibility is different for different areas of the Island, resulting in variations in remaining forest cover today. In addition, clearing by Europeans for agriculture and settlement has significantly impacted land conditions, primarily of the eastern and southern portion of the Island, including the CVRD.

Measuring the Condition of the Landbase

Landbase condition can be measured and assessed at many different scales. For example, although the CVRD region is large, forested landscapes and many associated species generally function at a much larger scale. It therefore becomes important to understand how conditions in the CVRD fit into the broader condition of forests on Vancouver Island.

This section focuses on the broader forest condition, and assesses its state primarily by measuring the amount of old forest present in different ecosystems for Vancouver Island and within the CVRD. An analysis of smaller ecosystems is provided in Section 2.2 (Sensitive Ecosystems). A secondary measure used is the level of land under protection, as it provides a general assessment of the potential future condition of the landbase.

Current land use also interacts with condition and levels of protection – for example, Crown land and private forest land are managed under different regulations and so future condition may be different. In addition, lands that are converted from forest to other uses (development lands) make a different ecological contribution into the future. These factors are relevant in the CVRD where a significant area of forest land is held as private holdings; however, this factor was not included in this first State of the Environment Report (see Summary).

Three indicators are provided in this report:

> Condition of Vancouver Island's forested landbase

> Condition of the CVRD's landbase

> Level of protected areas within the CVRD

Condition of Vancouver Island's Landbase

Indicator and Measure

This indicator examines the current forest condition for the different ecosections on Vancouver Island, as defined by the amount of forest >140 years in age. This indicator places information for the CVRD into an appropriate regional context.

Vancouver Island is classified into six ecosections, and the ecosystems within them are divided into a large number of "biogeoclimatic" units (Figure 2.1).[21] The eastern side of the Island – the Nanaimo Lowland and Leeward Island Mountains – are characterized by dry forests dominated historically by Douglas-fir and Garry oak, which historically burned relatively frequently by both natural and First Nation-driven fires. This "Coastal Douglas-fir" zone is one of the most diverse forested regions in BC, and under natural conditions had about 50% in old forest condition at any one time,[22] with many old fire-resistant trees scattered among younger forest stands.

21 A description of these zones can be found on the Ministry of Forest's Biogeoclimatic Ecosystem Classification (BEC) website: www.for.gov.bc.ca/HRE/becweb/resources/classificationreports/subzones/index.html

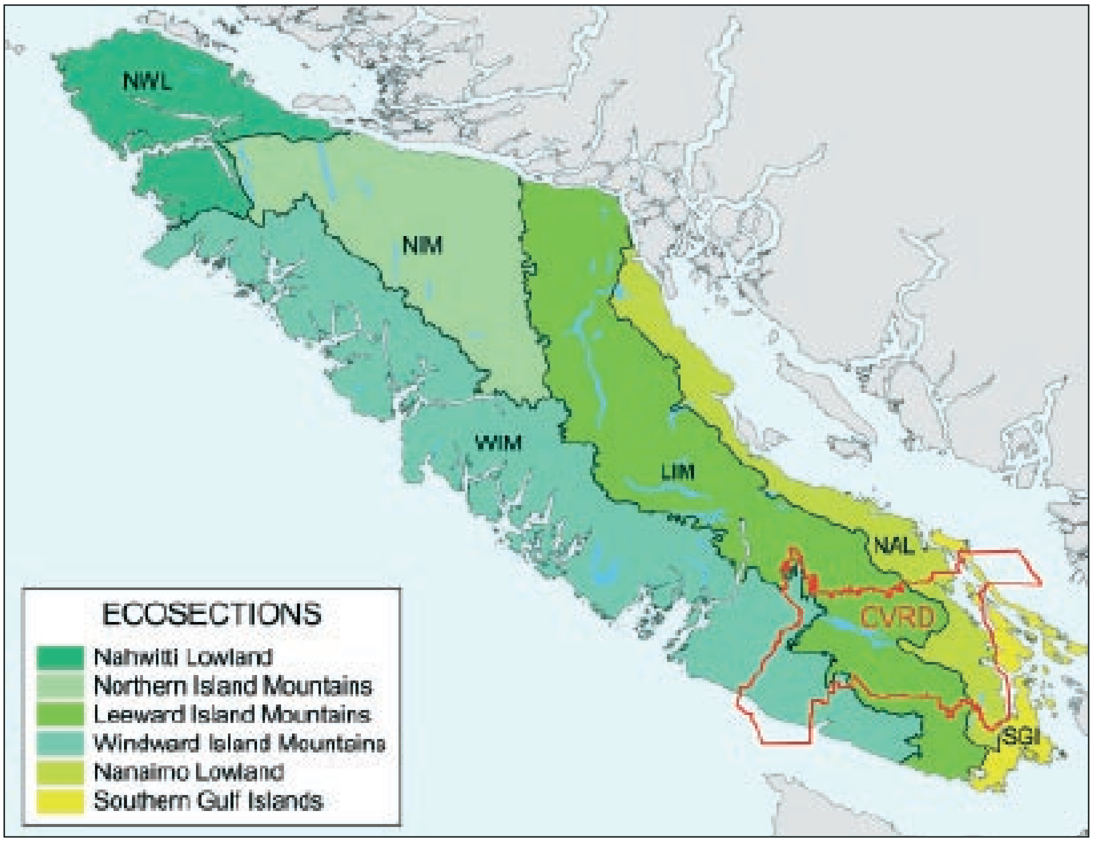
22 Percent in old forest condition is estimated based on stand-replacing fire interval estimates available from a variety of scientific studies for coastal ecosystems.

In contrast, the forests on the west side of Vancouver Island are some of the wettest in the province, and so burn very infrequently. As a result, they are characterized by huge-statured and often old or ancient western red-cedar, western hemlock and Sitka spruce forests, and under natural conditions typically had between 70–95% in old forest condition. These multi-storied canopy forests (forests with many layers) provide a home to a huge diversity of plants and animals and provide many natural functions.

British Columbia has some of the best forest classification systems and forest cover mapping available anywhere in the world, and this information is typically publicly available for Crown land. However, although the information exists for private forest land and tree farm licenses, it is sometimes not released by companies or is available only in summary form. This is the case for the CVRD, where much of the forest is held privately. In the absence of access to privately held information, this indicator relies on Baseline Thematic Mapping (BTM) data.[23] Although BTM data can provide an overview of general trends, the level of detail available in the data is relatively coarse and not as accurate as typical forest cover data.

The "age" of the forest stand is defined by air-photo interpretation, and presented by ecosection.

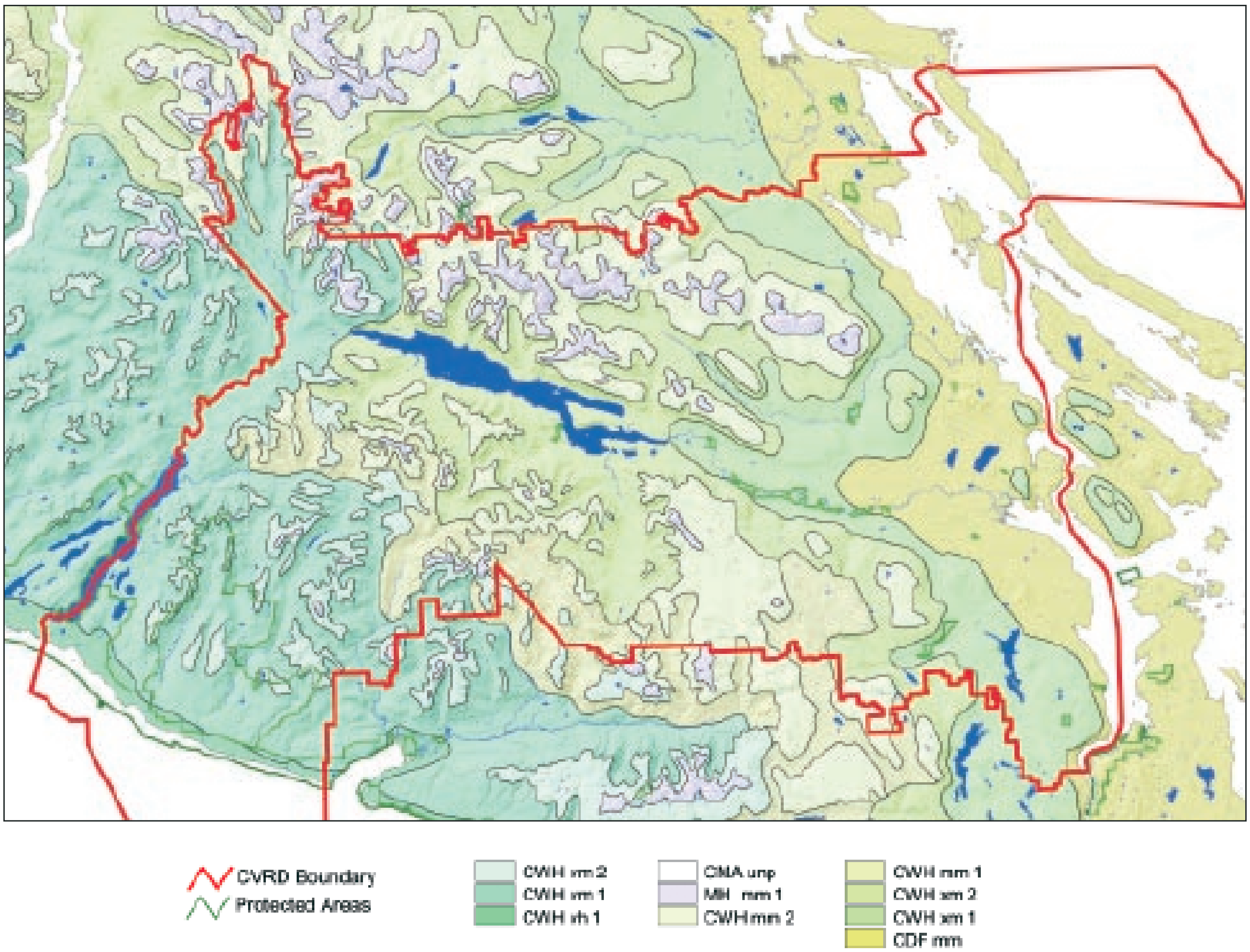
FIGURE 2.1: Distribution of ecosections on Vancouver Island, highlighting the CVRD



23 Baseline Thematic Mapping – available at: www.hectaresbc.org

In addition, the forests of the province are classified into biogeoclimatic zones, which provide a framework within which to categorize the condition of different "types" of forests. For example, Figure 2.2 shows the biogeoclimatic zones present within the CVRD. These forests differ in terms of their vegetation, soils and topography and span the range from dry Garry oak and arbutus woodlands in the east to wet cedar-dominated forests in the west.

FIGURE 2.2: Distribution of biogeoclimatic zones within the CVRD



CDF = Coastal Douglas-fir zone;
CWH = Coastal Western Hemlock zone;
MH = Mountain Hemlock zone.
The additional characters (e.g., vm1) describe the specific moisture and temperature regime within that specific region.
A detailed description of these biogeoclimatic zones is available online.[24]

24 See www.for.gov.bc.ca/hfd/library/documents/TREEBOOK/biogeo/biogeo.htm

Findings

Coastal temperate rainforests are defined by their old-growth forests, so assessing the amount of remaining old forest provides an indicator of the health of the ecosystem as a whole today. In addition, it likely reflects the ability of the ecosystem to resist, at least to some degree, the coming impacts of climate change into the future.

For Vancouver Island, the distribution of older forests remaining in different ecosystems is very uneven. The drier zones on the east side of the Island (the Nanaimo Lowlands ecosection) have extremely low levels of old forest remaining, with 2.5% of the forested landbase greater than 140 years in age. This is a fraction of what would have existed under natural disturbance conditions.

Levels of older forest are higher on the western/northern sections of the Island – ranging from 40–55%. However, although these percentages are much higher, they are still considerably lower than the amount of old forest present under natural disturbance conditions, when typically 70%– >90% of the landbase would have been older than 140 years in age.

Table 2.1 shows a breakdown of the amount of older forest (>140 years in age[25]) remaining in each of four ecosections (locations shown in Figure 2.1 and Figure 2.2).

A recent detailed mapping exercise for part of the area – the Coastal Douglas-fir (CDF) zone[26] – provides more accurate and fine-scale information about the amount of older forest cover. For the whole CDF zone (not just the section within the CVRD), more than 33% of the land area has been converted to urban, rural, agricultural and industrial use, while 2% is wetlands, 4% is natural non-forested areas and 60% remains forested. Of the forested portion only 610 ha (less than 1%) remains as old growth (structural stage 7), with 13% remaining as mature forest. Wetland and estuary ecosystems represent only 2% of the entire CDF area.

This context analysis is important for the CVRD because it highlights whether the condition within the regional district is mirrored in adjacent areas, or whether the condition within the CVRD is an anomaly in the broader forest landscape. The low level of old forest remaining, particularly in the eastern portion of Vancouver Island, suggests that ecological functions and values may not be being maintained at this scale. Where forest condition is poor at this scale, and also found to be to be poor within the CVRD, additional concern and action within the CVRD may be warranted. A more detailed analysis particular to sensitive ecosystems within this zone is presented in Section 2.2 (Sensitive Ecosystems).

25 Forests greater than 140 years in age are used to identify "natural older" forests for the ecosystems in this analysis. Typically, an age of greater than 250 years is used to identify old forests, particularly in wetter west coast ecosystems, where natural old growth can be in excess of many thousands of years in age. However, for simplicity of presentation, and because of data limitations, 140 years is used to define "older" forests in this analysis since these forests likely established naturally – rather than as a result of harvesting – so represent naturally mature or old forests.

26 Madrone, 2008. Even this analysis is out of date since it is based on air photos taken since 1993.

TABLE 2.1: Vancouver Island – amount of old growth remaining in broad forested zones, by ecosection[27]

Ecosection	ZONE	Area (ha) Forest > 140 years	Total Forest area (ha)	Percent >140 years	Estimated Percent of natural remaining	Total for Ecosection (%)
Nanaimo Lowland	CDF	245	86,626	0.3	<1%	
	CWH	7,145	211,559	3.4	6%	
Total		7,390	298,185			2.5%
Leeward Island Mountains	CWH	138,258	764,623	18.1	36%	
	MH	62,561	129,096	48.5		
Total		203,930	932,882			21.9%
Northern Island Mountains	CWH	167,044	421,928	39.6		
	MH	63,442	135,991	46.7		
Total		232,527	577,858			40.2%
Windward Island Mountains	CWH	555,907	992,004	56.0		
	MH	33,208	80,941	41.0		
Total		589,348	1,080,937			54.5%

CDF = Coastal Douglas-fir zone; CWH = Coastal Western Hemlock zone; MH = Mountain Hemlock zone.

27 From analysis of 2002 BTM data, available at www.hectaresbc.org

Condition of the CVRD's Landbase

Indicator and Measures

The amount of old forest >140 years in age (as above) is now analyzed within the CVRD. This focus allows for a more detailed analysis of the condition of individual biogeoclimatic zones, compared to the natural level of old forest expected under natural disturbance conditions.

Findings

The CVRD is about 360,000 ha in size. Of this total area, around 8% is identified as developed for agriculture, residential and urban (note this does not include forested areas that contain rural properties). The biodiversity values and ecological functions (e.g., provision of clean water, productive soil, native biodiversity) provided by these "converted" forest lands are typically much lower than those provided by remaining forests. Of the remaining broad landbase, almost 70% is young forest or recently logged, with 18% in forest >140 years in age (Table 2.2).

TABLE 2.2: Approximate land use within the Cowichan Valley Regional District[28]

Land Use Type	Area	Percent
Agriculture	9,164	2.6
Residential / Agricultural Mix	5,314	1.5
Urban	12,440	3.5
Freshwater	9,918	2.8
Recently Logged	91,917	25.8
Young Forest	156,234	43.9
Old Forest	65,302	18.4
Alpine	1,333	0.4
Wetlands	955	0.3

28 Analysis of Baseline Thematic Mapping (BTM) from statistics generated from HectaresBC (www.hectaresbc.org

Ecologically it is important to look in more detail at individual biogeoclimatic zones, especially given the diversity of ecosystems present within the CVRD. Figure 2.2 illustrates the diversity of forested biogeoclimatic zones present within the CVRD, as described above.

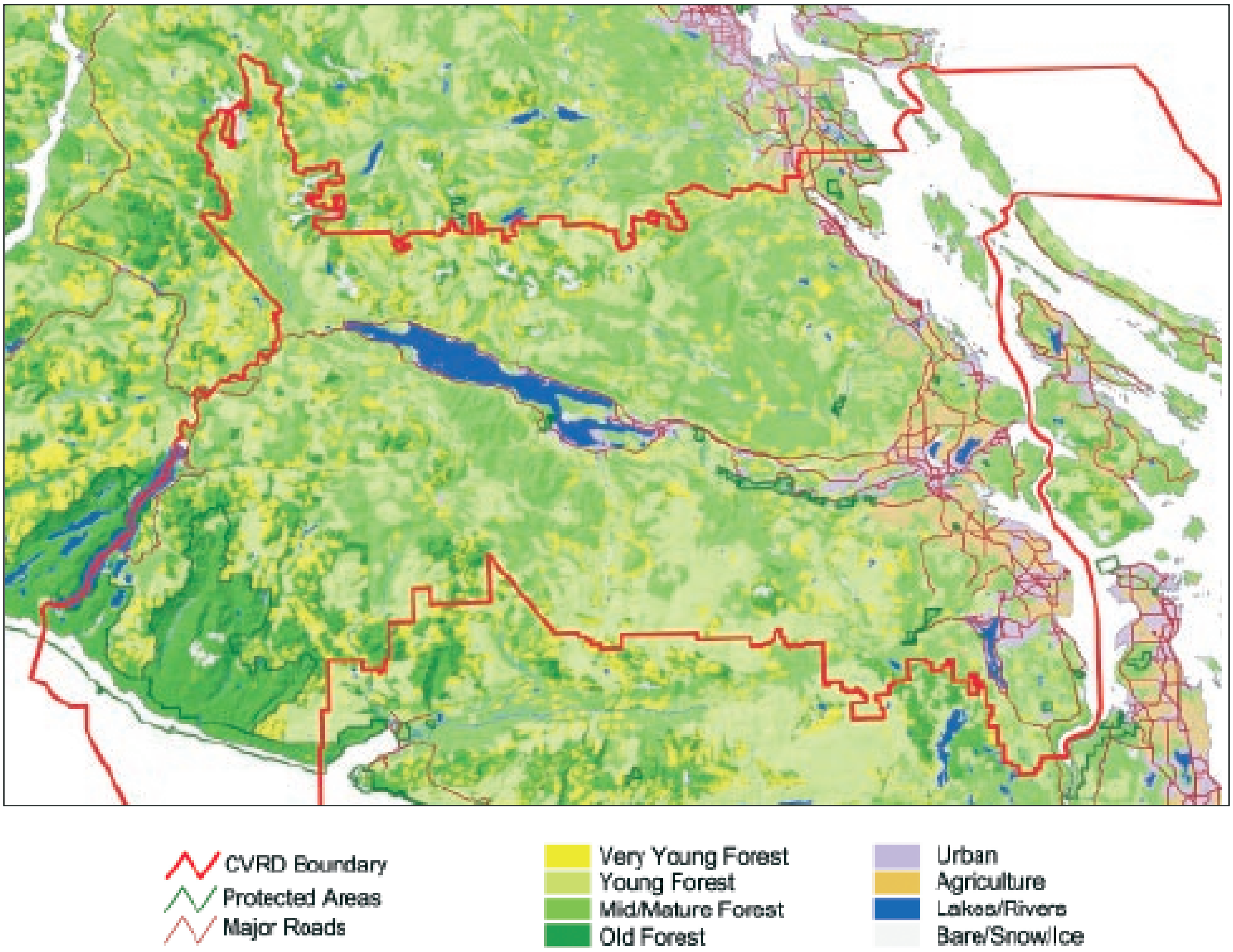
Figure 2.3 and Table 2.3 provide a more detailed illustration of the amount of old forest remaining in each zone within the CVRD, including the (largely) dry zone on the east coast, and the wettest zones on the west coast. The CDF zone has the highest percent of human settlement – almost 50% of the whole zone is agriculture/residential or urban. For the remaining forested portion within the CDF zone, no old forest remains.[29] Historically, around 50% of the CDF landscape would have been greater than 140 years in age.

The two drier Coastal Western Hemlock zones (adjacent to the Coastal Douglas-fir zone) also have extremely low levels of forest >140 years in age remaining (2% and 4% respectively), compared to an estimated historic level of around 50% or more, resulting in very poor forest condition today.

For this whole eastern portion of the CVRD, the vast majority of the landbase is in second growth forest less than 40 years in age. This is shown by the yellow and light green forests in Figure 2.3. The only significant areas of older forest remaining are within the Carmanah/Walbran valleys on the west coast of the region (shown by dark green).

29 Very small areas of "high structure" forest remain in this zone, but they are sufficiently small as to not be visible using these data. These small areas are highlighted in the "Sensitive Ecosystems Inventory" (Section 2.2).

FIGURE 2.3: The CVRD landbase coloured by broad age group categories[30] of forest and other land use (urban/agricultural)



Source: Data analysis based on BTM Data, 2002.

30 Approximate age group categories: Very young = less than 10 years old; Young = less than 40 years old; Mid / Mature = 41 – 140 years in age; Old = >140 years in age. Based on analysis of BTM data, current to 2002.

Land use and condition shifts towards the west, with the percentage of development declining and the percent of old forest increasing in general. However, the mid-elevation zones (CWHmm1 and CWHmm2) have some older forests remaining, but still very low levels of forest >140 years in age (7% and 12% respectively). Again, compared with the predicted historic level of old forest (around 50% old forest) this represents very low levels of older forest (Table 2.3).

As the higher elevation zones and west coast forests are reached, older forests are more prevalent (see dark green within the Carmanah/Walbran provincial park), but in general (except for the CWHvm1) at levels still considerably lower than the predicted levels of 70 – 95% forests > 140 years that would occur under natural disturbance conditions.

TABLE 2.3: Landbase condition data – area (in hectares) and percent in four broad age categories[31] for forested zones, and percent in urban/agriculture/mixed zones

Biogeoclimatic Zone	Forest type	Permanent Conversion Area and Percent	Forested: Area and Percent Less than 20 years		Area and Percent 20 – 140 years		Area and Percent > 140 years		Percent of natural forest > 140 years
CDF	Dry	20,000 (49%)*	1,280	6%	18,900	94%	0	0%	<1%
CWHxm1	Dry	3838 (7%)**	6,400	15%	34,300	82%	768	2%	4%
CWHxm2	Dry	1280 (2%)***	17,700	25%	49,900	71%	2,820	4%	8%
CWHmm1	Moist	-	11,000	42%	13,100	51%	1,790	7%	14%
CWHmm2	Moist	-	31,500	55%	18,900	33%	6,910	12%	24%
MHmm1	Moist/ Wet	-	4,610	37%	2,560	21%	5,120	42%	73%
CWHvm1	Wet	-	17,400	25%	16,600	24%	34,600	50%	61%
CWHvm2	Wet	-	5,890	37%	1,540	10%	8,450	53%	61%
CWHvh1	Wet	-	256	6%	0	0%	4,350	94%	98%

Note: This table is organized by biogeoclimatic zones (see Figure 2.2). The far right-hand column shows today's older forest as a percent of that occurring historically (red text indicates those below the "high risk to ecological integrity" threshold as defined below)

*CDF: 21% agriculture; 11% residential/agricultural mix, 17% urban.
** CWHxm1: 1% agriculture; 2% residential /agricultural mix; 4% urban
*** CWHxm2: 2% urban.

31 Note that these "age" cut-offs are approximate, and based on broad categories of photo-interpretation.

The estimated percent of natural forest remaining provides a more "ecosystem-specific" assessment of current condition – since naturally the levels of old forest differ across ecosystems. An analysis of science literature undertaken for the Coast Information Team[32] looked at how the levels of old forest relate to potential "risk" to ecological integrity, and recommended that more than 70% of natural levels represented low risk, while less than 30% of total level of old forest represented high risk to ecological integrity.[33]

For forest types within the CVRD, the wettest outercoast zone (CWHvh1) has a high proportion of its original old forest, so there is a high probability that ecological systems remain fully functioning. The other wetter zones have around 70% of the natural levels of old forest remaining – meaning there is reasonable probability that landscape-level ecological integrity is maintained.[34] However, east coast moist and dry zones all have considerably less than the "high risk threshold" of 30% of old forest remaining, meaning that there is a high probability that landscape level ecological integrity is not maintained.

Level of Protected Areas within the CVRD

Indicator and Measures

The level of "protection" for different ecosystems provides a general overview of the potential future condition for an area. Landscapes with high levels of "conservation focused" protected areas tend to have high-functioning ecosystems into the future irrespective of the condition today, as these areas are either maintained or allowed to restore back towards natural condition through time. Protected areas are often thought of as providing "core" areas within which biodiversity values can be maintained, which then help to maintain biodiversity and ecological functions in other non-protected parts of the landscape. However, for them to be effective in this role, there needs to be a relatively high percent of protection, and protected areas need to be large, well distributed and representative of the ecological diversity. The higher the level of core protection, the higher the likelihood of meeting these criteria.

There are a number of different ways in which lands can be "protected" and these can contribute towards conservation goals to varying degrees, including federal and provincial parks, ecological reserves, regional parks, municipal parks, and conservation lands.

32 www.citbc.org

33 Price, Holt and Kremsater, submitted.

34 This single indicator of course does not consider the implications of habitat fragmentation, road density, disturbance, etc., which may also result in increased risk, but which are not assessed here.

Findings

Table 2.4 shows a breakdown of the amount of protected area for each zone for each type of park. It does not include municipal parks, which are typically not managed specifically for conservation goals.

TABLE 2.4: Total area (hectares) and percent protected areas – by biogeoclimatic zone[35]

Type	CDF	CWHxm1	CWHxm2	CWHmm1	CWHmm2	CWHvm1	CWHvm2	CWHvh1	MHmm1	TOTAL
National Park	0			0		1,790		3,330		5,120
Provincial Park	1,020	2,300	256	0	256	15,400	1,540	256		21,000
Regional Park	256	768		0						1,020
Total Park	1,276	3,068	256	0	256	17,190	1,540	3,586	0	27,140
Total Area	41,200	47,100	78,600	25,000	57,000	70,400	16,100	4,610	13,800	
Percent Park	3.1%	6.5%	0.3%	0.0%	0.4%	24.4%	9.6%	77.8%	0%	7.7%

In the east, there are generally very low levels of protected areas – 3% or less for the drier zones, except for the CWHxm1, which incorporates the Cowichan River Park. Working westwards, higher levels of protection are found – but the overall level of representation in protected areas for the CVRD remains low at 7.7%.

There is no set level of protected area that is considered necessary to maintain core ecological functioning. However, politically set levels of 12% are well known to be inadequate.[36] More recent scientific analyses suggest that to be effective, levels closer to 50% of the landscape managed with an emphasis on conservation are required for effective maintenance of biodiversity and ecosystem services.[37]

35 From www.hectaresbc.org

36 Svancara et al., 2005.

37 See review in Holt, 2007 and Svancara et al., 2005.

Summary

The CVRD landbase has been continuously utilized by humans since glacial retreat, but this utilization has expanded dramatically in scale and scope since European settlement. The human footprint now covers approximately 275,000 ha of the CVRD's 360,000 ha – over 75% of the total landbase (including development and logging), and affects the ability of the landbase to supply and maintain ecological values and services.

Impacts are particularly severe on the east coast, where around 50% of the landbase has been converted from its historic forested condition, and the remaining forested landbase has very little or no older forest or older forest attributes remaining. At higher elevations, and towards the west coast, the condition of the forested landbase is better – but is still lower than levels of old forest under natural conditions. Most protected areas within the CVRD serve to protect west coast forests, with almost no ecological protection on the east coast. The total level of protection (<8%) for the CVRD is much lower than what is needed to maintain ecological values into the future.

Missing Information

This analysis provides broad landscape trends, but could be improved by gaining access to more detailed or up-to-date forest cover information. The southern part of Vancouver Island, including the CVRD, is unusual for British Columbia in having a high proportion of forest land held as privately owned forests. This makes data availability and analysis more difficult than in areas of the province which are primarily Crown land. Most of the eastern forests of the CVRD are privately owned, and most of the western portion is Crown land managed as tree farm licenses where data are also not freely available. Compiling a complete and up-to-date database with up-to-date data is therefore difficult.

The Baseline Thematic Mapping (BTM) data used in this analysis are current to about 2002. Continued forest harvesting and conversion is ongoing within this region. An important "next step" in this analysis would be to assess the potential impacts of recent and already-planned development within the region. The broad "age class" breaks inferred from the BTM data are estimates only, based on photo-interpretation, and are useful in providing information on broad trends, but inaccurate when it comes to determining forest stand ages. A comprehensive data layer for conservation lands was not available, so these areas – which tend to be relatively small but focus on very high value areas – are not included in this analysis.

References

Baseline Thematic Mapping data available through www.hectaresbc.org

Holt, R.F. 2007. Conservation Planning and Targets for the Coastal Douglas-fir Ecosystem. A Science Review and Preliminary Approach. Prepared for ILMB, Nanaimo. Available at **www.veridianecological.ca**

Madrone Environmental Services. 2008. Terrestrial Ecosystem Mapping of the Coastal Douglas-fir Biogeoclimatic Zone. Prepared for B. Zinovich, ILMB.

Price, K, R.F. Holt and L. Kremsater. Submitted 2009. How Much is Enough: Can Threshold Science Inform Old Growth Targets? Submitted manuscript available at **www.veridianecological.ca**

Svancara, L.K., R. Brannon, M. Scott, C.R. Groves, R.F. Noss and R.L. Pressey. 2005. Policy-Driven Versus Evidence-Based Conservation: a Review of Political Targets and Biological Needs. BioScience 989: Vol. 55, No. 11.

2.2 Sensitive Ecosystems

Introduction

Ecosystems are areas of similar soil, topography and climate – but can be defined at many different scales. Section 2.1 assesses broad landscape conditions across Vancouver Island and the CVRD in particular. This section examines the CVRD's ecosystems using a finer scale.

The diversity of ecosystems – unique combinations of plants, animals and their physical environment – defines the beauty and richness of the natural world. Maintaining this natural diversity is key to preventing species extinctions and is a critical aspect of maintaining natural resilience into the future. The CVRD contains a range of rare, sensitive and keystone ecosystems that have very high ecological and social values. This section focuses on those ecosystems that are relatively rare (compared to the whole landbase) and have particularly high ecological values. Three particular systems (or groups of systems) are included:

Garry oak woodlands and other "sensitive" ecosystems. Garry oak woodlands are one of the most endangered ecosystems in Canada. Garry oak extends south to California, and south-western BC represents the northern edge of its range and the only place in Canada where these ecosystems are found. Garry oak and associated ecosystems provide a home for a wide diversity of species – including seven species of reptiles, seven species of amphibians, 33 species of mammals, 104 species of birds, 694 species of plants and 800+ species of insects and spiders.[38] Of these, more than 100 are identified as "at risk" – including more than 75 plants, two reptiles, 14 birds, three mammals, 13 butterflies and 10 other insect species. Some species that were formerly linked to this habitat type are no longer found here – including the western bluebird, Lewis's woodpecker, acorn woodpecker and streaked horned lark.

Other "sensitive" ecosystems that have high ecological values include wetlands and riparian areas, older forest (see section 2.1), terrestrial herbaceous areas (rocky outcrops and grassy knolls), coastal bluffs and coastal dunes and spits. These small systems have been identified as "sensitive" by the federal and provincial governments, and some are also identified as rare or threatened in the BC Conservation Data Centre's ranking. Garry oak woodlands and the other "sensitive" ecosystems are mapped together as part of a Sensitive Ecosystem Inventory (SEI).

38 Garry Oak Ecosystems Recovery Team: www.goert.ca

Shoreline ecosystems. The shoreline is the interface between terrestrial and marine environments and ecologically it is important to both. It allows access to the historical abundance of the ocean for land species, and provides critical habitats for many marine and intertidal species. Shorelines in general are important for some key species – including forage fish, which provide a prey base for many marine species.

Estuaries. Estuaries are special areas of shoreline that have particularly high ecological values resulting from the mix of habitat types present. The CVRD is home to one of BC's highest value estuaries – the Cowichan Estuary – and other smaller estuaries that are locally very high value.

Key Pressures

Many of the ecosystems of concern here are small, or have only small remaining areas compared to their historic distribution. As a result they tend to be inherently sensitive. Key pressures differ for individual areas, but in general include:

> **Ecosystem loss** from conversion to agricultural or residential lands, which typically results in complete loss of the original ecosystem

> **Ecosystem degradation** through harvesting, which alters species composition and the age of trees, and alters natural disturbance processes

> **Ecosystem degradation/modification** as a result of lower impact development or invasive species, which can radically alter the dynamics of the system

> **Loss of natural processes** – Many of the drier terrestrial ecosystems were historically maintained by frequent low severity fires which maintained open meadow and woodland ecosystems. Fire suppression has resulted in changes to ecosystem dynamics for these systems, and loss of open meadow ecosystems

Measuring Sensitive Ecosystems

Fine-scale mapping – such as Terrestrial Ecosystem Mapping (TEM) – can be used to assess the current distribution of Garry oak and other sensitive ecosystems. TEM mapping is available for some areas of the CVRD, but public availability is typically limited to Crown land (see Section 2.1). A Sensitive Ecosystem Inventory[39] for the eastern portion of the region has been completed and assessed for changes over time based on an approximate 10-year review.

39 See BC Ministry of Environment Sensitive Ecosystems Inventories website: www.env.gov.bc.ca/sei/

Shoreline and potential forage fish habitat mapping has been undertaken by a large number of stewardship groups, under various projects.

This report uses the following indicators:

> Sensitive Ecosystem Inventory – analysis of a decade (1992-2002)

> Garry oak ecosystems – historic change analysis (1800-2003)

> Shoreline condition and forage fish

> Estuary condition

Note that, although an ecosystem may be "mapped as existing", the actual functioning condition can be difficult to assess. For example, small, isolated patches of ecosystems may not maintain a full complement of species or be able to act as useful habitats due to isolation. Invasive species, disturbance from humans, or pollution can also affect habitat functionality.

It can also be difficult to assess the current condition of sensitive ecosystems because there is often a lack of historic information to provide an appropriate benchmark. For this section's indicators, some information on trends through time is available.

Sensitive Ecosystem Inventory

Indicators and Measures

A Sensitive Ecosystem Inventory (SEI) was initiated on the east side of Vancouver Island and southern Gulf Islands in 1993, primarily focused on the Coastal Douglas-fir (CDF) biogeoclimatic zone.[40] Seven relatively unmodified, rare and fragile terrestrial ecosystem types, plus two important but modified ecosystems that provide high wildlife habitat, are identified within that inventory. The inventory has been further updated to 2002. It is therefore possible to analyze how much of these important ecosystems have been lost over this period. The specific indicators used here are:

> Area of sensitive ecosystems present in 1990-1992, on the east of the Island and in the CVRD

> Updated area of sensitive ecosystems present in the CVRD in 2002

These indicators do not provide a comparison with a "natural" historic benchmark for all important ecosystems within the whole area, since the historic distribution and condition for smaller ecosystems is unquantified.

40 http://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=2124

Findings

Nine specific sensitive ecosystems are identified: seven "natural" systems and two modified systems that have high value for biodiversity.[41] These are:

> Coastal bluffs

> Sparsely vegetated areas (sand dunes/gravel spits)

> Terrestrial herbaceous areas – natural grasslands and grass- or moss-covered rock outcrops

> Wetlands

> Riparian habitat

> Woodland – dominated by Garry oak, mixed Douglas-fir/arbutus/Garry oak assemblages or trembling aspen

> Older forest – more than 100 years in age

> Older second growth forests (modified system 60–100 years in age)

> Seasonally flooded agricultural fields (modified system)

An overall assessment of the whole east coast of the Island (a study area which included part of the Cowichan Region) shows that about 8% of the study area had one of the seven unmodified ecosystems present, and an additional 11.6% of the study area had one of the two modified types, with much of this being the older second growth forests. The portion of the Cowichan Region that was included in this study was found to have a lower percent of sensitive ecosystems remaining than the full study area – with 5.4% of the landbase having an unmodified sensitive ecosystem present and 5.0% of the Cowichan study area having one of the two modified ecosystems in 1994.[42] This study was based on sampling photos taken between 1990 and 1992.

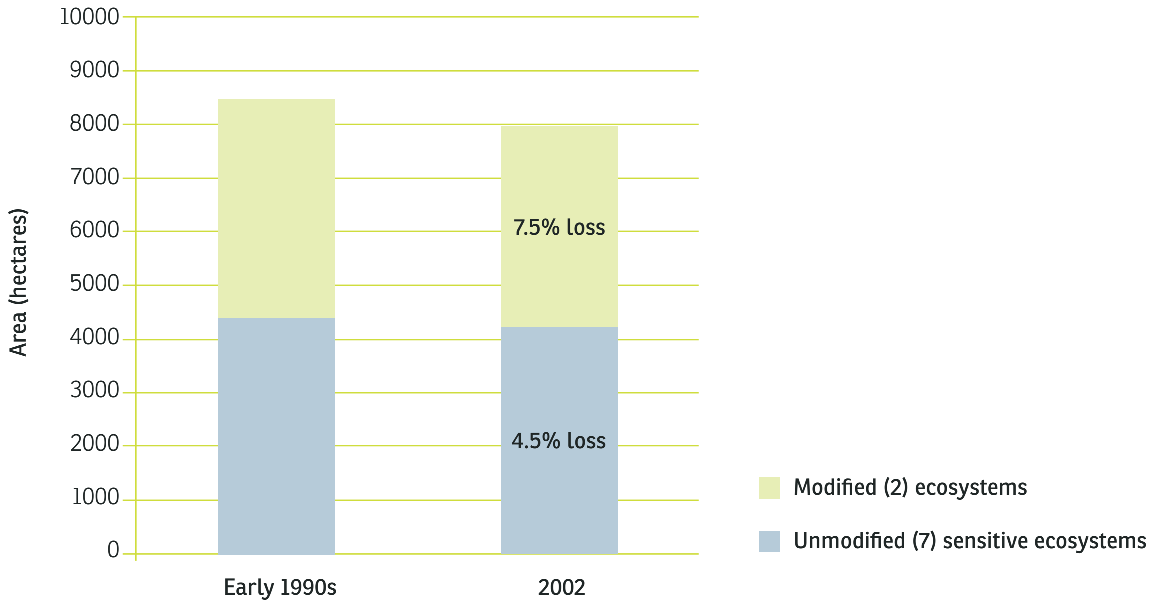
An update of the area of sensitive ecosystems was undertaken based on air photos taken in 2002. Over this approximately 10-year period between samplings, over 8,800 ha or 11% of the nine ecosystems identified in 1992 had been lost over the whole study area (east side of Vancouver Island). This included 1,460 ha of the seven unmodified sensitive ecosystems – with losses primarily in old forest (8.6%), riparian habitat (4.6%), woodland (2.6%) and wetland (2.0%).

41 See www.env.gov.bc.ca/sei/ for information and photographs about each type

42 Note that the mapping does not include all of the CVRD region, but only a limited portion primarily within the Cowichan watershed.

In the Cowichan Region, 4,417 ha of sensitive ecosystems were originally identified in the early 1990s, with a loss over 10 years of 205 ha (4.7%) for the seven unmodified systems, and a 7.5% loss for the two important but modified systems (Figure 2.4). Note that this does not provide an assessment of this historic loss of these ecosystems, compared with a natural benchmark over a longer time period.

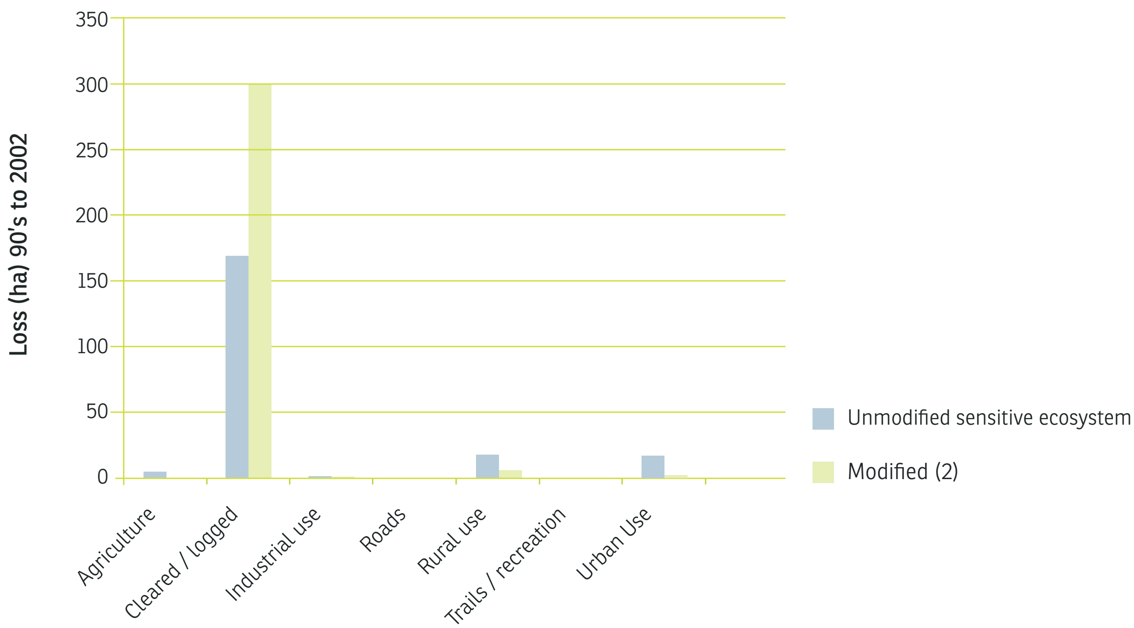
FIGURE 2.4: Loss of sensitive ecosystems over a 10-year period from areas of the Cowichan watershed



Source: Data from AXYS Environmental Consulting Ltd., 2005.

The analysis over the 10-year period also identified the pressures that appeared to have caused the changes in ecosystem condition within the Cowichan Study area (Figure 2.5). The primary cause of change is the clearing or logging of land, with smaller impacts due to rural/urban development. The sub-regional areas where losses have occurred within the CVRD are shown in Table 2.5.

FIGURE 2.5: Cause of ecosystem loss by broad disturbance categories



Source: Data from AXYS Environmental Consulting Ltd., 2005.

TABLE 2.5: Locations within the Cowichan study area (which does not include Gulf Islands) where losses primarily occurred (1992 – 2002)

	1992 Area of SEI (ha)	Loss in 2002 (area in ha)	Loss %
Duncan	0.2	0	0%
Ladysmith	57.6	1.1	2%
Lake Cowichan	15.6	0	0%
North Cowichan	3027.7	135.1	4.5%
Unincorporated	5382.3	375.8	7%
Total	8483.5	512	6%

Source: Data from AXYS Environmental Consulting Ltd., 2005.

Of the total area of sensitive ecosystems remaining in the landscape today, very few are thought to be pristine or existing with a full complement of native species. For most areas mapped as "existing in 2002", many are expected to have: significant losses of functionality due to fragmentation, which prevents effective movement of species between patches; small patch size, which results in a lower number of species present in any one patch; disturbances (e.g., dogs or soil disturbance from human activities); and invasive species – all of which are not factored into this analysis. In addition, development has continued in the remaining SEI areas since 2002, so the extent of losses to these areas since that time is unknown.

> *"The Coastal Douglas-fir zone is the rarest biogeoclimatic zone in BC and is of great conservation concern."* BioDiversity BC[43]

Garry Oak Ecosystems

Garry oak ecosystems are included in the analysis of sensitive ecosystems above. However, they also represent a particular area of concern and have been the focus of detailed work, so are reported on separately here.

Indicator and Measure

A mapping exercise has been undertaken for Garry oak ecosystems in part of the Cowichan Region and on Saltspring Island, showing trends through time from the year 1800 to 2003.[44]

Findings

Less than 10% of the original Garry oak ecosystems remain on south-eastern Vancouver Island.[45] Within the Cowichan Region (and including Saltspring Island), there has been a similar loss of 78% of the Garry oak ecosystems (Figure 2.6). Matching the broader geographic pattern, loss of deep soil ecosystems has been higher, since these sites are more productive and better for development and agriculture. Many of the remaining shallow soil ecosystem sites are still at risk of development today. Much of the remaining area is dominated by invasive plant species, and less than 5% of the total remaining Garry oak ecosystems are in natural condition. In addition, it is important to remember that development activities and invasive species both continually change the distribution and condition of these mapped ecosystems.

---

43 Austin et al., 2008.

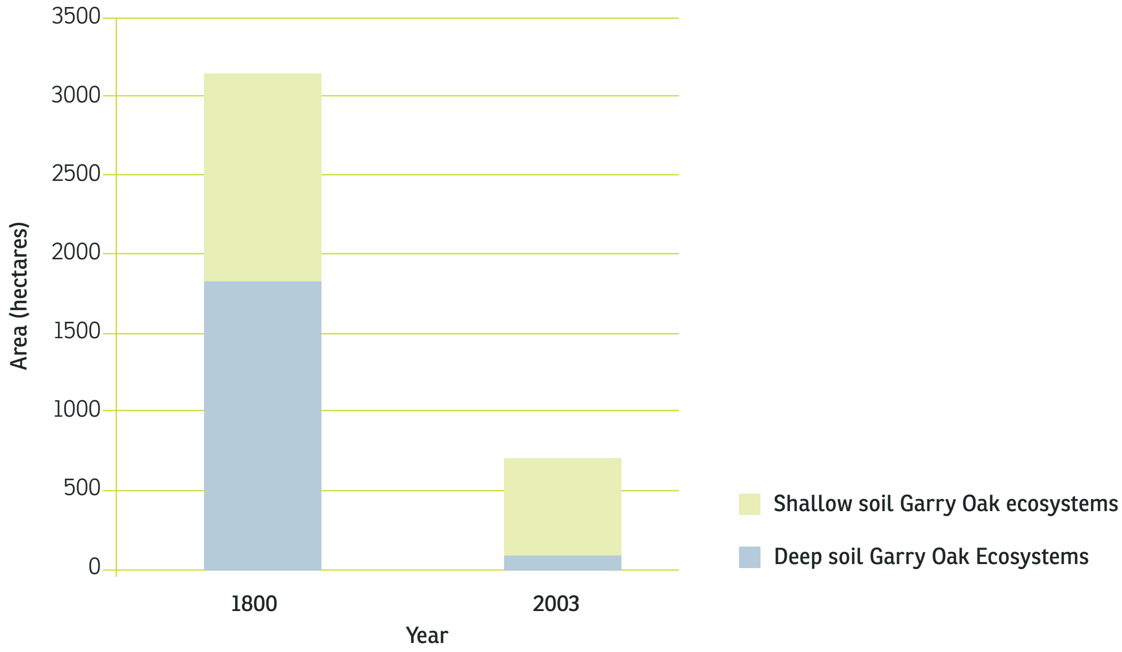
44 Miller and Lea, 2004.

45 Lea, undated.

One of the best examples of remaining Garry oak ecosystem can be found at the Cowichan Garry Oak Preserve (near Maple Bay) (Figure 2.7).

The geographic location for Garry oak ecosystems is shown for the mid- 1800s (Figure 2.8) and in 2003 (Figure 2.9).

FIGURE 2.6: Estimated area of deep and shallow soil Garry oak ecosystems in year 1800 and in 2003

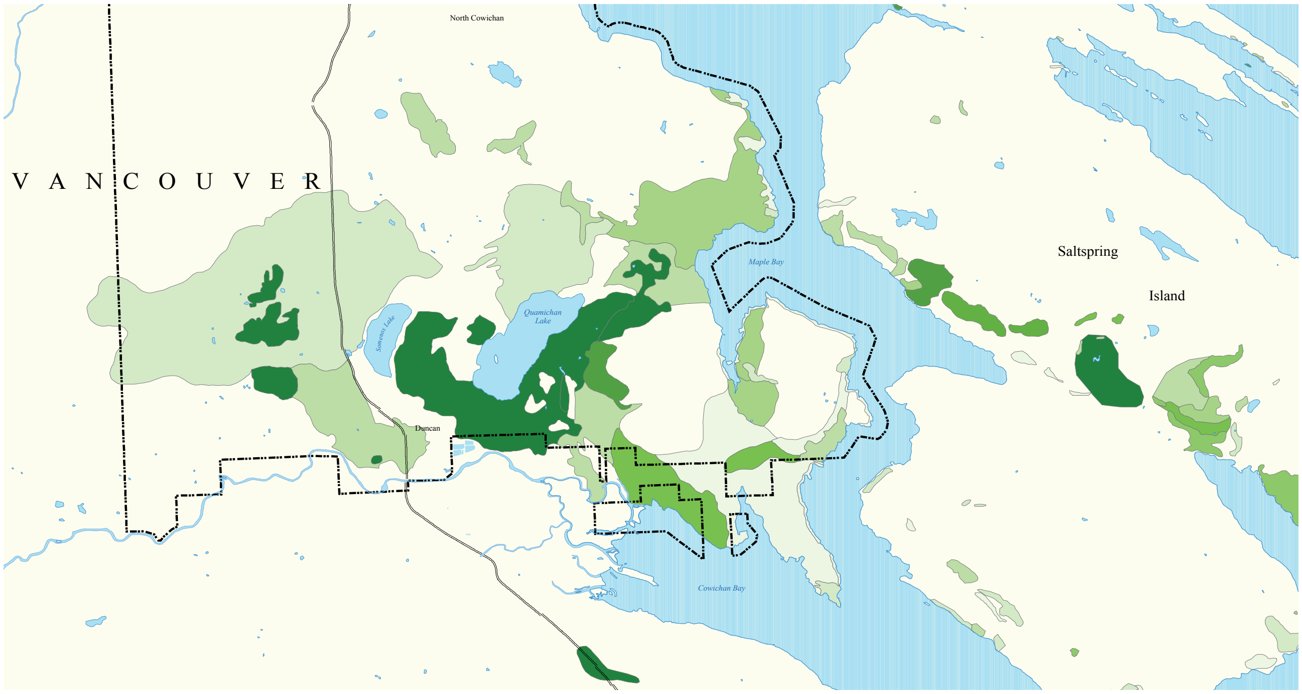


Source: Miller and Lea, 2004.

