Migratory Waterfowl in the Cowichan Valley

Written for the Cowichan Community Land Trust Society
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(Cover drawing source: Brua, 2002, Birds of North America Online)

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ii Executive Summary

This project was started by the Cowichan Community Land Trust. The aim of this report was to bring together all available information about migratory waterfowl and issues of concern in the Cowichan Valley. The areas included are from Cowichan Bay to the Chemainus Estuary, and contain a wide variety of habitat types for waterfowl.

The waterfowl species that inhabit these areas and were studied in this report include swans, geese, dabbling and diving ducks, loons, and grebes. The Christmas Bird Count data and the BC Coastal Waterbird Surveys data were examined in an attempt to spot any significant trends in bird populations. The data are not meant for scientific studies but are indicative of general trends.

It was found that the species that seem to be most noticeably in decline are grebes, many of the diving ducks and Pacific Loons. These are all birds that prefer marine (as opposed to freshwater) environments, and this should have impacts on how the rest of the project continues. The species that are increasing most significantly are Trumpeter Swans and Canada Geese, both of which have posed problems to landowners and farmers.

It would be useful to do a field project where both major estuaries and all wetlands in between are included in bird population counts. There is little data available for the Chemainus Estuary compared to the Cowichan Estuary. As a whole the Cowichan Valley is an internationally and in some cases globally significant place for migratory waterfowl, and it is unrealistic to select only certain areas for management purposes.

There are many ways to encourage waterfowl and wetland conservation in the Cowichan Valley, mainly through public communication in the form of a workshop. If field work takes place it would be useful to involve as many local people as possible. Waterfowl conservation can also be included in other projects such as the Stewardship Support Project by the CCLT.

The main issues to be addressed are improving habitat quality, further assessment of specific populations, and helping farmers and landowners to deal with problems involving large numbers of birds. Other smaller or larger issues will likely come out of this once the work begins.

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1.0 Introduction

1.1 The Cowichan Community Land Trust Society and the Project

The Cowichan Community Land Trust (CCLT) is a non-profit organization located in Duncan, British Columbia. It was started in 1995 when it was declared an organization that is entitled to hold conservation covenants.

Past projects have included many stewardship, ecological restoration and community outreach programs. As part of the Stewardship Support Project, a regional focus on migratory waterfowl habitat use, habitat changes and loss is being made. This report is a summary of information about local waterfowl, their habitats, changes to these habitats over the years, and potential effects of these changes. It also includes suggestions for a public workshop, future research, fieldwork and management.

"*The Stewardship Support Project will provide an opportunity to the Cowichan Valley community to envision the lowland areas of the Cowichan Valley as a continuous migratory waterfowl habitat area that requires consideration, community input, careful planning and stewardship to increase the quality and quantity of waterfowl habitat….This project will identify waterfowl habitat areas that have been impacted by changes in land use and will develop or recommend appropriate environmental and natural resource restoration techniques by working with landholders, stewards, local community organizations and government agencies."* (From project proposal).

1.2 Migratory Birds and Wetlands

Wetlands and estuaries provide resting and feeding ground for migratory birds. Estuarine habitats include freshwater and brackish marshes, river channels and lakes, floodplains, and tidal flats (Kistritz, 1992). Migratory birds depend on these habitats along the Pacific Flyway for stopovers on their journey south or for a place to overwinter.

The process of migration is extremely demanding. In order to prepare for it, birds engage in hyperphagia or overeating while they are still in the breeding territory (Kereki, 1999). This storage of fat provides energy for the flight and the amount that is stored can determine the success of the migration (Kereki, 1999). Therefore, the main reason for the choice of a stopover or staging location is usually the availability of food, which is crucial for the fitness of the animal.
By definition, migratory birds spend parts of each year in different locations that are often in separate countries. The Yukon Waterfowl Technical Committee (1996) emphasized that "migratory birds belong to no state, province, territory, or nation, but are a shared resource for which responsibilities for conservation and management must also be shared." Though the Cowichan Valley typically sees large numbers of waterfowl in winter only, this area is an important part of the Pacific Flyway.