<< *FIGURE 2.7: Cowichan Garry Oak Reserve, showing camas meadow*

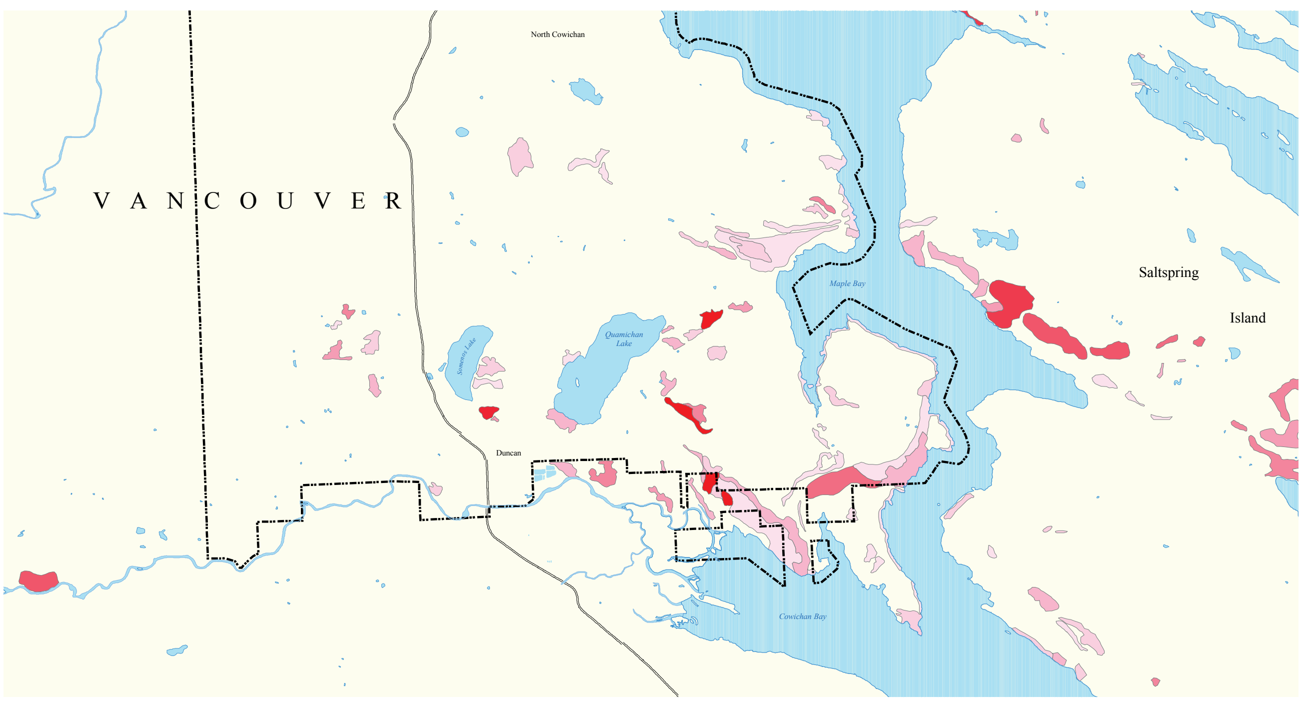
Source: Chris Junck, Garry Oak Ecosystem Recovery Team.

FIGURE 2.8: Distribution of ecosystems dominated by Garry Oak in combination with Douglas-fir and/or arbutus. Darker green shading indicates higher percent composition of Garry oak ecosystems. Compiled from mapping from the 1850s and 1860s



Source: Miller and Lea, 2004.

FIGURE 2.9: Current distribution of Garry oak ecosystems within the same area. Darker red shading indicates higher percent composition of Garry oak ecosystems



Source: Miller and Lea, 2004.

Shoreline Condition and Forage Fish

Shorelines provide the interface between the marine and terrestrial environments – they are high value for humans and for biodiversity, and for all the processes that sustain both. Shorelines are being increasingly "modified" by human activities, as they are converted to industrial, residential and recreational uses. "Hardening" (moving in rocks to reduce natural erosion) or altering vegetation along the shoreline can impact many important ecological functions (Figure 2.10).

FIGURE 2.10: Example of a hardened shoreline

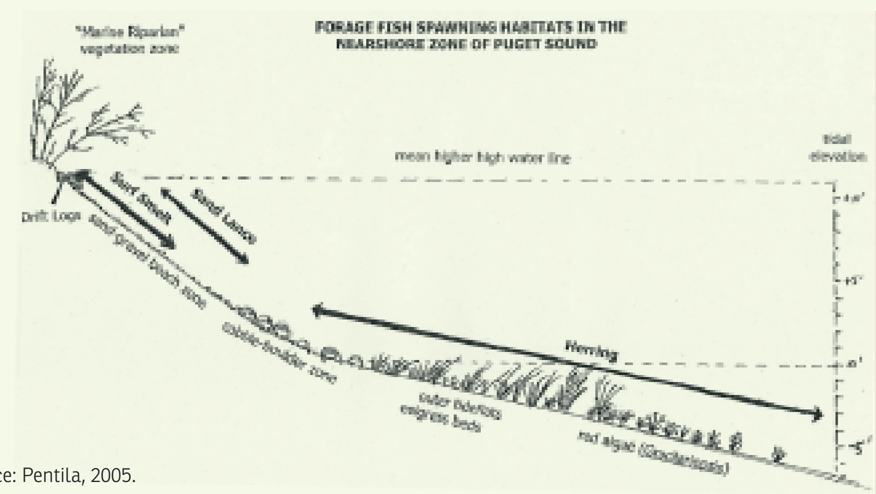
Source: R. de Graaf

> *"Across the Georgia Basin, only 5.3% of the shoreline was "modified" as of 2003, but these tend to represent some of the most important functional areas on the coast – estuaries, sheltered bays and sloping shorelines."*
>
> SeaChange Marine Conservation Society, 2009a.

Shorelines are important for many different values. Many marine species inhabit the intertidal zone for some or all of their life history – including crabs and shellfish. Many terrestrial species also use the shoreline as an important food source. Linkage or interface areas are often of high biodiversity value, since they provide habitat for a wide range of species.

One particularly important role of the nearshore is to provide spawning habitat for "forage fish" (e.g., Pacific herring, surf smelt and Pacific sand lance) which school in large numbers to spawn in intertidal or shallow water, and therefore are particularly vulnerable to disturbance (Figures 2.11 and 2.12). These species are in the middle of the marine food web and are important prey species for a large number of other species, ranging from salmon to a diversity of bird species to marine mammals. The native eelgrass (Zostera marina)[46] is an important component of this habitat, providing an environment for herring (and many other species) within the tidal flats.

FIGURE 2.11: Distribution of forage fish habitat in the nearshore



Source: Pentila, 2005.

FIGURE 2.12: Surf smelt eggs

Source: R. de Graaf

46 An introduced eelgrass, Zostera japonica also inhabits these coastal shorelines. It is unknown to what extent the two species are functionally similar, and they inhabit slightly different depths of water, with the native species tending to be at greater depths.

The specific spawning habitat requirements for forage fish vary by species: herring favour the subtidal and spawn on vegetation such as eelgrass habitats and algae, while surf smelt use the upper intertidal zone and require small gravel and coarse sand. Sand lance use the intertidal zone and dig small pits in the sand in which to spawn. In addition to specific substrate features, the vegetation along the shoreline can affect the quality of habitat by moderating temperature and wave disturbance conditions – though relatively little is known about the specific factors that impact spawning success. The physical process of sediments moving from terrestrial surfaces and along beaches through wave action is also key to maintaining beaches in a functioning condition. Many shoreline modifications disrupt these processes.

In addition to direct spawning habitat, conditions that allow successful foraging and reduced predation are also key. Eelgrass and kelps are important elements of the nearshore. For example, eelgrass roots in the substrate and provides structural diversity within the water column, as well as providing food and shelter to many species. Eelgrass also plays an important functional role in the ecosystem by "fixing" carbon and thereby making it biologically available.

It is hard to predict whether a particular shoreline provides good forage fish habitat. Although potential habitat can be identified using a combination of slope, gravel and sand composition, only about 10% of "apparently suitable" shoreline is actually used at any time.[47]

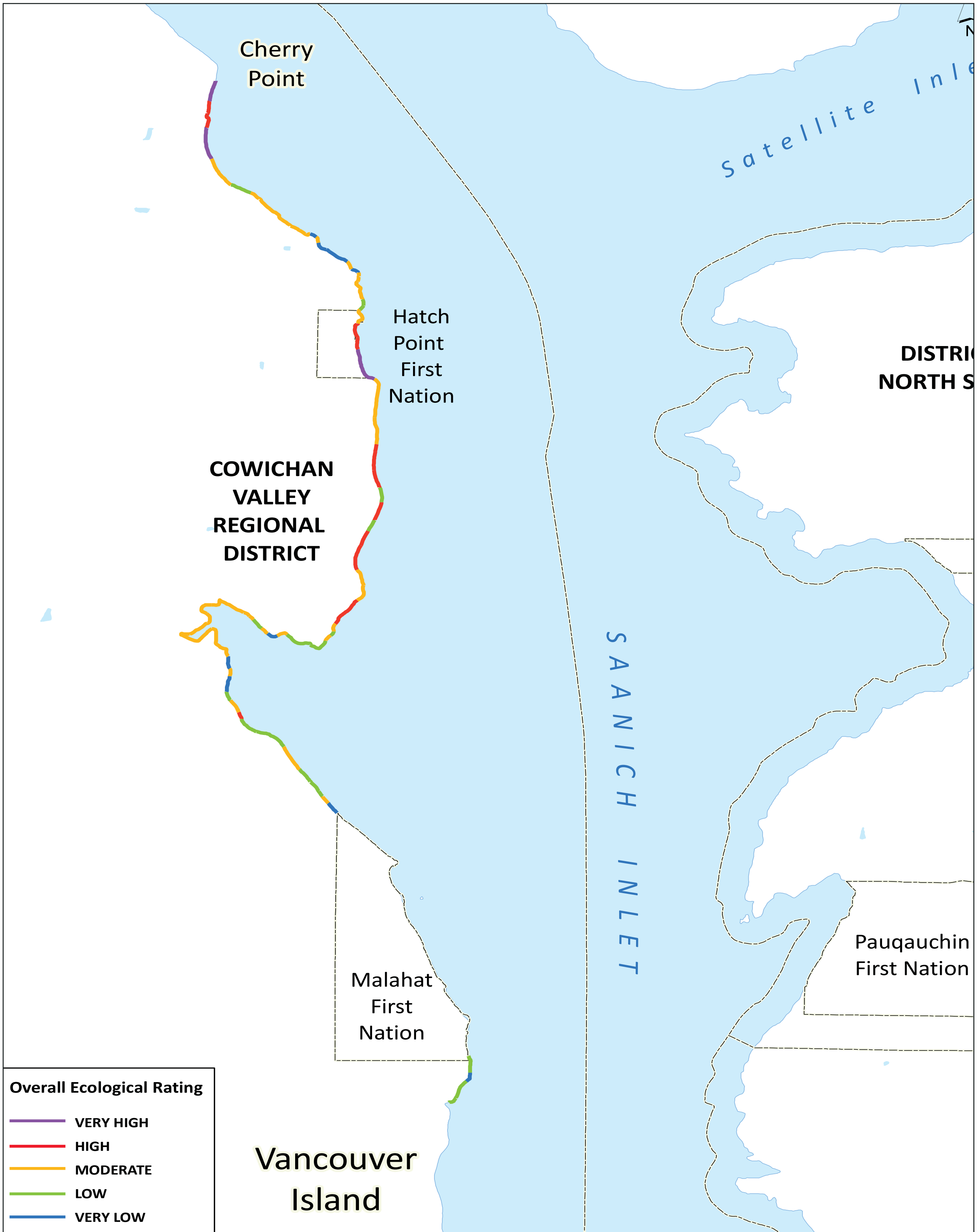
Impacts to all these habitats can be caused by a wide variety of activities, from "hardening" the shoreline, building docks that reduce light and disturb the breakwaters, and dredging the shoreline, to disturbance from propellers, pollution from boats, oil and other forms of industrial disturbance and pollution. The cumulative impacts of multiple small modifications can result in considerable change through time, resulting in the loss or significant degradation of these habitat values.

Indicators and Measures

SeaChange[48] conducted shoreline modification surveys over a period of three years for the shorelines around the Saanich inlet and peninsula (Table 2.6), using the shore zone mapping data collected by Parks Canada. Only a portion of the CVRD shoreline has been mapped (Bamberton to Cherry Point), of which the vast majority is in the yet-to-be-developed areas. The following field data were included in the final rating system: specific intertidal features (e.g., eelgrass), habitat cover, wildlife features, proximity to sensitive ecosystems, and presence of key lifecycle species. In addition, focused sampling for forage fish habitat has been done along a longer length of shoreline by a range of stewardship groups.[49] These two sets of data were combined and used to create an ecological ranking system for the entire shoreline (very high to very low ecological rating).

47 R. de Graaf, personal communication, 2010.

48 SeaChange Marine Conservation Society, 2009b.



PROJECT:	MAP SCALE:	REVISION DATE:	DRAWN BY:
Saanich Inlet & Peninsula Atlas of Shorelines	1:40,000	March 2, 2010	J.Thomson

The level of modification within each section was then quantified from field data and summarized for each section of shoreline. The specific indicators used here are:

> Length of shoreline in each category (very high to very low ecological rating), and percent modification of each.

Findings

Within the CVRD, only 13.8km of shoreline was categorized in terms of its ecological rating. Of this length, a relatively small proportion of the CVRD shoreline has been classified as having a "very high" (5%), or "high" ecological rating (15%), with 44% of the shoreline identified as "moderate" and another 36% identified as "low" or "very low" (see Figure 2.13 and Table 2.6).

Of these areas, a total of 16% (representing 2.2 km in length) is identified as "modified." This is lower than the average over the whole Saanich inlet and peninsula, which has an average of 30% modified (Figure 2.14).

<< *FIGURE 2.13: Ecological ratings of the CVRD shoreline*

Source: SeaChange Marine, 2009.

49 Data collected by the following groups: Cowichan Valley Youth Streamkeepers; Cowichan Valley Naturalists; Friends of Forage Fish Maple Bay; Ramona C. de Graaf, BSc, MSc. (BC Shore Spawners Alliance) and Dan Penttila, MSc, Washington Department of Fish and Wildlife

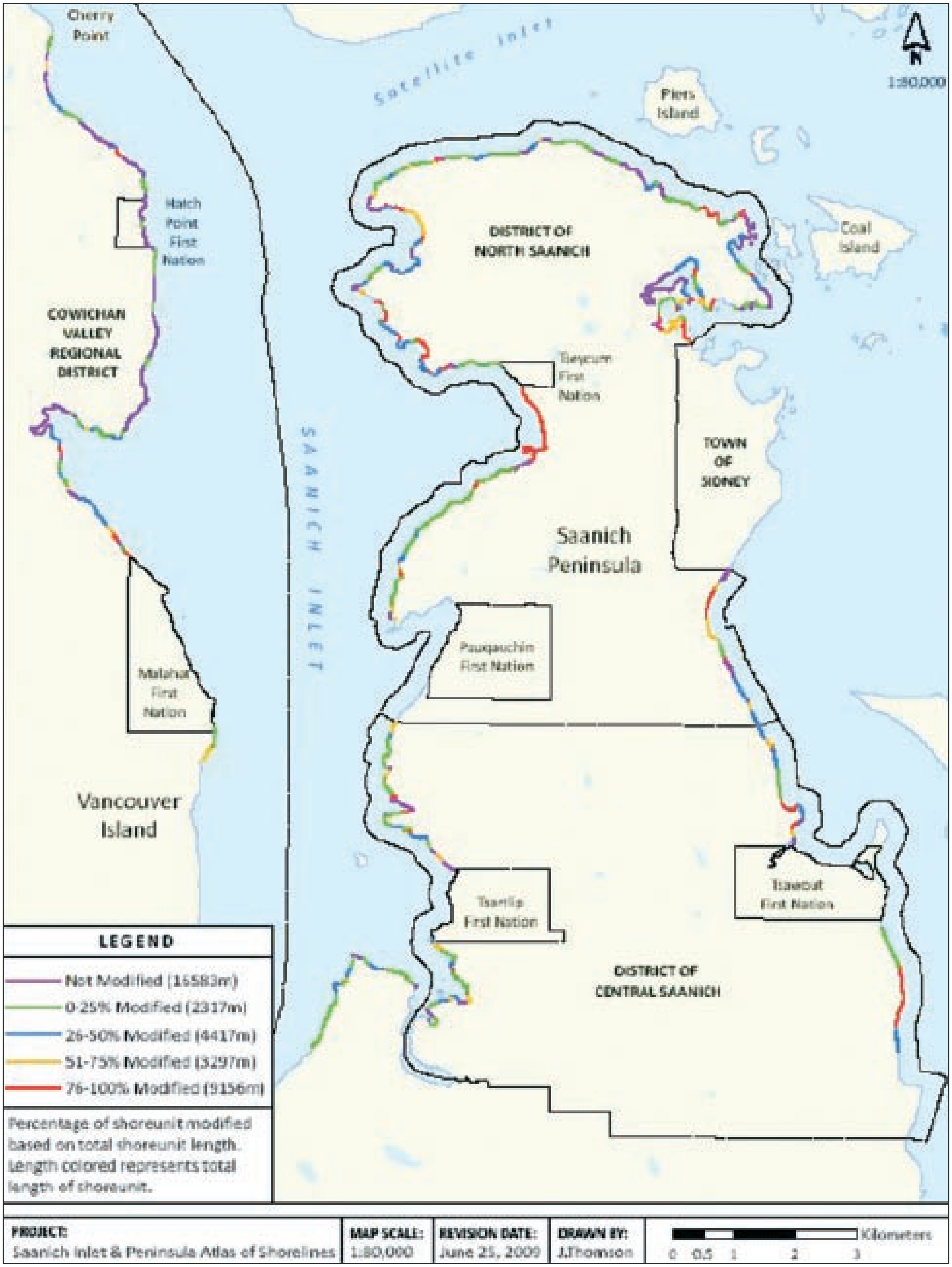

Cherry Point
Satellite Inlet
Piers Island
1:80,000
Hatch Point First Nation
DISTRICT OF NORTH SAANICH
Coal Island
COWICHAN VALLEY REGIONAL DISTRICT
Tseycum First Nation
TOWN OF SIDNEY
SAANICH INLET
Saanich Peninsula
Malahat First Nation
Pauquachin First Nation
Vancouver Island
Tsawout First Nation
Tsartlip First Nation
DISTRICT OF CENTRAL SAANICH
LEGEND
Not Modified (16583m)
0-25% Modified (2317m)
26-50% Modified (4417m)
51-75% Modified (3297m)
76-100% Modified (9156m)
Percentage of shoreunit modified based on total shoreunit length. Length colored represents total length of shoreunit.
PROJECT: Saanich Inlet & Peninsula Atlas of Shorelines
MAP SCALE: 1:80,000
REVISION DATE: June 25, 2009
DRAWN BY: J.Thomson
Kilometers
0 0.5 1 2 3

TABLE 2.6: Ecological ratings for 13.8km of the CVRD shoreline, with total length and percent modified

Overall Ecological Rating	% of total CVRD area	Shore unit Count	Total Length (m)	Total number of seawalls present	Total length modified (m)	% modified based on total length
VH – Very High	5%	4	1,050	1	20	0%
H – High	15%	12	2,332	6	269	2%
M – Moderate	44%	35	6,245	21	603	4$
L – Low	23%	18	3,005	19	798	6%
VL – Very Low	13%	10	1,248	12	513	4%
Totals	100%	79	13,880	59	2,203	16%

Source: SeaChange Marine Conservation Society, 2009.

For the CVRD shoreline that has been studied, a relatively low percent has been modified. However, it is important to note that relatively small sections of the 13.8km of shoreline that have been categorised have high ecological ratings (only 5% is rated very high), and so therefore relatively small amounts of modification may have significant impacts overall. A key example would be shoreline hardening that results in loss of forage fish habitat, which has significant impacts throughout the food web (within both the marine and the terrestrial environment).

In comparison with the broader study area (Table 2.6), which includes the entire Saanich inlet and peninsula, the CVRD area has had relatively little modification of its shoreline to date. However, trends point to increasing modifications through time.

<< FIGURE 2.14: Shoreline modification for the entire Saanich inlet and peninsula area

Source: SeaChange Marine Conservation Society, 2009b.

More subtle changes may also occur. Loss of the marine riparian zone can impact shade levels – often critical to smelt egg survival – and can affect the amount and species of insect prey available for migrating smolts and resident animals in estuaries and marine shorelines. Disruption of sediment drift along shorelines can also affect nutrients available on beaches, altering erosion processes and habitat quality. In addition, the cumulative effects of increasing areas of impervious surface (Section 3.1) affect the rate of run-off and the amount of pollutants that enter the water courses, and this, combined with loss of riparian and shoreline vegetation, all work together to impact the overall functioning of the shoreline.

Often, lack of understanding of the importance of shoreline habitats results in unintentional impacts. This, combined with a lack of detailed knowledge about critical habitat areas (such as forage fish habitat), may be having a significant yet largely unquantified series of effects on a wide variety of ecological values.

Cowichan Estuary Condition

Estuaries are extremely high-value ecosystems. Their location at the conjoining of the terrestrial, aquatic and marine environments gives them very high productivity and high biodiversity values, and they often provide key habitat for species and key ecosystem services.[50]

The Cowichan Estuary (Figure 2.15) is located where the Cowichan and Koksilah rivers join Cowichan Bay. One of the largest estuaries in the province (277 ha), it is identified as one of the top 10 important estuaries in BC.[51] This complex of tidal flats, shallow marshes, and marine zone provides habitat for at least 229 bird species throughout the year, and is a critical stopover along the Pacific Flyway. Eelgrass habitats and other areas provide rearing habitat for salmonids and other marine species, and the intertidal area is used for at least 31 species of fish, including juvenile herring and salmonids.

Threats to this system include a wide diversity of potential impacts caused by the interplay of the three realms: terrestrial, freshwater aquatic and marine. Key pressures include terrestrial land development causing direct habitat loss, dyking around rivers that causes changes to nutrients available in intertidal communities, the pollution of freshwater or marine environments from septic systems or industrial use, which then can affect both the freshwater aquatic and marine habitat, and marine pressures such as fishing and oil spills.

50 Ministry of Environment, 2006.

51 Viz-a-viz Management Resources Inc., 2005.

FIGURE 2.15: Cowichan Estuary

Source: Google Earth, 2009.

The Cowichan Estuary Management Plan (1987) zoned the estuary and reduced the amount of area open for log storage. In addition, it initiated an environment review process, and identified areas for habitat enhancement and restoration. This plan was revised again in 1995 and reviewed for relevancy in 2006.

Indicators and Measures

Two specific indicators of estuary condition used here are:

> Habitat loss over time, due to different factors within the estuary

> Water quality within the estuary

Findings

Habitat Loss

Historically, habitat has been lost from the Cowichan Estuary through settlement that resulted in dyking to provide flood protection and create agricultural lands. Around 32% of marsh habitat was lost from eastern Vancouver Island estuaries at the turn of the century, with an estimate of 50% loss from the Cowichan Estuary.[52, 53] These losses of habitat have been caused by a wide range of impacts, including the 1920s railway loading platform built across the tidal flats and into the estuary, and log booming, handling and storage that have occurred until recently over significant areas of the estuary/bay. All of these activities have impacted intertidal habitats compared to the historic condition of the estuary. Loss of eelgrass habitat remains of particular concern and is implicated in the declines observed for local fish populations (Section 2.5).

Habitat loss in upland areas adjacent to the estuary has been caused by sawmill construction, dumping of waste material, and marina expansion adjacent to Cowichan Bay. Run-off of pollutants from the mill, from agricultural activities and from communities surrounding Cowichan Bay all combine to impact habitat quality and functioning.

In addition, ongoing habitat degradation is occurring due to increasing numbers of invasive plant and animal species. Key species that appear to be increasing include Japanese knotweed, yellow flag iris, bullfrogs and white clematis.

52 Campbell and Boyd, 1988.

53 Ministry of Environment, 2006.

The Cowichan Estuary Management Plan has contributed substantially to reductions in habitat loss and degradation in the estuary complex[54, 55] by:

> Reducing the area impacted by log storage and handling (from more than 50% to around 19% of the estuary area)

> Promoting the acquisition of marsh and farm land for conservation and restoration by stewardship groups (approximately 300 ha is protected within the estuary area)

> Promoting joint stewardship restoration of key habitats

> Reducing the impacts of wood waste in the estuary from sawmills.

Water Quality

Water quality for the estuary and bay is potentially affected by a variety of sources, including inputs from the two main rivers systems (Cowichan and Koksilah, see Section 2.6), from adjacent agricultural land (grazing animals and manure spreading), from adjacent industrial uses (sawmill waste and industrial railway), from adjacent communities (sewage inputs), and from boats and marinas.

In the 1990s, three primary major sources of water quality concern were identified: wood treatment stains (antisapstains); dioxins and furans (typically from wood waste), which were found in crabs and resulted in a closure for crab fishing between 1989 and 1996; and fecal coliform bacteria, which was well known and the cause of the closure for shellfish harvesting that has been in place in the estuary since 1973.

More recently, the water quality of the estuary appears to have improved to some degree.[56] Many water quality indicators (nutrient levels, total and dissolved metal levels and toxic substances) were found to be below threshold levels and, in addition, there appeared to have been a reduction in both the stain pollution and dioxins and furans. These gains appear to result from specific measures identified within the management plan that were intended to reduce the release of these pollutants into the estuary.

54 Williams and Langer, 2002.

55 Vis-à-vis Management Resources Inc., 2005.

56 Rideout et al., 2000.

However, levels of fecal coliform bacteria were still consistently over guideline levels in both the Cowichan and Koksilah rivers, and in the Cowichan Estuary and Bay. The source of this pollution is hard to determine, but appears to be a combination of non-point sources in the river systems and (until 2006) the sewage treatment plant for Cowichan Bay, particularly during winter months. More recently, the original Cowichan Bay sewage treatment facility has been closed, and sewage is now pumped to a site further up the Cowichan River, which has a larger capacity. However, fecal coliform levels in the bay remain in excess of provincial standards, particularly at specific times of year. Pollution levels tend to be lowest during the summer dry period when freshwater inflow is lowest and sewage "leakage" is lowest. During wetter periods bacteria levels increase as septic systems overflow and storm drains become active, which results in higher levels of contamination in the estuary.

Additional potential sources such as cattle grazing adjacent to the estuary have generally been moved away from the site. However, manure is spread in the area and may also be a source of ongoing fecal coliform contamination (in addition to the continuing inputs from river systems, as discussed above).

Fecal coliform contamination indicates potential impacts to human health due to the presence of pathogenic bacteria found in mammalian feces. As a result of this contamination the shellfish fishery in the estuary has been closed since 1973, and it remains closed today.

In addition to human health concerns, contamination with significant amounts of fecal waste also has ecological impacts. For example, the additional nutrients can over-stimulate algal growth, which has the effect of reducing the levels of dissolved oxygen in water. This affects the natural benthic community[57] present in the ecosystem, and can result in impacts on or death of aquatic life due to lack of oxygen. Typically, this is noticed when it gets to the "fish kill" stage. Algal blooms have been noted in the lower reaches of the Cowichan and Koksilah rivers.

Fecal coliform bacteria are an indication that a water supply is being contaminated by feces from a warm blooded animal (e.g., cows, humans, birds). The fecal coliform bacteria themselves are typically harmless, but they indicate the potential for other deleterious bacteria. Ease of monitoring is the reason this indicator is commonly used to test water quality.

57 A benthic community is made up of a group of organisms that inhabit the bottom of a body of water, such as a lake or ocean. Benthic organisms do not have a backbone, and can be seen with the naked eye.

In summary, the Cowichan Estuary has undergone significant impacts over time, due to a wide variety of development. The management plan appears to be reducing further impacts in some areas, and restoration activities are improving habitat conditions on conservation lands around the estuary. However, there are ongoing concerns about the health of the estuary system, including:

> On-going water pollution from non-point sources from the two rivers supplying the estuary

> Fecal coliform pollution of the estuary/bay, and the shellfish closure that was initiated in 1973 and remains in effect today.

Summary

The CVRD has within its boundaries some of the most unique ecosystems in BC, which confers a high responsibility for their maintenance. Within the Coastal Douglas-fir zone there is a high diversity of smaller ecosystems – forests, meadows, riparian areas, and wetlands – many of which are "sensitive," and tend to be inherently fragile or located in areas where development pressure is greatest.

An assessment of one of these – Garry oak ecosystems – for part of the Cowichan Region shows the extent of the impact over time. Less than 20% of the historic ecosystem remains, and less than 5% remains in its "natural" condition. The pressure on these ecosystems comes from a wide diversity of sources and so is hard to quantify, keep updated and manage.

Shorelines have high ecological values, and are also under high development pressures. A range of best management practices can reduce impacts to these values, but are often not implemented. We lack knowledge of the importance of different shorelines (for example, forage fish habitat is not well understood). On-going development along shorelines is resulting in continued loss of and degradation of these habitat types.

Estuaries are rare features along shorelines, and have typically also seen high development pressure. Habitat loss within the Cowichan Estuary has been high, but its condition is improving over time. However, water quality issues remain, particularly in wetter seasons and from non-point sources.

Missing Information

A full analysis of trends for all potentially "sensitive" ecosystems compared with their historic condition is not possible with presently available data. The trends presented here therefore do not give the full picture of trends across a longer timescale.

The ecosystem services provided by many of these habitat types is largely unquantified. For example, the effect of the loss of mature riparian forest on flooding probability is recognized, but not specifically quantified. Similarly, the extent of shoreline ecosystem degradation on forage fish spawning success and cascading impacts through marine ecosystems is unknown.

References

Austin, M. et al. 2008. Taking Nature's Pulse: The Status of Biodiversity in British Columbia. **www.biodiversitybc.org**

AXYS Environmental Consulting Ltd. 2005. Redigitizing of Sensitive Ecosystems Inventory Polygons to Exclude Disturbed Areas. Summary Report. Prepared for Canadian Wildlife Service.

Campbell, A.P, and W.S. Boyd. 1988. Intertidal and Adjacent Upland Habitat in Estuaries Located on the East Coast of Vancouver Island – Tech Report Series No. 38. Environment Canada. CWS.

Cowichan Community Land Trust. 2004. Ecological Strategies for the Cowichan Estuary. Report to MWLAP. Available at: **www.naturecowichan.net/Cowichan%20Estuary%20report%20-%20Jan%2004.pdf**

CWS. Sensitive Ecosystems Inventory: East Vancouver Island and Gulf Islands 1993 – 1997. Volume 2 Conservation Manual. Canadian Wildlife Service Technical Report Series 345. Available from **www.env.gov.bc.ca/sei/van_gulf/publications.html**

Lea, T. Undated. Historical Garry Oak Ecosystems of Vancouver Island, British Columbia, Pre-European Contact to the Present. Ministry of Environment. Available from **www.goert.ca**

Miller, K. and T. Lea. 2004. Historical Garry Oak Ecosystems of the Cowichan Valley and Saltspring Island. 1:50,000 Map. Biodiversity Branch, BC, Ministry of Water Land and Air Protection, Victoria BC. Available from: **www.goert.ca**

Ministry of Environment. 2006. Estuaries of British Columbia. **www.env.gov.bc.ca/wld/documents/Estuaries_brchr06.pdf**

Pentilla, D. 2005. Marine Forage Fishes in Puget Sound. Puget Sound Nearshore Partnership Report No. 2007-03. Washington Department of Fish and Wildlife.

Rideout, P., B. Taekema, J. Deniseger, R. Liboiron and D. McLaren. 2000. A Water Quality Assessment of the Cowichan and Koksilah Rivers and Cowichan Bay. To view this report online, search for **"GBEI_waterquality_E.pdf"**

SeaChange Marine Conservation Society. 2009a. Saanich Inlet and Peninsula Atlas of Shorelines. Public Report. Available from **www.seachangelife.net**

SeaChange Marine Conservation Society. 2009b. Saanich Inlet and Peninsula Atlas of Shorelines. Technical Report. Available from **www.seachangelife.net**

Vis-à-vis Management Resources Inc. 2005. A review of the Cowichan Estuary Environmental Management Plan. Final Report. **cowichanbay.info/CowichanEstuaryPlanReviewFinalReport2005.pdf**

Williams, G.L. and E.O. Langer. 2002. Review of Estuary Management Plans in British Columbia. Canadian Manuscript Report of Fisheries and Aquatic Science 2605. **www.dfo-mpo.gc.ca/Library/276486.pdf**

2.3 Species at Risk

Introduction

The number of species at risk is a key indicator for the current health of an ecosystem, because species in trouble today are likely responding to changes that have happened in the past. Tomorrow's species at risk will be those that are responding to today's impacts. Loss of species from an area is important because it lowers the resilience of the ecosystem to future change and can have unforeseen cascading consequences into the future.

Many different species have very specific life history requirements and can be affected by many subtle specific changes; however, loss of key habitat types is often the main cause of species decline. Habitats in the Cowichan Valley Regional District (CVRD) that have been particularly impacted include old forests, wetlands, Garry oak ecosystems and the associated meadows and grasslands, marsh and estuarine habitat, rocky bluffs, and shorelines. Many of the species at risk in this region historically inhabit these ecosystems.

Species at Risk in the Cowichan Valley Regional District

The diversity of ecosystems that occurs in the CVRD, ranging from some of the wettest to some of the driest in BC, provides habitat for a great diversity of species. Many species are largely unknown, and new species have been recently discovered here. For example, the number of known arthropods[58] found in the canopy of ancient trees on the West coast increases every time someone studies them. Some species are naturally rare – found only in certain habitat types, or at low levels across the landscape – and these species may or may not be at risk. Some species, however, are known to be "at risk" due to small population sizes or the specific impacts of human activities on their habitat.

58 Arthropod are invertebrates of the phylum Arthropoda (the largest phylum in the animal kingdom). Arthropods have jointed limbs, a segmented body, and an exoskeleton made of chitin. The group includes the crustaceans, insects, arachnids, and centipedes.

Measuring Species at Risk

The BC Conservation Data Centre systematically assigns "risk" ratings to different species and populations that may be of concern. A number of different systems are used, including global ratings and provincial conservation status rankings. This section reports on the "red" list – extirpated, endangered or threatened in BC – and the "blue" list – those of special concern in BC. Ideally, trends through time for species of concern could be tracked, in order to understand whether conditions are improving or worsening for individual species. However, in the absence of good trend population data for most species, this section's indicators focus on:

> Number of animals at risk, with a focus on Vancouver Island marmot and Roosevelt elk

> Number of plants at risk

> Number of ecological communities at risk

Animals at Risk

Indicator and Measure

The BC Conservation Data Centre compiles information and trends on species that may be at risk in BC, and classifies them based on global and provincial ranking systems.[59] The information provided is based on these rankings for species found or thought to be found within the Cowichan Valley Regional District.

Findings

The Conservation Data Centre identifies a total of 71 animal species that are known to be at risk in this region and are thought to be found within the CVRD (Table 2.7). In addition, there are other species highlighted as yellow-listed, which are under status review.

59 BC Conservation Data Centre: www.env.gov.bc.ca/cdc/

This section provides detailed findings about the Vancouver Island marmot and the Roosevelt elk.

TABLE 2.7: Number of red- and blue-listed animal species within the CVRD

Type	#Red	#Blue	Total
Amphibians		1	1
Birds	4	16	20
Gastropods	5	7	12
Insects	5	10	15
Lampreys	1		1
Mammals	4	4	8
Reptiles	2		2
Ray-finned fishes		2	2

Source: BC Conservation Data Centre.

Many of the individual species at risk are associated with estuarine or riverine habitats, and many are associated with the ecosystems of concern highlighted in Section 2.2. Of these, some are also of high global concern – including the Cowichan Lake Lamprey (G1 global ranking[60]) and Vancouver Island Marmot (G1 global ranking).

Of these animals, eight are found only on Vancouver Island and nowhere else in the world (endemics) – the northern pygmy owl, the white-tailed ptarmigan, an ermine, the Cowichan lake lamprey, the Vancouver Island marmot, the American water shrew, the "greenish blue" butterfly and the (now-thought-to-be-extinct) Vancouver Island wolverine.

60 Conservation status ranks are based on a one to five scale, ranging from critically imperiled (G1) to demonstrably secure (G5). Status is assessed and documented at three distinct geographic scales: global (G), national (N), and state/province (S).

Some are well-known species, such as Stellar sealions and the old-growth-forest-nesting marbled murrelet. Others are lesser known or understood, such as the broadwhorl tightcoil, the western thorn snail, and the warty jumping slug.

A full list of species at risk is available in Appendix A.

Jumping Slugs. Five different species of jumping slugs exist and are endemic to western North America. The warty jumping slug is known to exist in Canada only on 14 different sites on Vancouver Island, south of Nanaimo. It lives in moist riparian low-lying areas and requires decaying logs and litter as shelter. All five species display a "jumping" or twisting behaviour that is thought to be a defence against predators. Habitat loss and fragmentation are thought to be the greatest threats to the population. Only three or four of the known locations are within protected areas – the others are subject to development or private forest land management.[61]

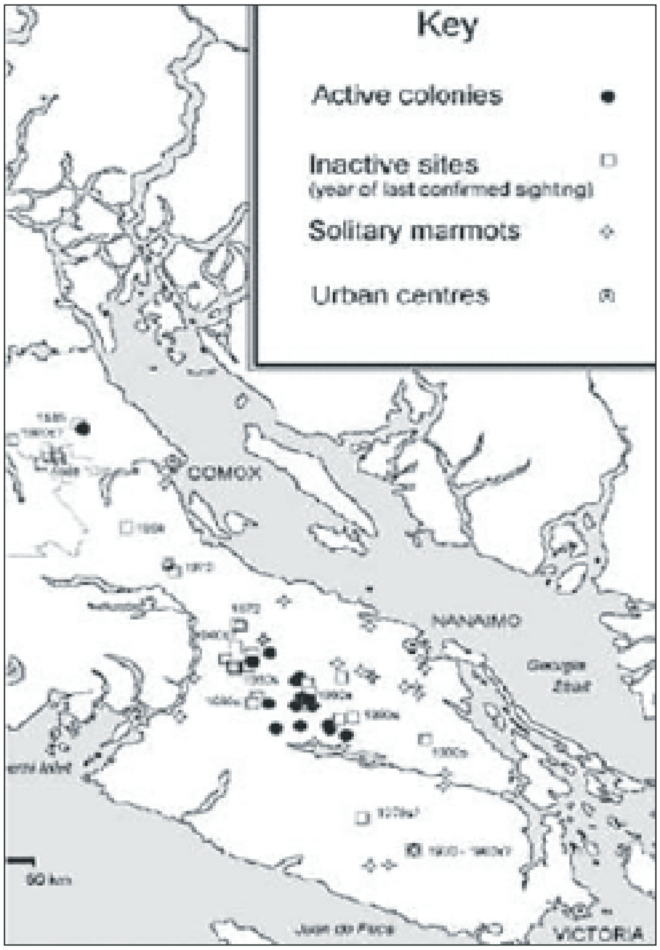
Vancouver Island Marmot

The Cowichan Valley Regional District is home to a significant proportion of the remaining wild population of the Vancouver Island marmot, a globally rare subspecies (Figure 2.16). It is red-listed in BC, and endemic to Vancouver Island. Unusually, compared to many of the other species of concern within the regional district, the marmot is a high-elevation species, historically living in the alpine and treeline areas, and – more recently – primarily inhabiting recently logged habitats where they are thought to be more vulnerable to predation. With the exception of Mount Washington, all known active colonies are located within five adjacent watersheds – the Nanaimo, Cowichan, Chemainus, Nitinat and Cameron River drainages – with 90% of the estimated population in the year 2000 found within this 150 km2. The CVRD obviously plays a key role in the recovery of this species (Figure 2.17).

FIGURE 2.16: The at-risk marmot is one of Canada's most significant species

61 COSEWIC, 2003.

FIGURE 2.17: Marmot population centres



Note: Most southern locations are located within the CVRD.

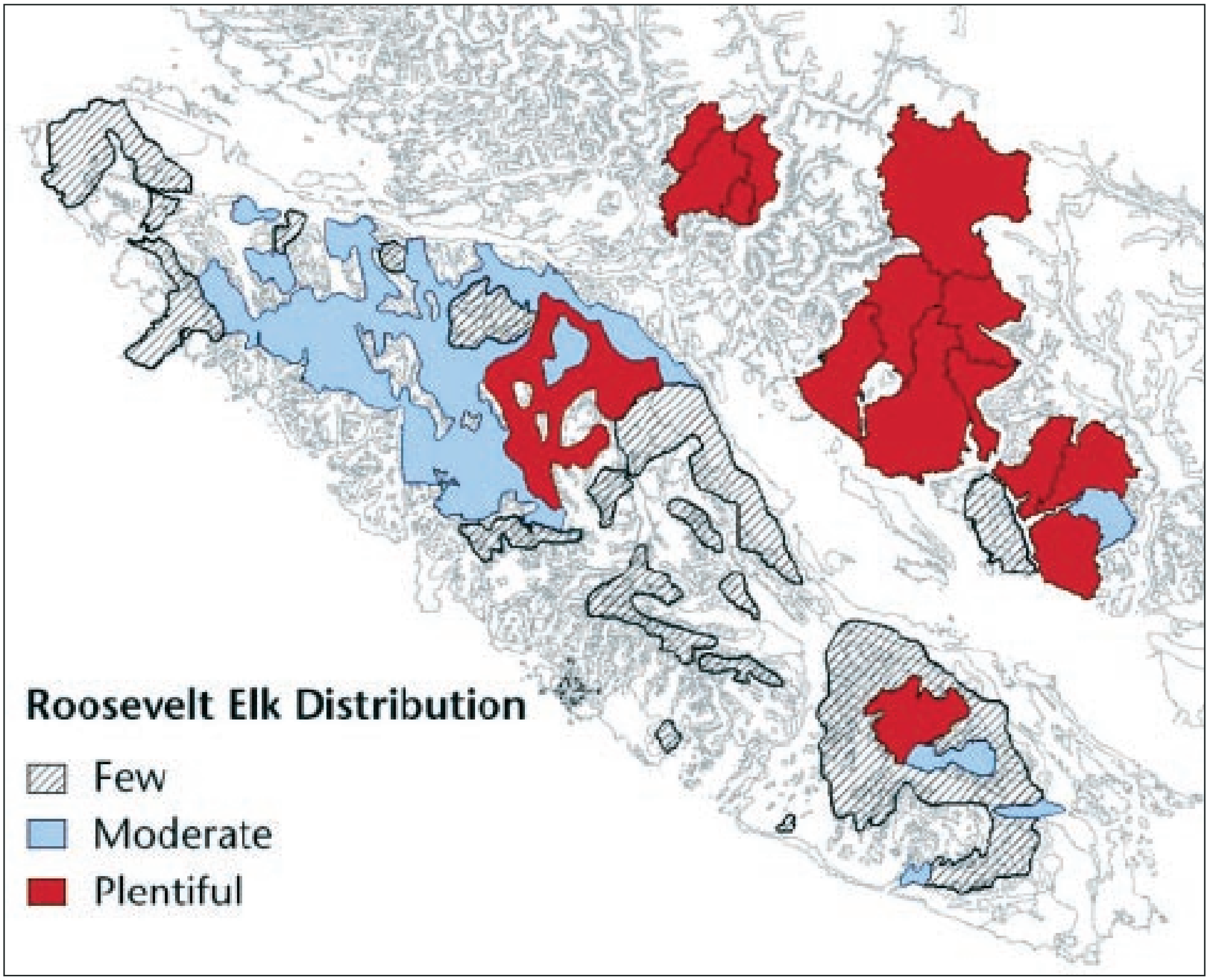
Source: Vancouver Island Marmot Recovery Team, 2000.

Roosevelt Elk

Roosevelt elk are a blue-listed species with high cultural and social values within the Cowichan Valley Regional District. There are around 5,000 Roosevelt elk in BC, of which about 4,000 are on Vancouver Island. Most are found in the northern regions of the Island, but there are relatively isolated sub-populations in the south, and in the CVRD (Figure 2.18). There are areas of local decline, but the populations are increasing overall.

Loss of habitat from human development and over-hunting has extirpated local populations in some areas of southern Vancouver Island. Sub-populations of elk on Vancouver Island have been categorized as to whether they are increasing, stable, or declining. Within the south Island meta-population, most of which are part of, or border, the CVRD, there is a tendency for sub-populations to be small (80% of the local populations have less than 25 animals). Of this total of 560 animals, around 30% are thought to be in stable-to-declining sub-populations, 30% are stable, 30% are increasing and 10% have unknown population trends. On the rest of the Island, populations tend to be bigger and more stable (data from 2000). Historically, elk lived in old forests, which provided food and cover – particularly in riparian areas. Fragmentation of this habitat by forestry and urban expansion, combined with predation pressures, mortality on highways, and hunting and poaching has resulted in declines in populations from historic levels.

FIGURE 2.18: Roosevelt elk distribution on Vancouver Island



Source: Henigman et al., 2003.

For the CVRD, recent population estimates (June 2009) for the sub-units identified in Table 2.8 are shown in Figure 2.19. The largest sub-unit within the regional district is area 4-10 (the Shaw sub-unit) which contains an estimated population of 175 animals. Many of the other sub-units have small estimated numbers of elk.

TABLE 2.8: Number of elk estimated for each sub-unit

Area	Sub Population	Name	Area (km2)	Estimated #elk	Percent local population	Percent total population
4	1	Koksilah	317	10	2	0.6
4	2	South Cowichan	118	15	3	0.9
4	3	North Cowichan	198	50	12	2.9
4	4	Robertson	158	10	2	0.6
4	5	Sutton	110	5	1	0.3
4	6	Meade	88	20	5	1.2
4	7	Cottonwood	50	40	9	2.3
4	8	McKay	44	60	14	3.5
4	9	Nixon	76	5	1	0.3
4	10	Shaw	92	175	41	10.2
4	11	Nitinat	326	30	7	1.7
4	12	Little Nitinat	139	10	2	0.6
4		TOTAL	1716	430	100	25.1

Note: The size of the sub-units varies significantly. The location of each sub-unit is identified by the numbers on Figure 2.19.

FIGURE 2.19: Location of population sub-units for Roosevelt elk, relevant to the CVRD

Source: Kim Brunt, Ministry of Environment.

Plants and Ecological Communities at Risk

Indicators and Measures

The BC Conservation Data Centre compiles information and trends on species that may be at risk in BC, and classifies them based on global and provincial ranking systems.[62] The information provided is based on these rankings for plants and ecological communities at risk that are found or thought to be found within the Cowichan Valley Regional District.

Findings

The Conservation Data Centre lists a total of 63 plant species that are either red- or blue-listed, and are found or are likely to be found within the CVRD (Table 2.9). Of these, one – Macoun's meadowfoam – is endemic to Vancouver Island (Figure 2.20).

62 BC Conservation Data Centre: www.env.gov.bc.ca/cdc/

FIGURE 2.20: Macoun's meadowfoam

Source: www.ubcbotanicalgarden.org

TABLE 2.9: Number of plant species at risk in the CVRD

Name	Class	Blue	Red	Total
Non-vascular plants		14	3	17
Vascular plants	Conifers	1		1
	Dicotyledons	25	25	50
	Ferns	1		1
	Monocotyledons	5	5	10
	Quillworts	1		1
Totals		47	33	80

Source: BC Conservation Data Centre.

Many of the plants of concern are associated with the "at risk" or sensitive ecosystems (Section 2.2) such as Garry oak communities and shoreline systems.

Ecological Communities

In addition to the individual plants and animals at risk, 84 ecological communities are also identified as at risk: 35 are blue-listed, and 49 are red-listed. Many of these are associated with the Coastal Douglas- fir (CDF) ecosystem (see Section 2.2). For example, 36 of the 84 are primarily associated with dry CDF ecosystems, with eight blue-listed and 28 red-listed ecological communities, including the Garry oak- and arbutus-dominated systems. The conversion of native ecosystems to urban or rural developments and agricultural land (again, as outlined in Section 2.2), combined with the high level of private land in the CDF ecosystem, result in this high density of at-risk communities found in the CVRD.

Communities at risk within the CVRD also include a variety of riparian ecosystems. For example, the Sitka spruce/false lily-of-the-valley ecosystem on the outer west coast occurs on infrequently flooded riparian benches which are highly productive and grow some of the tallest spruce trees in the world. This impressive ecosystem is now red-listed across its range as a result of harvesting.

Summary

The CVRD has a high density of animals, plants and ecological communities at risk, compared to many other areas of the province. This results from the natural diversity of the region – some of the wettest and some of the driest ecosystems in the province occur in the CVRD – combined with its long history of development.

The identification of a plant, animal or ecological community as "at risk" in BC does not necessarily confer any special protection for that species. In order for federal "endangered species" legislation to apply, a long and specific process has to be undertaken. Many local, provincial and even globally rare species and ecosystems are not captured under this federal legislation. No provincial "endangered species" legislation exists in BC, though some species are protected to some degree under other more general legislation. Ecological communities, such as the massive riparian Sitka-spruce forests, are not protected from harvesting provincially, even if they are identified as red- or blue-listed, unless the decision is made to do so voluntarily.

Missing Information

For many species within the CVRD, the specific locations and habitat requirements of endangered species are unknown. This makes protection difficult, even when there is the will to do so. For other species, the lack of regulations makes identification and maintenance of habitat difficult as development or harvesting continues.

References

BC Conservation Data Centre: **www.env.gov.bc.ca/cdc/**

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2003. Assessment and Status Report on the Warty Jumping Slug. dsp-psd.pwgsc.gc.ca/Collection/CW69-14-318-2003E.pdf

Henigman, J., J. Turner and K. Swift. 2005. Roosevelt Elk Wildlife Habitat Decision Aid. BC Journal of Ecosystems and Management. Extension Note. JEM 6 (1).

Quayle, J.F. and K.R. Brunt. 2003. Status of Roosevelt Elk in British Columbia. Wildlife Bulletin No. B-106. Ministry of Environment.

Vancouver Island Marmot Recovery Team. 2000 Update. Vancouver Island Marmot National Recovery Plan. RENEW Report No. 19.

2.4 Invasive Species

Introduction

Invasive species – both plants and animals – are identified as one of the primary threats to maintaining native biodiversity world-wide. Invasive species move into areas where they have not evolved as part of the ecosystem, and are often aggressive species capable of taking over natural ecosystems, frequently with high rates of spread or of reproduction and a lack of natural predators. Defining what constitutes "invasive" species can be difficult, since species move naturally around the globe – from some perspectives, European settlers into the CVRD were the quintessential "invasive" species that facilitated many of the other cascading impacts on biodiversity in the region (dealt with in other sections of this report). This chapter focuses more specifically on those animal and plant species that were not historically present in this region.

Invasive Species in the Cowichan Valley Regional District

Invasive species tend to follow humans into new environments. European settlement brought a large number of invasive species to Vancouver Island – deliberately, through horticultural interest, and by the accidental movement of species. Since that time, invasive species have continued to arrive through various means – on ships with lumber, as garden exotics gone wild, and under their own steam. When we think of invasive species, we tend to think of the most obvious species (e.g., plants such as scotch broom or animals such as bullfrogs), but invasive species also include insects and diseases. Species that are "native" to a region can also be classified as problematic "invasive" species if, for environmental reasons (e.g., droughts or land disturbance), they become overly prevalent within a region (such as the mountain pine beetle which has killed more than 16 million hectares of forest in interior BC in the last decade).

Invasive species have significant ecological impacts. The combination of rapid colonization and lack of native predators tends to result in the rapid spread of these species, which can radically alter the ecology of an area. Ecological changes affect food supplies for other species, including the timing and availability of resources; they can also alter chemical processes within ecosystems, resulting in the loss of nutrients for other species and alterations to the entire successional pathway for communities. Many native species can be lost as a result.

Human disturbances such as changing original ecosystems, creating linear corridors (roads/powerlines) and compacting soil, all lead to increased opportunity for many invasive species. The impact of climate change on invasive species is also expected to be significant; drier conditions are expected to significantly increase the ease of colonization by novel species from other places, further increasing the pressures on today's ecosystems.

Invasive species are found in most of the different ecosystems present in or adjacent to the CVRD, including terrestrial systems, freshwater aquatic systems, the marine foreshore, and marine aquatic systems.

Measuring Invasive Species

Keeping tabs on the diverse array of potential invasive species is extremely difficult. Mapping of key species – usually obvious plants and some animals – occurs in some areas of high interest, such as some sensitive Garry oak ecosystems. The Coastal Invasive Plant Committee[63] tries to monitor and maintain complete information for plant species, including identifying focal species that should be a priority for action, but the task is very large. Once a species becomes ubiquitous it often stops being a focus of sampling. Comprehensive mapping for all species does not exist, though great efforts are being made in this direction, particularly for plant species. Some aquatic invaders (such as some fish species) are actively encouraged as sport fish, and are purposely moved between lakes. There is a lack of systematic review of aquatic invasive species (though efforts are currently underway). Marine exotics are also less of a focus, though a few key species are notable. Included in this report are the following indicators:

> Number of invasive plant species and area affected

> Some invasive animal species of interest

Invasive Plants

Indicator and Measures

This report looks at the number and area of invasive plant species within the Cowichan Valley Regional District.

Findings

At least 30 invasive plant species are found within the CVRD region (Figures 2.21 and 2.22). According to the Invasive Alien Plant Program data (IAPP)[64], a total of appropriately 909 ha within the CVRD are affected by invasive species, located on approximately 2,000 individual sites. These figures are known to under-estimate the total area affected by invasive species. The most significant species by area included in the database are Scotch broom, followed by oxeye daisy, St John's wort, Himalayan blackberry, bull thistle and Canada thistle. A large number of other species are noted in that database, and though they affect relatively small areas, they can have significant ecological consequences.

63 coastalinvasiveplants.com/invasive_plants.php

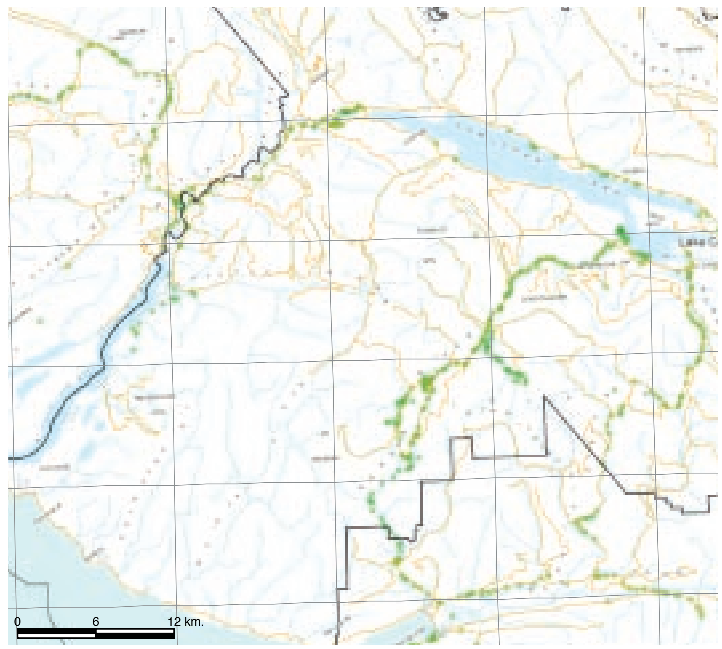
64 Invasive Alien Plant Program: www.for.gov.bc.ca/HRA/Plants/index.htm

The general distribution of invasive plant species is shown on Figures 2.21 and 2.22 by green dots representing specific areas where one or more invasive plant species have been mapped. The higher density on the east coast, compared with the west coast, is clear, as is the tendency to have highest densities along road and river systems. This is reflected in the dataset, with almost half of the mapped sites occurring in the Coastal Douglas-fir (CDF) zone, and the majority of the rest occurring in the dry portion of the Coastal Western Hemlock (CWH) zone (Figure 2.21).

FIGURE 2.21: Distribution of mapped invasive plant species – east side of the CVRD

Source: Invasive Alien Plant Program, accessed 2010.

FIGURE 2.22: Distribution of mapped invasive plant species – west side of the CVRD



Source: Invasive Alien Plant Program, accessed 2010.

TABLE 2.10: Number of mapped sites of invasive species, by biogeoclimatic zone

Biogeoclimatic zone	Number of sites
CDF mm	919
CWH mm 1	67
CWH mm2	13
CWH vm1	99
CWH xm 1	612
CWH xm 2	219
Grand Total	1929

Source: Invasive Alien Plant Program, accessed 2010.

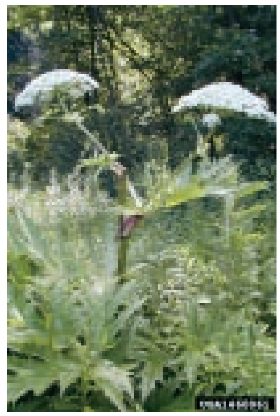
Some of these invasive species are relatively benign garden species, but others are having (or have the potential to have) very significant ecological, economic and health impacts. The most obvious impacts are the loss of "space" and increased competition for native biodiversity, resulting in increased impacts to sensitive ecosystems such as Garry oak meadows, as well as a wide diversity of impacts throughout the food chain (from insect predators and pollinators to the provision of edible forage for ungulates). Other species, such as knotweeds, can result in higher levels of soil erosion, since they alter streamside stability compared with native riparian species.

The economic impacts of invasive species are significant – invasive plants are estimated to result in losses of $50 million annually due to effects on agricultural crops in BC.[65] Knapweed alone is estimated to result in losses of $400,000 a year due to impacts on hay production in BC. Species that colonize roadsides (such as broom) also affect critical infrastructure and maintenance costs. The true cost of economic impacts, however, is unknown – particularly the impacts to the more nebulous ecosystem services such as the provision of clean water, flood control in natural riparian ecosystems, or loss of species and ecosystem diversity where impacts are often impossible to quantify.

65 Invasive plant council of BC: www.invasiveplantcouncilbc.ca/invasive-plants-bc/invasive-plants-in-bc

A few invasive species are relatively isolated within the region at the present time, in terms of area or number of sites affected, but have the potential for significant ecological impacts. Specific isolated invasive species are: common gorse (drier sites), giant hogweed (which is major public health hazard[66]), three species of knotweed[67](which affect many different habitats) and policeman's helmet (also known as Himalayan balsam, which affects riparian and moist areas).

FIGURE 2.23: Common gorse, giant hogweed, knotweed


Surveys by the Coastal Invasive Plant Committee show that giant hogweed has been found on seven sites, and gorse on 10 sites primarily within the Coastal Douglas-fir (CDF) zone, although distribution is understood to be much greater than existing surveys suggest. Giant knotweed has been found in small clumps, but also as continuous cover in a larger number of sites in the CDF and in the drier zones of the Coastal Western Hemlock (CWH) zone, primarily around Duncan, the Cowichan River and Maple Bay.

Bohemian knotweed is more common (with around 50 sites) primarily around the Cowichan River, while Japanese knotweed is most widespread (found on more than 100 sites from Shawnigan Lake to Cowichan River, Mill Bay and Cobble Hill). Policeman's helmet is a less well-known species of importance newly discovered on Vancouver Island, with four known locations within the CVRD. This species colonizes riparian areas; growing up to 3 m tall, it is an extremely invasive species with high seed production and rapid dispersal through hydrologic systems. As a result, it is often listed in the top-20 of invasive species.

66 Hogweed produces a noxious sap that can result in severe and painful burning and blistering when it comes into contact with skin. Hikers must take precautions not to brush against this dangerous plant that often grows alongside trails.

67 Lynne Atwood, Coastal Invasive Plant Committee, personal communication, 2009.

All of these species can quickly crowd out native vegetation, affecting native species and changing how important areas like riparian habitat function. In addition, smaller, apparently benign species such as the yellow iris can alter the availability and flow of water, as their very dense rhizomes raise the level of the land, turning riverine and marsh ecosystems into effectively more terrestrial systems , and favouring different overstorey species.

Invasive Animals

Indicator and Measure

No systematic assessment of invasive animals is available. Some forest-specific information is available for species of interest to commercial forestry operations.

Findings

Many of the most ecologically significant invasive animal species are often not even considered as such. For example, house cats are one of the most prevalent and impactful invasive species, estimated to kill more than a billion small mammals and hundreds of millions of songbirds in North America annually. Cats – feral and house – are designated as one of the top-100 worst invasive species on the globe.[68] Similarly, domesticated dogs also have significant impacts – from the spreading of disease to the general disturbance of native species resulting in reduced populations. Other species such as the European starling, the European house sparrow, rats and grey squirrels have also become so ubiquitous in the ecosystem that they are not included on invasive species lists. In some areas however, these species can have significant impacts on native species. For example, starlings can have significant impacts on breeding sites for cavity nesting birds in natural habitat adjacent to more urban settings.

Other species, such as the bullfrog and green frog, are both invaders of ponds within the CVRD. The bullfrog – a native of eastern North America – was introduced for "farming" in the early 1900s. This large species is a significant predator for many native pond-dwelling species, including fish, native amphibians, snakes, and even ducks.

68 IUCN, accessed 2010.

There are a variety of "introduced" fish species in various lake systems that have a variety of impacts on the native biodiversity. Species such as smallmouth bass can negatively affect native fish species and amphibians. One species of particular concern is the pumpkin seed sunfish (Figure 2.24), which is found in many bodies of water within the region. This species is a particular problem because it impacts native amphibians, and is thoughtlessly relocated by the public because it is an attractive species.

FIGURE 2.24: Pumpkin seed sunfish – attractive, but ecologically disastrous

Some species, such as slider turtles, have been released by the public (who bought them as pets), and appear to have become established in some areas. They have an omnivorous diet and their effects on native biodiversity are largely unknown. The extent of their range is also unknown.

Not all invasive species are obviously ecologically problematic. Some, such as the non-native eelgrass Zostera japonica, appear to function relatively similarly to the native species. However, long-term studies are lacking. The New Zealand mudsnail is a dramatic invader – radically changing aquatic environments in brackish habitats, sometimes occurring in densities of half a million individuals in a square metre. Currently, it is not found within the CVRD, but the potential for spread on recreational craft or fishing gear is ever-present. A recent new discovery of a population of mudsnails in Port Alberni, which spread northwards up the coast, shows the potential for the sudden spread of this and other invasive marine species.[69]

69 Davidson et al., 2008.

Many areas of the province are seeing significant impacts on forests as a result of invasive species, or large populations of insects and diseases (such as the massive impacts of mountain pine beetle in central BC). A few species of concern are currently active within the CVRD – including the fir engraver beetle, which impacts grand fir within drier biogeoclimatic (BEC) zones (CDF and CWHxm1) and which appears to have been increasing in the last 5 years. Drier conditions, predicted with climate change, exacerbate the effect of this beetle on grand fir, making these trees more susceptible to attack. Also, the spruce weevil is currently active within the CVRD; it affects regenerating Sitka spruce.

As for pathogens, there are currently few exotic pathogens in BC's forests, though one – Cryptococcus gattii (a microscopic pathogen which is normally found in tropical or subtropical locales in Australia, Africa, India or South America) – was identified on Vancouver Island in 2001 and is known to be present in the Cowichan Region[70]. With the potential to cause a human health risk, this species has unknown consequences for the broader ecosystem. With climate change, more invasions of this type are predicted in the future.

Summary

The most significant impacts to ecological systems worldwide are the combined effects of habitat loss due to human activities and invasive species.[71] Human activities often promote other invasive species, and so the intertwining and cumulative effects often increase the overall impacts on biodiversity values.

The CVRD is home to a wide variety of invasive plant and animal species, and this list continues to grow through time. Ecological impacts are varied, but invasive species primarily exacerbate loss of habitat caused by development in the drier east-side areas of the region. Many of the sensitive ecosystems identified in Section 2.2 are particularly hard-hit by invasive species, including Garry oak ecosystems, riparian areas and wetlands.

The full scale of impact, however, is unknown. Knotweed, for example, likely affects how riverine systems function in response to moderate floods, but effects such as these remain largely unquantified. Climate change is expected to significantly increase the ease of colonisation by novel species from other places[72] – further increasing the pressures on today's ecosystems.

70 Robert F. Service, New Concerns About Deadly Fungus Found in Oregon, Science Magazine, April 2010. http://news.sciencemag.org/sciencenow/2010/04/new-concerns-about-deadly-fungus.html

71 Millennium Ecosystem Assessment, 2000.

72 Harvell et al., 2002.

Missing Information

Various agencies maintain databases on invasive species, particularly plants, due to their known economic impacts to agriculture and forestry. However, these databases are often out of date, and focus only on specific species. Great efforts are made to prioritize invasive species actions, however the full task of trying to deal effectively with the wide range and abundance of invasive species typically swamps the capacity of agencies. In the CVRD, this situation is exacerbated by the large area of private forest land, for which data are largely unavailable.

Most databases currently focus on plant species, however work is on-going on Vancouver Island to compile a database of invasive aquatic species.

In largely rural settings such as much of the CVRD, the effects of accepted invasive species such as cats and dogs are significant but unquantified or managed.

References

Coastal Invasive Plant Committee. **coastalinvasiveplants.com/**

Davidson et al. 2008. Northern Range Expansion and Coastal Occurrences of the New Zealand Mud Snail in the Northeast Pacific. **www.aquaticinvasions.net/2008/AI_2008_3_3_Davidson_etal.pdf**

Harvell, C.J, C.E. Mitchell, J.R. Ward, S. Altizer, A.P. Dobson, R.S. Otsfeld, M.D. Samuel, 2002. Climate Warming and Disease Risks for Terrestrial and Marine Biota. Science. 296: 2158-2162.

Invasive Alien Plant Program Mapping Feature. **webmaps.gov.bc.ca/imf5/imf.jsp?site=mofr_iapp**

IUCN Invasive Species Specialist Group. **www.issg.org/database/welcome/**

Millennium Ecosystem Assessment. 2000. **www.millenniumassessment.org/en/index.aspx**

2.5 Fish

Fish are an important part of the Cowichan Valley Regional District (CVRD). They are ecologically critical to both the terrestrial and aquatic ecosystems as food for other organisms, as users of the habitat and food resources, and as nutrient inputs into these ecosystems. They are also important to people and communities for food, economic wealth, and their spiritual and cultural value. Salmon species in particular are a cultural icon of this region and a key indicator of ecosystem health because they reflect the cumulative impacts occurring in marine, freshwater and terrestrial environments of the CVRD and larger area.

Introduction

The CVRD covers a wide range of different watersheds, each of which has its own specific fish values, and each of which is vital to maintaining the biodiversity of fish, and especially salmon, in the area. Watersheds such as the Nitinat, Caycuse, Cheewhat, Carmanah, and Walbran flow west into the Pacific. Others, such as the Koksilah, Chemainus, and Cowichan rivers flow east into the Strait of Georgia. In addition, there are numerous small streams and lakes, many of which are affected by specific local land and water uses.

While there is a considerable diversity and abundance of fish present, declines are occurring – particularly for some species in some systems, and likely due to human activities. There are many species and stocks of fish which use the Cowichan Region in different ways and at different times. Some are year-round residents, some are ocean migrants that can return in a single year or multiple years. Some fish have several genetic and physical variations within the same watershed in response to different habitat conditions around the watershed. Different characteristics of each individual watershed, such as water quality and temperature, the annual flow regime, and spawning habitat availability are just a few of the variables that affect fish populations.

This report focuses on one of the most important watersheds for salmon: the Cowichan Basin drainage area. It is one of the largest tributaries flowing into the Strait of Georgia and has significant salmon populations. The Cowichan Basin is also relatively data-rich and is culturally significant for this region.

The Cowichan Basin watershed is influenced by many natural factors, including a mountainous terrain and coastal climate. Historically, mild-wet winters and cool-dry summers were the norm. Climate trends now suggest increasing annual stream temperatures. Rain-dominated watersheds such as the Cowichan will be more easily affected by changes in winter flood events (increasing in frequency) and low-flow periods. Unlike most of other river systems in the district, the Cowichan River flow is buffered (or moderated) by the presence of a large lake (Cowichan Lake), and further by the presence of a water-control structure (weir) at the outlet of this lake.

Human impacts on the watersheds have been extensive: early forest harvesting proceeded through extensive clearcutting, resulting in significant changes to the quality and quantity of water entering the system. The rivers themselves were impacted by the running of logs through the system. Fish harvesting has been extensive, both in the rivers and the ocean. Ocean conditions themselves have changed. All these impacts have occurred and interacted over significant periods of time during the last century, and many are ongoing today.

Fish in the Cowichan Basin Watershed

The Cowichan River is designated as a Canadian Heritage River System. One major reason for this designation is the significant abundance and importance of the fishery resource. The Cowichan River is historically known for its substantial runs of chinook, coho, chum, and steelhead salmon. As a result, it is an index river for the US/Canada Pacific Salmon Treaty, and is used as an indicator of abundance, survival, and exploitation of chinook in the broader region of the Georgia Basin.

Chinook salmon have a special status in BC. The Cowichan has, in the past, supported some of the largest spawning runs of chinook in the entire Georgia Basin.

Other native species include rainbow trout, resident cutthroat, and Dolly Varden char, and – within Cowichan Lake – resident Kokanee salmon. The Cowichan is known as one of the finest trout rivers on Vancouver Island and possibly in the whole of BC. In addition to these well-known fish species there are many smaller fish, such as minnows, chub, sculpins, and lamprey which are important parts of the ecosystem. The Vancouver lamprey, resident in Cowichan Lake, is listed as a "threatened" species under the Canadian Species at Risk Act.

Several species of fish have been introduced into the Cowichan watershed, mostly in the early 1900s, including brown trout, Kamloops trout, speckled char, lake trout, catfish, and Atlantic salmon.[73] Only brown trout appear to have established themselves to significance in the system. There are other, more recent, observations of invasive fish species which are not documented in this report but are a concern to the native biodiversity in the region.

73 Neave, 1941.

Measuring the State of Salmon in the Cowichan Basin Watershed

Indicator and Measures

For the purpose of this report salmon abundance is a main indicator of watershed health, both at present and as a trend through time. Ideally, historical data on the salmon runs (i.e., prior to extensive harvesting that was initiated more than 100 years ago), would provide the most appropriate benchmark for understanding recent trends. While this data cannot be readily accessed in this timeframe, data does exist on relatively long-term escapement (number of adults that escaped being caught and returned to the river to spawn) for key species within the Cowichan. These data sets are presented for each major species/stock.

It is important to note that other, more detailed, watershed trend indicators might provide additional insight into fish abundance trends, and a more precise indication of the factors affecting specific components of the salmon life history, from egg in the river to returning adult. These additional indicators might include habitat area and quality changes over time, water quality, food productivity for species such as aquatic invertebrates, egg-to-fry survival rates, fry density and distribution, predator pressures (such as presence of predator birds and fish), etc. These indicators would provide more baseline data to help us understand the trends in adult fish abundance. Some of this information will be available in an assessment of the habitat in the Cowichan watershed which was undertaken in conjunction with this report.[74]

However, the number of adults spawning remains an overall indicator which is relatively easy to measure. Like a canary in a mineshaft, salmon are an indicator of the overall health of the watershed, because they integrate so many of the factors mentioned above.

When interpreting trends in numbers of fish, it is important to understand that fish abundance is determined by a combination of the following three general types of factors (a few of these factors are explored in detail towards the end of this section):

1. The ocean ecosystem (factors such as ocean conditions affecting food sources, near-shore habitat complexity, productivity of the estuary, competition with other species, natural predation, etc.)
2. The freshwater ecosystem (factors such as spawning and rearing habitat, habitat quality, water quality, adjacent land use, predation pressures, water temperatures, competition and predation from other species, etc.)
3. Direct human interventions such as fishing or hatchery production.

74 DFO, 2010.

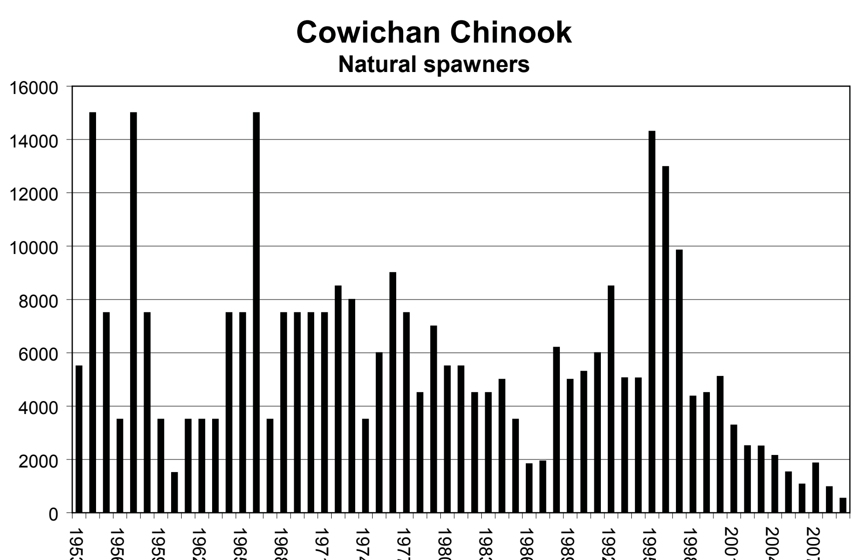
Determining which of these many factors has the most influence on fish population trends is a complex issue. Multiple species can be affected differently by different factors and can in turn affect one another. In addition, trends can alter within individual systems – making it difficult to summarize information. One thing is certain: the freshwater ecosystem is an important determining factor in the abundance of fish in the Cowichan Basin watershed.

Findings

Chinook

Historically, the major chinook run in the Cowichan returns in the fall, and over the last 56 years has had an average "escapement" (i.e., returning spawning adults) of 6,000 fish (Figure 2.25), with high variability across the years. For example, a strong El Niño in 1983 resulted in poor spawning numbers three to four years later, and improved ocean conditions in the late 1980s led to some large return numbers. Since the mid-1990s, however, natural spawning numbers have declined significantly to very low numbers, with the lowest ever recorded in 2009. Other contributors to this declining trend include: ocean conditions combined with continued high fishing pressure (catch rate), both from commercial and sport fisheries, fluctuating hatchery production, and impacts to freshwater areas (fish rear their young in the lower river and estuary prior to heading to the ocean, and survival in these zones has decreased through time). It is important to note that Cowichan chinook abundance has declined more than other chinook populations in the lower Strait of Georgia (such as Nanaimo or Squamish), suggesting that local impacts are significant for the Cowichan fish.

FIGURE 2.25: Annual estimates of chinook salmon "fall" spawners in the Cowichan River, 1953 – 2009



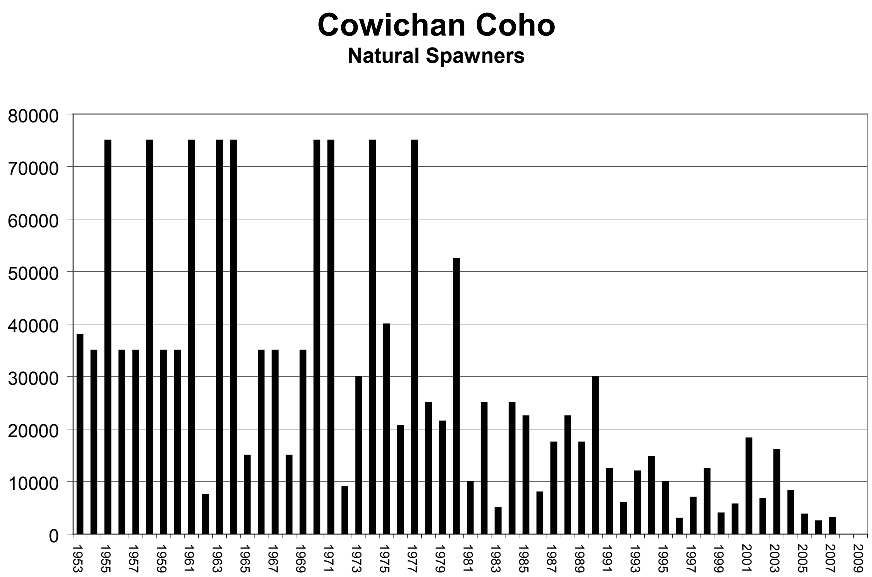
Source: Data from 1953 to 1987 are based on DFO Fisheries Officers' estimates. Data from 1988 to present are based on DFO fixed point enumeration (counting fence) and carcass mark/recapture estimates where necessary. DFO Salmon Escapement Database (NuSEDs), 2010.

The spring-run population of chinook salmon is currently at an extreme low, practically at zero. Little is known about the historic size of this population, though anecdotal information suggests that this run was once of similar size to the fall run.[75] Good information on the factors affecting this population is unavailable.

Coho

Coho populations are currently at low levels throughout the Georgia Basin. The coho return to the Cowichan in the fall, taking advantage of habitat and migration options as water levels rise significantly from October through December. As with chinook, the escapement numbers for coho spawning in the Cowichan system have also dramatically declined recently – with 2007 numbers lower than any seen previously (less than 1,000 individuals compared with in excess of 70,000 in periods up to the 1970s) (Figure 2.26). One important difference from chinook is that the commercial and sport fishery catch rate for coho is low. Therefore, the continued low abundance of coho is most likely due to a combination of factors affecting survival in both the ocean ecosystem and the freshwater ecosystem. Coho spend a full year in freshwater prior to entering the ocean, making the freshwater ecosystem especially important. Suitable freshwater rearing habitat and/or near-shore marine habitat has likely become a major limitation for coho abundance (see Section 2.2 for information on the condition of the Cowichan estuary).

FIGURE 2.26: Annual estimates of coho salmon spawners in the Cowichan River, 1953 – 2009. No estimates were made for 2008 and 2009



Source: Data from 1953 to 1992 are based on DFO Fishery Offices' estimates. Data from 1993 to 2007 are based on expansion of selected tributary estimates. DFO Salmon Escapement Database (NuSEDs), 2010.

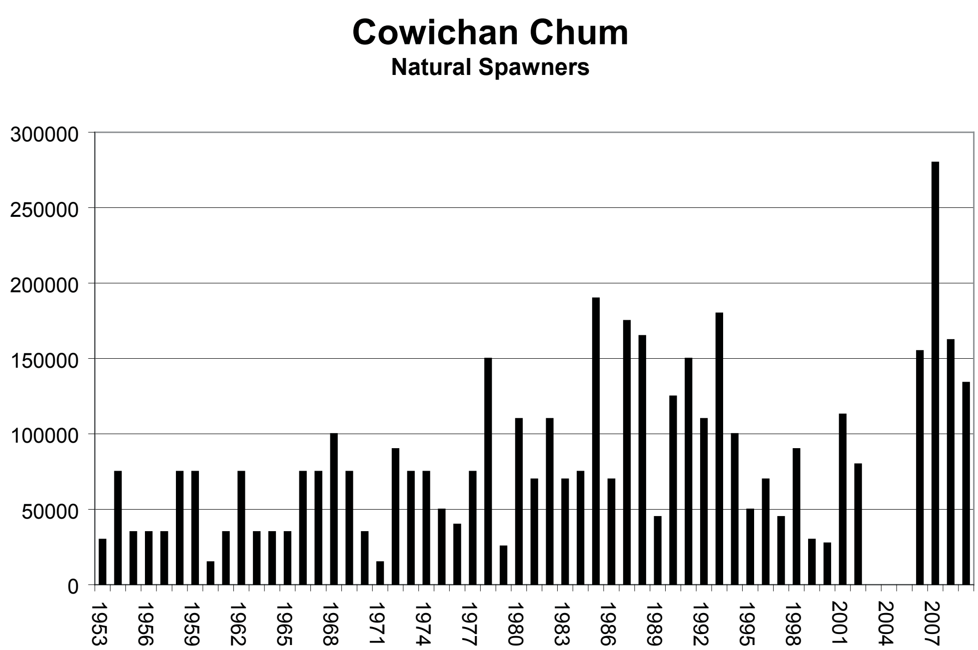
75 Burns, 2002, referenced in Burt and Robert, 2002.

Chum

Chum salmon stocks are considered as part of a single management unit called the Inner South Coast (ISC) chum stock. The average return for ISC wild chum salmon was 1.3 million from 1968-1982, which reduced to 1.1 million for 1983-1996[76].

Although numbers fluctuate widely (Figure 2.27), the estimates for chum spawning returns do not show the obvious negative trends seen for the other species. Chum salmon have the most limited interaction with the watershed of all the salmon species. They spawn in the lower reaches of the river and migrate to the ocean shortly after emergence from the gravel. The factors generally considered to have the greatest influence on chum abundance are those which affect eggs in the gravel (flooding, stream bed movement, predation, etc.), as well as ocean conditions.

FIGURE 2.27: Annual estimates of chum salmon spawners in the Cowichan River, 1953 – 2009. No estimates were made for 2003 through 2005



Source: Data from 1953 to 2003 are based on DFO Fishery Officer and Fishery Managers' estimates. Data from 2006 to present are based on enumeration of migrants using a Dual Identification Sonar unit (DIDSON). DFO Salmon Escapement Database (NuSEDs), 2010.

76 DFO, 1999, quoted in LGL, undated.

Steelhead and Trout

Steelhead on the Cowichan have both winter runs and spring runs. Many steelhead stocks on Vancouver Island have declined significantly in the last 30 years. The distribution of steelhead within the Cowichan system has also declined; steelhead are now absent from many tributaries of Cowichan Lake. Similarly, the steelhead in the Koksilah River are classified as of conservation concern.[77] Data for steelhead are more difficult to obtain, but Cowichan River abundance is thought to be 500 – 800 winter-run escapement, which is considered to be at 10 – 30% of habitat capacity,[78] though it is not known if this represents the historic abundance of fish in this system. A number of stewardship-based restoration projects, such as the remediation of Stoltz Bluff, are hoped to benefit this species.

Resident rainbow trout are very limited within the Cowichan system today, though they were historically abundant. They are suspected to have been impacted by historic heavy fishing pressure.

Resident cutthroat trout appear to be scarce, while sea-run cutthroat trout appear more numerous. However, detailed population trends are unavailable.

Factors Affecting Salmon Abundance in the Cowichan Basin

Fish (particularly salmon) abundance and distribution is affected by a wide range of factors in both the freshwater and marine environments. Some of these factors, such as those related to environmental change or marine harvest regimes, are determined on a broader scale than the Cowichan Region. Others, such as instream water levels and riparian conditions, are directly related to impacts in the local area. The table at the end of this section (Table 2.11) summarizes the range of factors affecting Cowichan salmon abundance and distribution, and their relative impacts on these species.

There is general agreement within the local Cowichan Stewardship Roundtable (which deals with local fisheries issues) that the highest risks in the freshwater ecosystem stem from low water flow, high water temperature, and sediment loads from bank erosion. Additionally, the loss of rearing area in the lower river is significant. As the fish migrate to the ocean, the ability to feed and grow in the lower floodplain, in the estuary (where much habitat has been lost as a result of a wide variety of development – see Section 2.2), and in the nearshore environments of the southern shores of Vancouver Island and the Gulf Islands, is critical

77 Lill, 2002.

78 Lill, 2002.

to determining overall abundance. Other important factors affecting salmon returns include harvest by commercial and sport ocean fisheries (particularly for chinook), the production from the Cowichan hatchery, and broader ecosystem considerations such as seal and killer whale predation, land use impacts and changes in ocean currents.

A few of these factors are explored below.

Water Quality and Quantity

In the Cowichan, water flow and quality (e.g., temperature) are thought to be key issues affecting fish populations, at least in some years[79]. The Cowichan is a rain-dominated system, so water levels are maintained by groundwater aquifers adjacent to the river and reduced precipitation levels can significantly alter low-flow levels during critical periods of the year. Natural hydrology in the Cowichan is altered by a low-head weir located at the outlet of Cowichan Lake, and intakes for the Crofton Mill and City of Duncan water supplies, both located about 10 km above the mouth of the river. The weir is theoretically to be used to maintain fish habitat in time of low flow, and is typically successful in maintaining water levels. However, lake levels have at times been insufficient to maintain adequate water flow, leading to conflicts between ecosystem, fish and human water requirements.

There have been recent years when summer (low-flow) water levels in the Cowichan Basin system have been critically low – which results in significant impacts to habitat availability for spawning, migration and rearing, reducing overall fish productivity. At critically low levels, fish are dissuaded from even entering the watershed system and cannot bypass physical barriers in the system. The stranding of fish in side channels at times of low flow can be a significant issue and, although stewardship efforts are made to recover these losses, both coho and chinook salmon incur significant mortality through stranding.

Water quality also interplays with habitat quality. For example, above Skutz Falls the spawning habitat is of high quality, with much lower quality below the falls due to the high proportion of cobbles and boulders, combined with high fine sediment inputs. In addition, higher air temperatures combined with low water flow results in increasing water temperature, which, in turn, can have significant impacts on these primarily cold-water species (e.g., reducing growth rates, survival of fry and resistance to parasites and diseases). Increased temperatures are thought to be of particular concern within the Koksilah River system, as the temperature within this system is not buffered by a major lake (as is the case with the Cowichan River).

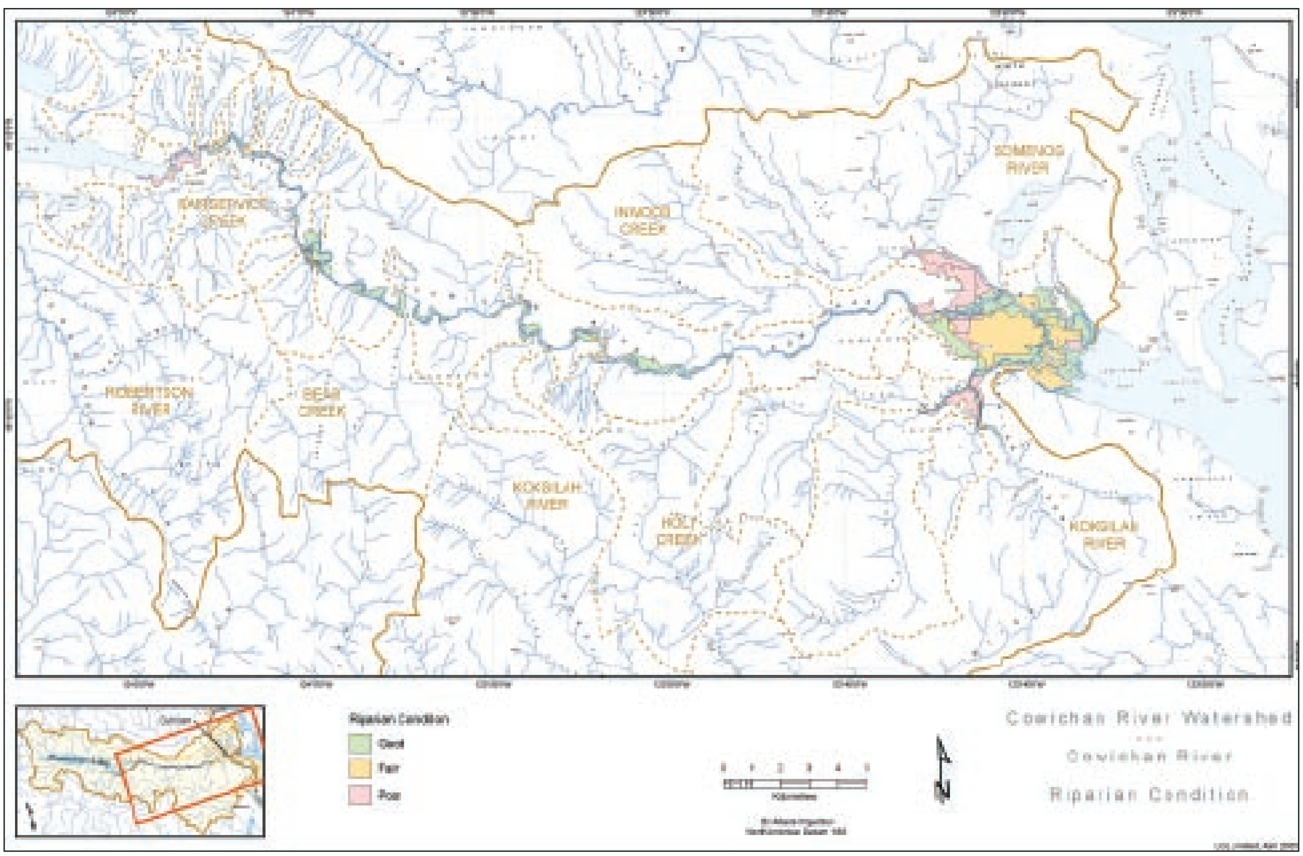
79 W. Luedke, Department of Fisheries and Oceans, personal communication, 2009.

Habitat Quality

In general, spawning and rearing habitats have been degraded over time compared to their historic condition. No "natural" habitat baseline is available because the most significant effects occurred over the last hundred years or more, with progressive clearcutting of most of the Cowichan watershed and harvesting of second-growth underway. Over this period, significant changes have occurred within stream channels and riparian habitat, reducing the natural complexity of the system, altering the input of natural coarse woody debris to the system (which creates spawning habitat under natural conditions), and affecting water quality and temperature. Development and dyking on the floodplain has changed the natural dynamics of the floodplain and affects habitat availability, particularly for rearing fish.

At the lower end of the system (from Cowichan Lake to Cowichan Bay), significant areas of riparian habitat are also considered to be in poor condition (Figure 2.28). The effects of pollution and habitat degradation on fish populations in the Cowichan Estuary (Section 2.2) are largely unquantified, but this area is important as a juvenile rearing habitat. Stewardship efforts have worked to improve the condition of habitat, but significant limitations remain.

FIGURE 2.28: Riparian condition for the lower Cowichan system



Note: This map used with permission of Cowichan Tribes.

Marine Harvesting

Marine harvesting can be a significant factor affecting the abundance of salmon in a watershed. Marine harvesting occurs through commercial fisheries using seine, gillnet, or troll gear, and through recreational fisheries and First Nations fisheries.

For Cowichan chum, coho, and steelhead, the ocean harvest is relatively low and not likely a limiting factor for abundance. For chum salmon spawning in the Cowichan, the marine harvest is held at a conservative level of less than 20%, mostly from commercial fisheries in Johnstone Strait and more locally in Satellite Channel, but also including a small portion of recreational catch. Cowichan Tribes also harvest fish in the vicinity of the Cowichan River.

For coho salmon, the marine exploitation is even lower, mostly likely in the range of 5-10%. However, this level of fishery impact is relatively recent (since 1997). Prior to 1997, coho catches were significant, up to 80% of the total production of many stocks. For wild steelhead, harvest is currently at low levels. For chum, coho, and steelhead, river abundance is not determined by harvest, but more likely by natural limiting factors in both the freshwater and marine ecosystems.

Cowichan chinook are harvested at a much higher rate in ocean fisheries. In recent years, an average of about 60% of the Cowichan chinook were harvested by marine fisheries, plus another 10-15% by Cowichan Tribes for constitutionally protected food, social, and ceremonial use. The marine harvest of these chinook included about 15% by Washington State fisheries, about 15% by the commercial troll fishery, and about 30% by recreational fisheries in southern BC.

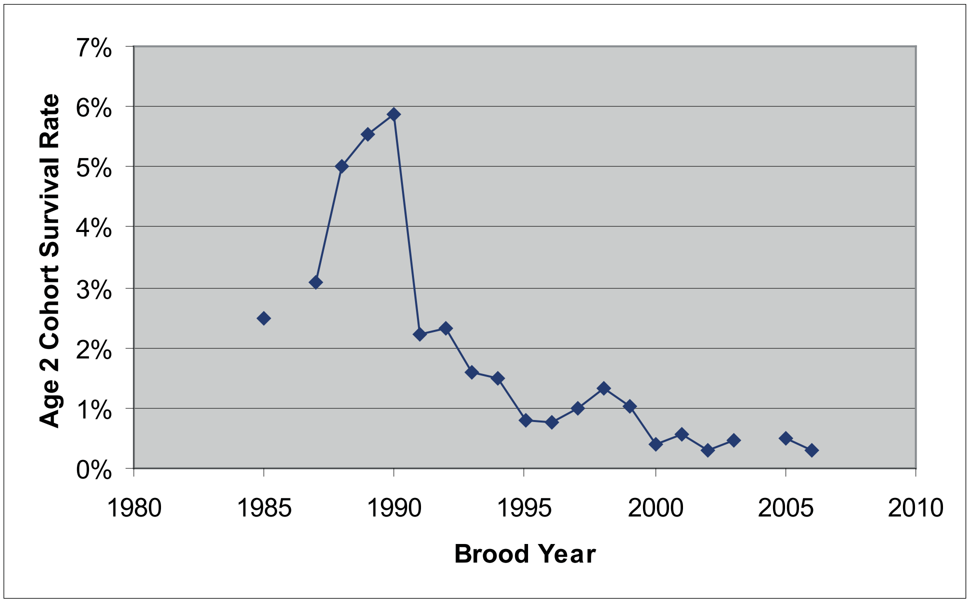
Ocean harvest of Cowichan chinook has been a significant factor in the low number of these fish returning to the river. In order to reduce overall harvest, several actions have been taken in recent years. These have included an approximately 50% reduction in allowable catch by the commercial troll fishery, significant closures of the recreational fishery in the Gulf Islands during the fall migration, and the extensive implementation of more selective fisheries in Washington State. Whether these management actions are sufficient to effect a reversal in recent precipitous declines in Cowichan chinook returns will become clear in upcoming years.

Marine Survival

The trends in marine survival of chinook and coho entering the Strait of Georgia suggest that changes in marine conditions have had a negative consequence on salmon abundance. There is substantial evidence that salmon mortality in the ocean occurs mainly in the first few months after leaving the river and estuary, as they mature in the nearshore areas of the region's coastline, Gulf Islands and Georgia Strait. The specific causal factor is not known and is widely debated, but lack of food, lack of habitat, and increased predation are all likely contributing factors. Changes in the Strait of Georgia, such as increased water temperature, may in part be due to climate change; other changes such as water quality may have a range of causes, including storm water and upland development. Additional changes include more variable primary plankton production, loss of kelp forests in many parts of the Strait, and major shifts in the ecosystem structure.

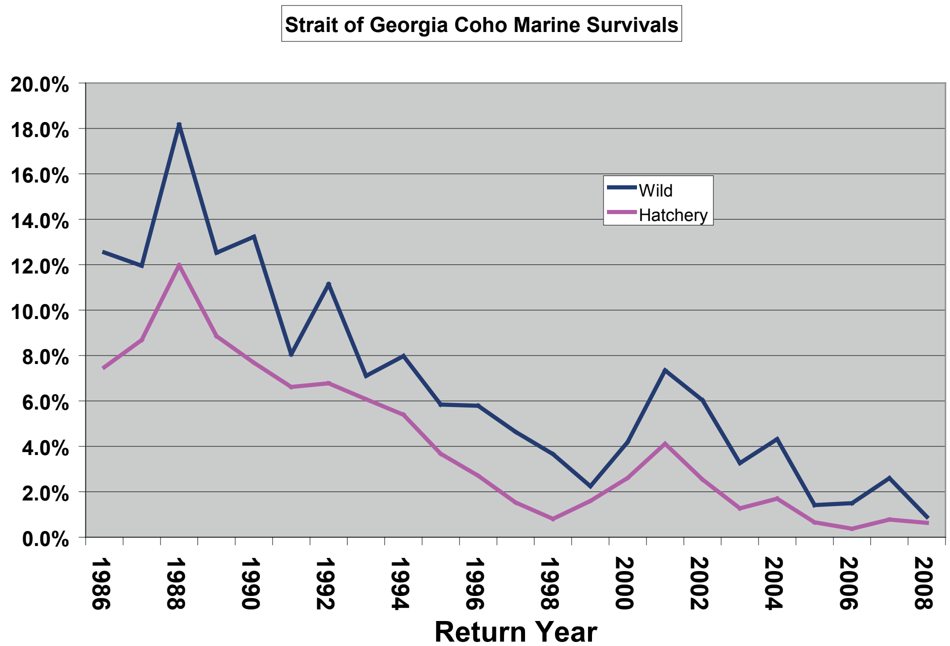
Figure 2.29 below shows a significant decline in marine survival of chinook from smolts released from the hatchery to age two since the early 1990s. Note that using age two precludes most of the fishery impacts, and so is a good indicator of natural impacts. The recent survival rate of Cowichan Hatchery chinook is only 0.3% on average (e.g., three out of 1,000 chinook survive to age two). This level is comparable to other hatcheries in the lower Strait of Georgia. Similarly, marine survival for Strait of Georgia coho has been poor for both hatchery and wild stocks, with the decline starting about 1990 (Figure 2.30).

FIGURE 2.29: Cowichan Hatchery chinook survival rate trend to age 2, based on coded wire tag recoveries



Source: DFO, 2010.

FIGURE 2.30: Marine survival data for Coho in the Strait of Georgia showing declining trend



Source: DFO, 2010.

Summary

Fish – particularly chinook and coho salmon – historically have been foundation species in the Cowichan Region, as these hugely abundant species provided massive inputs of nutrients to both aquatic and terrestrial ecosystems. Their populations have been central for maintaining human populations, and remain a critical component of both the First Nations' cultures and the community's vitality. In addition, fish populations have an important impact on the functioning of the broader ecosystem, providing food and nutrients to ocean, aquatic and terrestrial ecosystems. Because of all these factors, dominant fish species are good indicators of broader ecosystem health since they are affected by a wide range of factors and reflect these factors in data on their survival to reproduction.

In the last five years, the number of returning spawners for two of the Cowichan River's primary salmon runs – fall coho and chinook – have been reduced by approximately 90% from levels documented in the last 80 years, while others, such as chum, remain fairly stable. Often, the diversity of trends, and of factors affecting these fish (see Joint Technical Working Group evaluation in Table 2.11) is used as a reason for inaction, since it is always easy to point the blame at some factor that is out of local control. Yet many land-use factors within the terrestrial and freshwater ecosystems of the CVRD are highlighted in this evaluation as having a high impact on these fish populations.

The long-term implications of the fish population crashes will be realized over the coming generations for both ecosystems and humans. These implications can be expected to cascade through ecosystems and human communities, and result in both obvious and less obvious changes into the future. Significant effort and action is required at all levels and jurisdictions to return these stocks to their former abundance and to reverse the current trends of increasingly poor ecosystem health.

The Joint Technical Working Group (organised by DFO[80]) has provided an initial evaluation of the significance of the issues or limiting factors affecting salmon life history (Table 2.11). The impact level suggests how important this factor is in the decline of the Cowichan fishery. The certainty column defines how certain it is that the impact rating is correct.

80 W. Luedke, DFO, personal communication, 2009.

TABLE 2.11: Qualitative assessment of the importance of different factors affecting the Cowichan fishery. Note that as described above, the specifics likely change by species; however, broad patterns are visible from this table

Issue or limiting factor in salmon life history	Comment	Risk: Impact	Risk: Certainty
HARVEST IMPACTS			
a. Impact by **commercial** marine fisheries	> Primarily associated with chinook, where catch rates have remained high. New rules have recently reduced catch by 50%. > Other species affected very little by commercial catch.	Moderate	High
b. Impact in marine **recreational** fisheries	> Increased incidence of Cowichan chinook in the west coast Vancouver Island fishery, but lots of variation from year to year, so hard to deliver specific actions. > Recreational priority over commercial access to chinook.	High	High
c. Catch in First Nations fisheries	> Food fisheries have constitutional priority and are important to Cowichan Tribes. Part of this issue is that this fishery is at the end of the gauntlet of fisheries.	Moderate	Moderate
d. In-river poaching	> Thought to be minor issue in Cowichan.	Low-Moderate	Low
e. Bycatch in non-salmon fisheries	> Bycatch in ground fish trawl fisheries is generally low but in some years is significant.	Low	Moderate
HATCHERY ISSUES			
f. Lack of long term plan for the hatchery.	> Changes in the ecosystem, the need for succession planning at the hatchery, infrastructure issues, changing role of the hatchery all need to be addressed.	High	High
g. Hatchery infrastructure	> Water is a limiting factor in the Cowichan hatchery. There may be other potential issues which have not been clearly established at this time.	Moderate	Moderate
HABITAT ISSUES IN FRESHWATER			
h. Water quality	> Many factors affect water quality, including sewage, septic fields, sediment load due to natural erosion, increasing water temperatures, etc.	High	High
i. Water flow	> Many factors affect water flow, including high localised water use and lack of metering and monitoring. Expected to be exacerbated by climate change.	High	High
j. Smothering of eggs by sedimentation	> Typically natural erosion that is exacerbated by human impacts, particularly land use /logging /clearing and exacerbated by invasive species (e.g., knotweed).	High	High
k. Scouring substrate/ redds[81] by floods	> Land use (logging and clearing) results in greater flow variation	High	High

81 A salmon redd is a depression created by the upstroke of the female salmon's body and tail, sucking up the river bottom gravel and using the river current to drift it downstream. The female salmon digs a number of redds, depositing a few hundred eggs in each during the one or two days she is spawning.

TABLE 2.11: Qualitative assessment of the importance of different factors affecting the Cowichan fishery. Note that as described above, the specifics likely change by species; however, broad patterns are visible from this table

Issue or limiting factor in salmon life history	Comment	Risk Impact	Risk Certainty
l. Lack of rearing habitat in mainstem[82]	> Loss of habitat is caused by loss of riparian cover, reduced large natural woody debris in streams, land use issues (forest-increased runoff and flood control; agriculture-dyking, development-impervious surface, etc.)	High	High
m. Lack of rearing in lower river and estuary	> Land use reduces habitat availability, quality, and complexity (e.g., loss of large woody debris and eel grass habitat). Also impacted by log booming in the estuary and channelization of natural streams.	High	High
n. Fry stranding in side channels	> Caused by lack of water in the creek at the right time – factors include changes to groundwater hydrology, side channel morphology due to development, operation of weir, etc.	Medium	Medium
o. Stress during spawner migration and spawning	> Stress increased by many factors, particularly low water flow caused by weir operation, water extraction, groundwater hydrology changes and climate change. > High water temperature also increases stress for these "cold water" species. Impervious surface runoff, fishway blockages and human disturbance all contribute.	High	High
p. Lack of spawning gravel	> Natural dynamics of creeks are impacted by "bank stabilization" work, so new gravel does not become available. Fish can't get access to existing gravel due to sedimentation cementing the existing gravel, and the impacts of invasive species such as knotweed.	Medium	Medium
ECOSYSTEM CONSIDERATIONS			
q. Predation on eggs or fry	> Existing fish such as trout or sculpin, birds, and other species.	Medium	Medium
r. Seal predation on smolts	> Unknown extent of this issue. Known to be high in some east coast Vancouver Island rivers. Likely have habituated seals in area.	Unknown	Unknown
s. Poor survival of smolts	> Likely a combination of low food and habitat availability. Begins with rearing success in lower river and estuary, need for complexity in foreshore areas, and changing conditions in Georgia Strait. Land use in lower watershed and effects of climate change may be primary issues. In Georgia Strait there is poor understanding of the causal factors for early marine mortality.	High	High
t. Seal predation on mature adults	> Unknown extent of this issue, but seals observed in Bay and lower river up to fishway. Evidence of predation.	Unknown	Unknown
u. Predation by southern resident orcas.	> Chinook known to be preferred food source and Cowichan chinook historically resided in lower Georgia Strait in August-Sept.	Unknown	Unknown

82 A mainstem is the main channel of the river in a river basin (as opposed to the streams and smaller rivers that feed into it).

Data Gaps

Key data gaps relate to the identification and understanding of issues and factors limiting ecosystem productivity and fish abundance, and their relation to human activities in the region. The identification of key indicators related to ecosystem health and the collection of data for these indicators will be important in linking the ecosystem health to species such as salmon. Some potential indicators to be explored were discussed above, and include such things as habitat area and quality, habitat utilization, water quality, productivity (such as benthic invertebrate densities), egg to fry survival rates, fry density and distribution, and predator interactions (e.g., birds and fish).

References

Burns, T. 2002. A Salmonid Production Plan for the Cowichan Valley Regional District. For Cowichan Fish and Habitat Renewal.

Burt, D.W. and C.B. Robert. 2002. A Review of Environmental Factors Affecting the Production of Cowichan River Chinook Salmon. Prepared for Fisheries and Oceans Canada.

Department of Fisheries and Oceans. 2010. Watershed Impacts Analysis—in Development. W. Luedke. Personal Communication.

ESSA Technologies. 2007. Helping Pacific Salmon Survive the Impact of Climate Change on Freshwater Habitats: Case Studies. Pacific Fisheries Resource Conservation Council.

Lill, A.F. 2002. Greater Georgia Basin Steelhead Recovery Action Plan. Prepared for the Pacific Salmon Foundation, Vancouver, BC.

LGL Limited. Undated. Cowichan Recovery Plan. Prepared for Cowichan Tribes. Draft.

Neave, F. 1941. Cowichan River Investigation. Pacific Biological Station, Nanaimo, BC. 18 p.

Steelhead Recovery: **www.bccf.com/steelhead/focus8.htm#juv-cow**

2.6 Water

All life depends on an adequate supply of clean water. Water provides one of the most obvious links between ecosystem services and human and societal health. Aquatic and terrestrial ecosystems are both intimately linked to the availability of unpolluted water, with specific requirements dependent on the particular ecosystem or species. Water moves between different systems in complex and often unpredictable ways. Changes in water abundance or quality can therefore have unexpected consequences elsewhere.

Introduction

Water in its natural state is highly variable, with differences in the levels of natural nutrients, algae levels, natural turbidity (from landslides or natural breakdown of the earth's surface), water hardness, trace elements from surrounding bedrock, and dissolved oxygen levels to name just a few factors. Temperature and flow rates interact with these natural factors and affect basic water quality both seasonally and annually. Both the availability (quantity and timing) and the quality (e.g., levels of nutrients, algae, temperature) of water are key to maintaining many natural processes. Species and their ecosystems are adapted to complex natural patterns of water flow. However, since natural complexity defines water resources, it also makes it inherently difficult to monitor and understand.

In natural systems, water falls as rain or snow into watersheds. Water storage occurs as snow, in lakes, rivers and streams (surface water), in the ecosystems themselves (forests/wetlands) and in aquifers (underground water bodies). The rate and timing of melt and run-off, as well as a variety of other factors, affect how and when these reservoirs of water are maintained. Although we tend to manage individual components of this water cycle separately, they are intimately linked with each other and affect how much and when water is available for ecological systems and for human uses.

All aquatic and riparian life requires certain water levels. Some systems, such as floodplain systems, are maintained by flooding. Many species require the permanent or ephemeral habitats created by the movement of water at certain times of year. Aquatic invertebrates, which are the foundation of many food webs, require sufficient water at certain time periods to maintain their populations. Most of these values are not monitored at all. This section focuses on water as an integral part of the region's natural ecosystems, and looks at the vulnerability of particular systems in relation to the production of specific services such as fish spawning habitat.

Threats/Pressures

Many activities can affect the water cycle in subtle (or not so subtle) ways. Climate itself is a key driver, affecting how much rain falls, when, where, and at what speed snow melts, how much evaporates back into the atmosphere, and how much ends up stored in the natural reservoirs of ground and surface water systems. Changes in climate will affect this basic system.

Land management is also key. Functional forest systems store water in the biomass of vegetation, soil, trees and moss layers, and regulate the rate of flow. When mature forests are cleared, patterns and rates of flow change. Less water is intercepted by forest canopies, and less water is used in biologic processes by plants, leading to an increase in water received at the ground surface and often an increase in run-off, erosion, and sediment delivery to surface water bodies. In addition, water can be re-routed by roads associated with forest harvest or other clearing activities. Vegetation regrowth affects how long these new patterns last. Where natural ecosystems are converted to residential or urban uses, patterns of water flow can be altered more drastically and permanently.

Water quality is often also changed as land-use patterns change. Natural ecosystems, which typically function to clean water, can be changed to systems where non-natural levels of sediment or pollutants are added. Overlaid on the basic patterns of water flow, water use by humans also impacts the system. The withdrawal of water for household use, agriculture or industry from any of the natural storage systems affects water availability for natural processes. Key sources of pollutants include inefficient sewage systems (both single-house systems and treatment plants), discharge from industrial sources, pesticides or fertilizers from agricultural and forestry activities, domestic gardens, and stormwater discharge. Section 3.3 looks at the consumption of drinking water in the region.

The Cowichan Valley Regional District (CVRD) has three major watersheds on the drier east coast – the Cowichan, the Koksilah and the Chemainus. On the west coast, part of the Nitinat, and the Carmanah/Walbran watersheds are included in the CVRD. The Cowichan Region includes some of the wettest ecosystems in BC on the west coast – which remain primarily functionally intact and forested – and some of the driest systems in coastal BC on the east coast, which have seen considerable changes in natural patterns of storage, flow and water requirements. The east coast therefore has the least water, but also the highest demand and highest potential for changes to natural hydrology due to land use changes. As a result, this section focuses on the east coast systems of the CVRD.

Measuring Water

Global forces drive water patterns: drivers such as the Pacific Decadal Oscillation[83] or El Niño result in cycles of dry or wet periods and changes in temperature, which in turn cause changes in the natural flow of water. As a result, very long term datasets are often needed to understand the state and trends of water supplies. Even without this high level of natural variability, indicators that reflect the real health of water for ecological systems are hard to find and are even harder to collect data for. As a result, data collection and indicators tend to focus on water values primarily in relation to human health. Ideal indicators for measuring the health of water sources for ecosystems might include:

> Degree of divergence from natural flow regimes

> Water integrity index for key watersheds/systems

> Degree of divergence from natural water quality

> Benthic community health for watersheds

However, data for these indicators are largely unavailable, at least for the whole region. Instead this report examines the following indicators:

> Groundwater aquifers – quantity and quality of water

> Surface water – quantity and quality

Groundwater Aquifers

Indicator and Measures

Groundwater aquifers are effectively lakes that exist largely underground, trapped within layers of rock or substrate that hold water to some extent. They are maintained by rainfall and inflow from lakes and streams above ground, combined with natural and human-caused outflow. Aquifers differ in the extent to which they naturally hold water. The vulnerability of an aquifer to contamination from surface sources depends on the thickness and extent of the geologic materials overlying the aquifer, depth to water or depth to the top of any confined aquifers, and the type and permeability of aquifer material (e.g., sand and gravel, fractured bedrock). Aquifers are categorized as high (A), moderate (B), or low (C) with respect to vulnerability.

83 A long-lived, El Niño-like pattern of Pacific climate variability.

In addition, aquifers are also affected by their level of development. This level is determined through an assessment of demand on the aquifer relative to the productivity of the aquifer. Aquifers are categorized as high (I), moderate (II), or low (III) with respect to level of development. Combining Vulnerability and Development yields nine classes of aquifers, from IA (heavily developed with a high vulnerability to contamination) to IIIC (low development and low vulnerability).[84]

Findings

Groundwater is used by various groups and individuals in the CVRD for a variety of purposes. These include:

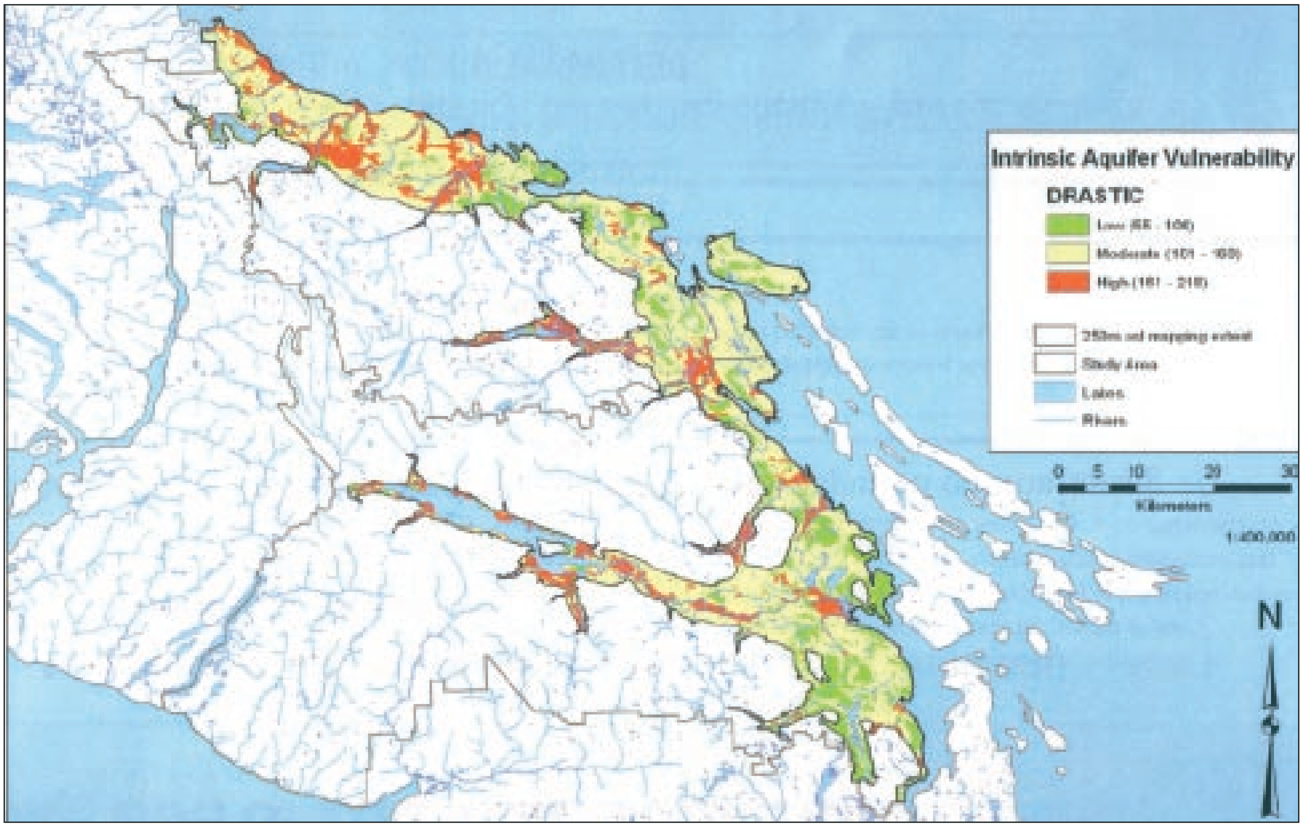
1. The provision of potable (drinkable) water by local governments (e.g., District of North Cowichan, City of Duncan, CVRD) to homes and businesses in the region
2. The provision of potable water by private individuals (e.g., bulk water sales), companies (e.g., Catalyst Mill provides Crofton's water), organizations (e.g., Braithwaite Estates Improvement District), or utilities (e.g., Arbutus Ridge)
3. Agriculture (especially for irrigation)
4. Industry
5. Golf courses
6. Private water withdrawal from wells for homes and other uses
7. Other specific uses – such as fish hatcheries

While some users monitor the total volume of groundwater they extract from the aquifers, many do not. There are 45 classified aquifers in the CVRD, including the Municipality of North Cowichan, City of Duncan, Town of Ladysmith and Thetis Island. Some of these aquifers are entirely within the boundaries of the CVRD, while others are partly in the region and partly in neighbouring regional districts (Regional District of Nanaimo to the north and Capital Regional District to the south). About half of these aquifers (23) can be characterized as sand and gravel (confined or unconfined) aquifers and the other half (22) are bedrock aquifers. The aquifers range in size from 0.6 km^2 to 76 km^2. Several of these aquifers have been studied in greater detail in the past few years. These include the Cherry Point aquifer, the Chemainus-Crofton aquifer, Thetis Island aquifers and the Cowichan River aquifer A.

The intrinsic vulnerability of these aquifers is shown in Figure 2.31.

84 Berardinucci and Ronneseth, 2002.

FIGURE 2.31: Intrinsic vulnerability of the aquifers in the CVRD



Source: Jessica Liggett, Natural Resources Canada, PowerPoint presentation, 2009.

Of these 45 aquifers, 17 are classified as inherently highly vulnerable. Four of these (Crofton- Chemainus, Duncan and two on Thetis Island) are also highly developed. In addition, six of the highly vulnerable aquifers are currently moderately developed: Upper Cassidy, Ladysmith, Honeymoon Bay, Lake Cowichan, Shawnigan Lake/Cobble Hill and Mill Bay (Table 2.12).

TABLE 2.12: Development and vulnerability rankings for the 45 aquifers relevant to the CVRD

Development	Vulnerability	Code	Number of aquifers
High	High	I A	4
High	Moderate	I B	1
High	Low	I C	1
Moderate	High	II A	6
Moderate	Moderate	II B	7
Moderate	Low	II C	8
Low	High	III A	7
Low	Moderate	III B	2
Low	Low	III C	9
Grand Total			45

Source: Pat Lapcevic, Ministry of Environment, 2010.

Examples of highly vulnerable bedrock groundwater systems include Shawnigan Lake aquifer and the Malahat aquifer. Bedrock fracture aquifers are particularly vulnerable to surface contamination because of the rapid flow of groundwater, and they require the preservation of soil cover and vegetation to maintain their water storage capacity. In addition, wells close to marine shorelines are susceptible to saltwater intrusions; this form of vulnerability is relatively unpredictable.

85 Warnock et al., 2010.

Thetis Island Aquifer

There are four aquifers and 295 wells recorded on Thetis Island. A survey of the ambient groundwater quality of Thetis Island aquifers was undertaken in 2008 by obtaining groundwater samples from 48 private wells on the Island and analyzing the water for a comprehensive suite of chemical and biological constituents.[85] Overall, the study found that the quality of the groundwater met the standards established by the Guidelines for Canadian Drinking Water Quality (GCDWQ) in over 90% of the health-based parameters. Fluoride was the only parameter detected above the guidelines in four samples. In one sample, arsenic was measured at 9.3 µg/L (standard is < 10 µg/L).

Lower Cowichan River Aquifer A

This aquifer is an unconfined, shallow but very productive aquifer which is generally overlain by the City of Duncan, Cowichan Tribes IR 1, portions of CVRD areas E and D, and North Cowichan. Between 2002 and 2007, the Ministry of Environment carried out a study of the ambient quality of the groundwater in this aquifer.[86] Overall, the groundwater quality met the water quality guidelines for most parameters and sampling dates. At one site, iron and manganese were measured on one occasion (December 17, 2002) at levels above the GCDWQ, but at much lower concentrations on subsequent sampling dates. Nitrate in the groundwater at one site increased from 0.94 mg/L to 2.1 mg/L over the course of the study. This increase is not statistically significant, but may be a reflection of chronic pollution in this system. The source of this additional nutrient and the ecological significance is unknown.

In addition, the Ministry of Environment maintains 10 observation wells in the CVRD and uses these to continuously monitor groundwater conditions. These wells monitor groundwater levels in seven different aquifers (six sand and gravel, and one bedrock). [87] Two examples of these 10 observation wells are highlighted below:

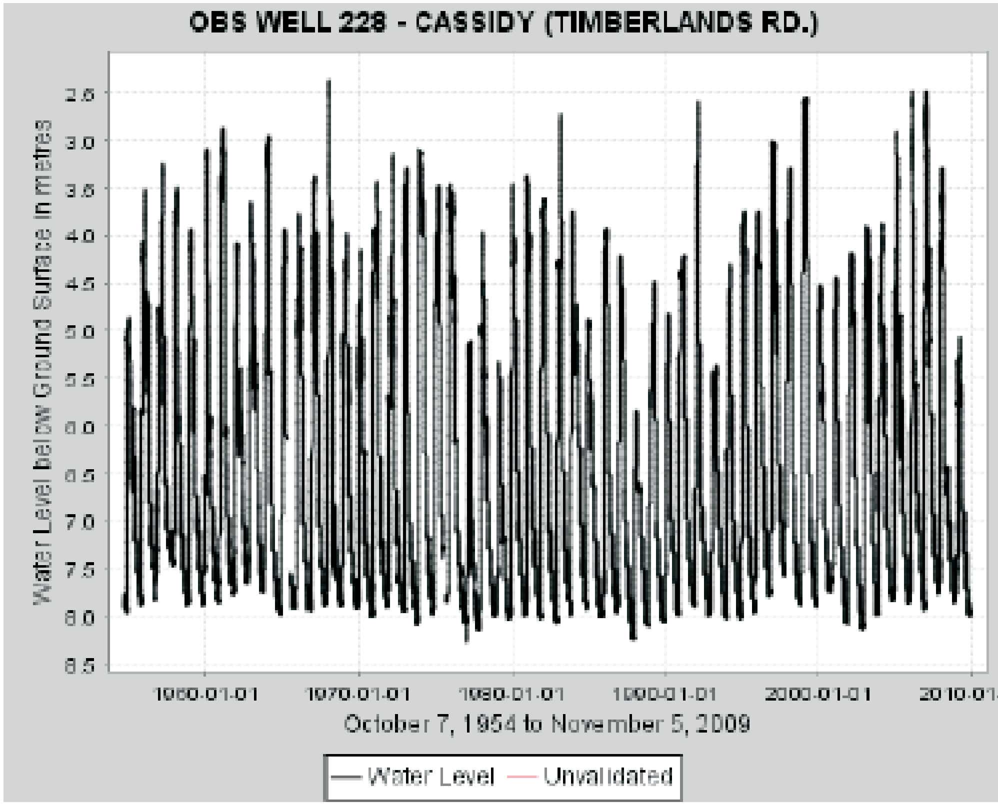
Cassidy (Well 228)

This well has been monitored for about 55 years, which represents the longest record in this area. Figure 2.32 shows the annual variation in water level, ranging from 2.5–5.5 m (most years the range is between 4 and 5 m). The annual minimum levels are consistently about 8 m below ground surface while the highs range from 2.5 m below ground surface to about 5.75 m below ground surface. This aquifer is not showing any signs of stress or unsustainable pumping, with the variations likely due to precipitation inputs in the “wet season” and discharge to the Haslam Creek in the summer.

86 Henderson and Lapcevic, 2010.

87 The data is publicly available at a100.gov.bc.ca/pub/gwl/disclaimerInit.do

FIGURE 2.32: Hydrograph (water levels) for the Cassidy Observation Well

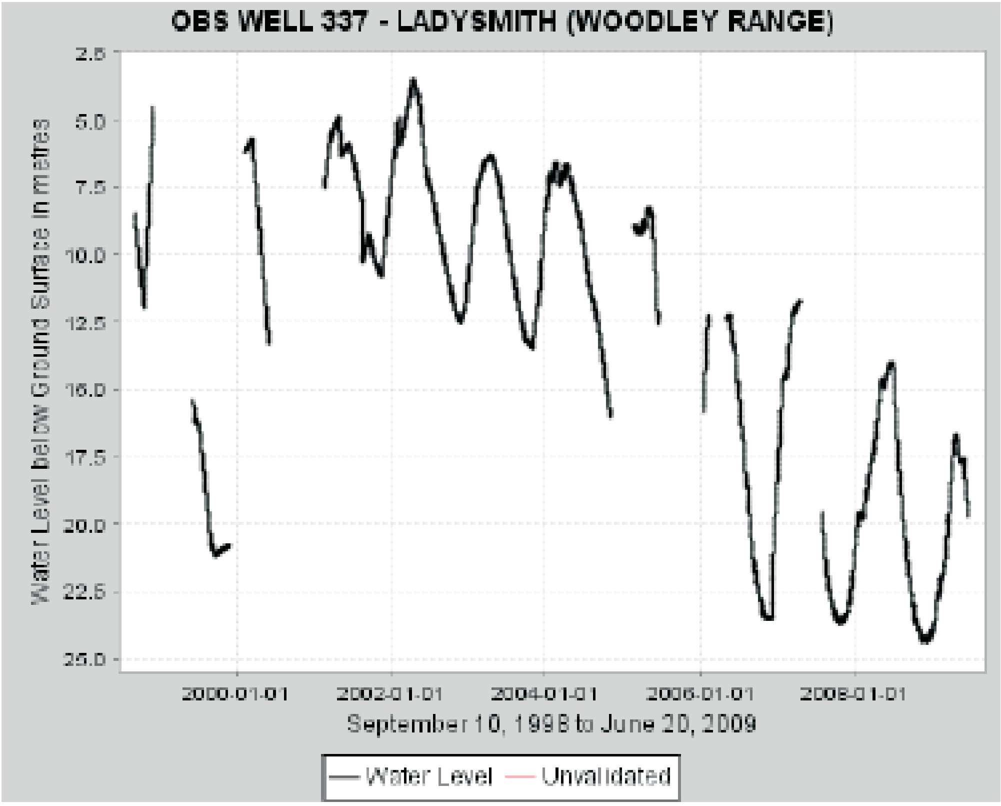


Source: Ministry of Environment, 2010.

Ladysmith (Well 337)

Figure 2.33 shows the water levels over a 10-year period for this well, with annual variability in water levels clearly visible. However, there is also a trend in reduced water levels for both maximum and minimum levels through time, with water levels in 2009 the lowest seen over this 10-year period. It is difficult to pinpoint whether these trends are a result of increased demand over time, or whether they reflect the low precipitation levels over the last period of years, or some combination of the two factors. Drying trends from climate change may influence this hydrologic system into the future. A continuation of this declining trend will result in continued impacts to the availability of water from this aquifer.

FIGURE 2.33: Hydrograph for the Ladysmith Observation Well



Source: Ministry of Environment, 2010.

It bears repeating that over 30% (17 out of 45) aquifers in this region are inherently vulnerable. Of these, 10 are highly or moderately developed today. Water quality in the areas sufficiently studied to comment on is generally good, although a few instances of contamination above drinking water standards are noted.

None of the studies comment on how aquifers interplay with other water resources, so effects on biological components of the system are unknown.

Surface Water Quantity

Indicators and Measures

> Water quantity indicators in this section focus on:

> Water quantity in the Cowichan River

> Water quantity in Shawnigan Creek

Findings

In general, many of the ecosystems within the CVRD maintain largely healthy functional aquatic ecosystems, with sufficient water levels. However, on some of the major river systems, the combined effects of human barriers (such as weirs or small dams) affecting patterns of flow throughout the year, water withdrawals for residential and industrial use, and natural or climate change-driven trends in water availability are raising concern.

Cowichan River / Watershed

The Cowichan River is critically important for fisheries values, and so a great deal of effort has been expended to gather extensive information on its water levels and whether they are sufficient to maintain fish populations. The Cowichan system is a rain-dominated system, so low-flow levels in the river naturally vary with levels of precipitation (in contrast to snow-dominated systems, which are buffered more by levels of snowpack).

In 2004, 667 water licenses were issued in the Cowichan and Koksilah watersheds[88], with pulp mills licensed for 83% of the total volume withdrawn. Demand for water from these licenses peaks during the months of lowest flow (typically the late summer/fall) in the system, which coincides with the critical flow periods required to maintain fisheries values and recreation opportunities. In a number of recent years, conflict between maintaining water supplies for industrial use and maintaining minimum levels to allow for the rearing and migration of salmon has become critical.[89] In addition, many fish are stranded annually in side channels in the lower reaches of the system, as these side channels dry up (see also Section 2.5). The cascading effects on other freshwater aquatic values are unquantified but are likely to be significant, particularly in these critical periods.

South Cowichan / Shawnigan Watershed

In the South Cowichan/Shawnigan area, there is significant water demand for agricultural uses – around 15 million cubic metres (m^3) annually, compared with 7 million m^3 for residential use, and 3 million m^3 for other urban uses. The relative proportion of ground versus surface water use is unknown here, since groundwater use is largely unmonitored. In general, there currently appears to be sufficient water to maintain these use rates. However, as with the Cowichan River, summer low-flow levels in Shawnigan Creek are sufficiently low that they are considered detrimental to aquatic system health[90] because, in some years, insufficient water can be stored to maintain both the highest use time and maintain downstream values. This negative effect on ecological systems is expected to increase as human demand increases through time.

88 LGL, 2005.

89 W. Luedke, Department of Fisheries and Oceans, personal communication, 2010.

90 WorleyParsons, 2009.

In addition to actual water flow, historic and ongoing changes to riparian ecosystems alter the natural ability of the land to moderate or buffer the flow of water from upland areas into streams, rivers and groundwater storage aquifers. In addition, the hydrology of the land has been altered significantly by tree harvesting and road building to date, and by the third-pass harvesting that is starting in many areas and which will again alter the interception of rainfall, affecting water flow rates, and factors such as sedimentation that can have significant impacts on aquatic ecosystems.

Climate change is predicted to alter historic patterns of precipitation, with a good probability that at least summers will be drier than historically (some climate models also suggest that winter precipitation patterns are expected to increase). As this combines with an ever-growing demand by the human population, the pressures on natural aquatic systems will increase, resulting in increased potential conflict between maintaining aquatic functioning and human water requirements.

Surface Water Quality

Indicators and Measures

As with all things watery, measuring water quality is also complex. Pure H_20 is rarely – if ever – found in nature. The concept of "quality" (defined by the amount of additional nutrients, metals, and/or sediments) varies both naturally and as a result of pollution by humans. Some natural water can kill those who drink it. However, in nature, species have adapted themselves to this natural variability and some have even evolved to live in water that is toxic to most other living things.

With respect to ecological values, measuring water quality is best reflected by directly measuring the levels and toxicity of pollution – this can include industrial waste, fecal matter, and even apparently harmless "sediment" that can result in decreased habitat quality in the water column for many species. However, measuring pollutants themselves is an almost impossible task, and typically more indirect indicators are used for water quality.

Measuring the health of the aquatic invertebrates that live in water is an effective example of an indirect indicator of water quality. These tiny animals – aquatic worms, the larvae of many aquatic insects, and many molluscs – live on aquatic plants and debris, in sediment, and in rock cavities at some point in their lifecycle. They are an essential part of the food chain (providing food for fish), and they feed directly on algae at the bottom end of the food chain. They can therefore be influenced by changes above and below them in the food chain. They are a good indicator of water quality because they are relatively sedentary and cannot move away from sources of pollution or sediment, and are relatively long-lived – allowing the effects of contamination to be observed over time. Ideally, monitoring the benthic invertebrates provides a robust understanding of water quality; typically, however, these data are often not readily available.

Where data exist, Aquatic Life Criteria can be used to set standards for a wide range of ecological parameters intended to maintain aquatic functioning. In addition, there are many indicators for which standard water quality guidelines or river/lake system-specific guidelines are mandated.[91]

More typically, water quality is measured in relation to human drinking water needs. The Ministry of Environment uses water quality guidelines that apply to all bodies of water, unless site-specific parameters have been set. In some cases, standards for drinking water – such as fecal coliform levels – may also reflect ecological concerns. For example, the additional nutrients present even in low levels of sewage waste can over-stimulate algal growth, which has the effect of reducing the levels of dissolved oxygen in water. This affects the natural benthic community present in the ecosystem, and can result in impacts on or death of aquatic life due to lack of oxygen. Typically, this is noticed when it gets to the "fish kill" stage. Using drinking water standards to understand the ecological significance of pollution is therefore a weak indicator.

In this section, a variety of indicators are presented by watershed or components of a watershed. These indicators provide water quality results from both Aquatic Life Criteria standards and drinking water standards.

Findings

Cowichan and Koksilah Watersheds

Cowichan Lake is a naturally resilient water storage system. Its depth and relatively large size result in a fairly stable system able to regulate water temperature and assimilate localized nutrient inputs from local septic systems and new development. Using short-term trends for available standard indicators, water quality in the lake remains generally good.[92]

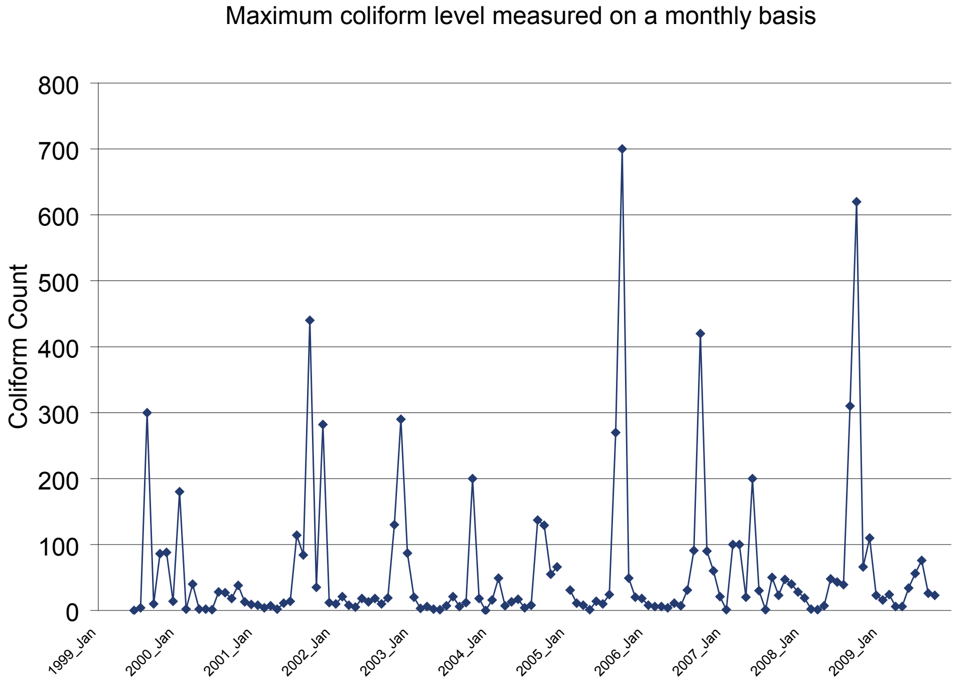
The Cowichan River water quality is also generally considered good. Many indicators are measured, and only a few of these do not meet thresholds, at some limited time periods. The dissolved oxygen objective was not regularly attained in the lower reaches of both the Cowichan and Koksilah Rivers, and chlorophyll-a (a measure of algal growth) has exceeded its objective in the lower portion of the Cowichan River. One consistent water quality issue is that both the Cowichan and Koksilah Rivers exceed fecal coliform bacteria levels frequently, making the river water undrinkable (Figure 2.34).[93]

91 www.env.gov.bc.ca/wat/wq/BCguidelines/approv_wq_guide/approved.html

92 www.bclss.org/library/cat_view/60-bclsmp-lake-reports/82-level-1.html and Deb Epps, Ministry of Environment.

93 Rideout et al., 2000.

FIGURE 2.34: Maximum coliform levels measured by month for the Cowichan River, over 10 years



Note: Shows the variability in the data, with averages being very low (typically lower than the standard), with fairly frequent spikes.

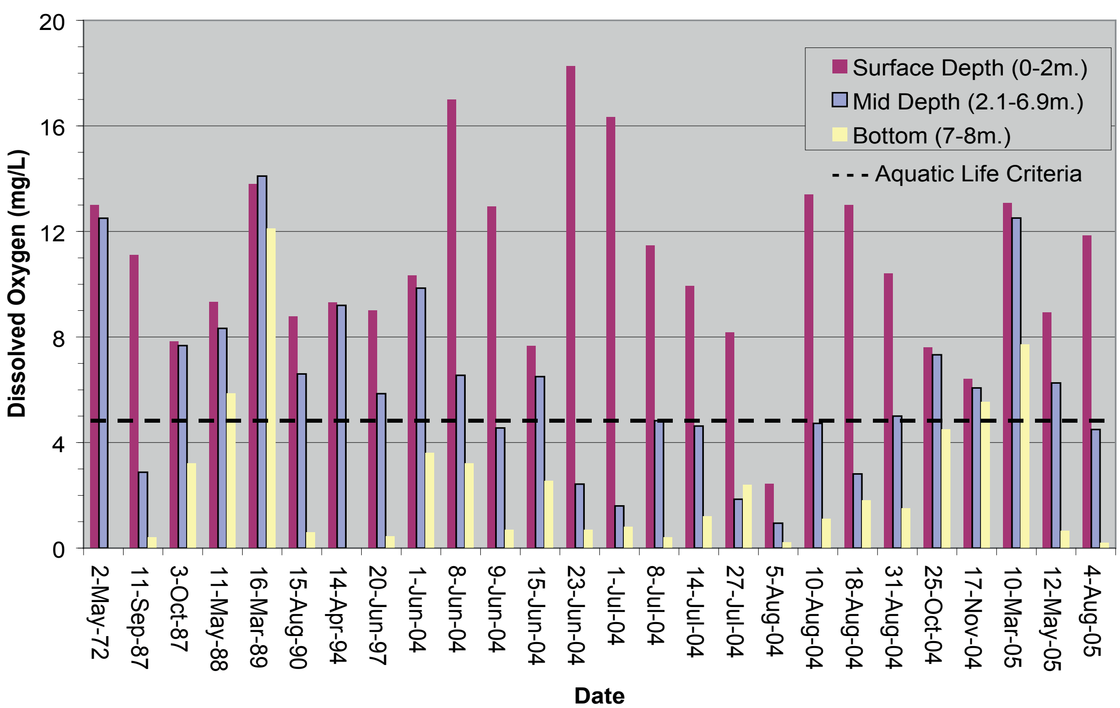
Source: Analysis of data from Water Survey of Canada hydrometric station BC08HA0018 on the Cowichan River.

Although both the Cowichan and Koksilah Rivers frequently exceeded human drinking water standards for fecal coliform bacteria, neither of the two sewage discharges appear to be significant contributors to this pollution. Instead, other "non-point" sources appear to be largely responsible, including inputs from leaky septic systems and stormwater run-off. These water quality issues appear to have downstream impacts in the high-value Cowichan estuary/bay area (see Cowichan Estuary discussion in Section 2.2). In addition, the impacts of higher nutrient loads in the Koksilah River are exacerbated by the lack of significant lakes flowing into it and the slow-moving warm water in this system. It is largely unknown what long-term impacts this will have on aquatic life. The levels of metals and other toxic substances such as oil, grease and hydrocarbons in the Cowichan and Koksilah Rivers are generally low, though on occasion there were comparatively high concentrations of these contaminants measured in a number of stormwater conduits in urban and industrial areas of the watersheds.

Quamichan Lake

Quamichan Lake is located in a sub-basin of the Cowichan watershed, and is a large but relatively shallow lake system. Its natural properties tend to result in high nutrient levels within the lake system, with external sources also affecting nutrient levels. An analysis of water quality in relation to both drinking water standards and aquatic life standards has been assessed for this lake.[94] As with the Cowichan and Koksilah watersheds, certain Aquatic Life Criteria[95] were not met for various measures in some years in Quamichan Lake: dissolved oxygen levels (see Figure 2.35), temperature for trout rearing, phosphorus levels, total copper levels and total iron levels. These measures can have significant impacts on the functioning of the aquatic system – for example, dissolved oxygen levels affect the fish population, with "fish kills" periodically occurring at Quamichan Lake. Such events can occur naturally in shallow, nutrient-rich lakes such as Quamichan, as algal blooms reduce oxygen levels to below that needed for other biodiversity, and can be exacerbated by external factors such as temperature, and by the input of additional nutrients from sources such as septic fields.

FIGURE 2.35: Dissolved oxygen averaged with depth at the Quamichan Lake deep station site (1972 – 2005)



Note: The Aquatic Life Criteria are shown as a dotted line.

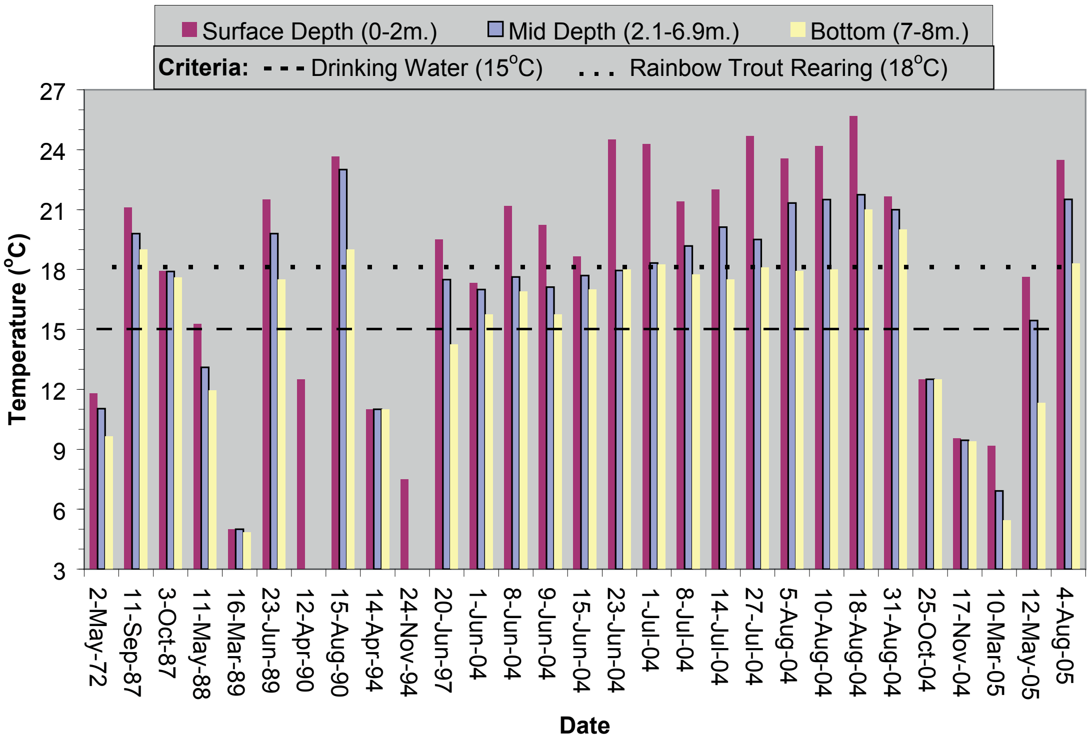
Source: McPherson and Epps, 2006.

94 Deb Epps, Ministry of Environment, personal communication, 2010.

95 McPherson and Epps, 2006.

Regarding drinking water criteria, water quality in Quamichan Lake has been identified as poor – with some of the poorest readings to date being recorded in recent years (2004 and 2005). The lake did not meet standards in some years for samples associated with temperature (see Figure 2.36), and for other values such as acidity levels, turbidity levels, organic carbon levels, phosphorus levels and fecal coliform levels.

FIGURE 2.36: Temperature data for Quamichan Lake – 1972 to 2005



Note: Two different comparison standards are shown – drinking water criteria, and Aquatic Life Criteria (rainbow trout rearing).

Source: McPherson and Epps, 2006.

Overall, productivity in Quamichan Lake appears to be increasing over the last decade, compared to the 1990s. The natural shallowness of the lake, combined with an increasing nutrient supply (both natural and from pollution) and warm weather conditions, are all working together to result in negative consequences for both ecological and human systems. Long-term data is unavailable, so a comparison of natural patterns of productivity over time is not possible. However, a trend to warmer temperatures outside the natural range has been identified, and this trend exacerbates the effects of increased nutrient levels, often with dire consequences for aquatic ecology.

Shawnigan Lake

The Shawnigan watershed is primarily forested, with approximately 10% in the Agricultural Land Reserve. The majority of the lakeshore is developed with some form of housing. Much of the forest in the watershed was harvested in the early 1900s, and additional harvesting – sometimes a third rotation – is ongoing today. The number of people living in this area has increased over the last 30 years.

Historically, conditions within the lake are thought to have changed with land use. For example, it is thought that a significant change in algae patterns occurred in the lake around the 1930s, likely as a result of the drastic logging and intensive settlement occurring at that time. It is also hypothesized that a lack of oxygen in the lake observed in the 1970s may have resulted from the decomposition of excessive wood waste that was dumped into the lake from early harvesting practices.[96]

In relation to drinking water quality, in 1984, higher levels of fecal contamination were found in samples from the near shore than in deep water sites, with inflow areas showing the highest levels of contamination.[97] In the more recent analysis of 2004[98], most lake sampling sites met drinking water guidelines (with disinfection only) during summer low flow, but all lake sites exceeded drinking water guidelines for E. Coli and fecal coliforms sampled in the fall and on all inflows sampled during the summer low-flow period. Various factors may contribute to this, including adjacent livestock and waterfowl, inefficient septic systems and storm-water runoff. However, the primary factors are thought to be failing local septic systems combined with heavy rain events.

In addition, the west arm of Shawnigan Lake is identified as being of particular concern because of its isolation from the main body of the lake and its relatively shallow nature, making it more susceptible to increasing nutrient inputs. However, in the "big picture," Ministry of Environment water monitoring shows water quality in Shawnigan Lake to be reasonably high most of the time.

Shawnigan Lake has also been the site of detailed water quality monitoring through the University of Victoria[99], and its composition has been compared to the adjacent Sooke Lake. The analysis of sediment cores provides a timeline of 100 years for many indicators of water quality. These two lakes are adjacent to one another, and have similar natural features. However, Shawnigan Lake has seen systematic development over the last 40 years compared with the relatively protected state of Sooke Lake. Much like the Ministry of Environment data, the broad findings of the University of Victoria studies generally suggest that water quality remains overall relatively good in both lakes. However, these studies also point to a trend of increasing concentrations of many chemicals, such as pharmaceuticals and caffeine in Shawnigan Lake, as well as human feces traces in

96 Nordin and McKean, 1984.

97 Nordin and McKean, 1984.

98 Rieberger et al, 2004

99 Azit Mazumder, University of Victoria, personal communication, 2010.

the depths of the lake. Many of these chemicals are not tracked by standard sampling regimes (e.g., those employed by the Ministry of Environment), and their detection suggests that there is an ongoing negative trend towards poor water quality in Shawnigan Lake that began in the mid-1970s as development started, and that this quality is getting increasingly poorer through time.

Summary

Water is essential to all life. Yet measuring, monitoring and understanding patterns and trends for water is complex and difficult. Based on relatively localized and short-term information, there is a general sense that there is lots of water within the CVRD most of the time, and that it is of reasonably good quality most of the time. However, some of the key groundwater aquifers in the Cowichan Region are naturally vulnerable, and an increasingly large number of them are becoming heavily developed. In addition, at critical periods and particularly in dry years, the conflict for water can become acute – leading to the potential for significant conflicts between values, and resulting in the need to choose between impacting crucial aquatic resources such as fish spawning, or industrial processes such as the mill. The level of pollutants, as measured using standard monitoring, typically is low; however, major rivers are no longer considered fit to drink due to fecal coliform counts, and cumulative downstream impacts have led to the closure of shellfish fisheries since the 1970s.

Naturally vulnerable lakes – such as Quamichan, which is large but shallow – already show significant impacts by pollution from a variety of sources. Other systems – such as Cowichan – are buffered by their large size and depth. However, cumulative effects are difficult to detect and often not observable until significant events such as "fish kills" are observed.

All these trends are cause for concern, and are highlighted when detailed long-term sampling is undertaken. The case study of Shawnigan Lake, which has seen significant development since the 1970s, illustrates the impacts of cumulative low-grade pollution over time. The collective understanding of how such changes affect the basis of ecological food chains can be defined as weak at best.

Climate change is expected to exacerbate these impacts. Drying trends, especially during current low-flow periods, and increasing air and therefore water temperatures, will result in a myriad of future impacts.

Missing Information

As outlined in each section, although much data are collected, there remains a lack of comprehensive understanding of the ecological health of the aquatic systems of the Cowichan Region.

Directly measuring how much water is used by humans would help us to understand the state of aquifers today, and to identify potential critical thresholds into the future.

The long-term monitoring of aquifers, aimed at explaining limiting factors (e.g., how precipitation will affect future water sources), is also needed.

Many small and large systems within the CVRD lack data. For example, summarised data for the Nitinat River in the west part of the region and the Chemainus watershed in the east are unavailable at this time. In addition, many smaller lakes and rivers in the region have not seen any data collection focus, yet some impacts on water availability and quality are suspected. This raises a number of questions, such as: What are the long-term trends for smaller streams such as Holland Creek that supply significant drinking water for Ladysmith? What are the implications of North Cowichan pumping water into the Fuller Lake to "flush" high nutrient levels?[100] Where do these nutrients go, and how will this continue if water supplies decrease with climate change?

100 John Deniseger, Section Head, Environment Quality Section, Ministry of Environment, personal communication, 2009.

References

BC Ministry of Environment. 2007. Environmental Trends in British Columbia: 2007. State of Environment Reporting. Victoria, BC. **www.env.gov.bc.ca/soe/et07/**

BC Lake Stewardship Society. 2008. The Importance of Cowichan Lake and its Watershed. **www.bclss.org/library/cat_view/60-bclsmp-lake-reports/82-level-1.html**

Berardinucci, J. and K. Ronneseth. 2002. Guide to Using the BC Aquifer Classification Maps for the Protection and Management of Groundwater. **www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/aquifers/reports/aquifer_maps.pdf**

EBA Engineering Consultants. 2006. Cobble Hill Area Well Protection Plan, Report Completed for Braithwaite Estates Improvement District Board, Millar's Water Supply Society and Cobble Hill Improvement District, GW Solutions Inc. and Vancouver Island University. 2009. RDN Electoral Area A Groundwater Assessment and Vulnerability Study. Report completed for Regional District of Nanaimo Development Services.

Henderson, G. And P. Lapcevic. , 2010. A Study of the Groundwater Quality of the "Lower Cowichan River A" Aquifer. In Progress.

LGL Limited. 2005. Cowichan Recovery Plan. Prepared for the Cowichan Treaty Office.

Nordin, R.N. and C.P. McKean. 1984. Shawnigan Lake Water Quality Study. Ministry of Environment.

Rideout, P. et al. 2000. A Water Quality Assessment of the Cowichan and Koksilah Rivers and Cowichan Bay. Prepared for Ministry of Environment. To view this report online, search for "GBEI_waterquality_E.pdf"

Rieberger, K., D. Epps and J. Wilson. 2004. Shawnigan Lake Water Quality Assessment 1976—2004. Ministry of Environment. **www.env.gov.bc.ca/wat/wq/studies/shawnigan2004.pdf**

Rieberger, K. 2007. Water Quality Assessment and Objectives for Shawnigan Lake: Overview Report. Ministry of Environment. **www.llbc.leg.bc.ca/public/pubdocs/bcdocs/444759/shawn_lk_overview.pdf**

Thurber Engineering Ltd., SRK Consulting Inc. and Eakin Hydrological Consultants. 2006. Chemainus River Aquifer Well Field 2005 Monitoring and Test Pumping Program Assessment Final Report. Report Completed for the Corporation of the District of North Cowichan.

Thurber Engineering. 2007. City of Nanaimo Engineering & Public Works Department Cassidy Aquifer Water Balance Study Completion Report. Report Completed for City of Nanaimo.

Warnock, K., G. Henderson, and P. Lapcevic. 2010. Gulf Islands Geochemistry Project: Thetis Island. Ministry of Environment Study. In Progress.

WorleyParsons. 2009. South Cowichan Water Management Plan. A Preliminary Assessment of Water Supply and Needs Within the South Cowichan Region. **www.cvrd.bc.ca/documents/Engineering%20Services/Utilities/Water/SCow%20WaterPlan%20FINAL-Feb09OCOMPRESSED.PDF**

2.7 Air Quality

Introduction

Air Quality in the Cowichan Valley Regional District

Air quality is directly related to human and ecosystem health. The effects of air pollution on human health include compromised breathing, the aggravation of existing respiratory and cardiac conditions, reduced lung function, and premature death. Poor air quality harms ecosystem diversity when the deposition of pollutants inhibits the functioning of plants, animals and aquatic life.

Some of the main sources of air pollution in the Cowichan Region include: light and heavy-duty vehicle emissions, open burning of woody debris from forest harvesting operations and land clearing, woodstove and backyard burning emissions, agricultural operations, and commercial/industrial emissions.[101]

Local air quality is also compromised by what goes on outside the boundaries of the region; Cowichan's airshed is part of the much larger Georgia Basin-Puget Sound airshed (Figure 2.37). Weather patterns within this larger airshed circulate air pollution from surrounding jurisdictions into the Cowichan Region and vice versa.

FIGURE 2.37: The Georgia Basin-Puget Sound airshed

Source: Environment Canada.

101 Environment Canada.

Measuring Air Quality

Reliable ways of measuring air quality in the Cowichan Region include monitoring levels of particulate matter, ground-level ozone and other key emissions in all segments of the region, and tracking respiratory-related hospital admission rates for children.[102]

Crofton's Catalyst Paper mill operates three monitoring stations in the Crofton/Maple Bay area as part of their emission permit. The Ministry of Environment operates a fourth station, on Cairnsmore Street in Duncan (Figure 2.38). These stations record emissions such as fine particulate matter, ground-level ozone and nitrogen dioxide. Note: The Crofton South monitoring station was closed in 2008, and replaced with the Escarpment Way station.

The Vancouver Island Health Authority tracks hospital admissions for children with respiratory problems.

Indicators included in this report are:

> Air Quality Index (AQI)

> Fine particulate matter ($PM_{2.5}$)

> Hospital admissions (for children aged 0-14 years)

FIGURE 2.38: Air quality monitoring station locations in the Cowichan Region

Source: Ministry of Environment.

102 Ozone is considered to be a very good indicator of respiratory health (whereas fine particulate matter, or $PM_{2.5}$, is a good measure of cardiovascular health), Glen Okrainetz, Director of Air, Health Protection Branch, BC Ministry of Healthy Living and Sport, personal communication, 2010.

Air Quality Index

Indicator and Measures

The BC Ministry of Environment has been collecting Air Quality Index (AQI) data since the mid- to late-1990s at three monitoring stations: Crofton Substation, Deykin Avenue and Crofton South (replaced in late 2008 by Escarpment Way). In November 2009, the Ministry of Environment installed a new station on Cairnsmore Avenue in Duncan to collect urban air quality data using BC's new Air Quality Health Index (AQHI).

The Air Quality Index (AQI) continually measures six parameters, and reports out daily on the highest single parameter, relative to its objective or break-point (Table 2.13). By comparison, the new Air Quality Health Index (AQHI) reports out every three hours, and is an amalgamation of all measured pollutants.[103]

The AQI is interpreted using the following scale: good (0 to 25), fair (26 to 50), poor (51 to 100) and very poor (100+).

TABLE 2.13: Air Quality Index parameters and objectives

Parameter	Sulphur Dioxide		Carbon Monoxide		Nitrogen Dioxide	Ozone	Particulates <10 micrometers	Particulates <2.5 micrometers
Averaging Time	1 Hour	24 Hours	1 Hour	8 Hours	1 Hour	1 Hour	24 Hours	24 Hours
Unit of Measure	ppm	ppm	ppm	ppm	ppm	ppm	ug/m^3	ug/m^3
Break-point:								
AQI = 25	0.17	0.06	13	5.0	0.105	0.05	25	15
AQI = 50	0.34	0.11	30	11.0	0.210	0.08	50	25
AQI = 100	2.00	0.30	64	17.4	0.530	0.15	100	50

Source: BC Ministry of Environment a100.gov.bc.ca/pub/aqiis/aqi.bulletin

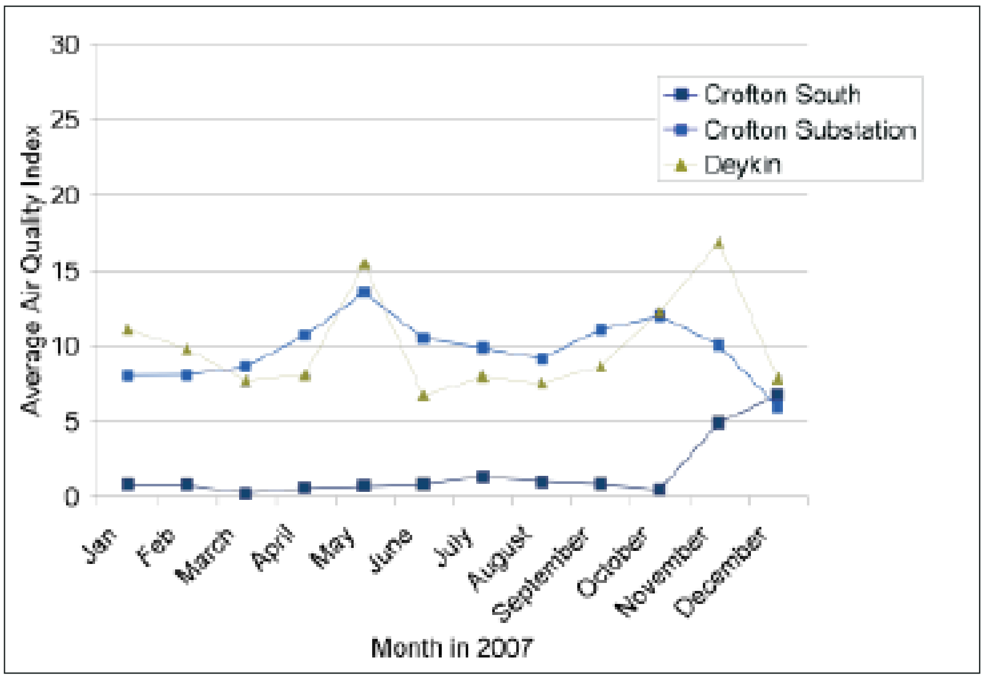
The AQI data is reliable and repeatable, and will be enhanced by AQHI data from the Duncan monitoring station.

103 BC's new Air Quality Health Index measures the combined effect of three contaminants felt to have the most direct impact on human health: nitrogen dioxide, ozone, and fine particulate matter ($PM_{2.5}$ and PM_{10}). Measurements are reported over a shorter term (the AQHI has a 3-hour running average versus the Air Quality Index's 24-hour average), and are therefore felt to provide more timely information for people with respiratory problems.

Findings

The most current and complete annual Air Quality Index (AQI) information available was for the year 2007. The data for 2007 indicate that the region's overall air quality is "good" according to the AQI scale (AQI=0 to 25). A monthly breakdown of data shows AQI readings well below the 25 mark (Figure 2.39). Hourly readings show that air quality only occasionally moves into the "fair" range (AQI=26 to 50) (Table 2.14).

FIGURE 2.39: Air Quality Index monthly readings for 2007



Source: Ministry of Environment.

TABLE 2.14: Number of "hourly maximums" in 2007 when AQI surpassed break-point of 25

Month	Crofton South	Crofton Substation	Deykin Avenue	Percentage of hourly AQI readings over break-point of 25
Jan	0	0	25	3.4%
Feb	0	0	26	3.9%
March	0	0	0	0%
April	0	33	0	4.6%
May	0	18	43	8.2%
June	1	25	0	3.6%
July	0	0	0	0%
August	0	0	0	0%
September	0	0	0	0%
October	0	0	19	2.6%
November	7	0	86	13%
December	19	0	0	2.6%
Total	27	76	199	3.4%

Note: Air Quality Index readings are taken every hour of every day, for a total of 24 readings per day and approximately 720 readings per month. This means there can be up to 24 hourly maximums that surpass an AQI of 25 in one day.
For example, all but one of the instances where the AQI surpassed the break-point of 25 at the Deykin Avenue monitoring station could have occurred in a single day.

Source: Ministry of Environment Air Quality Index readings, 2007.

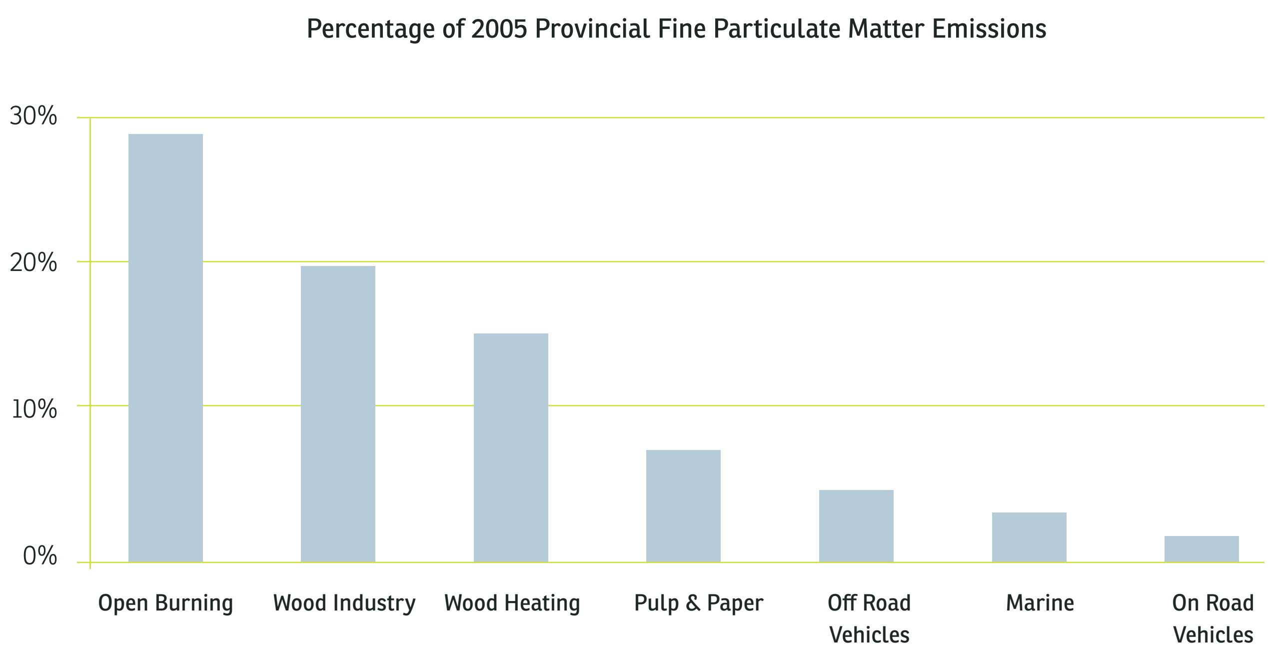
Fine Particulate Matter ($PM_{2.5}$)

Indicator and Measure

Fine particulate matter (also called $PM_{2.5}$ due to the size of the particles[104]) is one of the most important outdoor air pollutants in BC from a human health perspective, likely due to the fact that these very fine particles are easily inhaled and go deep into the lungs. $PM_{2.5}$ exposure is linked to a range of health impacts, including inflammation of the airways, more frequent use of medications, increased emergency room visits, hospitalizations and premature mortality.[105] People with heart or lung diseases, children and older adults are the most likely to be affected by particle pollution exposure.[106]

$PM_{2.5}$ comes from combustion sources, such as exhaust from vehicles (cars, trucks, buses), emissions from factories, and smoke from burning wood, land-clearing debris and garbage. Fine particulates also come from the reactions that transform some of the pollutant gases into solid or liquid particles (Figure 2.40).

FIGURE 2.40: Largest sources of $PM_{2.5}$ emissions in BC, 2005



Source: BC Lung Association State of the Air report, 2009.

$PM_{2.5}$ is measured using units of micrograms per cubic metre, and hourly readings are rolled up into a 24-hour average in order to compare to daily criteria.

104 The size of $PM_{2.5}$ particles is about 1/20th the width of a human hair.

105 BC Ministry of Healthy Living and Sport, June 2009.

106 US Environmental Protection Agency, accessed December 2009.

While no safe health thresholds for $PM_{2.5}$ have been identified[107], the provincial and federal governments have established $PM_{2.5}$ air quality objectives (Table 2.15). In addition, the Federal/Provincial Advisory Committee on Air Quality Objectives and Guidelines has developed an unofficial "Health Reference Level" for $PM_{2.5}$ that is an estimate of the lowest ambient $PM_{2.5}$ level at which statistically significant increases in health responses can be detected, based on available data and current technology.[108]

Two monitoring stations have been measuring $PM_{2.5}$ levels in the Cowichan Region since 2005: Crofton South (in operation from February 2005 to February 2008) and Escarpment Way (in operation since October 2008).

In addition, a temporary air quality monitoring site (called E-Sampler) affixed to the Cowichan Valley Regional District building in downtown Duncan collected $PM_{2.5}$ data from April 2008 to August 2009. This site has now been shut down, but its findings were useful in justifying the need for the new air quality monitoring site on Cairnsmore Street in Duncan. The Cairnsmore site is the first Air Quality Health Index monitoring site in the region, and has been gathering data, including $PM_{2.5}$ levels, since November 2009.

TABLE 2.15: $PM_{2.5}$ objectives

	Daily (24-hour period)	Annual mean	Annual voluntary planning goal
British Columbia standards	25 ug/m3	8 ug/m3	6 ug/m3
Canada-wide standards	30 ug/m3		
World Health Organization guidelines	25 ug/m3	10 ug/m3	
Health Reference Level	15 ug/m3		

Note: The Canada-wide standards are based on the 98th percentile annual ambient measurement over 3 consecutive years.

Source: BC Ministry of Environment, Environment Canada, World Health Organization.

The $PM_{2.5}$ data is accurate and reliable, and will be enhanced by new information currently being generated by the urban monitoring station on Cairnsmore Street in Duncan, and results from the CVRD's mobile aethalometer[109] testing, taking place in 2010.

107 BC Ministry of Healthy Living and Sport, June 2009.

108 National Ambient Air Quality Objectives for Particulate Matter. Part 1: Science Assessment Document. A report by the CEPA/FPAC Working Group on Air Quality Objectives and Guidelines.

109 An aethalometer is an instrument that provides a real-time readout of the concentration of soot particles in an air stream. These particles are emitted from all types of combustion, including diesel exhaust from vehicles and wood burning stoves.

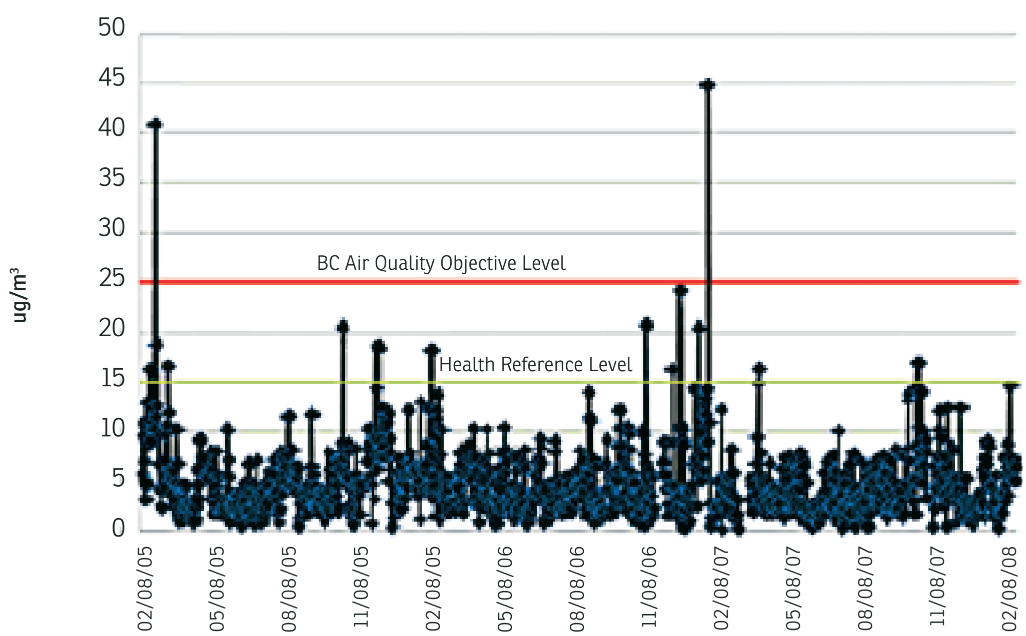
Findings

Levels of fine particulate matter ($PM_{2.5}$) are well below allowable levels, with some seasonal variation. Constant sources of $PM_{2.5}$ throughout the year include emissions from commercial/industrial processes and vehicle exhaust. In the fall and winter months, when additional sources of combustion are present (e.g., forest harvesting and land-clearing open-burning activities, woodstove use and backyard burning) and air inversions trap pollution at lower altitudes, air quality can diminish significantly. In spite of these seasonal pressures, levels of $PM_{2.5}$ remain within daily and annual objectives.

Daily levels of $PM_{2.5}$ measured at the Crofton South station have only exceeded provincial objectives two times in the last four years, and only in the winter months: in February 2005 ($PM_{2.5}$ =40.88 µg/m3) and in February 2007 ($PM_{2.5}$ =44.67 µg/m3) (Figure 2.41). Readings at the Escarpment Way monitoring station (which replaced Crofton South in 2008) have not exceeded provincial objectives, and surpassed the Health Reference Level on one occasion only (Figure 2.42).

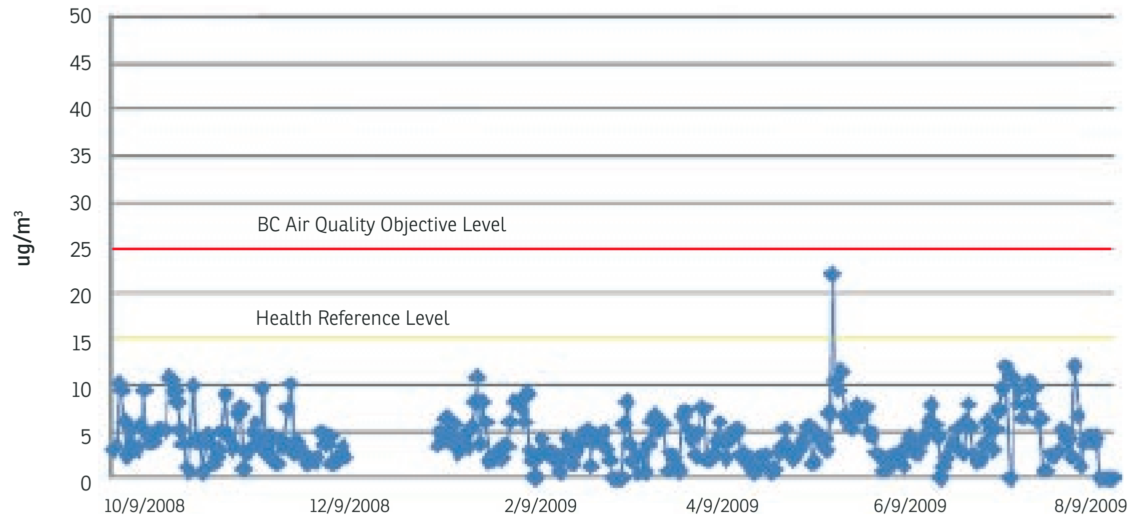
The E-Sampler station on the CVRD building recorded higher levels of $PM_{2.5}$ during the winter months, and had one reading in excess of provincial objectives in December 2008 ($PM_{2.5}$ = 36.67 µg/m3) (Figure 2.43). The Health Reference Level is frequently exceeded during the fall and winter months.

FIGURE 2.41: Crofton South daily $PM_{2.5}$ readings (February 2005 to February 2008)



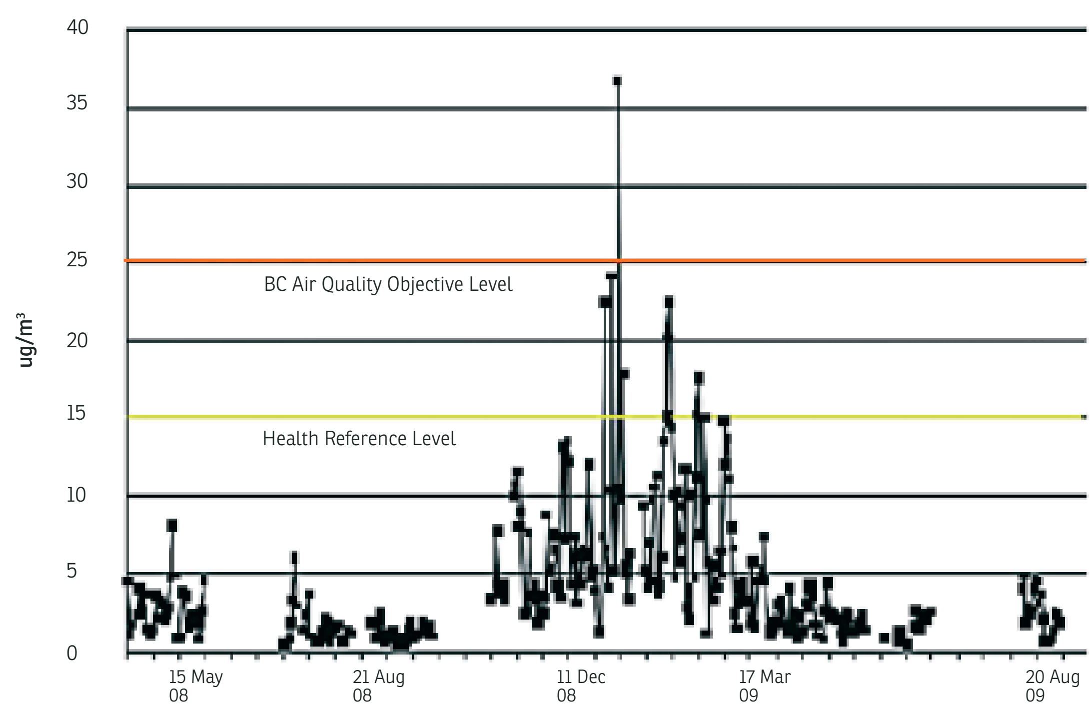
Source: Ministry of Environment.

FIGURE 2.42: Escarpment Way daily $PM_{2.5}$ readings (October 2008 to August 2009)



Source: Ministry of Environment.

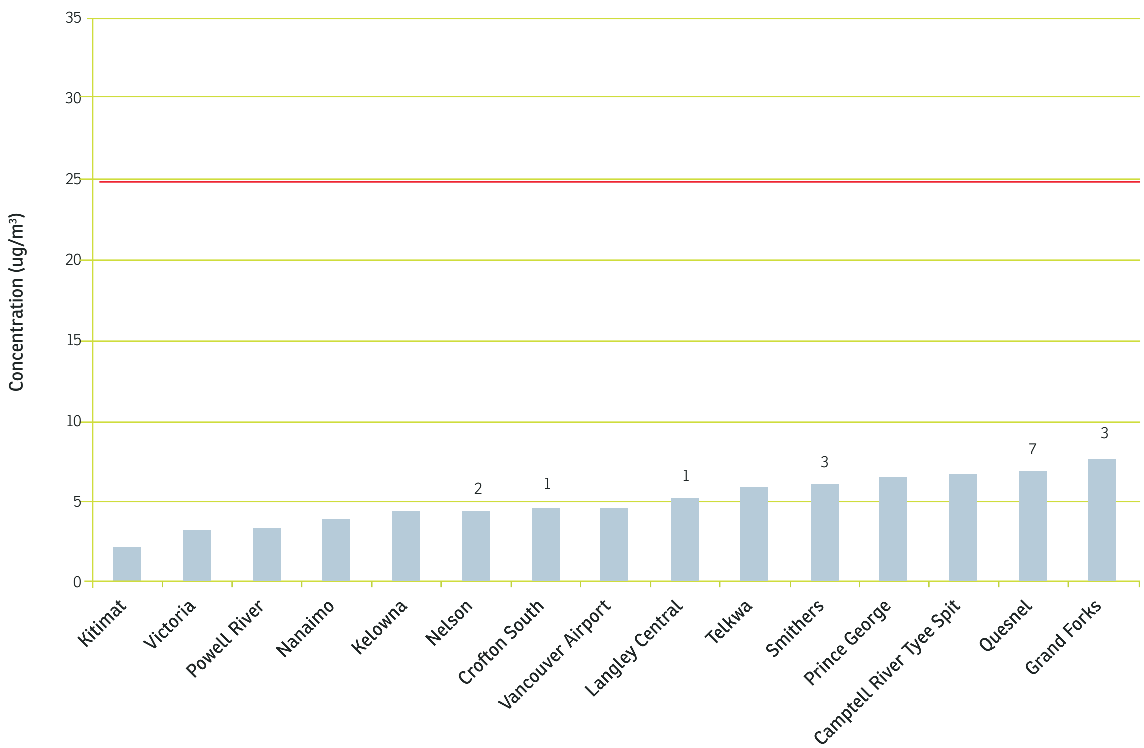
FIGURE 2.43: E-Sampler daily $PM_{2.5}$ readings (April 2008 to August 2009)



Source: Ministry of Environment.

The 2007 annual $PM_{2.5}$ level from the Crofton South station was 4.6 µg/m³, below BC's annual goal of 8 µg/m³. Using 2007 data from other BC communities, the Cowichan Region's air quality compares favourably, although it is generally higher than places such as Nanaimo and Powell River (Figure 2.44).[110]

FIGURE 2.44: Comparison of average concentrations of $PM_{2.5}$ in communities around BC, 2007



Note: The numbers at the top of the columns indicate the number of days in 2007 when $PM_{2.5}$ exceeded the provincial standard of 25 µg/m³.

Source: Ministry of Environment, Provincial $PM_{2.5}$ readings, 2007.

110 In order to determine whether or not a year of data is valid, the Ministry of Environment uses the "75% rule" that stipulates that each quarter of the year must have at least 75% data capture. Using this rule, the most current $PM_{2.5}$ data available for the Cowichan Region is for 2007.

Hospital Admissions (0-14 years)

Indicator and Measure

Air pollution causes measurable increases in the rates of hospitalization for people with respiratory and cardiovascular diseases, and for others who are considered more vulnerable to airborne pollutants, including children and seniors.[111]

Children respond to air pollution in different ways than adults, mainly because they take in more air – and thus more air pollution – per unit body weight when exercising than adults (20–50% more). In addition, children generally spend more time outside than adults. The impacts of poor air quality on children include respiratory problems such as airway irritation, coughing, and pain when taking a deep breath; wheezing and breathing difficulties during exercise or outdoor activities; aggravation of asthma[112] and increased susceptibility to respiratory illnesses like pneumonia and bronchitis; and suppressed lung growth.[113]

For these reasons, it is useful to assess air pollution levels by looking at the number of hospital admissions for children with respiratory problems.

The Vancouver Island Health Authority tracks annual hospital admissions for people between the ages of 0 and 14 years with "diseases and disorders of the respiratory system." This information is gathered at the region's three hospitals, and then broken out by patient geography and local health area.

The hospital admissions data is accurate and reliable, and could be enhanced by further disaggregation (e.g., by month, by respiratory disorder).

111 Health Canada website: www.hc-sc.gc.ca/ewh-semt/air/out-ext/effe/health_effects-effets_sante-eng.php#a6

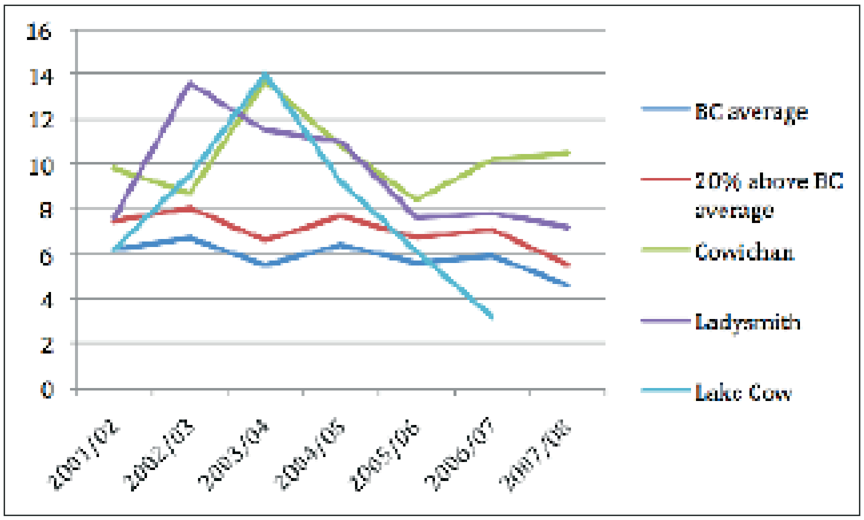
112 Children with asthma may be particularly vulnerable to air pollution at levels below current air quality standards. NIH/National Institute of Allergy and Infectious Diseases, Air Pollution Affects Respiratory Health In Children With Asthma, April 17, 2008.

113 US Environmental Protection Agency www.epa.gov/groundlevelozone/health.html. See also: Outdoor Air Quality–A Primer for Physicians (and Appendix), 2009. Prepared by the UBC School of Environmental Health and Centre for Health and Environment Research; BC Centre for Disease Control; BC Lung Association; and Ministry of Healthy Living and Sport. www.bc.lung.ca/airquality/airquality_primer.html

Findings

Hospital admission rates for children with respiratory problems in the Cowichan Region are higher than the provincial average – at times by a significant amount (Figure 2.45). The Vancouver Island Health Authority (VIHA) considers it problematic when admissions rates are at least 20% higher than the BC average.

FIGURE 2.45: Annual number of admissions per 1,000 people (case rate), by local health area, 2001 to 2008



Note: Lake Cowichan's case rate for 2007/08 was lower than the scale of this chart (meaning less than 1,000 people admitted).
Source: Vancouver Island Health Authority.

Summary

Air quality in the Cowichan Region is generally good, and pollution levels are well within provincial standards. However, there are no safe levels of air pollution, so significant human health impacts can occur even in relatively clean airsheds.[114]

Hospital admission rates for children with respiratory problems in the Cowichan Region seem to signal a problem. Admission rates are consistently more than 20% higher than the provincial average, and at times are twice this average.

114 A 2005 scientific study for the British Columbia Lung Association found that, even in areas with relatively low levels of air pollution, public health effects can be substantial and costly. This is because effects can occur at very low levels and a large number of people can potentially breathe in such pollutants. The study predicts that a 1% improvement in ambient $PM_{2.5}$ and ozone concentrations could result in $29 million in health care savings in the Lower Fraser Valley in 2010.

Seasonal variances in air quality are also of concern. Air quality diminishes significantly in the fall and winter months, due to increases in seasonal combustion (open burning and woodstove use). Sources of low-level air pollution throughout the year include vehicle exhaust and commercial/industrial emissions.[115]

Climate change has the potential to compound regional air quality. Predictions of drier, hotter summers and an increased possibility of forest fires could result in greater amounts of harmful dust and smoke particles.

Pressures on the Cowichan Region's air quality will continue to increase with a rising population and more economic activity. Mitigation of these pressures could come in the form of additional restrictions on backyard burning, "burn smart" public education campaigns, and region-wide support for smart growth principles that encourage compact, urban development and reduce reliance on vehicles.

The impacts of air pollution on Cowichan's ecosystem health appear to be negligible at present, however they are unquantified at this time.[116]

Missing information

Air quality monitoring stations are largely clustered around industrial activities in the Crofton area, and – with the exception of the new station in Duncan – do not capture information from other parts of the region. Future air quality monitoring stations and studies should be situated near major transportation corridors and areas of high woodstove use to capture other substantial sources of emissions. The CVRD's mobile aethalometer testing conducted in January 2010 will indicate whether a need exists for additional monitoring stations throughout the region.

Until recently, ground-level ozone has not been monitored in the Cowichan Region. The new Air Quality Health Index monitoring site on Cairnsmore Street in Duncan started measuring ground-level ozone in November 2009. Data generated from this site will provide vital information for subsequent State of the Environment reports. Ground-level ozone is a key determinant of human and ecosystem health, and can have devastating impacts on local economies, including significant crop damage. Ground-level ozone levels are at their worst during the summer months, when strong sunlight and hot weather trigger a chemical reaction that results in harmful concentrations.

115 This is based on modeling. Particle speciation can pinpoint actual sources of air pollution, but to date this technique has only been conducted in BC communities known to have serious air pollution problems, such as Prince George and Quesnel.

116 It is unlikely that current levels of air pollution are impacting the natural environment. Two measures of deposition-related impacts are acidification and nitrogen oxide emissions. A recent summary of data about Quamichan Lake water quality, compiled by the Ministry of Environment, suggests that acidification (measured by low pH levels) is not a concern. The BC Lung Association's 2009 Annual Report shows low levels of nitrogen dioxide in the Crofton area (less than 7µg/m3, which is well below the national objective of 60 µg/m3). These findings were validated via personal communication in 2010 with Earle Plain, Ministry of Environment Air Quality Meteorologist, who stated that regional sulphur and nitrogen oxide levels (contributors to acid rain or acidification) are extremely low and not problematic.

The usefulness of data on respiratory-related hospital admissions for children might be enhanced if records were available on a monthly basis. This might allow a more direct comparison with seasonal fluctuations in air quality (higher $PM_{2.5}$ in the fall and winter, potentially higher ground-level ozone in the summer).

VIHA is presently setting up the Cowichan Regional Health Network in order to identify health priorities. This network will bring together a wide variety of community leaders and health representatives, and will – among other things – try to identify the specific factors that are contributing to the Cowichan Region's higher-than-average respiratory admission rates.[117]

Health Canada is currently conducting a modeling study of the effects on human health of air emissions from the Canadian Pulp and Paper Industry. Crofton's Catalyst Mill is participating in the study. Findings should be available by mid- 2010, and may provide additional insight into regional health impacts of air pollution.[118]

References

BC Lung Association. 2009. State of the Air Report.

BC Ministry of Environment. 2005-2009. Air Quality Monitoring Records.

BC Ministry of Healthy Living and Sport. 2009. Guidance on Application of Provincial Air Quality Criteria for $PM_{2.5}$

Environment Canada. The Georgia Basin-Puget Sound International Airshed Strategy.

Environment Canada. 1998. National Ambient Air Quality Objectives for Particulate Matter. Part 1: Science Assessment Document.

Health Canada. Health Effects of Air Pollution. **www.hc-sc.gc.ca/ewh-semt/air/out-ext/effe/health_effects-effets_sante-eng.php#a6. Accessed December 2009.**

United States Environmental Protection Agency. Ground-Level Ozone Health Effects. **www.epa.gov/groundlevelozone/health.html. Accessed December 2009.**

United States National Institute of Allergy and Infectious Diseases. 2008. Air Pollution Affects Respiratory Health in Children with Asthma.

University of British Columbia School of Environmental Health and Centre for Health and Environment Research; BC Centre for Disease Control; BC Lung Association; and Ministry of Healthy Living and Sport. 2009. Outdoor Air Quality – A Primer for Physicians and Appendix.

Vancouver Island Health Authority. 2001-2008. Hospital Admissions Rates for Children Aged 0-14 with Respiratory Problems.

117 Mike Pennock, Population Health Epidemiologist and Co-Director of the Population and Public Health Observatory at the Vancouver Island Health Authority, personal communication, 2009.

118 Michelle Vessey, Manager, Environment and Technical Development, Catalyst Paper, personal communication 2009. See also: Air Quality Assessment of the Pulp and Paper Industry, PowerPoint Presentation by Gregory Crooks, M.Eng., P.Eng., July 14, 2009.

3.0 Human Interaction with the Natural Environment

3.1 Smart Growth

Introduction

Smart Growth in the Cowichan Valley Regional District

"Smart growth" is a concept that encourages compact, higher density community development, leaving rural areas for agriculture and forestry as well as ecosystem protection.[119] A smart growth community mixes residential and commercial uses, making it easy for people to walk or bicycle to jobs and services. Higher density residential areas are typically better served by public transit, schools, libraries, and other services.

While the Cowichan Valley Regional District (CVRD) has higher density nodes in communities such as Ladysmith, Duncan, Lake Cowichan, Chemainus, and Mill Bay, most of its population is quite dispersed. To achieve more smart growth, new growth and development should focus on nodal, higher density developments that gradually shift the balance away from sprawl. At this time, much of the development pressures are particularly intense around Cowichan Lake, Shawnigan Lake and just to the north in the Regional District of Nanaimo.

Growth in the region is managed by municipal governments within their jurisdiction (City of Duncan, District of North Cowichan, Town of Lake Cowichan and Town of Ladysmith). In the electoral areas, planning is the responsibility of the CVRD. Decisions made by these local governments – such as where to allow new subdivisions or infill development, what density of development to permit, and where to provide services such as piped water, sewers and roads – will influence the type of growth that occurs.

Measuring Smart Growth

To be able to tell the story of smart growth in the region, it would be ideal to be able to report on how land use has changed over time (and is expected to change in the near future), population density, how and where growth is occurring, whether people are within walking distance of shops and services (including public transit stops), and how they move around the region (for work and other purposes).

119 For more information on smart growth, see Smart Growth BC: www.smartgrowth.bc.ca

Statistics Canada tracks several relevant measures, including population and population density, housing type, and journey to work. Indicators included in this report are:

> Population density
> Compact housing
> Walkability of communities
> Proximity to transit
> Transportation modes: journey to work
> Maximum allowable parcel coverage

Population Density

Indicator and Measures

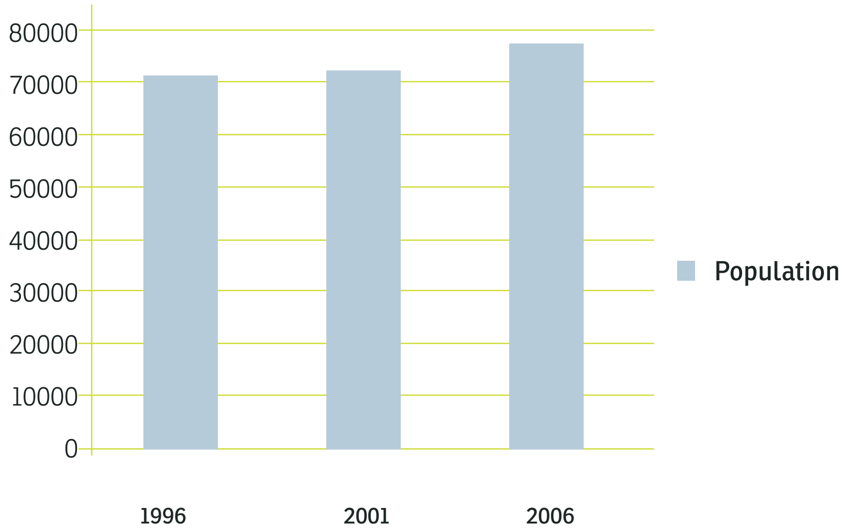
Statistics Canada tracks population data in its five-year census, both for the region as a whole and by census subdivision. Generally, the more densely populated a community, the better it meets smart growth criteria. For example, Smart Growth BC recommends having at least 15 residences per ha (1,500 residences/km^2) in order to make public transit a feasible option.

The census information is accurate and reliable, but incomplete for this report's purposes. For large electoral areas, an increase in population will show as increased density, but this does not indicate whether the additional population is being accommodated in higher density nodes or in a sprawled growth pattern. As well, census subdivision boundaries may change over time, making multi-year comparisons less reliable.

Findings

The Cowichan Valley Regional District has a land base of 3,473 km^2 with a population of 76,929 (2006 census). This gives an average population density of 22.1 people per km^2, much higher than the BC average of 4.4 people per km^2 but considerably lower than the Regional District of Nanaimo's 68.1 people per km^2.

FIGURE 3.1: CVRD Population, 1996–2006

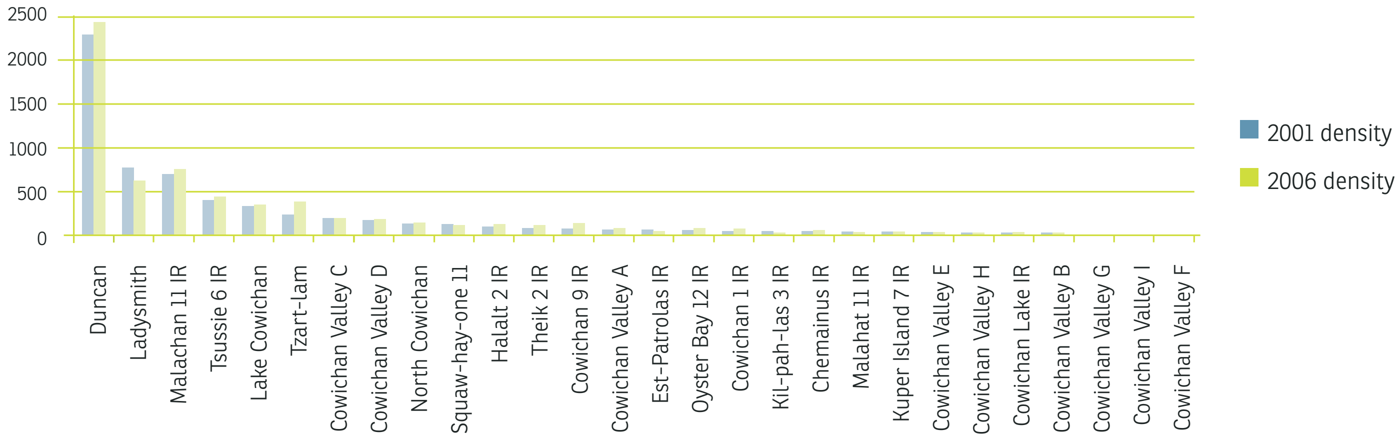


Source: Statistics Canada Census 1996, 2001, 2006

Population density of course varies considerably across the region. Figure 3.2 shows that the Town of Duncan has by far the highest density (2,430 people per km^2), with all other census subdivisions well under 800 people per km^2. Most of the electoral areas have very low density (below 200 people/km^2). [120]

120 For a map of electoral areas, see Figure 1.1 in Section 1.

FIGURE 3.2: Population density by census subdivision, 2001–2006



Note: Ladysmith shows a decline in density from 2001 to 2006 – this is due to a change in the area of the census subdivision.
Source: Statistics Canada Census 2001, 2006.

Compact Housing

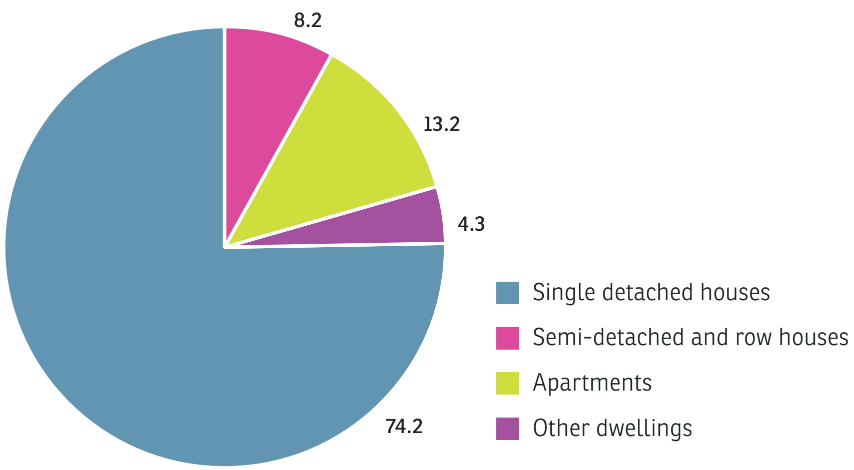
Indicator and Measures

Compact housing is a measure of dwelling unit type: single-family homes vs. duplexes vs. apartments or other forms of dwelling (e.g., trailers). A trend toward fewer single-family dwellings indicates an increase in residential density, which can help to reduce transportation-related energy use and emissions. Single-family detached housing makes up 49% of housing in BC.

Findings

About three-quarters (74%) of the housing stock in the Cowichan Valley region is single-family detached housing, with about 13% in apartments and 8% in semi-detached housing (Figure 3.3).

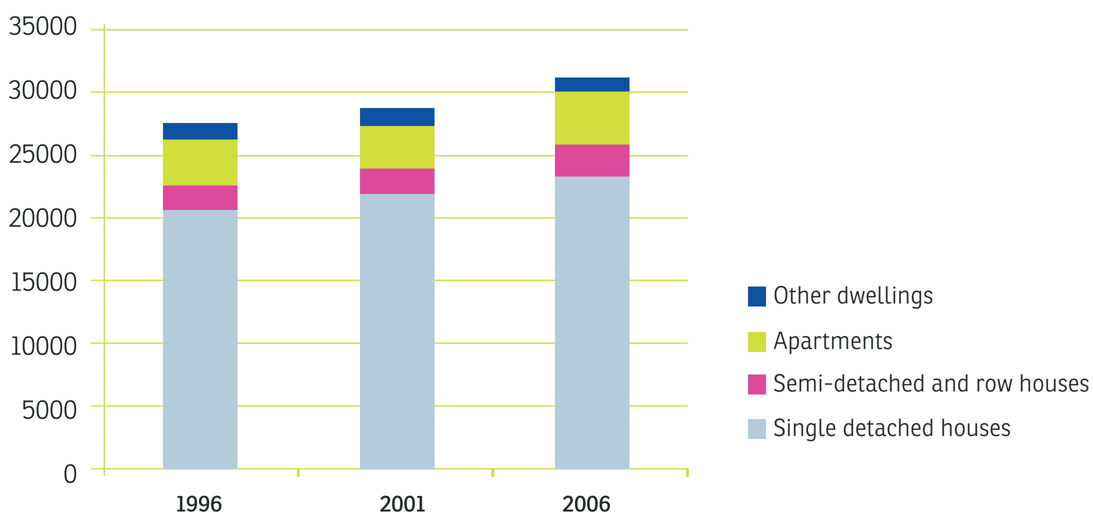
FIGURE 3.3: Housing stock (percentage of occupied dwelling type), CVRD 2006



Source: Statistics Canada Census, Community Profiles, 2006.

This overall percentage changed very little between 1996 and 2006, although the percentage of single family homes declined slightly (from 76.3% to 74.3%), with corresponding increases in apartment dwellings (11.9% to 13.2%) and semi-detached homes (6.7% to 8.2%) during this period (Figure 3.4). However, population growth continues to result in a growing number of single detached homes in the region.

FIGURE 3.4: Housing stock (by occupied dwelling type), CVRD 1996–2006



Source: Statistics Canada Census, Community Profiles, 2006.

Walkability of Communities

Walkable communities offer a lifestyle choice where people are less dependent on cars for their daily needs. Research[121] shows that walkable (and cyclable) communities are also healthier communities, as residents will incorporate more exercise into their daily routines.

Indicator and Measures

Walkscore.com provides an online ranking of the walkability of a given location, based on its proximity to services such as grocery stores, restaurants and coffee shops, cinemas, parks, libraries, drug stores and fitness facilities. This is based on Google data and shown in map form. Locations are given a ranking from a high of 100 to a low of zero.

Walkscore describes its rankings as follows:

> 90–100 = Walkers' Paradise: Most errands can be accomplished on foot and many people get by without owning a car.

> 70–89 = Very Walkable: It's possible to get by without owning a car.

> 50–69 = Somewhat Walkable: Some stores and amenities are within walking distance, but many everyday trips still require a bike, public transportation, or car.

> 25–49 = Car-Dependent: Only a few destinations are within easy walking range. For most errands, driving or public transportation is a must.

> 0–24 = Car-Dependent (Driving Only): Virtually no neighbourhood destinations within walking range. "You can walk from your house to your car."[122]

For the purposes of this report, a sample of locations across the region was entered into this program to rate their walkability. By its nature, this information is only as good as the data available from Google, and the sample locations do not provide a complete picture of the region. In addition, this information does not provide any trend data to show if walkability is improving or not. A preferred indicator would be one that measures the percentage of the region's population within walking distance of a defined suite of key services. However, in the absence of other more reliable data, it does provide some measure of the relative walkability of communities.

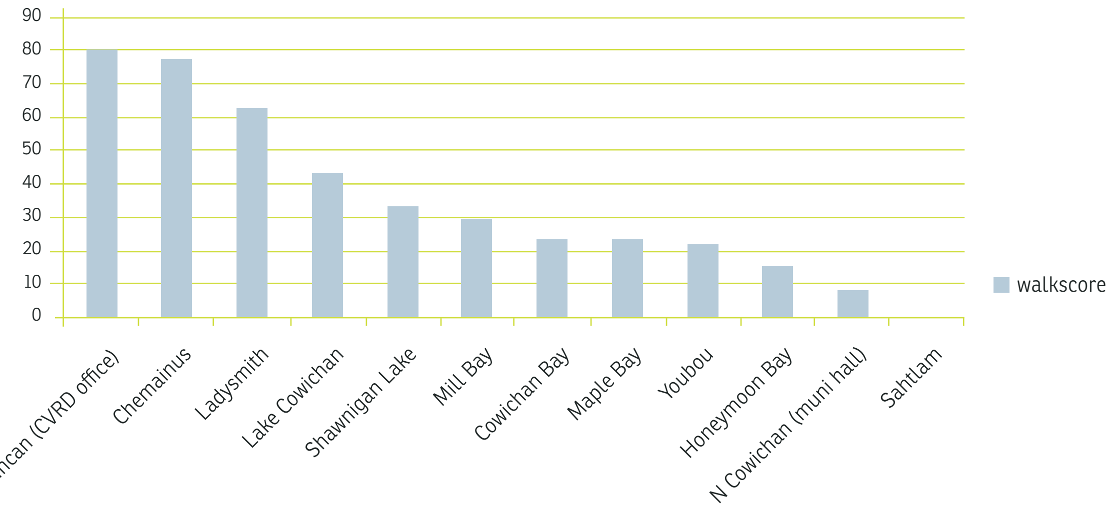
121 Frank et al, 2004.

122 www.walkscore.com/how-it-works.shtml

Findings

Data from walkscore.com show that the communities of Duncan, Chemainus and Ladysmith are considered very or somewhat walkable, while most other communities in the region are car-dependent (Figure 3.5).

FIGURE 3.5: Walkability of sample locations in the CVRD



Source: www.walkscore.com, accessed January 21, 2010.

Proximity to Transit

Indicator and Measure

People living close to public transit are much more likely to use transit services, especially if the routing and frequency of service meets their needs. BC Transit's annual performance summary (2008-09)[123] provides a summary of the population living within 400 m of transit routes. This information is generated by using the number of census blocks within 400 m each side of a transit route. Since most people start their journey with a walk from home to a bus stop, 400 m or less is deemed to be about the distance that most people are willing to walk to catch the bus (about a 10-minute walk).

Data to measure trends were not available for this report.

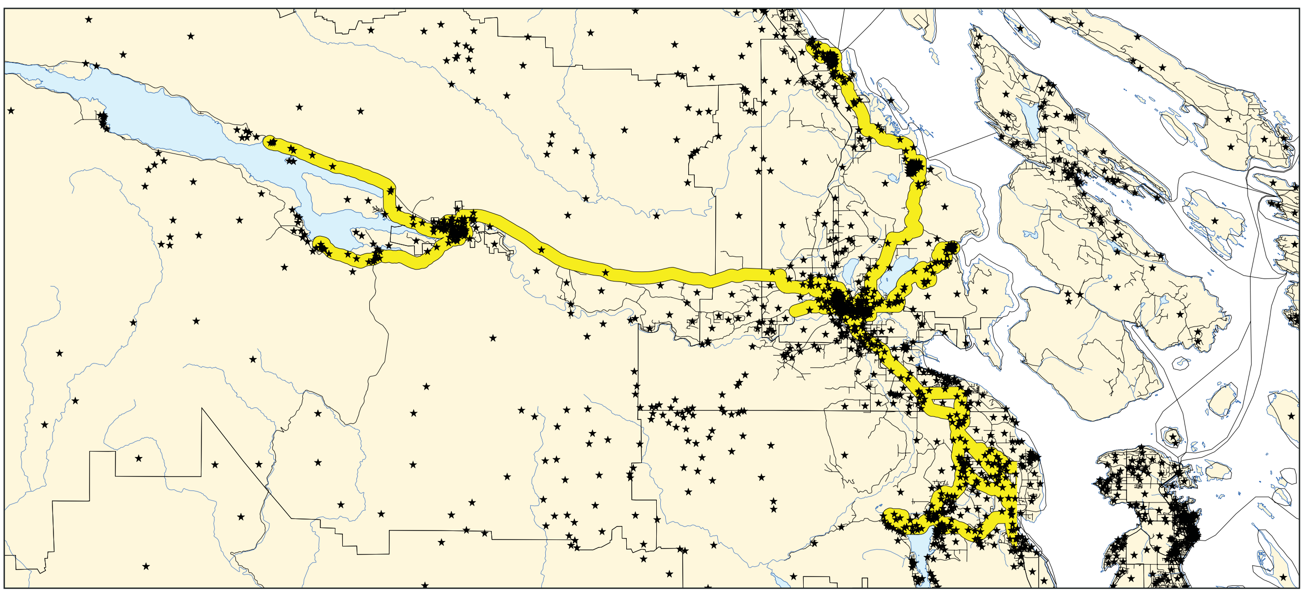
123 BC Transit, 2008/2009.

Findings

In 2008, about 38,100 people (half the region's population) lived within a 400m buffer around transit routes. This is mapped in Figure 3.6. This information does not indicate how far people would have to travel to a bus stop, nor the frequency of service along that route, both of which influence an individual's decision to take the bus instead of driving. For much of this area, bus frequency is well below the desired frequency (every 15-20 minutes during peak hours) that provides people with a realistic option to personal vehicle travel.

Also note that this map shows only part of the Cowichan Valley Regional District, since much of the region has no BC Transit service. The map does not include the new Duncan–Shawnigan–Victoria service that was started in 2008.

FIGURE 3.6: Population within 400 m of transit service, CVRD (Cowichan Lake east) 2008



Note: Each star represents a census block; not all census blocks are the same population. The yellow band is the 400m buffer around existing BC Transit routes.

Source: Peter Murray, Senior Transportation Planner, BC Transit.

Transportation Modes: Journey to Work

In a "smart growth" community, homes and places of work are close together, so that many residents can get to work by walking, biking or taking public transit. Where there are low- or medium-density settlement patterns – as seen throughout much of the Cowichan Valley Regional District – it is often impractical to offer a frequent transit service and most residents are too far from their workplace to be able to walk or cycle to work. However, communities such as Duncan and Ladysmith offer opportunities to walk or bicycle to work, or to car-pool with others.

The journey to work indicator provides insight both on the sprawl vs. smart growth nature of the region's land use, and on whether the trend is tending towards using lower-carbon methods to travel to work. Transportation is a significant contributor to greenhouse gas emissions, and this can be reduced by encouraging alternatives to automobile use.

Indicator and Measures

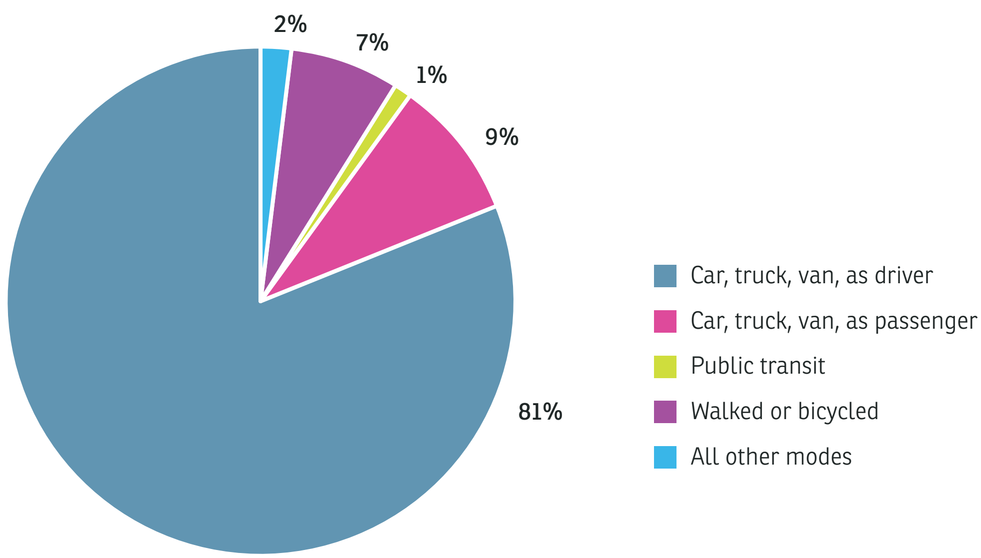
This indicator measures the mode of travel used by people as they journey to work: driving, riding as a passenger, walking/bicycling, via public transit, or other means. Statistics Canada tracks the mode of transportation to work by residents 15 years of age and over who worked at some time in the prior year (2001 and 2006 census). Census respondents are asked to identify the mode of transportation they most frequently use to commute from home to work.

This data is gathered by Statistics Canada as part of the five-year census. Journey to work data are not available for 1996. As well, the census tracks only the journey to work, and does not include data for other trips, e.g., for recreation or social purposes or to access services. This additional information would provide a more complete picture of total transportation activity in the region.

Findings

In 2006, by far the most common mode of transport to work was "vehicle driver" (81% of commutes). About 9% journeyed as a vehicle passenger, and a further 7% walked or bicycled (Figure 3.7).

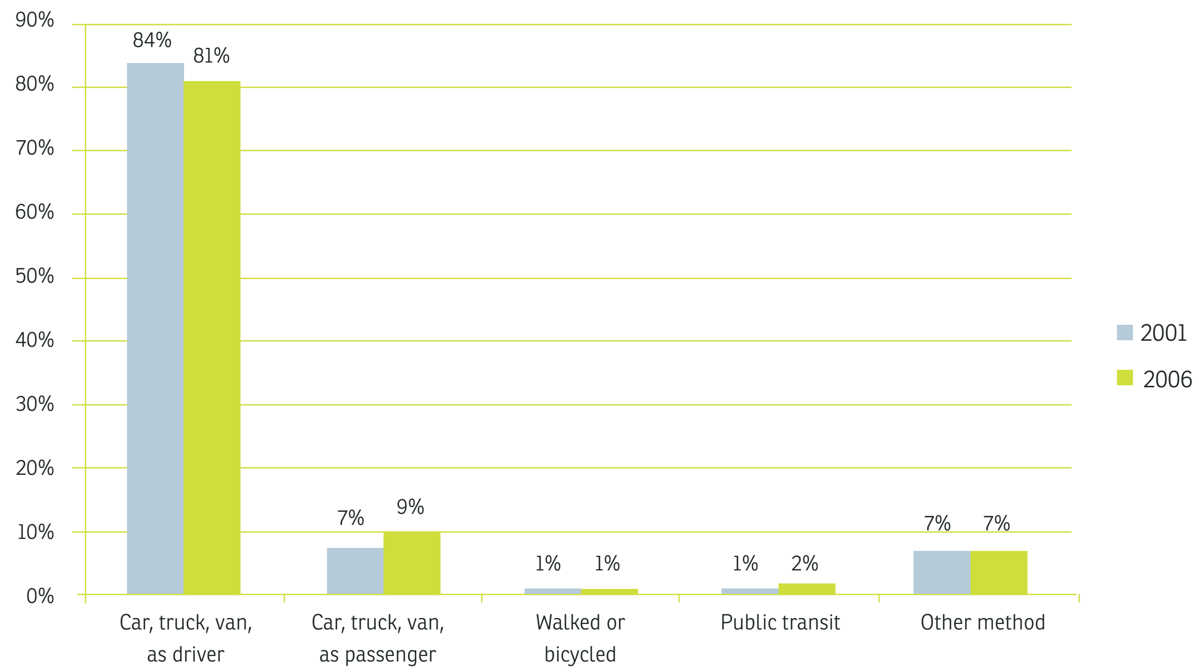
FIGURE 3.7: Journey to work mode share, CVRD, 2006



Source: Statistics Canada, 2006 Census.

When compared to 2001 census results, there has been a slight decline in the number of drivers (from 87% to 81%), with a consequent increase in the number of passengers (from 7% in 2001 to 9% in 2006) and a one percent increase in transit users (Figure 3.8). On average, more men than women travelled by private vehicle, and women were more likely than men to take transit or walk/bike.

FIGURE 3.8: Journey to work mode share, CVRD 2001 and 2006



Source: Statistics Canada, Census 2001 and 2006.

Results varied across the region, however. In the City of Duncan, the percentage of drivers dropped from 72% in 2001 to 66% in 2006, while journeys by walking or bicycling increased from 16% to 19%. In the Town of Lake Cowichan, the percentage of drivers remained constant (71%), while transit users increased (from 1% to 2%) and those walking/bicycling decreased from 14% in 2001 to 10% in 2006.

Many residents of the Cowichan Valley region work in Victoria, and the Jack Bell Foundation provides vanpool and carpool vehicles for these commuters. Table 3.1 provides a summary of the number of vans and cars leaving various destinations in 2002 and 2009. It should be noted that the number of vans leaving Duncan and Cobble Hill/Shawnigan Lake has dropped in response to the launch of BC Transit's Malahat commuter bus service in 2008.

TABLE 3.1: Jack Bell Vehicles 2002 and 2009

From	To	2002 Vans 8 Pass.	2002 Cars 4 Pass.	2009 Vans 8 Pass.	2009 Cars 4 Pass.
Nanaimo	Victoria- Downtown	3		1	
Ladysmith	Victoria- Downtown	0		1	
Cowichan Bay	Victoria- Downtown	2		2	
Lake Cowichan	Victoria- Downtown	1			1
Duncan	Victoria- Downtown	8		6	1
Duncan	Esquimalt	1		1	1
Shawnigan Lake	Victoria- Downtown	3			1
Cobble Hill	Victoria-Downtown	6	1	2	1
	Total	24	1	13	5

Source: Leon Teubes, 2010.

Maximum Allowable Parcel Coverage

The various land-use zoning designations within the CVRD permit buildings to cover up to a certain percentage of a property. Buildings – and the roads, sidewalks, parking lots and other features that accompany them – create impervious surfaces that do not allow water to soak into the soil.

Under natural forest conditions, about 55% of the water from a rainfall will soak into the ground (the rest is absorbed by plants or evaporates). This water soaks into the soil, either recharging groundwater or gradually travelling through the ground to reach streams and lakes. Only a very small amount (about 1%) runs over the land surface.[124] Changes to the landscape create more impervious surfaces, where almost all of the rainfall runs over the land (picking up oils and other pollutants) and is then collected via storm drain systems which pipe the polluted water directly to creeks. In a suburban development, as much as 25% of rainwater becomes overland runoff, and in paved parking lots it can be close to 100% runoff.[125] Lawns, clearcut forest areas and agricultural lands can also increase overland runoff, especially on slopes.

124 Ministry of Water, Land and Air Protection and Environment Canada, 2002.

125 Ibid.

These changes create harmful impacts to waterways and property. Water reaches streams and creeks more quickly than under natural conditions, eroding streambeds and banks and resulting in the loss of fish habitat such as salmon spawning areas. There is less water soaking into the soil, resulting in less aquifer recharge for drinking water, and less groundwater to supply streams during dry summer months. It is estimated that significant changes to streams occur when impervious surface cover exceeds 10%, and significant damage to streams occurs when impervious surface cover is more than 30%.[126]

This indicator is an important aspect of smart growth because how we develop communities affects how much impervious surface is created, which in turn affects the health of the Cowichan Region's waterways.

Measures

The Cowichan Valley Regional District has calculated the impervious surface that could be created if all properties were built out to the maximum allowable in the current OCP zoning, by watershed. This allowable amount of impervious cover varies by zone.

Note that the results show the amount of impervious surface that could be created if full build-out were to occur, not the actual amount of impervious surface, which is unquantified a this time.

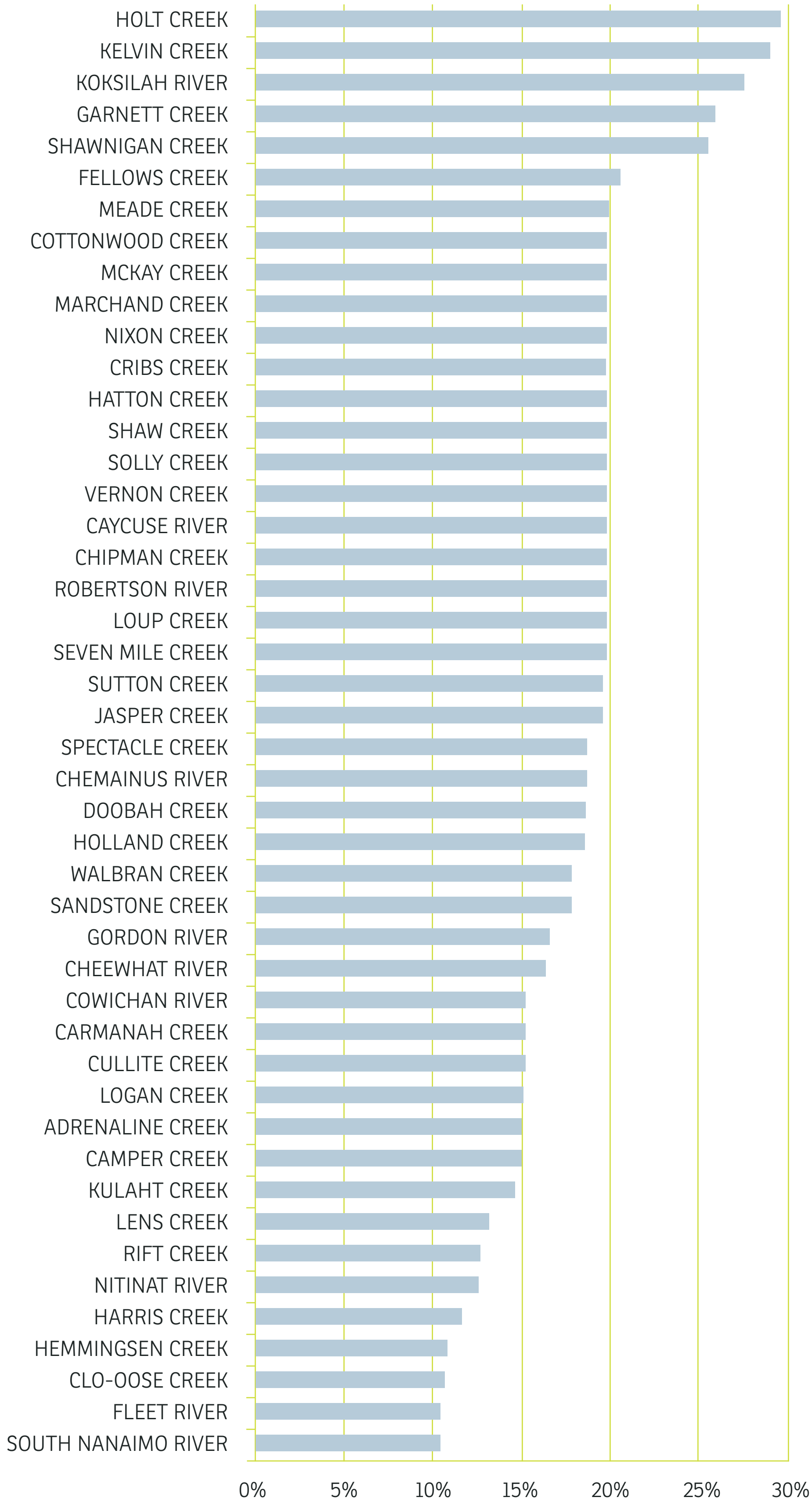
Findings

The results show that maximum allowable parcel coverage could create very high levels of impervious surface for many watersheds. Of the region's 68 watersheds, only 23 (one-third) of the watersheds would be below 10% impervious cover if maximum build-out were to occur. The rest would be between 10% and 30% impervious, with Holt Creek, Kelvin Creek, the Koksilah River, Garnett River and Shawnigan Creek coming very close to levels that would result in significant damage to stream ecology.

If such build-out were to occur, the impacts on the region's streams and waterways could be devastating.

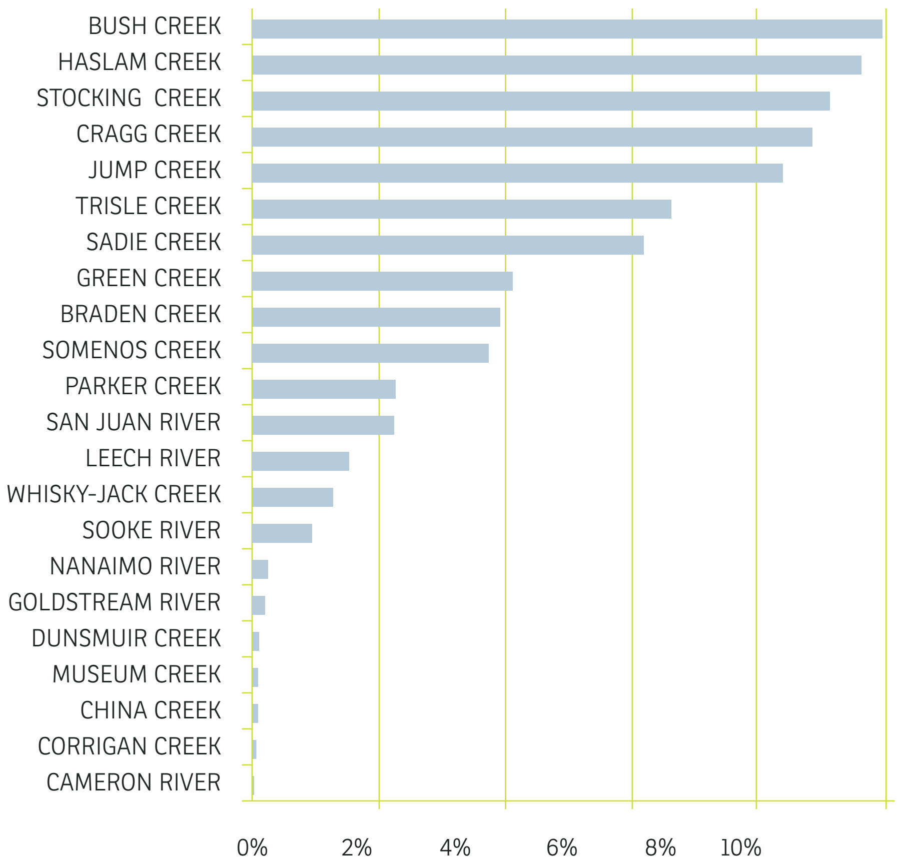
126 Schueler, 1995.

FIGURE 3.9: CVRD watersheds with 10–30% impervious cover based on zoning



Source: CVRD, 2010.

FIGURE 3.10: CVRD watersheds with less than 10% impervious cover based on zoning



Source: CVRD, 2010.

It would be helpful to be able to compare the actual impervious surface areas to these figures, so that more meaningful information on the current impact of impervious surfaces could be analyzed.

Summary

The Cowichan Valley Regional District has a population of about 77,000, and this number continues to grow. While some of the population is concentrated in higher density areas (such as Duncan), much of it is dispersed, with fewer than 200 people/km^2 in most parts of the region. This makes "smart growth" development very hard to achieve. About three-quarters of the population lives in single detached homes, and in communities where they are dependent on cars for most daily needs and errands. And, while many people live close to a transit route, the frequency of service along these routes does not always make transit a practical option. The exceptions are the new bus services to the Victoria area, which together with the Jack Bell vanpool service helps to take several vehicles off the road. However, about 90% of commuters travel to work by personal vehicle, with the vast majority of these as single occupant drivers.

Of considerable concern is the impact that could occur as a result of maximum build-out of allowable parcel coverage. While this is unlikely to happen to its full extent, it does raise the question of future impervious surface cover and the potential for impacts on streams and waterways.

Missing Information

At this time there is no reliable, regionally-consistent data on the location of new growth (is new development supporting density or sprawl?) and proximity to services such as food stores, schools, libraries, etc. (are people living close to services?). Also, it would be useful to be able to report on actual impervious surface cover, as this would give a better indication of the potential for harm to the region's streams and waterways.

References

BC Ministry of Water, Land and Air Protection and Environment Canada. 2002. Stormwater Management Planning: A Guidebook for British Columbia. **www.env.gov.bc.ca/epd/epdpa/mpp/stormwater/stormwater.html**

BC Transit. 2008/2009. Conventional Transit Information and Performance Summary.

Frank, Lawrence D., Martin A. Andresen, and Thomas L. Schmid. 2004. Obesity Relationships With Community Design, Physical Activity, and Time Spent in Cars. American Journal of Preventive Medicine Vol. 27. No 2. June, 2004, pp. 87-97. **www.act-trans.ubc.ca/smartraq/files/FRANK-AJPM-04-obesity.pdf**

Murray, Peter. 2010. Senior Transportation Planner, BC Transit. Personal Communication.

Schueler, Thomas R. 1995. The Peculiarities of Perviousness. Watershed Protection Techniques 2, 1: 233-38.

Statistics Canada. 2001 Community Profiles. **www12.statcan.ca/english/Profil01/CP01/Details/Page.cfm?Lang=E&Geo1=CD&Code1=5919&Geo2=PR&Code2=59&Data=Count&SearchText=cowichan&SearchType=Begins&SearchPR=59&B1=All&Custom= Accessed December 30, 2009.**

Statistics Canada. 2006 Community Profiles. **www12.statcan.ca/census-recensement/2006/dp-pd/prof/92-591/details/page.cfm?Lang=E&Geo1=CD&Code1=5919&Geo2=PR&Code2=59&Data=Count&SearchText=Cowichan Valley&SearchType=Begins&SearchPR=01&B1=All&Custom= Accessed December 30, 2009.**

Teubes, Leon, 2010. Executive Director, The Jack Bell Foundation. Email to Jenny Farkas. January 22, 2010.

3.2 Farm Land and Food Security

Introduction

Farm Land and Food Security in the Cowichan Valley Regional District

Food and agriculture are key components of the Cowichan Region's economy. The maintenance of a productive farming community supports local food production, which in turn reduces transportation-related greenhouse gas emissions[127], fosters self-sufficiency, provides insurance against disruptions in food supply, and protects consumers from increases in food prices due to rising fuel costs.

Farm land also provides key ecological services such as habitat for wildlife, refuelling areas for winter bird migration and pervious surfaces for groundwater recharge, and it contributes to the rural feel of the region. Organic waste (appropriately processed) can be applied on farmland, reducing the volume of material sent to the landfill and improving soil productivity.

Cowichan's temperate climate and fertile soils allow for year-round food production, and the area is well suited to many different agricultural activities – particularly at lower elevations along the east coast of the region.[128] The rivers, lakes, ocean and forest provide additional food sources, including fish, shellfish, sea vegetables and non-timber forest products such as mushrooms, salal, floral greenery, and medicines.

Imported food travels an average of 2,500 kilometres from farm to plate.[129]

Measuring Farm Land and Food Security

In measuring the state of farm land and food security, it would be ideal to be able to track trends in the total amount of land capable of being farmed versus the area actually being farmed in the region, as well as the kinds of food being grown relative to regional food production targets, the amount of food being purchased locally versus imported from out of the region, and the sustainability of agri-business (which provides economic stimulation for communities, income and employment generation for farmers, and food security for citizens).

127 The fossil fuels and other resources needed to grow, package and transport food in large quantities contributes significantly to greenhouse gas emissions (3% in BC and Canada, 8% in the US, 14% worldwide) and environmental depletion.

128 Cowichan Economic Development Commission (CEDC), 2009. Cowichan Region Area Agricultural Plan–State of the Industry Report and Visions, Goals and Objectives addendum.

129 The average North American meal travels close to 2,500 kilometres from farm to plate. (http://www.organicagcentre.ca/Docs/LocalFoodProcurementPolicies.pdf) To transport this average meal, we consume 4 to 17 times more petroleum than if the same meal were made from local ingredients. (Worldwatch Institute http://www.worldwatch.org/node/1749)

Considerable data have been collected for the 2009 Cowichan Region State of the Agriculture Industry report, and additional data are available from the Agricultural Land Commission and Statistics Canada's Census of Agriculture.

Indicators included in this report are:

> Local food production (food security)

> Farm land – total available and percentage in use

> Farm size and productivity

> Crop/livestock diversity

Local Food Production

Indicator and Measures

The Cowichan Region is one of the major agricultural areas on Vancouver Island, and has the potential to produce much of the food its residents need. Historically, the region produced large volumes of vegetables, berries and dairy products that fed a significant portion of the population;[130] as recently as 50 years ago, Vancouver Island farmers produced 85% of the Island's food.[131]

The Cowichan Agricultural Area Plan's Visions, Goals and Objectives document establishes a goal of 45% local food production, and has translated this goal into finite targets for food production.[132] These targets are based on the number of hectares needed to produce a healthy diet for the current population of the Cowichan Region, as outlined in the Canadian Food Guide.[133]

Findings

The Cowichan Economic Development Commission estimates that the Cowichan Region currently produces about 18% of its total food needs (Vancouver Island produces approximately 10% of the Island's total food needs).[134]

130 Cowichan Economic Development Commission, 2009.

131 Scott, 2004.

132 Cowichan Economic Development Commission. 2009.

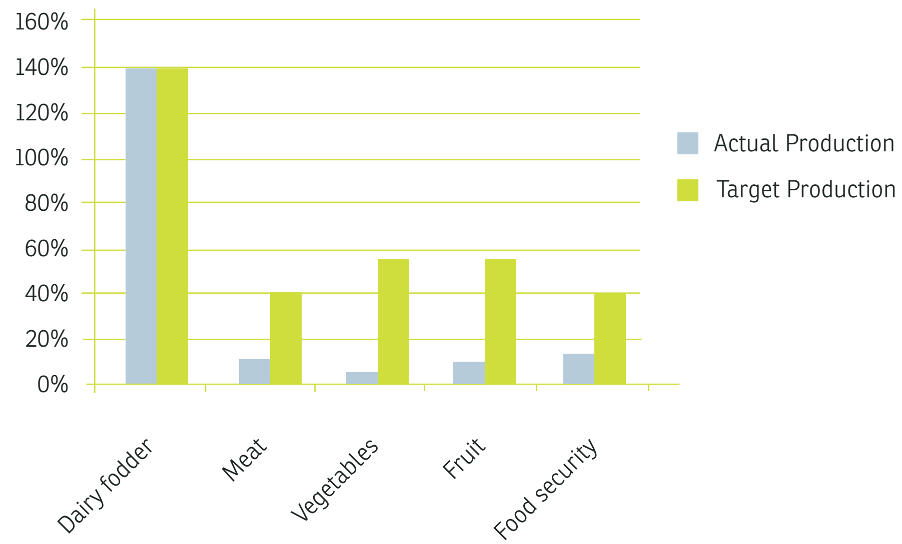
133 As outlined in "BC's Food Self-Reliance" www.agf.gov.bc.ca/resmgmt/Food_Self_Reliance/BCFoodSelfReliance_Report.pdf

134 Haddow, 2004.

In applying a regional goal of 45% local food production/food security, it becomes evident that Cowichan is producing more than enough fodder (e.g., hay, grasses, grains grown to feed dairy cattle), while the production of meat, fruits and vegetables are well below desired levels (Figure 3.11).

Data for seafood, non-timber forest products (e.g., mushrooms) and food grains were not available.

FIGURE 3.11: Actual food production versus food security targets



Source: Cowichan Agricultural Area Plan Visions, Goals and Objectives, 2009.

As part of its Food Security Mapping Project, the Cowichan Green Community is developing a 2010 local food map that will link customers with local farmers selling fresh food. www.cowichangreencommunity.org

Farm Land – Total Available and Percentage in Production

Indicator and Measures

The 2006 Cowichan Agricultural Area Plan used Canadian and BC agricultural land ranking systems[135] to determine how much of the region's land base is capable of agricultural production. These systems consider climate and soil characteristics, topography, drainage, and other landscape characteristics, and are not based on the current use of the land.

Part of the region's agricultural land base is protected through the Agricultural Land Reserve (ALR). Each year, the Agricultural Land Commission tracks the amount of land that is added to (inclusions) or removed from (exclusions) the ALR. This data does not monitor whether ALR land is actually being used for agricultural purposes, or what is being grown on that land.

Statistics Canada's Census of Agriculture records the amount of reported land being farmed (within and outside the ALR). This information is also monitored by the Ministry of Agriculture and Lands.

Findings

Total Available Farm Land

Almost 10% of the Cowichan Region's land base – or roughly 33,000 ha – is arable land, meaning land that can be cultivated. Of the region's 33,000 ha of arable land, roughly 50% (16,000 ha) is capable of producing crops such as vegetables, grains and fruit, and approximately 35% (9,400 ha) is considered prime agricultural land (suitable for a wide range of crops).[136]

When the Agricultural Land Reserve was established in 1974, it served to protect close to 22,000 ha of agricultural land. As of March 2008, there are about 17,700 ha of ALR in the Cowichan Valley Regional District (Table 3.2 and Figure 3.12) – for a net loss of approximately 4,300 ha.

While the overall trend for the past 35 years shows agricultural land being removed from the ALR and converted to other uses (residential development, industrial land, recreation facilities, and transportation infrastructures[137]), since 2000, the amount of ALR land has increased by 30 ha.

135 These ranking systems are the Canada Land Inventory and the Land Capability Classification System for Agriculture in British Columbia. Both systems identify land according to its potential and limitations for agriculture using a rating system of Class 1 to 7.

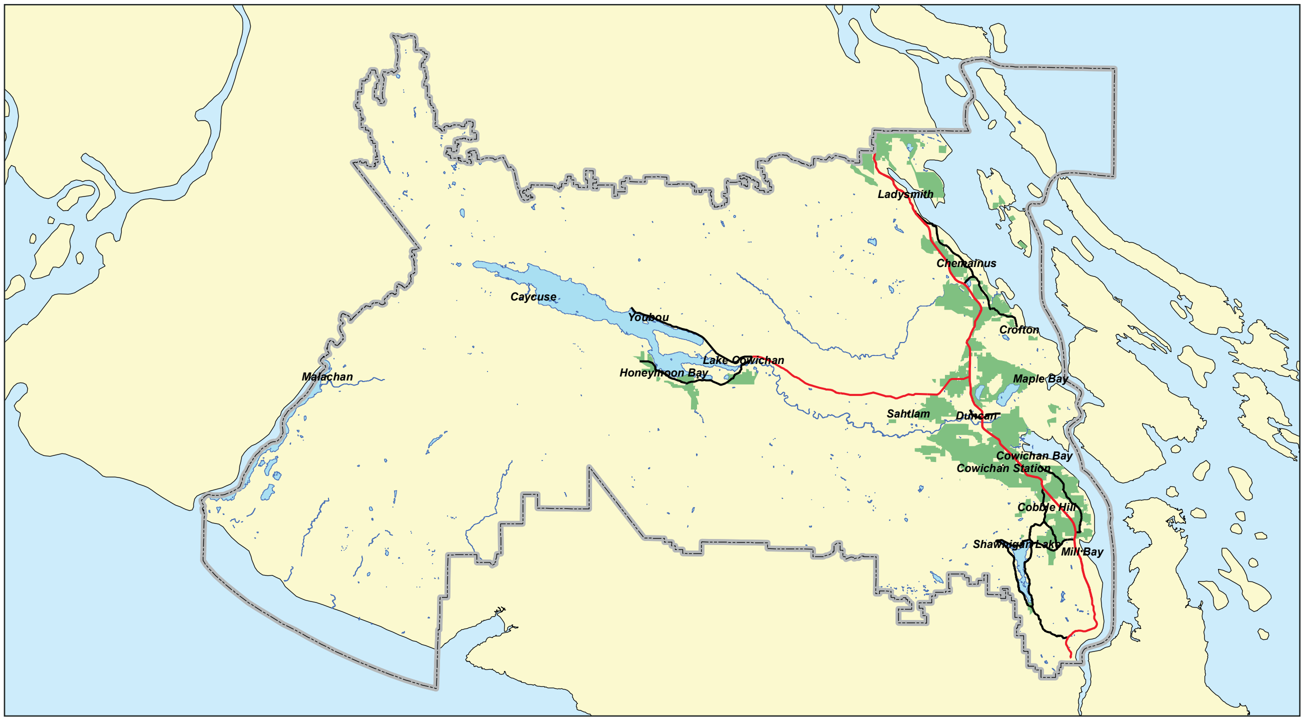
136 Cowichan Economic Development Commission, 2009.

137 Scott, 2004.

TABLE 3.2: Change in ALR, 1974–2008

	1974-2008	2000	2001	2002	2003	2004	2005	2006	2007	2008	2000-2008
Area at designation (ha)	21,984.0										
Inclusions (ha)	420.0	0.0	0.0	14.0	0.0	2.4	80.9	0.0	54.3	5.0	156.6
Exclusions (ha): govt	3,628.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exclusions (ha): landowner	1,054.0	0.0	0.0	35.0	18.2	36.8	3.0	0.0	30.0	4.0	127.0
Net change (ha)	-4262	0.0	0.0	-21.0	-18.2	-34.4	77.9	0.0	24.3	1.0	29.6
Area as of March 31, 2008 (ha) 17,722											

FIGURE 3.12: Location of Agricultural Land Reserve parcels, 2009



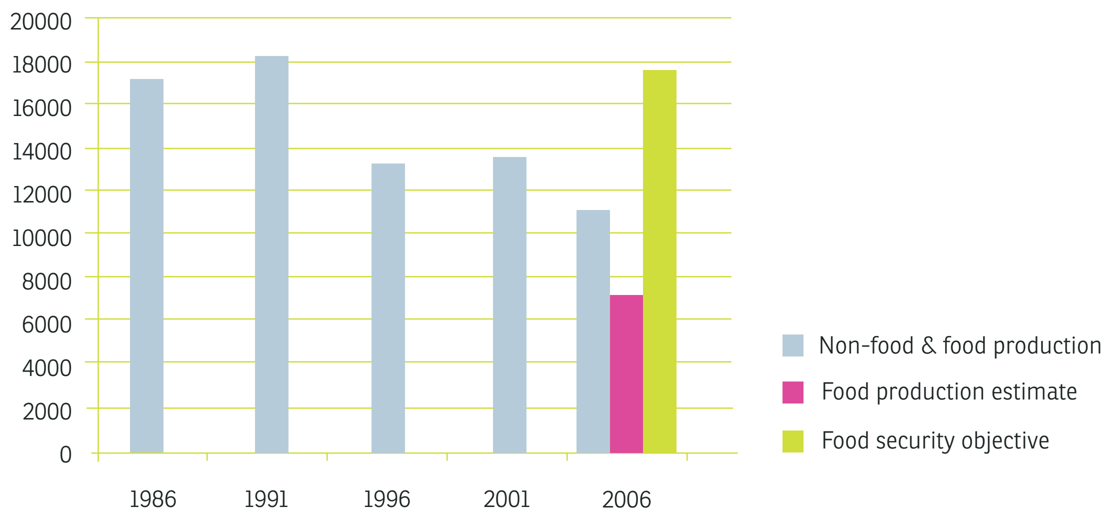
Source: Cowichan Green Community, 2009.

Percentage of Farm Land in Production

The reported amount of land being farmed has shrunk from a high of more than 18,600 ha in 1991 to about 11,600 ha in 2006 (Figure 3.13).[138] This figure of 11,600 ha includes non-food items (e.g., Christmas trees, maple tree taps, sod, vineyards, flowers and other nursery products).

The Cowichan Agricultural Area Plan estimates that the area includes a total of approximately 7,630 ha of food producing farm land.[139] This Agricultural Plan indicates that, to achieve 45% food security, the total amount of farm land in production would have to reach 17,977 ha. This means that the amount of farm land being used to produce food needs to more than double (from 7,630 ha to 17,977 ha) to achieve the region's food security target (Figure 3.13).

FIGURE 3.13: Area in farm production versus food production target



Sources: BC Ministry of Agriculture and Lands, 2008. Cowichan Valley Regional District Agricultural Overview, Cowichan Agricultural Area Plan, Vision, Goals and Objectives, 2009.

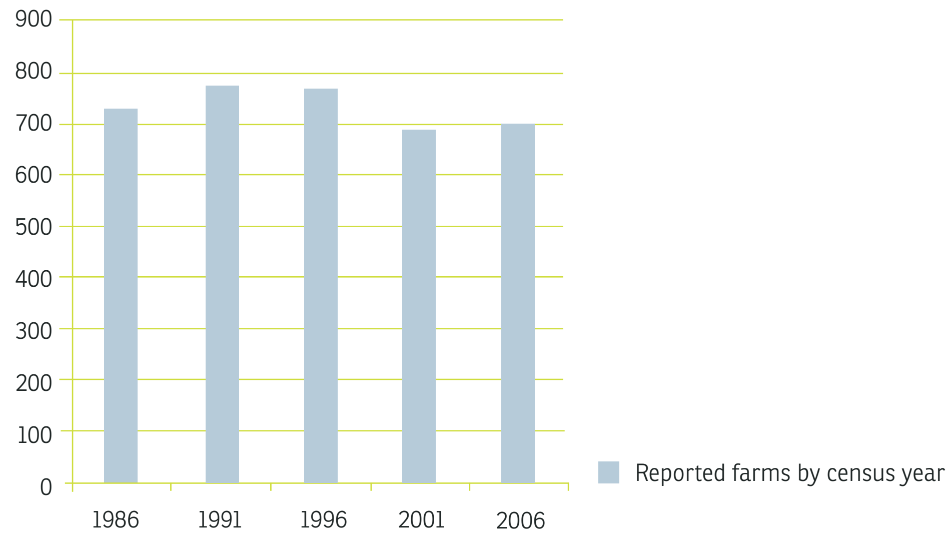
138 Ministry of Agriculture and Lands, 2008.

139 Cowichan Economic Development Commission, 2009.

The 2006 Census of Agriculture indicates that there are 700 farms in the Cowichan Region. The number of reported farms has remained fairly consistent since 2001, but has declined by more than 10% since the 1996 census (Figure 3.14).

The District of North Cowichan is home to a large percentage of the region's reported farms (55%), with most of the balance located in the South Cowichan area (28%) – including Cobble Hill, Cowichan Bay and Shawnigan Lake – and Saltair and on the Gulf Islands (12.5%).[140] This breakdown largely mirrors the location of the region's most fertile and arable land: on the east coast of the region, in the low elevation and floodplain areas.

FIGURE 3.14: Reported farms by census year, 1986 to 2006



Source: BC Ministry of Agriculture and Lands, Cowichan Valley Regional District Agricultural Overview, 2008.

The actual number of farms operating in the region may be significantly higher than the census data.[141] Some farmers prefer not to report their farming operations to avoid quota or supply management restrictions. Also, urban farming is an emerging trend that has yet to be properly accounted for.[142]

140 Cowichan Economic Development Commission, 2009.

141 Judy Stafford, Cowichan Green Community, personal communication, 2009.

142 Judy Stafford, Cowichan Green Communities, personal communication, 2009. For more information, see 2009 CVRD Issues and Opportunities, Phase 1 Discussion Paper.

An indication of the scope of unreported farms can be found in a 2000 study of small scale farming in South Cowichan. This study found that 10% of farm land in the South Cowichan sub-region was being used to grow food (including non-quota poultry and egg production) strictly for the benefit of family and friends.[143] A new Food Security Mapping Project being conducted by Cowichan Green Community may provide a more complete summary of farm operations.

Farm Size and Productivity

Indicator and Measures

Statistics Canada's Census of Agriculture data records farm size. Productivity is measured in farm receipts (farm revenues), which are also tracked using census data.

The Ministry of Agriculture and Lands monitors the number of reported farms in operation and the total hectares they are farming. However, due to the reluctance on the part of some farmers to be counted, this under-represents the number of farms. Also, direct sales at farm gates and at farmers' markets are not tracked, resulting in an incomplete picture of total farm receipts.

Findings

The average farm size in the region has been decreasing steadily for at least the past 20 years. In 1986, the average farm size was 31.2 ha; in 2006 it was 16.5 ha (a decline of 50%). Throughout this time, the majority of farms remained less than 52 ha in size, although there has been a slight increase in mid-sized farms (52–161 ha) (Figure 3.15).

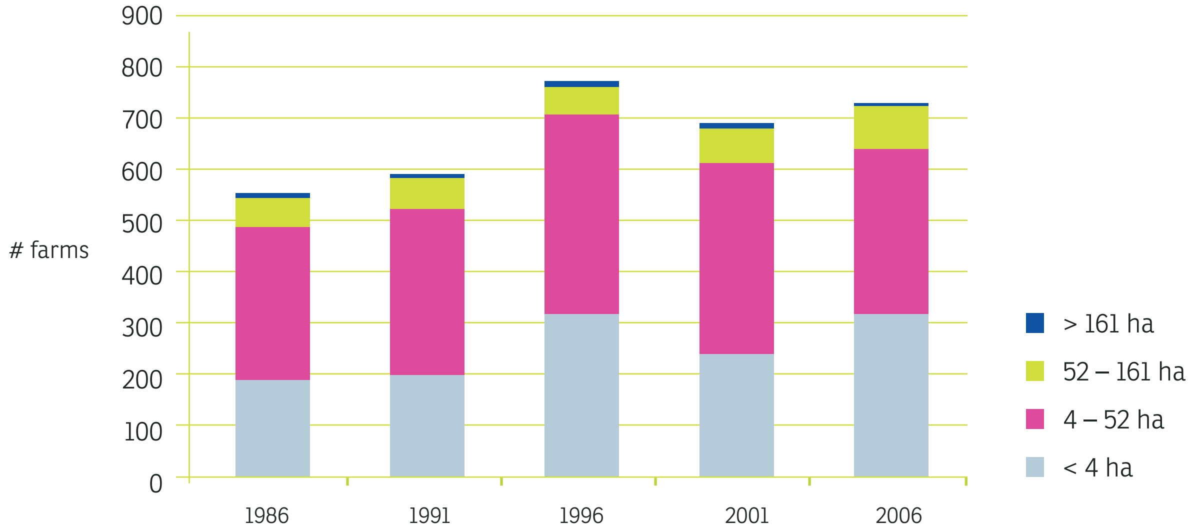
Despite the overall decrease in farm size, total farm gate sales increased by almost 50% between 2000 and 2005, and by 90% since 1986 (Figure 3.16).[144] In other words, farms are becoming smaller and more intensely productive. The average revenue per hectare increased from $1,467 in 1986 to $4,114 in 2005, a 280% increase. This increase in intensity may be partially attributable to more land under irrigation (each added hectare of irrigated land can displace 3+ hectares of non-irrigated land[145]).

143 BC Ministry of Agriculture and Lands, Small Scale Farming in South Cowichan Valley, 2000.

144 Cowichan Economic Development Commission, 2009.

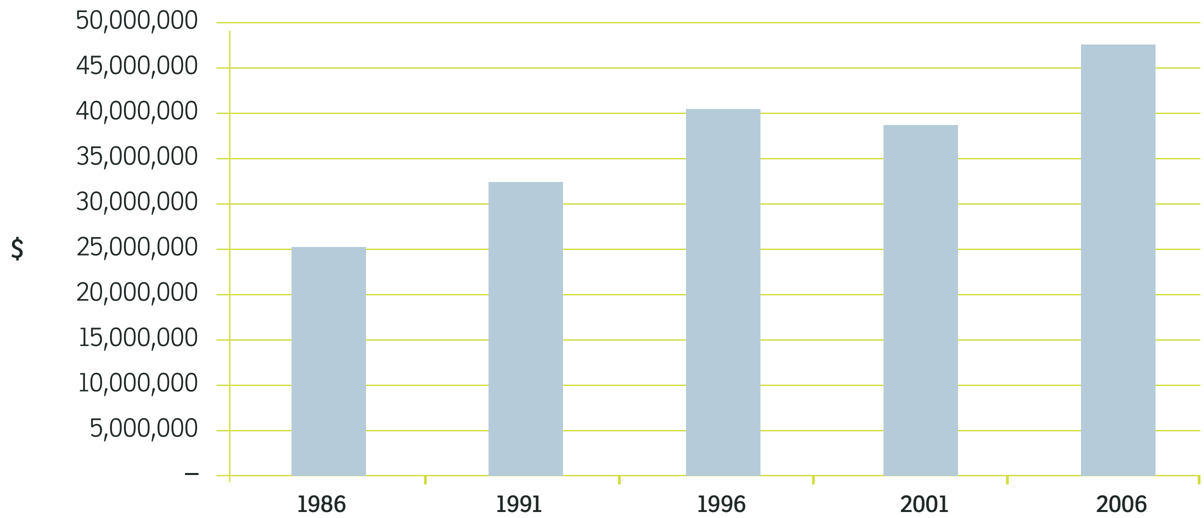
145 Cowichan Economic Development Commission, 2009.

FIGURE 3.15: Farm size, CVRD 1986–2006



Source: BC Ministry of Agriculture and Lands, Cowichan Valley Regional District Agricultural Overview, 2008.

FIGURE 3.16: Total Farm receipts, CVRD 1986–2006



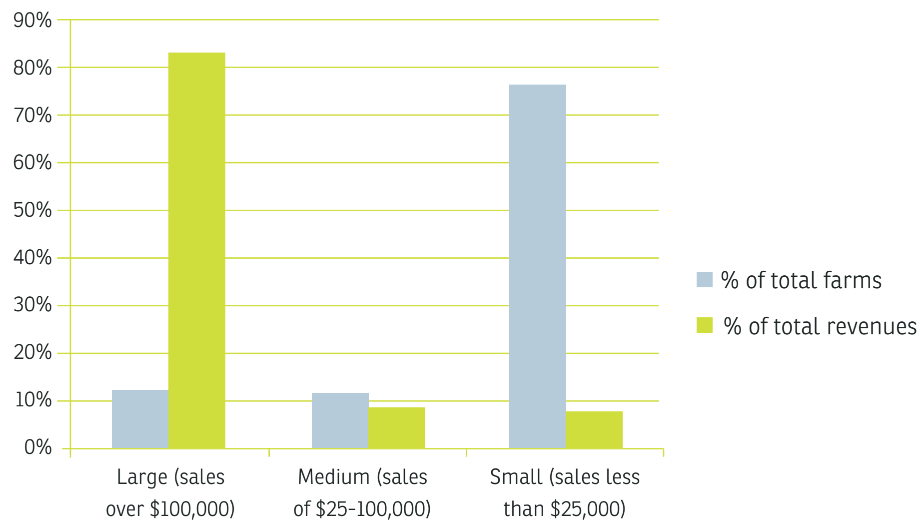
Note: Figures are reported in previous year dollars (e.g., 2006 is in 2005 $).

Source: BC Ministry of Agriculture and Lands, Cowichan Valley Regional District Agricultural Overview, 2008.

The vast majority of the region's farm revenues (83%) are generated from large-scale farms (sales over $100,000) which represent roughly 12% of all farms. Many of these high output farms are commodity producers who sell their product globally through formal marketing agencies and auctions.[146]

Almost in direct contrast, medium-scale/developing farms (sales of $25,000-$100,000) and small-scale farms (sales under $25,000) make up 84% of all farms, and generate 17% of revenues (Figure 3.17). Smaller farmers tend to sell most of their products directly to local consumers and retailers (only one in five uses formal marketing agencies), and almost half (40%) rely entirely on selling their products literally at the farm gate (Figure 3.18). [147]

FIGURE 3.17: Percent of total revenue generated by farm size in 2006

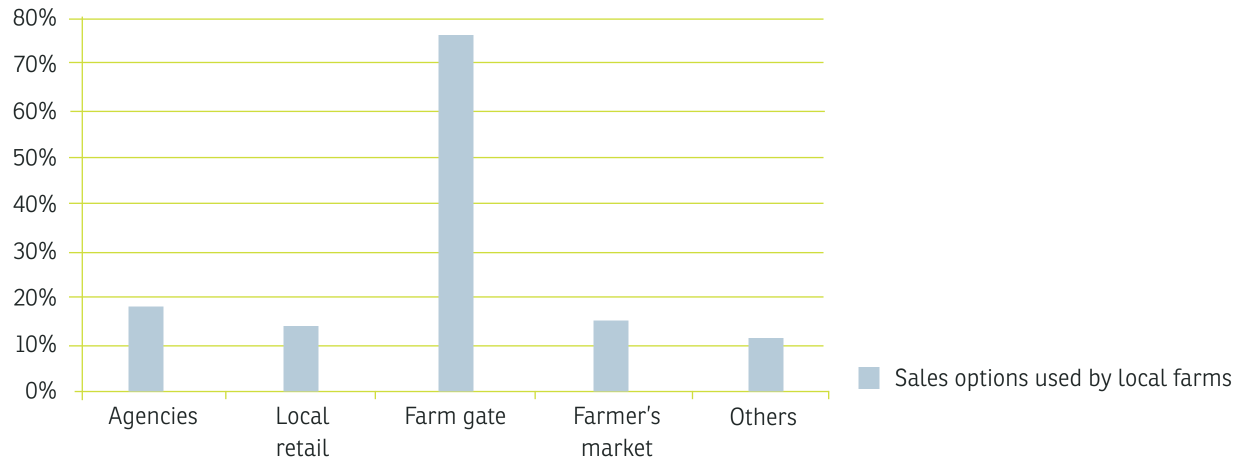


Source: Cowichan Economic Development Commission, State of the Agricultural Industry, 2009.

146 Cowichan Economic Development Commission, 2009.

147 BC Ministry of Agriculture and Lands, Small Scale Farming in South Cowichan Valley, 2000.

FIGURE 3.18: Methods of selling agricultural goods – sample of 72 South Cowichan farms



Source: Ministry of Agriculture and Lands, Small Scale Farming in South Cowichan Valley, 2000.

Crop/Livestock Diversity

Indicator and Measures

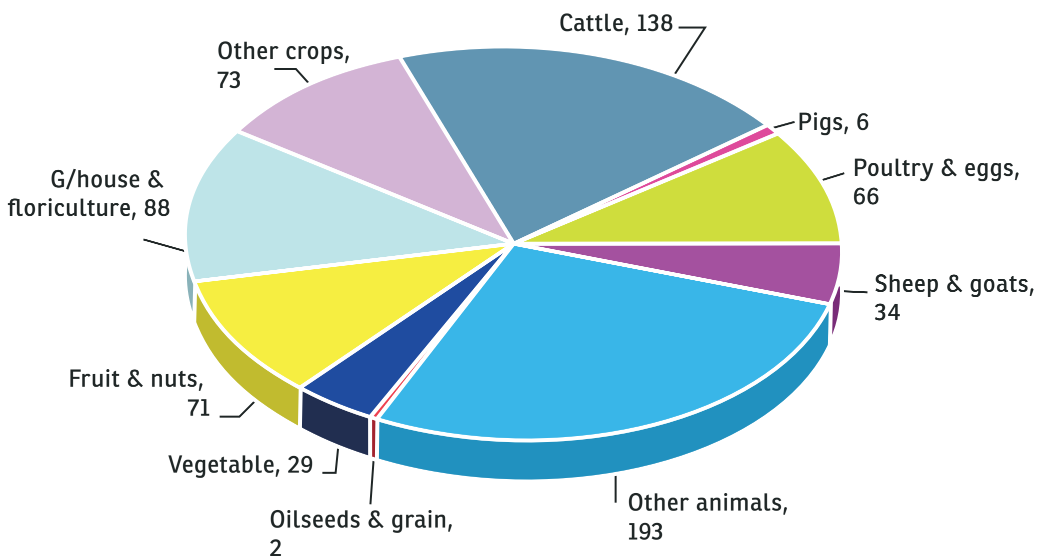
Statistics Canada tracks the variety of crops and livestock in production in its Census of Agriculture. Crop data is available as number of farms and total hectares, while information about livestock is reported as number of farms and number of heads of livestock, making it somewhat difficult to compare these types of production. Also, some farms produce both crops and livestock, so it is not possible to extract distinct totals in these areas of production.

This census data likely does not fully reflect the full range of agricultural activities taking place in the region. This is due to a significant number of farmers who choose not to be reflected in census data, as well as an increasing interest in urban or backyard farming. Also, food production from the sea and forests is not presently tracked.

Findings

Of the 700 reported farms in the region, approximately 47% are primarily involved in livestock operations, and approximately 37% are primarily involved in crop operations (Figure 3.19).[148] Many farms produce a combination of crops and/or livestock; a study of small scale farming in South Cowichan found that two-thirds of all farms (66%) are mixed farm operations.[149]

FIGURE 3.19: Livestock and crop major production categories (2006)



Source: Cowichan Agricultural Plan, State of the Industry Report, 2009.

The vast majority of crop operations (90%) are comprised of field crops[150] , although the production of fruits, berries and nuts[151] has risen from 1% to 3% over the past 20 years. This is accounted for largely by grape growing for the wine industry (grape production has grown from 1 ha in 1986 to 75 ha in 2006), as well as an increase in blueberry production (3 ha in 1986, 15 ha in 2006). The total area of cropland under production rose between 1986 and 2001, but shrank between 2001 and 2006 (Figure 3.20).

Vegetable production dropped from a high of 6.6% in 1996 to 1.2% in 2006.

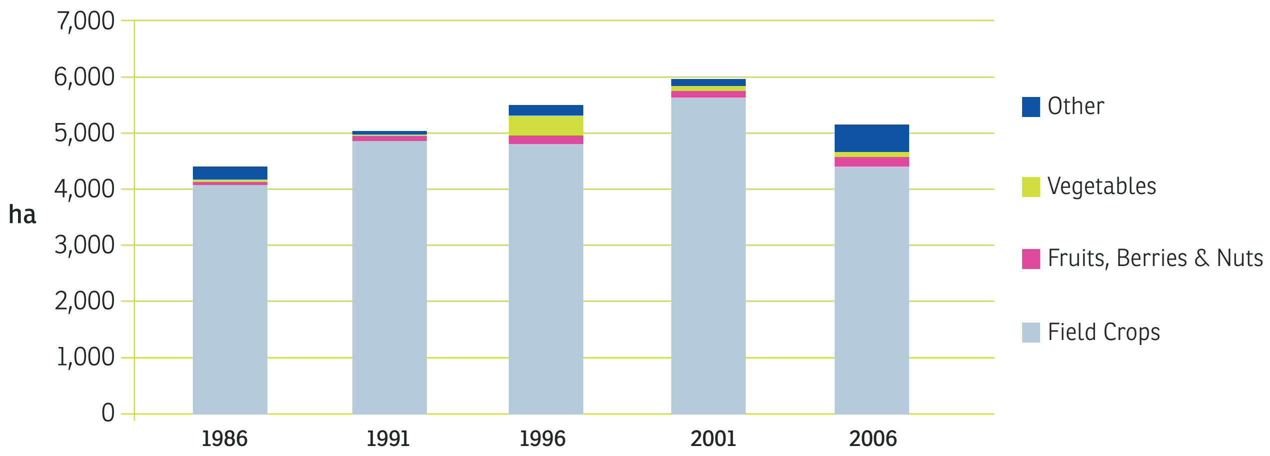
148 Cowichan Economic Development Commission, 2009.

149 BC Ministry of Agriculture and Lands, Small Scale Farming in South Cowichan Valley, 2000.

150 E.g., oats, alfalfa, rye, potatoes, hay, flaxseed, sunflowers.

151 E.g., apples, pears, plums, cherries, peaches, apricots, strawberries, raspberries, cranberries, Saskatoon berries, hazelnuts.

FIGURE 3.20: Crop land, CVRD 1986–2006



Note: "Other" includes crops not individually reported for confidentiality reasons.

Source: BC Ministry of Agriculture and Lands, Cowichan Valley Regional District Agricultural Overview, 2008.

Livestock operations include beef cattle, dairy cattle, chickens, turkeys, eggs, pigs, sheep, goats and honey. Predominantly non-food livestock includes horses, llamas, alpacas and rabbits. In 2006, the Cowichan Region accounted for 91% of all turkeys, 46% of all dairy cows, and 55% of all goats on Vancouver Island.[152]

The 2009 State of the Agriculture Industry report identifies a disturbing trend that has the potential to further compromise the region's ability to reach its food security goal. "The livestock industry is in a state of decline – especially ruminant livestock – dairy, beef and sheep. This is due to a combination of factors including increasing feed and fertilizer costs as well as significant increases in slaughter costs. Dairy production has also moved out of the area in recent years, as quota has become more transferable. This trend is disturbing because a large portion of the land base in the Cowichan Valley is only capable of producing forages. Also, the livestock industry has contributed greatly to helping maintain the agricultural infrastructure of the area."

A 2000 report on small scale farming in South Cowichan pointed to another troubling trend. It identified a key limitation to the growth of small scale livestock production as a "lack of auction and processing facilities."

152 Ministry of Agriculture and Lands, 2008.

The number of certified organic farms has risen in the past few years, from 6 farms in 2001 to 16 farms in 2006. Most of these grow fruits, vegetables or greenhouse crops. Greenhouse production has tripled in the past 20 years, from 14,874 m^2 in 1986 to 47,101 m^2 in 2006.

Summary

Agriculture is clearly a thriving and valuable industry in the Cowichan Region. The availability of arable land, coupled with an abundance of small-scale farming (characterized by small acreages, high-intensity production, crop/livestock diversity and direct sales to local consumers and retailers) appears to offer the necessary ingredients to achieving regional food security objectives.

However, current rates of reported productivity fall short of food security targets. Key barriers to achieving these targets include: access to irrigation water (and natural constraints on available water volumes) and skilled labour, an absence of processing and distribution facilities, high land prices, and restrictive food quotas.

Run-off from agricultural operations is contributing to water pollution, but there is no data on the extent of agricultural pollution or the steps being taken to reduce it.

Missing Information

There are several aspects of agriculture and food security that could not be adequately addressed in this report. Items which could be included in future such reports if data were available include the following.

> Water supply for agriculture: A changing climate means more extreme weather events (droughts, heat waves, floods) that can alter how and what kinds of food can be grown, the kinds of pests and diseases that growers will have to contend with, and the availability of fresh water. As of 2008, about 2,465 ha are irrigated in the Regional District.[153] Agricultural capability maps indicate that over 9,400 ha could be improved to prime (Class 3 or better) with irrigation – an increase of just under 7,000 ha. Data on groundwater availability are limited, and better information is required on how water supplies might be affected by climate change, and how the increased withdrawal of water for irrigation might affect adjacent ecosystems.

> Agricultural pollution: Run-off from agricultural operations is contributing to water pollution, but there is no data on the extent of agricultural pollution or any steps being taken to reduce it. The Ministry of Agriculture has been working with some local farms to implement their Environmental Farm Planning approach, which promotes stream bank buffers and other environmentally sustainable farm management practices. The South Cowichan Water Study program has identified this as an area of further study over the next few years in that portion of the region.

153 Ehrler-Limousin, 2009.

> Food processing capacity: Lack of local food processing capacity has been identified as an issue but there is no data to support clear reporting on progress (or lack of progress) to providing the necessary facilities.

> Food quotas: Supply-management quotas have been identified as a key barrier to achieving food security. These quotas may prevent local producers from meeting local demand. Further examination of this issue is warranted, and could begin with an assessment of existing quotas and how they relate to food security targets.

> The viability of farming: Small-scale farmers play a vital role in contributing to regional food security. Issues affecting their long-term viability include high land prices and unsustainably low incomes. Related issues include food distribution challenges and access to larger markets, and the availability of skilled labour. Presently, little data exists to provide a more complete understanding of these challenges.

> Urban agriculture: Many people have become interested in producing food at home or in community gardens. This provides an important contribution to the local food supply, but no data are available to report on this activity.

> Productive agricultural land within/outside the ALR: At this time, there is no accurate information about the total land area being farmed in the Cowichan Region (ALR and non-ALR), or what is being grown on that land. Current estimates do not include urban farms and farming operations taking place "under the radar."[154] The Cowichan Region's 2009 State of the Agriculture Industry report indicates that, of the 32,830 ha of arable land in the region, only 35% are in production.[155] This report also states:

"5.1% of the land in the Cowichan Valley is in the ALR. Only 3.3% of the land base in the region is actively farmed – presumably, most is within the ALR – so a significant portion of the ALR is not actively farmed."[156]

> Food security: future reporting may want to compare actual levels of food production to the regional objectives, and report on some of the indicators highlighted in the 2010 Cowichan Food Security Plan.[157]

---

154 Judy Stafford, Cowichan Green Communities, personal communication, 2009. For more information, see 2009 CVRD Issues and Opportunities, Phase 1 Discussion Paper.

155 Cowichan Economic Development Commission. 2009.

156 Cowichan Economic Development Commission. 2009.

157 This plan is available at: www.cowichangreencommunity.org/sites/default/files/CowichanFoodSecurityPlanFinalDraft.pdf

References

Agricultural Land Commission Statistics. www.alc.gov.bc.ca/alr/stats/Statistics_TOC.htm. Accessed December 30, 2009.

Cowichan Economic Development Commission. 2009. Cowichan Region Area Agricultural Plan—State of the Industry Report.

Cowichan Green Community. 2008. Cowichan Food Security Plan.

Ehrler-Limousin, Arnold Harasymchuk. 2009. From the Ground Up—Issues And Opportunities: Phase 1 Discussion Paper.

Haddow, Wayne. 2001. Consumers are King. FarmSpeak Conference. Cited in A Baseline Assessment of Food Security in BC's Capital Region (2004).

Ministry of Agriculture and Lands. 2008. Cowichan Valley Regional District Agricultural Overview.

Municipality of North Cowichan. 2008. Food Security and Agricultural Enhancement: Discussion Paper.

Scott, Ramona. 2004. Agriculture and Conservation: Striving for the Best of Both in One World. Presentation to 2004 Canadian Food Security Conference on behalf of The Land Conservancy of BC.

Westland Resource Group. 2005. Water Facts. Report Prepared for Cowichan Valley Regional District, BC Ministry of Environment, Fisheries and Oceans Canada, Catalyst Paper Corporation, Cowichan Tribes and Pacific Salmon Commission.

3.3 Drinking Water Supply

Introduction

Drinking Water in the Cowichan Region

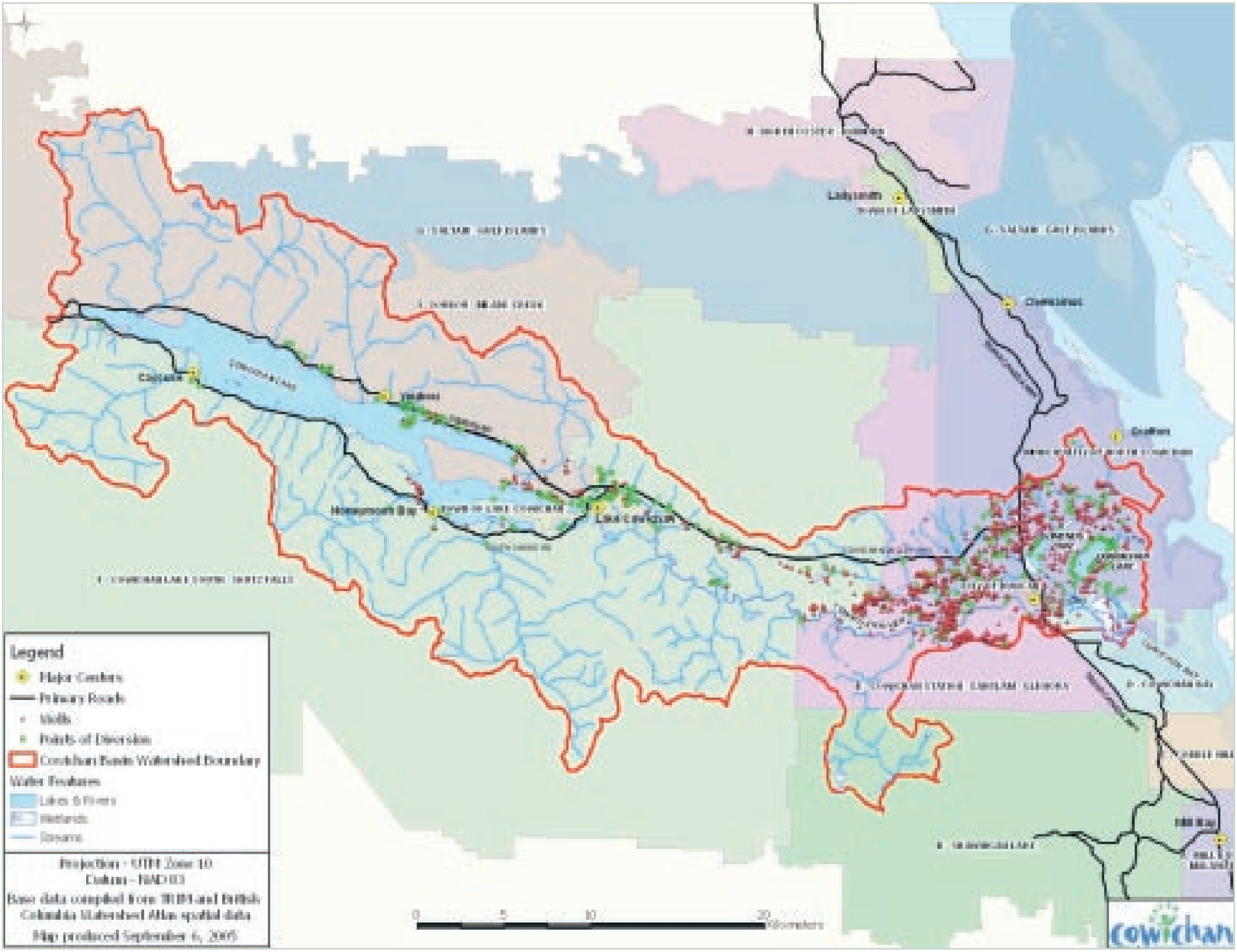
Drinking water (also known as potable water) is used for a variety of household purposes such as drinking, cooking, washing dishes, and showering. Potable water (i.e., water from the same source that supplies drinking water pipes) is also used for many non-drinking purposes, such as flushing toilets, washing cars and irrigating lawns. Business and industry also need water for a variety of activities and processes. The over-use of water for such human purposes can have serious ecological consequences. For example, streams can run dry and be unable to support fish and other aquatic species, and wetlands can no longer support the same types of plants and animals.

In the Cowichan Region, water is either drawn from groundwater sources (wells) or from surface water sources (lakes, creeks). Regional, local and First Nations governments supply much of the water used by CVRD residents and businesses, with the balance supplied by approximately 25 private operators and extracted via private wells (Appendix B). While the total number of private wells in the region as a whole is not known, the Ministry of Environment wells database identifies more than 1,300 wells in the Cowichan Basin, with more than 530 water licenses in that area (Figure 3.21). In 2004, 667 water licenses were issued in the Cowichan and Koksilah watersheds[158], with pulp mills licensed for 83% of the total licensed withdrawal volume.

See Section 2.6 for more information on water quantity and quality in the Cowichan Region.

158 LGL, 2005.

FIGURE 3.21: Location of wells and points of diversion in the Cowichan Basin



Source: Cowichan Basin Water Issues, Final Report, 2005.

The supply of drinking water is a major concern for the Cowichan Region. Despite this region's often wet winters, water is a limited resource – especially during dry summers. As the population of the region increases, there will be additional pressures on water supply. Climate change is also expected to further limit water supply, as reduced snow packs (see Section 1) lessen the run-off to lakes and creeks during the spring and summer. Concern regarding groundwater levels and aquifer supply is also on the increase, with some well users fearing that new draws on aquifers will exceed their capacity to provide drinking water for all users.

Concerns about drinking water cannot be isolated from the use of water for other purposes: agriculture, ecosystem needs (fish and other aquatic populations), industrial use, and water-based recreational activities. The Cowichan Valley Regional District is addressing some of these issues through studies such as:

> The South Cowichan Water Plan Study[159]: a preliminary study of the region's current water resources and needs (with estimates of future needs), and a water management framework. This will lead to a Water Management Plan for the areas of Mill Bay/Malahat, Shawnigan Lake, Cobble Hill, and Cowichan Bay.

> The Cowichan Basin Water Management Plan[160]: a comprehensive review of water supply issues in the Cowichan Basin, with recommendations on ways to provide adequate water for human and ecological needs now and into the future. One outcome of this Plan has been the formation of a Cowichan Basin Watershed Advisory Board to guide the implementation of the Cowichan Basin Water Management Plan.

Concerns about water quantity are coupled with concerns about water quality. Both surface water and groundwater sources are vulnerable to contamination from pollutants. Water purveyors (public and private) are responsible for testing and treating (if necessary) drinking water before it is delivered to households. Therefore, water users on these systems can generally be assured of the quality of the drinking water, unless boil water advisories are issued. For residences served by private wells, there are always fears about contamination from nearby sources such as leaking septic fields. In coastal areas, sea level rise, particularly in conjunction with aquifer draw-down, could lead to salinization of the water supply, rendering it undrinkable.

Measuring Drinking Water

It would be ideal to be able to measure the total and per capita amount of drinking water consumption from all sources across the region. However, as noted above, there are many different water systems throughout the Cowichan Region, both public and private, and most homes in the region are not metered. This makes it virtually impossible to track region-wide water consumption with any accuracy. Only partial information was available for inclusion in this report.

It would also be helpful to be able to track the water levels of the region's aquifers, in order to better understand whether the region is using groundwater faster than it can be replenished by precipitation. Again, these data are only available for parts of the region.

159 WorleyParsons, 2009.

160 Westland Resource Group, 2007.

This report does not include any information on the quality of drinking water. Data on boil water advisories is available, but it was not felt to be a useful indicator. The CVRD is gradually replacing problematic water sources, or taking over privately run small water systems, to ensure that drinking water quality remains high, and the boil water advisories largely indicate where this has not yet happened.

Water Consumption

Indicator and Measure

This indicator is a measurement of the quantity of water consumed. The indicator includes the total amount of water consumed (for household, industrial/commercial, and agricultural purposes), as well as the per capita amount. This is important to know, since, even if per capita use is dropping, the overall amount consumed could increase as the population increases, stressing limited water supplies further.

Data on water consumption is variable across the CVRD. Where there are municipal water systems (as for Ladysmith, Lake Cowichan and Duncan), monthly water consumption data are available.

All CVRD-operated water systems are automatically on Stage 1 watering restrictions from June 1 to October 31 of each year, limiting the number of watering days and hours. In drought conditions, additional water use restrictions may apply.[161]

Findings

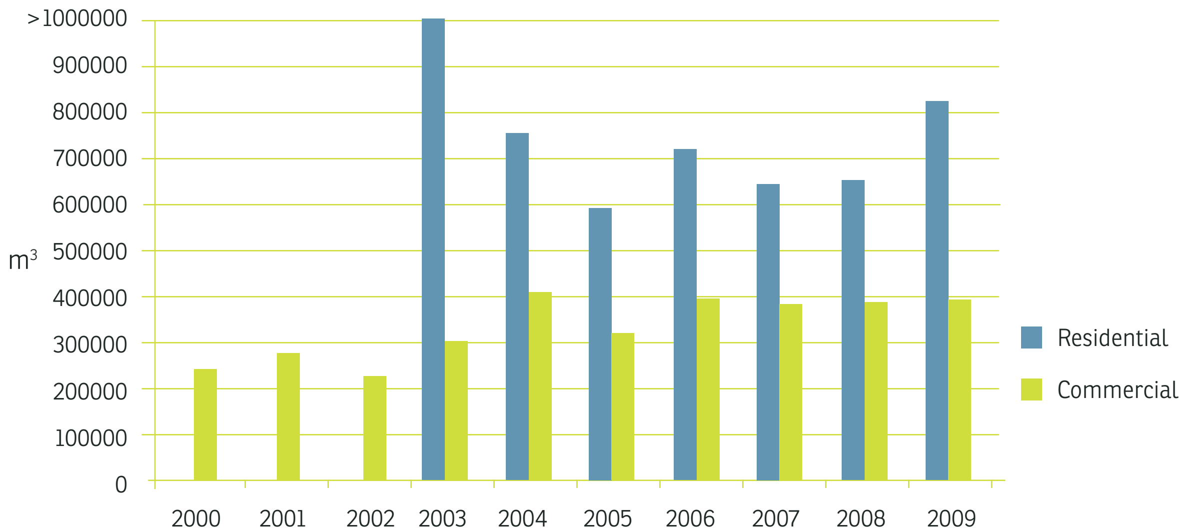
Water consumption data were available for three communities: Ladysmith, Duncan and Lake Cowichan.

Town of Ladysmith

Ladysmith is the first community in the region to have all water users on meters. All commercial operators were metered as of the mid-1990s. As of 2002, all residential users were also metered, and charging for water use based on metered amounts began in 2005. Ladysmith data show annual usage for commercial and residential users (Figure 3.22).

161 CVRD Watering Regulation Summary Table, cvrd.bc.ca/documents/Engineering%20Services/Utilities/Water/Forms/WateringRegTable.PDF

FIGURE 3.22: Town of Ladysmith water consumption 2000–2009



Source: Town of Ladysmith.

For 2003, the first year meters were fully operational, residential consumption was 2,750,000 m^3 annually. This dropped to 750,000 m^3 the following year, even though water usage was not being charged by consumption, and further yet in 2005 (to 580,000 m^3) when consumption charges were first introduced, indicating that metering helped to raised awareness of water conservation. Overall, water usage since 2002 has declined by 23%, in spite of a population increase of 17%.[162] However, total residential usage has generally increased over the past five years. For 2009, the per capita consumption (residential only) was 313 m^3 per person.

Commercial usage has been relatively stable for the past five years.

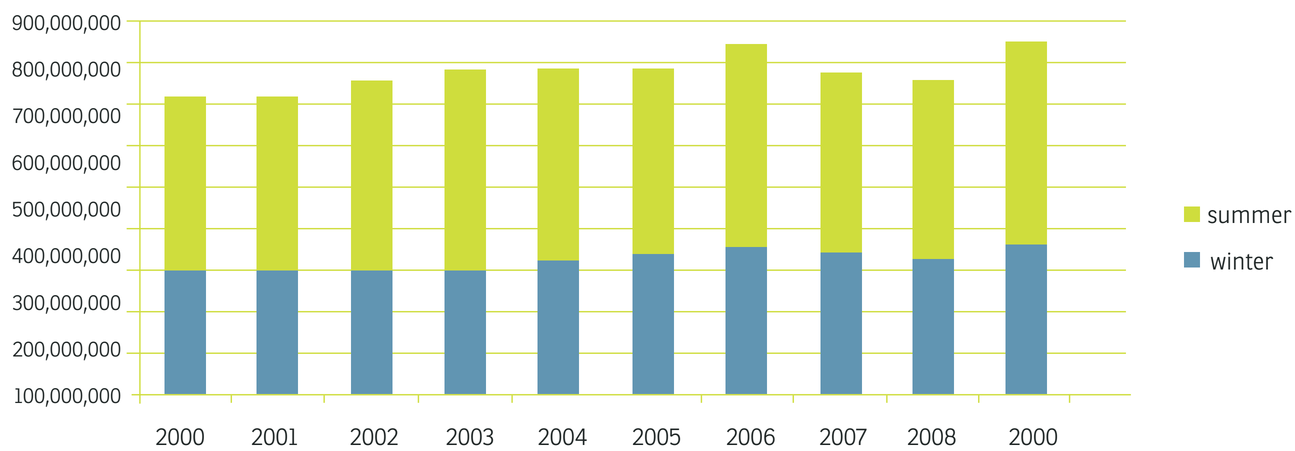
City of Duncan

The City of Duncan tracks monthly overall water consumption. Figure 3.23 below shows water consumption from 2000 to 2009, for winter water use (January–March and October–December) and summer use (April–September). Summer water use is typically higher as it includes lawn and garden watering.

The City of Duncan is retrofitting residences with water meters over the next few years.

162 Joe Friesenham, Director of Public Works, Ladysmith, personal communication, 2009.

FIGURE 3.23: City of Duncan water consumption 2000–2009



Source: City of Duncan

Total water consumption has gradually increased over the past decade, although amounts vary in relation to the summer weather. However, the population of Duncan rose by only 3% between 2001 and 2006, yet the winter water consumption rose by almost 15% during this same period.

Town of Lake Cowichan

The Town of Lake Cowichan tracks daily and monthly water consumption. Figure 3.24 shows the community's total water consumption over the past decade, for winter use (January–March and October–December) and summer use (April–September). As in Duncan, water use during the six months including summer is higher due to outside watering.

Most of Lake Cowichan's commercial operations are metered. The Town of Lake Cowichan is currently installing meters for all water users, and all residences will be metered by the end of 2010. The process of installing meters is helping to identify more leaks, as each meter's backflow valve pressurizes each house.

FIGURE 3.24: Town of Lake Cowichan water consumption 2000–2009

Source: Town of Lake Cowichan.

Water consumption data are variable as the Town has had significant issues with leaky pipes, which it has been working to fix. In general, water consumption has been decreasing since 2005, largely due to fixing leaks in the system. In 2009, there was a big leak (half a million litres a day) that took a long time to locate, resulting in a spike in use. The Town of Lake Cowichan's population grew by 4.3% between 2001 and 2006.

Other Users

Industry is one of the most significant water users in the region. Catalyst Paper, for example, has a licence to use 240 million litres of water per day from the Cowichan River (although actual usage is lower, at approximately 150 million litres per day), which it pipes to the Crofton Mill. This is also the water source for the community of Crofton.

Summary

Having secure supplies of drinking water is essential to the people of the Cowichan Region, and the ability to provide reliable sources of drinking water shapes growth and development. Drinking water in the Cowichan Region comes from both groundwater and surface water sources, provided by public and private water purveyors as well as from individual wells.

Many of the region's residents are not on a metered water system, so it is hard to track use from households (as opposed to the water used by industry, business and agriculture, which may also be served by the same water source). As well, data on the consumption of groundwater by private wells are not available. Three municipalities are moving towards water metering. Ladysmith now has full metering, and residential water use has declined considerably since meters were first installed, although it seems again to be on the rise. Water consumption in Duncan and Lake Cowichan is generally rising, and both communities are in the process of installing water meters. Water consumption varies by year, in part due to summer watering of lawns and gardens.

Missing Information

Information on groundwater use by private wells is very limited. Even in the Cowichan Basin, where more extensive studies have been conducted, information on the use of water from wells is poor. There is monitoring of the quantity of surface water taken by licensed water users, but no monitoring to ensure that groundwater extraction matched the permitted amount.[163]

References

BC Ministry of Environment. 2007. Environmental Trends in British Columbia: 2007. State of Environment Reporting. Victoria, BC. **www.env.gov.bc.ca/soe/et07/**

Westland Resource Group. 2005. Issues Report. Report Prepared for Cowichan Valley Regional District, BC Ministry of Environment, Fisheries and Oceans Canada, Catalyst Paper Corporation, Cowichan Tribes and Pacific Salmon Commission. September 2005.

Westland Resource Group. 2005. Water Facts. Report Prepared for Cowichan Valley Regional District, BC Ministry of Environment, Fisheries and Oceans Canada, Catalyst Paper Corporation, Cowichan Tribes and Pacific Salmon Commission. October 2005.

Westland Resource Group. 2007. Cowichan Basin Water Management Plan. Report prepared for Cowichan Valley Regional District, BC Ministry of Environment, Fisheries and Oceans Canada, Catalyst Paper Corporation, Cowichan Tribes and Pacific Salmon Commission. March 2007. **cvrd.bc.ca/documents/Engineering%20Services/Environment/Cowichan%20Basin%20Water/CBWMP_29Mar07.PDF**

WorleyParsons. 2009. South Cowichan Water Plan Study: A Preliminary Assessment of Water Supply & Needs Within the South Cowichan Region. Report Prepared for the Cowichan Valley Regional District. February 2009. **www.cvrd.bc.ca/documents/Engineering%20Services/Utilities/Water/SCow%20WaterPlan%20FINAL-Feb09OCOMPRESSED.PDF**

163 Louise Knodel-Joy, Sr. Engineering Technologist, Water Management, CVRD, personal communication, 2010.

3.4 Climate Change Mitigation and Adaptation

Introduction

Climate change is upon us. The 2009 Copenhagen climate conference update[164] states that "rapid, sustained, and effective mitigation is required to avoid dangerous climate change" and that "inaction is inexcusable."

In order to mitigate the effects of additional climate change, the amount greenhouse gases released into the atmosphere must be reduced. At the same time, steps need to be taken to adapt to the climate change that is already happening and is expected to become more pronounced in the coming years. Together, steps to mitigate and adapt to climate change are referred to as climate action.

Section 1 provides a description of the climate change impacts expected in the Cowichan Region.

Measuring Climate Action

Measuring Climate Mitigation Efforts

Efforts to mitigate climate change can be measured by tracking:

> Energy and emissions

- The use of fossil fuels as an energy source
- The use of "clean"[165] (low-carbon) energy sources
- Greenhouse gas emissions from buildings, transportation and waste management activities; and

> The availability of carbon sinks (that absorb carbon dioxide from the atmosphere).

Energy use and greenhouse gas emissions data are available through the provincial Community Energy and Emissions Inventory[166] (CEEI) which tracks energy use from buildings, transportation and waste in all BC communities. The 2007 CEEI Reports presents high-level estimated community energy consumption and greenhouse gas emissions from various sectors.

164 Climate Change Synthesis Report, Copenhagen, 2009. www.climatecongress.ku.dk/pdf/synthesisreport

165 Low carbon or carbon neutral sources of energy, such as solar or wind power.

166 toolkit.bc.ca/ceei

The province is currently working on updating and improving the data quality of the CEEI reports; however, revised data were not available at the time of writing. CEEI background material notes that

> *"As with most inventories, the level of accuracy depends highly on the completeness of the data sources and consistency in the methodologies applied... The CEEI Working Group will continue to work to improve data accuracy. As data improves, past reports will be updated and re-posted in order to provide a consistent method of comparison over time."*[167]

The 2007 CEEI Report User Guide provides additional information on accuracy and technical issues.

The 2007 CEEI data are limited, in that reporting was restricted to information that was available province-wide, and does not include, for example, energy and emissions related to oil-based home heating or wood stoves. However, the provincial nature of the data makes it easy to compare the results for the Cowichan Valley Regional District (CVRD) to other regional districts.

Measuring Climate Adaptation Strategies

Climate adaptation measures include actions taken to prepare communities for the expected impacts of flooding, drought, sea-level rise, and more intense wind- and rain-storms. These changes will create impacts throughout the region, including to industries such as agriculture, forestry, tourism, and fishing, and to infrastructure requirements. At this time there are no statistical measures of climate adaptation strategies, but this report lists some of the actions taking place with climate change needs in mind.

Adaptation measures will also require taking action to address expected population and social changes brought by global climate change, such as climate refugees from other countries. However, these matters are beyond the scope of this State of the Environment report.

167 www.env.gov.bc.ca/epd/climate/ceei/faq.htm

Energy and Emissions

Indicator and Measure

The Community Energy and Emissions Inventory (CEEI) tracks energy use from buildings and transportation, and estimates emissions from these sources as well as from solid waste and deforestation. Emissions are measured as "carbon dioxide equivalent" (CO_2e), as some sources such as methane have a far greater greenhouse gas impact than carbon dioxide.

> The buildings sector is subcategorized into residential, commercial and industrial buildings. Each subcategory includes the number of connections, the amount of actual energy consumed (e.g., electricity in kWh and natural gas in GJ), and the resulting carbon dioxide equivalent (CO_2e) totals for each building subcategory, as well as a CO_2e subtotal for the sector.

> The on-road transportation sector is subcategorized into several passenger and commercial vehicle classes. Each subcategory includes an estimate of the amount of fuel used (e.g., gasoline, diesel fuel, and mobile propane), and the resulting CO_2e totals for each vehicle class, as well as a CO_2e subtotal for the sector. Emissions from rail, marine and air travel are not included in the 2007 data.

> The solid waste sector includes the estimated mass of waste disposed of by local governments at community and/or regional landfill(s), with the associated CO_2e (methane) net of any known landfill gas flaring, methane capture, etc.

> The land-use change (deforestation) sector includes the estimated amount of CO_2e from the clearing of forests for urban development and agriculture. For the purposes of greenhouse gas accounting, deforestation is defined as "the direct human-induced conversion of forested land to non-forested land." This measure looks only at deforestation, and does not consider afforestation activities. This data is provided only at the regional district level.

The Cowichan Valley Regional District and some of its member municipalities have also undertaken inventories of their own (corporate) energy and emissions.

Findings

Community Energy and Emissions Inventory (CEEI) Results

Table 3.3 and Figure 3.25 show that in the Cowichan Region, on-road transportation consumes more energy than buildings (55% compared to 45%). However, when comparing the greenhouse gas emissions from these sources, the contribution of transportation is more than six times that from buildings (Figure 3.26). This is because electricity is a major source of energy for buildings, and in British Columbia most electricity comes from "clean"[168] (hydro) sources (the 2007 electricity emissions factor used is 0.022 tonnes/kWh.[169]).

In the Cowichan Valley, deforestation is also identified as a significant source of greenhouse gas emissions (9%). Deforestation has been identified globally as one of the largest contributors to overall greenhouse gas emissions, and as a primary area for action to mitigate climate change.[170]

Total emissions from all sectors are 427,398 tCO_2e.

TABLE 3.3: Energy use – buildings and on-road transportation

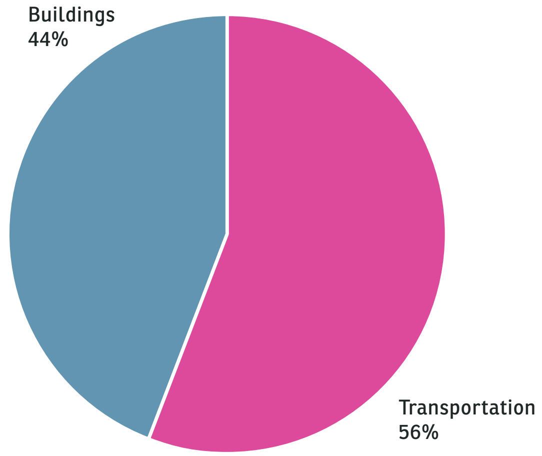
Buildings	(Energy GJ)
Residential	2,291,368
Commercial	1,110,984
Industrial	104,292
Total	3,506,644
On-road transportation	Energy (GJ)
Small cars	754,182
Large cars	367,023
Light trucks, vans, SUVS	2,154,185
Commercial vehicles	897,786
Tractor trailer trucks	123,607
Motor homes	86,746
Motorcycles/mopeds	28,688
Bus	90,314
Total	4,502,531

168 Hydro-electric power is considered a "clean" source of energy as it is a low-carbon form of energy, unlike, for example, electric power from a coal-fired power station. However, it should be noted that British Columbia imports power from Alberta and the United States during peak periods, and so not all electricity comes from "clean" sources.

169 CEEI Reports User Guide, March 2009.

170 International Panel on Climate Change, Contribution to Group III: Summary for Policymakers, 2007. www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-spm.pdf

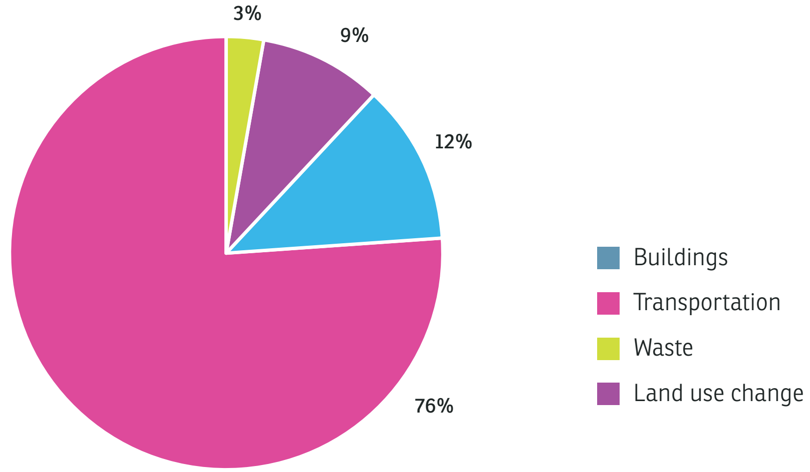
FIGURE 3.25: Energy use by sector, 2007



Source: Community Energy and Emissions Inventory, 2007

www.env.gov.bc.ca/epd/climate/ceei/pdf/2007Cowichan-Valley-rd.pdf

FIGURE 3.26: Emissions by sector, 2007



Source: Community Energy and Emissions Inventory, 2007

www.env.gov.bc.ca/epd/climate/ceei/pdf/2007Cowichan-Valley-rd.pdf

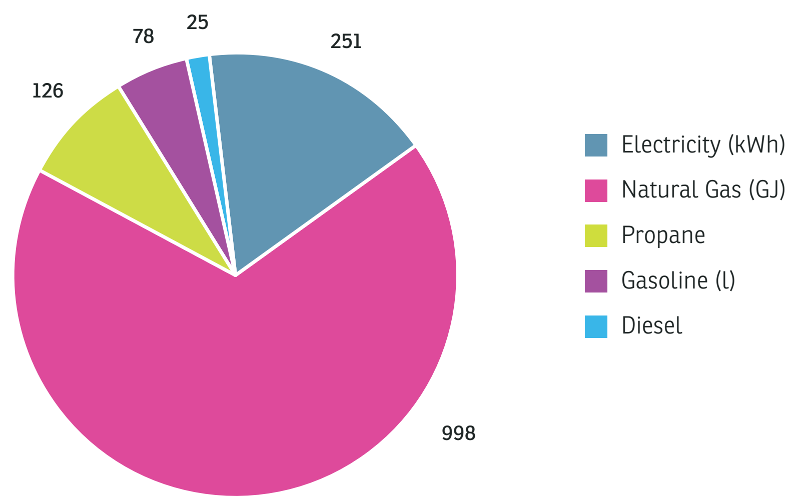
Cowichan Valley Regional District Emissions

The Cowichan Valley Regional District and its member municipalities have signed the Climate Action Charter[171], pledging to reducing both corporate greenhouse gas emissions (resulting from local government operations) and community emissions (from the community as a whole), and becoming carbon neutral in respect to their operations by 2012. Figure 3.27 shows the CVRD's corporate emissions from a variety of fuel sources. Natural gas is by far the largest source of corporate emissions from these sources. The total emissions from the CVRD corporate activities are 1,478 tCO_2e. This is less than 0.4% of the total (community) emissions for the region, meaning that, while the CVRD must lead the way in reducing emissions, community emissions remain by far the largest contributor to climate change.

If the CVRD were to buy offsets for its corporate emissions at $25 per tonne (to become "carbon neutral),[172] this would cost almost $37,000 per year, based on 2007 activities.

Under the 2008 Local Government (Green Communities) Statutes Amendment Act, municipalities are required to have specific and quantifiable emission targets in their Official Community Plans by May 2010 (the Regional District has until May 2011 to prepare emissions targets for the region).

FIGURE 3.27: Emissions, CVRD 2009



Note: Units are tCO2e.

Source: CVRD, 2009.

171 www.cd.gov.bc.ca/ministry/docs/climate_action_charter.pdf

172 $25 per tonne is the amount that provincial facilities will pay to offset carbon emissions in 2010. Local governments are not currently legally required to pay carbon offsets.

Emissions by Municipality

The City of Duncan has prepared a 2008 Report on Energy and Emissions.[173] This report found that overall corporate (municipal operations) energy consumption in 2007 was 14,946.6 GJ, and emissions were 332.4 tCO_2e. Categories include city-owned facilities, Public Works and Fire Department vehicles, water and wastewater systems, street and signal lighting, and solid waste generated at city-owned facilities. Corporate emissions increased by 3.8%, or 12.6 tCO_2e, from 2007 to 2008. The report identified targets for inclusion in the Official Community Plan (suggesting a 33% reduction by 2020 and 80% by 2050, relative to 2007 levels), and a series of strategies to reduce energy use and emissions.

The Town of Lake Cowichan has also produced a detailed Report on Energy and Emissions[174] (2009). This report found that total emissions for corporate operations in 2007 were 205.2 tCO_2e. The top greenhouse gas emitters for the Town of Lake Cowichan operations are the vehicle fleet (49%) and facilities (45%).

Carbon Sinks

Natural ecosystems – such as oceans, forests, wetlands and grasslands – absorb carbon dioxide from the atmosphere and so can act as "carbon sinks", making carbon dioxide at least temporarily unavailable to contribute to atmospheric warming. Management strategies and natural processes within ecosystems can either result in additional storage or in release of carbon dioxide over time. For example, forest fires can result in significant amounts of carbon dioxide being released back into the atmosphere. Similarly, harvesting high biomass (i.e., large structured) forests, especially those that have been undisturbed for many hundreds of years and have large amounts of carbon tied up in their soils, can result in a significant release of carbon back into the atmosphere.[175]

The science behind how much carbon ecosystems can absorb and store is imperfect and complex, and depends on issues such as age, productivity, tree species and wetland type, as well as their natural pathways, and the impacts of management systems. There are few simple measures of this process available currently, but undisturbed forested ecosystems such as those present on the west coast of the CVRD can store significant amounts of carbon for very long periods. Ecosystems with higher natural disturbance rates (e.g., fires), especially in productive sites such as those on the east side of the CVRD, can also be managed to sequester a maximum potential amount of carbon. Strategies for taking account of carbon in management decisions for any ecosystem are in their formative stages. However, this measure has been included in this report, as it is

173 City of Duncan, 2008.

174 Town of Lake Cowichan, 2009.

175 Holt, 2009.

an item of increasing interest to communities, particularly given the potential to use ecosystems to reduce the currently dangerous build-up of carbon dioxide into the atmosphere. There are also potential synergies to be gained in future, with the possibility of using "carbon offsets" from ecological assets to contribute to both the broader mitigation of climate change and ecological adaptation to the changes that are already destined to occur.[176]

Indicator and Measure

This report provides a baseline of information on the amount of forest and wetland cover in the region (as discussed in Section 2.1). Recently logged forest land has not been included in this table on the assumption that any remaining trees do not contribute significantly to carbon absorption.

Findings

Table 3.4 indicates that there are 222,491 ha of forest/wetland in the Cowichan Region, or about 23.6% of the landbase.

TABLE 3.4: Carbon sinks

Land Use Type	Area(ha)	Percent
Young Forest	156,234	43.9
Old Forest	65,302	18.4
Wetlands	955	0.3
Total	222,491	23.6

176 The 2010 Provincial Budget promised to introduce a Carbon Offset Credit program for reforestation. www.bcbudget.gov.bc.ca/2010/speech/2010_Budget_Speech.pdf

Climate Adaptation Strategies

As noted in Section 1, predicted major impacts to communities in coastal BC resulting from climate change include:

> Increased winter flooding in low-lying areas

> Summer water shortages resulting from drought and reduced snow-packs

> Increased damage from wind- and rain-storms

> Sea level rise and higher storm surges.

Indicator and Measure

Ideally, all parts of the region would have climate adaptation strategies to deal with the impacts most likely to be faced in that part of the region. In addition, land use zoning would identify (and prohibit construction within) areas subject to flooding or other hazards, and all infrastructure (e.g., stormwater pipes) would be designed to cope with expected increased levels of storm water flow and a rise in sea level.

As noted above, there are no statistical measures of adaptation at this time. However several plans and activities indicate that the Cowichan Valley Regional District is beginning to consider adaptation approaches.

Findings

Examples of strategies that address climate adaptation include the following:

> Flood Management: The winter of 2009-2010 saw considerable impact from flooding, especially in the lower Cowichan/Koksilah river flood plain. The City of Duncan, with a population of approximately 5,000, lies at the centre of the floodplain. The Cowichan Tribes has about 3,800 members, many of whom live on the floodplain. In addition to residential areas, there is urban and agricultural development in the floodplain, as well as significant and critical infrastructure. To date, land use planning has not controlled the development of houses and other critical infrastructure on the floodplain.

  The 2009 Lower Cowichan/Koksilah River Integrated Flood Management Plan[177] reviewed flood hazards on the lower floodplain, and prepared maps showing the degree of flood hazard. These were based on an increase of 1 m in the 200-year ocean level, with or without a change in the 200-year peak river discharges (at the time of writing, the flood management report has yet to be released, so maps are not included in this State of the Environment report). The flood management report suggests several strategies and actions to address flood issues.

177 Northwest Hydraulic Consultants, 2009.

> Drought management: The Cowichan Basin Water Management Plan considered the combined impacts of population growth and climate change, making several recommendations on ways to ensure an adequate drinking water supply for the future. A Water Management Plan for the South Cowichan (Mill Bay/Malahat, Shawnigan Lake, Cobble Hill, and Cowichan Bay) is also under development.

> Agriculture: A changing climate means more extreme weather events (droughts, heat waves, floods) that can alter how and what kinds of food can be grown, the kinds of pests and diseases that growers will have to contend with, and the availability of freshwater.

> Fisheries: The Pacific Fisheries Resource Council has prepared a backgrounder on climate change impacts[178] in the Cowichan River system, based on the work from the Cowichan Basin Water Management Plan.

> Energy resiliency: The Regional District is currently in the process of developing a Regional Energy Plan that will identify a range of energy-related policies and initiatives aimed at developing more energy resilient communities and providing a range of adaptation strategies.

Summary

The Regional District and its member municipalities, together with many groups and individual citizens, have recognized climate change as an issue that needs to be addressed. Some early steps have been taken to mitigate and adapt to climate change, but major region-wide strategic and sectoral approaches have yet to occur. This report provides a baseline for future climate action reporting.

Missing Information

There are many gaps in the data on climate action. For example, while data are available on fossil fuel use, there are no data sources on how much energy is being generated from "clean" energy sources such as solar or wind power. In addition, the Community Energy and Emissions Inventory (CEEI) does not provide trend data that show whether energy consumption (overall and per capita) is increasing or decreasing, and did not include some fuel sources such as heating oil and the use of wood stoves.

As noted above, the 2007 CEEI data are incomplete. The provincial government is working on updated inventories that will contain additional data. One data gap of concern for the Cowichan Region is marine transportation emissions, which contain many substances of air quality concern as well as greenhouse gases. The CVRD hopes to develop a more detailed emissions inventory in the near future.

178 www.fish.bc.ca/backgrounder-climate-change-adaptation-strategies-cowichan-river-basin

Data on carbon sinks in the region are incomplete, and do not provide a clear picture of the value of these sinks. For example, while the amount of data on forests and wetlands can be derived from available information, there is no conclusive information to date as to the relative value of older forests, younger forests, and wetlands as carbon sinks.[179]

Gaps in adaptation data are even more significant. The region and its member municipalities do not have comprehensive adaptation strategies, so it is not yet clear what activities should be taking place. However, some parts of the region have begun to address issues that are current and likely to worsen with climate change, such as winter flooding and water-supply shortages because of summer drought. Some research work is now underway to look at the sensitivity of the shoreline zone to sea level rise, also currently a data gap.

References

BC Ministry of Environment. 2007. Cowichan Valley Regional District Community Energy & Greenhouse Gas Emissions Inventory: 2007. **www.env.gov.bc.ca/epd/climate/ceei/pdf/2007Cowichan-Valley-rd.pdf**

City of Duncan. 2008 Report on Energy and Emissions. Unpublished Report.

Holt, R.F. 2009. Ecosystem-Based Management in the Great Bear Rainforest. Defence for Climate and Species. **www.savethegreatbear.org/resources/Reports/climate_report_0309**

Hyla Environmental Services. 2008. Data Requirements for Community Energy and Emissions Inventories in British Columbia. **www.env.gov.bc.ca/epd/climate/pdfs/ceei-data-req.pdf**

Northwest Hydraulic Consultants. 2009. Lower Cowichan/Koksilah River Integrated Flood Management Plan. Prepared for Cowichan Valley Regional District.

Province of British Columbia. 2009. CEEI Reports User Guide. **www.env.gov.bc.ca/epd/climate/ceei/pdf/ceei-user-guide.pdf**

Town of Lake Cowichan. 2009. Report on Energy and Emissions.

179 Several studies are underway.

PHOTO: ANDREW LEONG

3.5 Waste Management

Introduction

Waste Management in the Cowichan Valley Regional District

Waste management has traditionally meant the safe disposal of solid waste (garbage and recyclables) and liquid waste (sewage). The Cowichan Valley Regional District has set itself a long-term goal of Zero Waste, which means that it needs to start managing its waste streams very differently, as well as looking at reducing and recycling waste as well as recovering resources from its waste streams.

This is consistent with steps being taken by other Regional Districts in the province, and the provincial government is encouraging all local governments to consider approaches such as Integrated Resource Recovery that look at liquid and solid "waste" not as something to be disposed of, but something to value as a potential source for other purposes, such as district heating or a waste-to-energy facility.

Measuring Waste Management

Solid waste management is measured in terms of volumes of garbage and recyclables disposed of at regional facilities. Liquid waste management is a measure of the ability to appropriately treat this waste stream so that it does not result in water quality or health issues.

Solid Waste

Solid waste management is a Regional District responsibility. Currently, solid waste is collected and sent to regional facilities such as Bings Creek, Meade Creek and Peerless Road.

The Bings Creek Solid Waste Management Complex is the regional transfer station for the consolidation of the majority of the region's residual solid waste. Bings Creek receives waste from residential and commercial collection services, as well as from the Meade Creek and Peerless Road Recycling Drop-off depots. From Bings Creek, the waste is compacted and placed in transport trailers for shipment to the final disposal location (currently Rabanco in Washington State).

When the local garbage incinerator was closed down in the mid-1990s, the region started shipping solid waste to the Cache Creek landfill on the Lower Mainland. In 2007, the region started exporting garbage to Washington State instead. Recent provincial restrictions on out-of-province garbage shipments may compel the region to explore options closer to home, such as temporarily using the Hartland Landfill in the Capital Regional District.

Indicator and Measures

The region established a Zero Waste initiative in 2002, both as a challenge and a principle for developing a sustainable economy. The initiative focuses on reducing the region's environmental footprint by minimizing the amount of waste that must be land-filled through reduction, reuse and recycling. Ways to move towards the Zero Waste goal are set out in the region's Solid Waste Management Plan.[180]

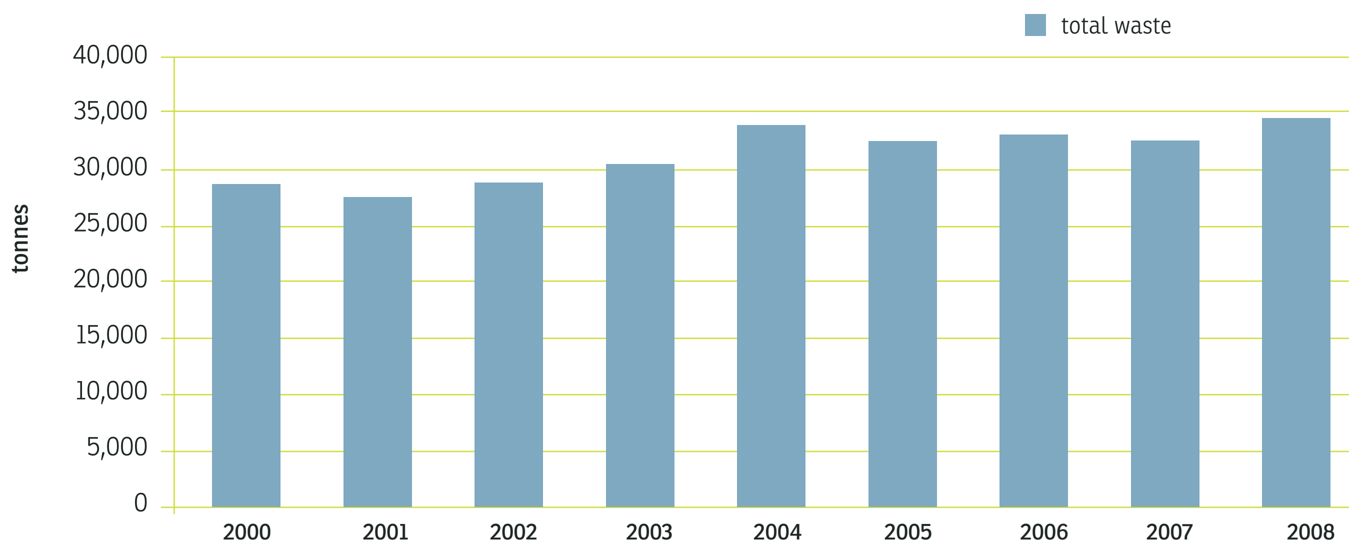
Solid waste can be measured as the total and per capita volume of waste disposed of, as well as the total and per capita volume of recyclables brought to CVRD facilities. However, this does not include information on organic waste that is composted or burned, garbage that is left by the roadside (illegal tipping), or bottles and cans brought to depots for refund.

Findings

Waste disposal

Total waste disposal has increased over the past decade, from about 28,000 tonnes in 2000 to 33,000 tonnes in 2008 (Figure 3.28).

FIGURE 3.28: Total waste disposal, CVRD 2000–2008

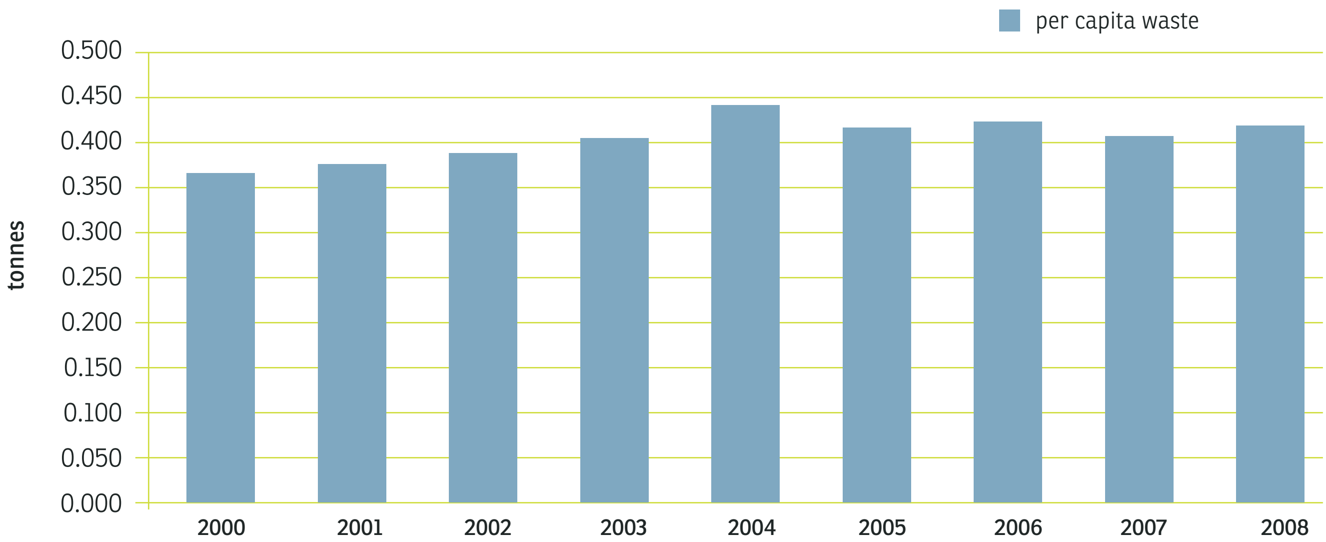


Source: CVRD Annual Monitoring Report, 2007.

180 CVRD Engineering Services, Solid Waste Management Plan, Amendment No. 3, 2006.

However, the regional population has also grown during this period. While the per capita amount of waste disposal has increased overall since 2000, it has declined somewhat since the middle of the decade (Figure 3.29), perhaps in response to greater recycling rates and greater awareness of the need to reduce waste.

FIGURE 3.29: Per capita waste disposal, CVRD 2000–200



Source: CVRD Annual Monitoring Report, 2007.

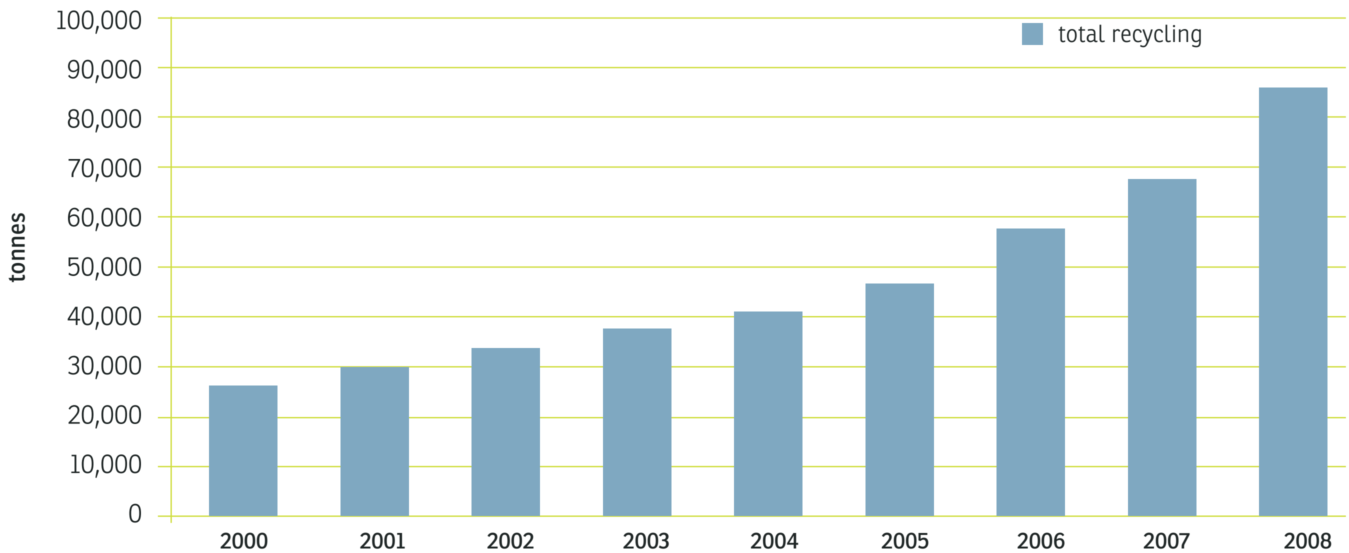
Waste disposal volumes are also affected by the economic climate; for example, during times of increased construction, more construction waste will be brought to landfills.

Recycling

Recycling programs are part the Regional District's Zero Waste initiative. Recycling programs, and the rate of participation, have increased very considerably over the past decade, from about 26,000 tonnes in 2000 to nearly 86,000 tonnes in 2008 (Figure 3.30). Residents and businesses can recycle paper (newspaper and mixed paper), metal containers and aluminum foil, a variety of plastics, and corrugated cardboard through the Blue Box program. Regional recycling participation rates reached a historic high of 75% per person in 2007, but declined slightly in 2008 to 71.9%.[181]

181 CVRD, 2010.

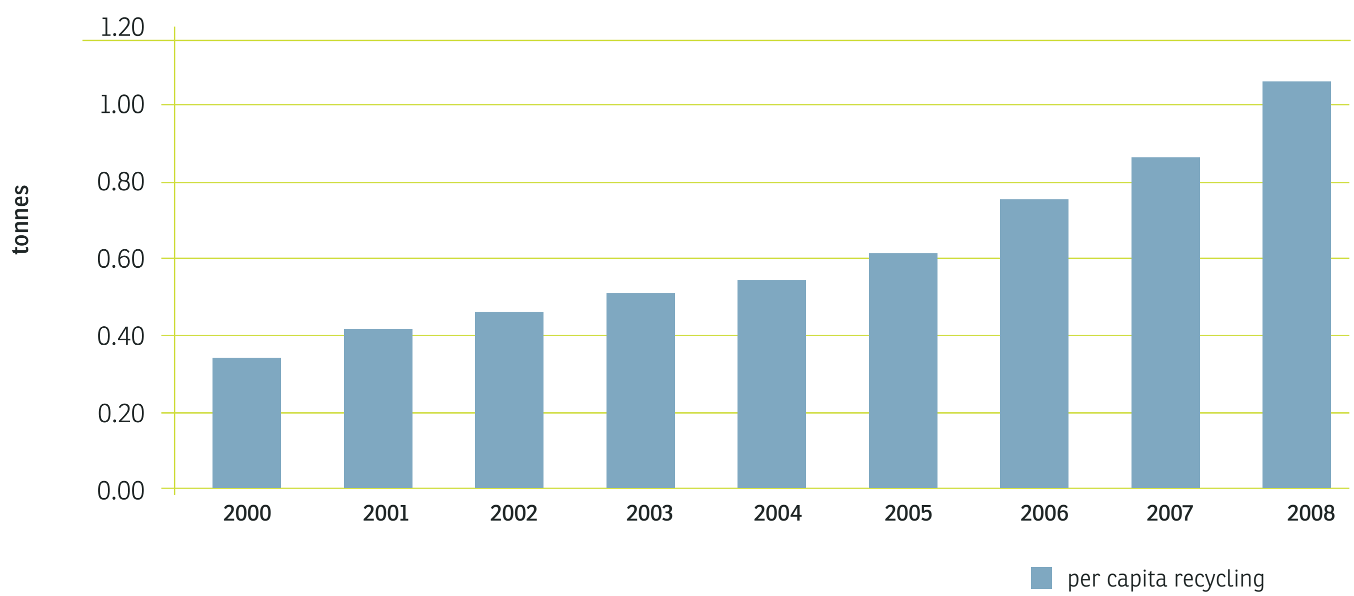
FIGURE 3.30: Total recycling, CVRD 2000–2008



Source: CVRD Annual Monitoring Report, 2007.

Per capita recycling rates have also seen a steady increase, from 0.34 tonnes per capita in 2000 to 1.06 tonnes per capita in 2008 (Figure 3.31).

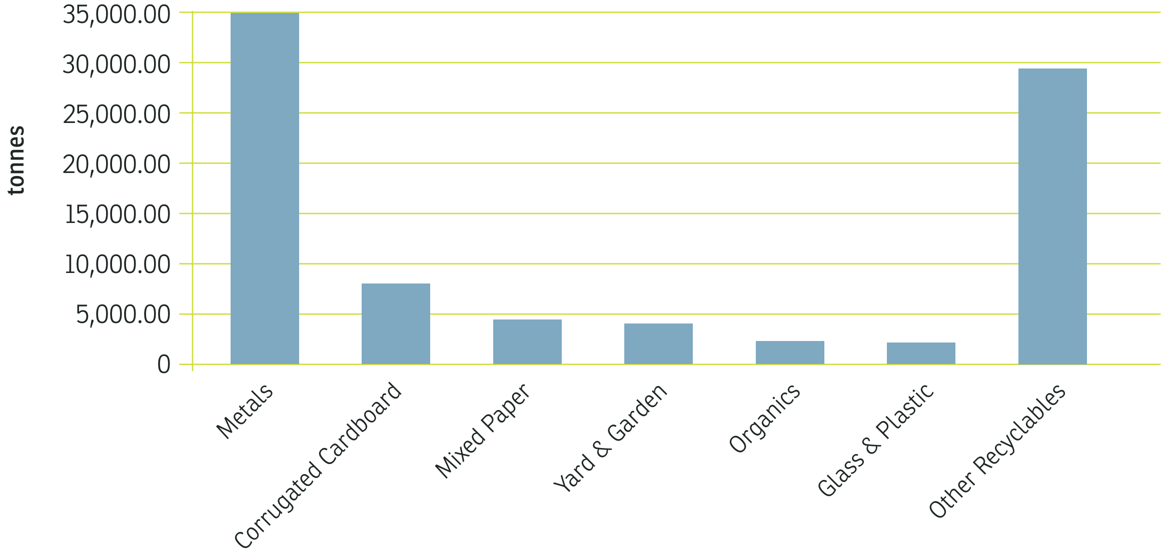
FIGURE 3.31: Per capita recycling, CVRD 2000–2008



Source: CVRD Annual Monitoring Report, 2007.

Metals are by far the largest category of recycled materials by weight (Figure 3.32).

FIGURE 3.32: Recycled materials by weight



Source: CVRD Annual Monitoring Report, 2007.

Higher recycling rates are very laudable. However, it should be noted that the combined volume of waste and recycled materials has doubled from 0.71 tonnes per capita in 2000 to 1.48 tonnes per capita in 2008, so the overall amount of "stuff" that residents are disposing of has increased considerably.

The Cowichan Recyclists offer businesses year-round pick-up of recyclable materials – using a bicycle.

Organic Waste

Organic waste makes up about 3% of the waste stream. While this is a small proportion, organic waste is increasingly being recognized as a valuable resource both for composting and for waste-to-energy through anaerobic digestion.

In 2006 the Town of Ladysmith introduced curb-side organic waste pick-up. The organic waste is converted to compost at a plant in Nanaimo.

The CVRD has several initiatives planned, including the introduction of residential food waste collection, the addition of new products (such as electronic waste) to recycling programs, the development of a new regional recycling depot, better enforcement of existing diversion bylaws, and increased education and communication with residents and the private sector. The goal is to achieve 50% reduction in per capita waste disposal rates over the 1990 levels.[182]

Liquid Waste

Liquid waste (sewage) in the Cowichan Region is managed through a combination of local government treatment plants, private wastewater treatment systems and septic fields serving individual homes or small clusters of homes. Any of these can cause problems for water quality and ecosystem health if they are not well managed. Private septic systems are especially challenging to monitor and enforce, as their performance cannot be measured on an ongoing basis, and because failing septic systems are often not recognized until they result in downstream problems.

The CVRD currently manages 15 sewer systems, with different requirements for each system. There are four classes of treatment:

> Class A treatment applies anytime there is a drinking water well nearby (within 300 m of the disposal field);

> Class B is similar (high level of treatment) but with lower standards for nitrate levels if there is room to remediate in the ground (thereby posing no threat to drinking water);

> Classes C & D apply where there is a lower risk of contamination to the water supply (this depends on the receiving environment).

182 Ibid.

In situations where the sewer discharges into a body of water (e.g., the Joint Utilities Treatment facility, which serves the City of Duncan, North Cowichan, Cowichan Bay, Eagle Heights and portions of Cowichan Tribes, discharges into the Cowichan River) the treatment standards are much higher. More information on water quality related to septic and sewage is included in Section 2.6.

CVRD-operated systems range in size from 40 homes to 800. In addition to its own systems, the CVRD routinely takes over privately run systems (package plants) that are failing, and then brings them up to provincial standards. The CVRD typically takes over two to three package plants a year. The CVRD has now adopted a policy that requires all new private package plants be built to standard, and then turned over to the CVRD for operation.

In 1998, a South Sector Liquid Waste Management Plan was conducted to address a variety of issues:

> Wastewater contamination at Shawnigan Lake and the Mill Bay foreshore;
> Elevated coliforms in surface water sources;
> Elevated nitrates in groundwater;
> Nutrient loading (nitrogen and phosphorus) leading to eutrophication[183] in some surface waters;
> Concerns about Saanich Inlet water quality raised by the Saanich Inlet Study; and
> Increased pressure on the treatment and disposal of liquid waste resulting from population growth.

In 1999, the CVRD prepared a Central Sector Liquid Waste Management Plan to address:

> Replacement of the Cowichan Bay treatment plant; and
> Reduction of the phosphorus load to the Cowichan River.

The plan also looked at a source control program to reduce the discharge of inappropriate waste to the sewer systems.

One aspect of liquid waste management that is being adopted or is under review by other local governments in British Columbia and elsewhere is an approach that utilizes the resources (notably heat, energy and soil amendments) from liquid waste. This is described by the provincial government in their Integrated Resource Recovery approach.[184] To date, this approach has not been implemented in the Cowichan Region.

183 Excessive nutrients in a lake or other body of water, usually caused by runoff of nutrients (animal waste, fertilizers, sewage) from the land.
184 www.cd.gov.bc.ca/lgd/infra/resources_from_waste.htm

Indicator and Measures

The Ministry of Environment monitors larger treatment plants to ensure that they meet provincial standards. Smaller systems (septic systems for less than 15 homes, or under 22,730 litres[185] per day flow) are monitored by the Vancouver Island Health Authority (VIHA).

Many operators of private wastewater systems do not routinely sample their effluent, even though this is a requirement from the Ministry of Environment.[186] The CVRD does not keep track of private wastewater systems. Unless a problem arises, there is no way to track the day-to-day functioning of these systems (where a water system shows higher-than-normal levels of nitrates and phosphates, VIHA can go after the water system operator, but has no way to address how the wastewater plant is being operated.) The Ministry of Environment can charge a plant operator under groundwater protection legislation, but this is a reactive rather than preventive approach.[187] An additional "unknown" is how many septic fields are below the water table during the winter (and therefore ineffective at treating effluent), for example around Cowichan Lake.

Findings

Discharges from local government treatment systems have created health concerns from time to time. Nutrient loading is a big issue. In the Cowichan River, there are two sewage treatment plant discharges (Town of Lake Cowichan and North Cowichan/Duncan sewage lagoons). There is evidence of increasing nutrient levels downstream of North Cowichan/Duncan, despite significant improvements to the discharge.[188] The quality of discharge coming from the North Cowichan/Duncan sewage lagoons has improved significantly in recent years (80% reduction in phosphorus) as a result of a new phosphorus removal system that was constructed to reduce the amount of phosphorus discharged to the Cowichan River. Typical phosphorus loadings have been reduced from an average of 4.5 ppm to less than 1 ppm.[189]

185 5,000 gallons

186 Louise Knodel-Joy, Sr. Engineering Technologist, Water Management, CVRD, personal communication, 2009.

187 Ron Cook, Public Health Inspector, Vancouver Island Health Authority, personal communication, 2009.

188 Deb Epps, Environmental Impact Assessment Biologist, BC Ministry of Environment, personal communication, 2009

189 From North Cowichan website: www.northcowichan.bc.ca/siteengine/ActivePage.asp?PageID=154 . This page includes figures about the population served by these sewage lagoons..

The greatest concerns relating to liquid waste arise from the private septic fields. As noted in Section 2.6, leaking septic fields can harm water quality, as shown by the examples of evidence in the Cowichan/Koksilah systems and Shawnigan Lake. Management plans for Quamichan[190], Fuller and Shawnigan Lakes include strategies to get houses off septic systems.[191] The major concern is that there is no day-to-day monitoring of septic fields, and problems are only identified (if at all) when a concern is raised and VIHA is asked to investigate.

Summary

The CVRD has set a long-term goal of Zero Waste, with a more immediate goal of achieving a 50% per capita reduction in the disposal of solid waste (over 1990 levels) and has an extensive recycling program to support this. The volume of recyclables has risen significantly in the past ten years, both in terms of total volume and per capita volumes. At the same time, however, total and per capita volumes of solid waste (garbage) have also increased, indicating that while people are recycling more, they are also buying (and disposing of) more "stuff".

Results for liquid waste management indicate that the CVRD is working to take over, and bring up to provincial standard, more of the smaller treatment plants, thus addressing some of the issues related to leaking septic fields. However, there remain many septic fields that continue to contribute to water quality issues in the region.

190 www.quamichanlake.ca/sites/default/files/QuamichanWatershedManagementPlanFinal-October2009.pdf

191 Deb Epps, December 2009.

Missing Information

Information on the composition of the solid waste stream (e.g., electronics, plastics, construction waste) was not available. This data would provide more information on the major sources of solid waste, and direction on where to look for further ways to eliminate, reduce or recycle waste from these sources.

With respect to liquid waste, the CVRD does not keep track of private wastewater systems. Unless a problem arises, there is no way to track the day-to-day functioning of these systems (where a water system shows higher-than-normal levels of nitrates and phosphates, VIHA can investigate, but does not have the authority to address how the wastewater plant is being operated). The Ministry of Environment can charge a plant operator under groundwater protection legislation, but this is a reactive rather than preventive approach. An additional "unknown" is how many septic fields are below the water table during the winter (and therefore ineffective at treating effluent), for example around Cowichan Lake.

References

BC Ministry of Community and Rural Development. 2009. Resources from Waste: A Guide to Integrated Resource Recovery. Available from **www.cd.gov.bc.ca/lgd/infra/resources_from_waste.htm**

CVRD. 2007. Solid Waste Management Plan. Annual Monitoring Report.

CVRD. 2010. Recycling and Waste Management Annual Progress Report. **www.cvrd.bc.ca/documents/Engineering%20Services/Solid%20Waste/Planning/2008AnnualSWReport.PDF**

Dayton and Knight. 1999. Central Sector Liquid Waste Management Plan. Report Prepared for the CVRD. **www.cvrd.bc.ca/documents/Engineering%20Services/Utilities/Liquid%20Waste%20Management%20Planning/central%20sector%20liquid%20waste%20management%20plan.pdf**

Stanley Consulting Group. 1998. South Sector Liquid Waste Management Plan. Report Prepared for the CVRD. **www.cvrd.bc.ca/documents/Engineering%20Services/Utilities/Liquid%20Waste%20Management%20Planning/SSLWMP-JUNE07.PDF**

3.6 Leadership and Innovation

Introduction

Leadership and Innovation in the Cowichan Region

Communities within the Cowichan Region, as well as the Cowichan Valley Regional District (CVRD) itself, are increasingly concerned about making themselves more environmentally, socially and economically sustainable. Sustainable Cowichan's "12 Big Ideas" starts by noting that:

> *"If we carry on living for today and not thinking about tomorrow, we run the risk of losing some of our natural assets forever. We believe we must start right away to strengthen our environment and community by growing in smart ways, to repair the damage we have done to our natural assets and preserve them for future generations. And that local government must lead the way in this effort. This is why we put together our list of big ideas for making our region more sustainable. This list is made up of small, medium and large actions we need to take to build a strong, resilient Cowichan."*[192]

Measuring Leadership and Innovation

The intent of this section is not to provide statistical data, but rather to capture just a few of the ways that the Cowichan Region, governments, business and industry, community organizations, and individual citizens are striving to create a healthy and sustainable environment in the Cowichan Region.

This list is clearly incomplete. There are far too many initiatives, large and small, to capture in this report. However, the intent is to provide a flavour of the work taking place, and a sense of hope that among the many issues and challenges that we are facing, there are groups and individuals who are striving to make a difference to this region and beyond. These examples have been organized under the "12 Big Ideas" headings.

192 http://www.12things.ca/12things/punchline.php

Leadership and Innovation

Get Real about Climate Change

> The Cowichan Action on Climate Change/Cowichan Carbon Busters is a group of citizens working to help the community make the transition to a non-fossil fuel economy.

> The municipalities of Duncan, North Cowichan, Ladysmith and Lake Cowichan are putting emissions reductions targets into their Official Community Plans.

> The CVRD is developing an integrated flood management plan to address flooding and drought issues in several parts of the region already being affected by climate change.

> The CVRD is developing a greenhouse gas emissions reduction plan for its facilities.

Eat Local Because Food Security Matters

> Cowichan Green Community is developing a Cowichan Local Food Map to improve community access to food in the Cowichan Valley and encourage people to buy and grow local foods.

> Economic Development Cowichan has developed an Area Agriculture Plan to look at the region's agricultural capacity. This includes an Issues and Opportunities Report which will form the basis for an action plan.

Be Energy Smart

> The Cowichan Valley School District 79's Live Smart BC initiative has reduced energy use in schools.

> Queen Margaret's School Science and Technical Centre and renovations to Spurgin Hall have incorporated numerous energy efficient features including a heat recovery ventilation system, an HVAC system for in-floor radiant heat, passive solar features, and recycled building materials. The building was constructed using timber from the site and was located to take advantage of the surrounding woodlands, thereby reducing the impact to the natural environment.

> Providence Farms' St. Ann's building utilizes numerous energy efficient construction elements, including passive solar energy, the first cob wall in North Cowichan, sensitive design, and materials and finishes that will not impact people with environmental sensitivities.

> The CVRD is conducting a review of the energy and water efficiency of its buildings.

Get Up to Speed on the New Green Economy

> The Town of Ladysmith's Trolley Service supports sustainability by reducing greenhouse gases, provides increased mobility for residents and visitors of all ages, reduces parking congestion at the town's two major shopping areas, and strengthens the local economy by enabling more people to access local businesses.

> Catalyst Paper's Crofton Mill implemented a "Power Watchers" program that identified potential electricity savings of 11 – 15% ($4.7 – $6.5 million in annual energy savings).

Clear the Air to Reduce Carbon Emissions

> The Idle Free BC program in Ladysmith educates people about reducing idling time to improve air quality.

> The Municipality of North Cowichan and CVRD offer a rebate program to people who install newer, more efficient and less polluting wood burning stoves.

> The Bings Creek Solid Waste Management Complex now accepts yard waste and wood trimmings free of charge as an alternative to backyard burning, thereby improving air quality.

Don't Hog the Water so There is Enough for All

> The CVRD is actively engaged in the Cowichan Basin Watershed planning process, and is developing a regional water quality monitoring plan. This plan will examine water quality and conduct a benthic analysis for each of the region's watersheds, including two marine sites (Cowichan Bay and Ladysmith harbour).

> The City of Duncan, Town of Ladysmith and CVRD water service areas offer rebates to homeowners who replace older toilets with low flush (3l or 6l) toilets.

> There are automatic summer watering restrictions throughout the Cowichan Region (June 1- October 31); these can be more severe if there are drought conditions.

Grow Up, Not Out

> North Cowichan's new Official Community Plan (OCP), currently under development, focuses on strategies related to smart growth, sustainable communities and the avoidance of sprawl.

> The joint development of a South Cowichan OCP process is providing synergies in a subregional context and will strengthen smart growth principles.

> The Regional District's decision to develop a regional sustainability plan will provide background information necessary to balance the rural nature of the majority of the region with the need to encourage smart growth development patterns (and the provision of associated services) in the future.

Revive Biodiversity

- The Somenos Marsh Wildlife Society operates, maintains, manages, and preserves the Somenos Marsh Conservation Area for the study of nature, the observance of flora and fauna, the protection of wildlife habitat and for public education.
- The Quamichan Watershed Stewardship Committee works to restore and maintain the health of the Quamichan Watershed as an important fish and wildlife habitat and recreation area.
- Trees for Tomorrow grants from the BC Provincial government have provided the opportunity to plant trees in several areas of the Cowichan Region.
- CVRD Parks has a program to remove invasive species in parks.
- The CVRD will be reviewing and updating the South Cowichan Liquid Waste Management plan in the coming year.

Get Serious About Zero Waste

- Local Thrifty's Food Stores stopped using plastic bags in 2009 and ask customers to use reusable cloth bags or compostable/recyclable paper bags.
- Cowichan Recyclists[193] provide recycling services to local businesses by bicycle, picking up mixed recycling and organics for approximately 80 businesses in Duncan and Cowichan Bay.
- Various CVRD departments are working to reduce waste by going paperless, encouraging recycling, and reducing the use of bottled water.

Be Carbon Neutral

- The Regional District and municipalities have all signed the BC Climate Action Charter, committing to be carbon neutral in respect to their operations by 2012.
- The CVRD has replaced the oil furnaces at Mesachie Lake Main Hall and Honeymoon Bay Community Hall with new heat pumps.
- Major retrofits have taken place at the Island Savings recreational centre to reduce energy usage.

193 http://www.cowichanrecyclists.com/index.html

Audit our Assets

- The CVRD has a Sensitive Habitat Atlas that allows people to identify the location of various environmental features and data, including salmon streams, wetlands and hydrology.
- The CVRD will be updating their aerial photography database and collecting valuable LIDAR data in the coming year.
- This State of the Environment report is a way of tracking environmental values.

Lead the Way

- The CVRD will soon begin work on a regional sustainability plan.
- The Cowichan Stewardship Round Table (CSRT) has established a forum to share information, identify communities of interest, rank projects at a watershed scale, pool resources, attract funders, and enable a new way of conducting stewardship business.
- The Stolz slide remediation has been recognized as the largest river restoration in BC.
- The Cowichan Watershed Board has been established and recognized by the Province as leading the way in the development of watershed-based governance.

4.0 Future State of the Environment Reporting

This 2010 State of the Environment report is the first of its kind for this region, and provides a snapshot of the wide and complex environmental issues facing the Cowichan Region. The report endeavours to establish some reliable and repeatable ways of measuring how the environment is doing.

In preparing this report, there were significant challenges in finding the data to “tell the story” of the Cowichan Region and its natural environment. In some cases data were readily available, in other cases the data were either lacking entirely or were less than desirable for the purpose. Nonetheless, this report has begun the process of tracking progress (or lack of) towards maintaining and restoring a healthy natural environment in this ecologically rich and special region.

The CVRD Environment Commission hopes that this report will spur the collection and release of additional data that will help to better “tell the story”, and that there will be future State of the Environment reports that add to and build on the findings of this first report.

Appendix A: Full List of Known Species at Risk

Class (English)	English Name	Blue	Red	Grand Total
Amphibians	Red-legged Frog	1		
▶ Amphibians Total		1		1
Birds	Band-tailed Pigeon	1		
	Barn Owl	1		
	Barn Swallow	1		
	Cassin's Auklet	1		
	Double-crested Cormorant	1		
	Great Blue Heron, fannini subspecies	1		
	Green Heron	1		
	Marbled Murrelet		1	
	Northern Goshawk, laingi subspecies		1	
	Northern Pygmy-Owl, swarthi subspecies	1		
	Olive-sided Flycatcher	1		
	Peregrine Falcon, anatum subspecies		1	
	Peregrine Falcon, pealei subspecies	1		
	Purple Martin	1		
	Short-eared Owl	1		
	Sooty Grouse	1		
	Tufted Puffin	1		
	Vesper Sparrow, affinis subspecies		1	
	Western Screech-Owl, kennicottii subspecies	1		
	White-tailed Ptarmigan, saxatilis subspecies	1		
▶ Birds Total		16	4	20
Gastropods	Black Gloss	1		
	Blue-grey Taildropper		1	
	Broadwhorl Tightcoil	1		
	Dromedary Jumping-slug		1	
	Oregon Forestsnail		1	
	Pacific Sideband	1		
	Scarletback Taildropper	1		
	Threaded Vertigo		1	
	Umbilicate Sprite	1		
	Warty Jumping-slug	1		
	Western Thorn	1		
	(blank)		1	

Class (English)	English Name	Blue	Red	Grand Total
▶ Gastropods Total	7	5	12	
Insects	Autumn Meadowhawk	1		
	Beaverpond Baskettail	1		
	Blue Dasher	1		
	Boisduval's Blue, blackmorei subspecies	1		
	Common Ringlet, insulana subspecies		1	
	Dun Skipper	1		
	Edith's Checkerspot, taylori subspecies		1	
	Greenish Blue, insulanus subspecies		1	
	Johnson's Hairstreak		1	
	Moss' Elfin, mossii subspecies	1		
	Propertius Duskywing	1		
	Western Branded Skipper, oregonia subspecies	1		
	Western Pine Elfin, sheltonensis subspecies	1		
	Western Pondhawk	1		
	Zerene Fritillary, bremnerii subspecies		1	
▶ Insects Total		10	5	15
Lampreys	Cowichan Lake Lamprey		1	
▶ Lampreys Total		1	1	
Mammals	American Water Shrew, brooksi subspecies		1	
	Ermine, anguinae subspecies	1		
	Keen's Myotis		1	
	Roosevelt Elk	1		
	Steller Sea Lion	1		
	Townsend's Big-eared Bat	1		
	Vancouver Island Marmot		1	
	Wolverine, vancouverensis subspecies		1	
▶ Mammals Total		4	4	8
Ray-finned Fishes	Cutthroat Trout, clarkii subspecies	1		
	Dolly Varden	1		
▶ Ray-finned Fishes Total		2		2
Reptiles	Sharp-tailed Snake		1	
▶ Reptiles Total		1	1	
Turtles	Western Painted Turtle–Pacific Coast Population		1	
▶ Turtles Total		1	1	
▶ Grand Total		40	21	61

Appendix B: Major Water Suppliers, CVRD

MAJOR PUBLIC SUPPLIERS	Area	Number of hook-ups
Cowichan Valley Regional District	Arbutus Mountain Estates (Area B: Shawnigan Lake) – groundwater (wells)	Serves 165 modular homes and a clubhouse facility
	Cherry Point Estates (Area D: Cowichan Bay) – groundwater (well)	Serves 30 single-family dwellings
	Dogwood Ridge Water System (Area E: Cowichan Station/Sahtlam/Glenora) – groundwater (well)	N/A
	Fern Ridge (Area A: Mill Bay) – groundwater (well)	Serves 28 residences
	Honeymoon Bay (Area F) – groundwater (well)	Serves approximately 129 single-family dwellings, two recreational parks (180 sites), and six small commercial and institutional developments
	Kerry Village – (Area A: Mill Bay) – groundwater (well)	Serves 62 residences
	Lambourn Estates (Area D: Cowichan Bay) – groundwater (wells)	Serves 137 residences
	Mesachie Lake (Area F:Cowichan Lake South/ Skutz Falls) – groundwater (well)	Serves 96 residential and commercial properties
	Saltair (Area G: Saltair/Gulf Islands) – surface water from Stocking Lake	Serves about 831 residential and commercial properties
	Satellite Park (Area C: Cobble Hill) – groundwater (well)	Serves 78 residences
	Shawnigan Lake North (Area B: Shawnigan Lake) – primary source is surface water (Shawnigan Lake), supplemented by groundwater (well).	Services approximately 633 single-family dwellings, a condominium complex, and an elementary school
	Youbou (Area I: Youbou/Meade Creek) – surface water (Youbou Creek) and two wells at Lakeside Estates	Serves 308 residences and 11 commercial buildings

MAJOR PUBLIC SUPPLIERS	Area	Number of hook-ups
Town of Ladysmith	Ladysmith and part of Saltair – surface water (Holland Creek and Stocking Lake)	N/A
District of North Cowichan	Town of Chemainus and Chemainus First Nation – groundwater (wells)	N/A
	South End of District of North Cowichan – groundwater (well)	N/A
City of Duncan	Duncan – groundwater (wells)	Serves 3,000 residences, and 550 commercial and other buildings
Town of Lake Cowichan	Town of Lake Cowichan – surface water (Cowichan Lake)	Serves a population of approximately 3,000 people
Cowichan First Nation	Cowichan First Nation – groundwater (wells)	Serves approximately 425 residences.
Halalt First Nation	Halalt First Nation – groundwater (well)	Serves 60 residences and 4 businesses
Kuper Island First Nation	Kuper Island First Nation – groundwater (well)	Serves 100 residences
Malahat First Nation[194]	Malahat First Nation – groundwater (wells)	Serves 25 residences

MAJOR PRIVATE SUPPLIERS		
Braithwaite Water System	Cobble Hill	N/A
Burham Park Water System	Cobble Hill	N/A

194 Note: This chart does not include the smaller First Nations in the Cowichan Region.

MAJOR PRIVATE SUPPLIERS		
Catalyst Mill (in partnership with the District of North Cowichan)	Town of Crofton	Serves a population of approximately 2,500
Cobble Hill Water System	Cobble Hill	N/A
Cowichan Bay Water System	Cowichan Bay	N/A
Diamond Waterworks	Area H: North Oyster/Diamond	N/A
Lidstech Water System	Shawnigan Lake Village	N/A
Meredith Road Improvement District	Shawnigan Lake	Serves approximately 50 residences
Mill Bay Waterworks	Mill Bay	N/A

Environment Commission | Cowichan Valley Regional District
June 2010

2010 STATE OF THE ENVIRONMENT

CVRD ENVIRONMENT COMMISSION

Environment Commission | Cowichan Valley Regional District
June 2010