Figure 1. Changes in the extent of estuarine marshes in the Strait of Georgia

Location	Past Area (ha)	Present Area (ha)	Change in Area (%)
Campbell River	23.00	26.00	+13.0
Courtenay	85.00	74.00	-12.90
Baynes Sound	122.00	117.00	-4.10
Little Qualicum	12.00	11.00	-0.80
Englishman	54.00	47.00	-12.90
Nanaimo	**280.00**	**130.00**	**-53.60**
Chemainus	**155.00**	**121.00**	**-21.90**
Cowichan	**190.00**	**101.00**	**-53.10**
Squamish	165.00	115.00	-30.30
Burrard Inlet	140.00	10.00	-92.90

Source: Berris and Gushue, 2005 (Original Source: Levings and Thom, 1994)

Figure 1 highlights the loss of wetlands in the Cowichan region. The Cowichan and Nanaimo estuaries have had the biggest losses, and a 20% loss for the Chemainus estuary is very significant.

1.3 Reasons for Concern/Importance of Wetlands

Birds are a key part of estuarine and wetland dynamics, transporting huge amounts of energy between trophic levels. Estuaries export nutrients to the ocean (Kereki, 1999), and these nutrients and organic matter must somehow be re-cycled. Birds eat a lot of plants, fish, and other organisms, and transport energy back to the wetlands via their feces (Berris and Gushue, 2005).
Birds contribute to these ecosystems in other ways too, such as increasing erosion by digging in mud flats, and hindering plant growth and marsh plant succession (Berris and Gushue, 2005).

Since birds can transfer such large amounts of energy, the size of their populations has a very strong impact on wetland and estuary ecosystems (Butler et. al., 1994). Small changes can have cascading effects which impact many other species of both plants and animals. Herbivores and benthivores such as geese, swans, and diving ducks, are responsible for the greatest transfers of energy (Butler et. al., 1994). These birds also have relatively large body sizes, which further increases their effects. Scoters and other diving ducks are often the top predators in marine intertidal systems. For example, one study showed the cascading effects they had in reducing the mollusk populations in a British Columbia intertidal zone (Lewis, 2000).

Because they have such a noticeable impact, birds are also used in many cases as indicator species for the overall health of the local wildlife (Berris and Gushue, 2005).

The Cowichan Valley, as demonstrated by its large dairy farming, agricultural and wine industries, is one of the most fertile areas on Vancouver Island. It is one of the few areas that can provide suitable habitat for waterfowl, as it was stated in a report by Booth (2001): “Marine areas along the east coast of southern Vancouver Island and the Gulf Islands represent one of the most fertile areas for seabirds in BC.”

Not only do wetlands provide migration corridors for birds, but they are also filters for water contaminants, which recharge groundwater and lessen the impacts of flooding by moderating water levels (Pacfic Coast Joint Venture, 1996). Wetlands have higher productivity and biodiversity than many other ecosystems as well.

The conservation of migratory birds will depend on the health of the wetlands and estuarine environments of the Cowichan Valley. Without sufficient habitat, there may be a decline in birds, and without the wildlife to support it, wetlands will suffer.

1.4 Study area

This project encompasses the Cowichan River and Koksilah River and their Estuary, the Chemainus Estuary, Somenos and Quamichan Lakes and their associated creeks and wetlands, and any other waterfowl habitat between Cowichan Bay and Chemainus. Previous studies have treated all of these areas separately, when from a birds’ eye view they are a single, if partially separated, area. Within the study area, there are various types of habitat including open ocean, shallow bays and estuaries, swamps, marshes, wetlands, riparian areas, rivers, lakes, wooded and forest stands, agricultural lands and seasonally flooded fields (Blood et. al., 1976).

Waterfowl in the Strait of Georgia have been affected by the many human activities that take place there including recreation, industry, boat traffic, shipping lanes, pollution and land development along the coast (Badzinski et. al., 2005). Along the coast of Vancouver Island, the human population is increasing, and with it the rate of development (Lovvorn and Baldwin, 1995). The high abundance and species richness of birds in this are is unique due to the type and variety of habitat types (Booth, 2001). However, these habitats are being lost or changed in many areas.

"Actions to compensate for impacts on wetlands have occurred on a local, case-by-case basis, overlooking the need for systems of alternative wetland habitats at regional landscape scales, [such as the Cowichan Valley]", (Lovvorn and Baldwin, 1995)

Figure 1.2. Map of the Study area.

Information about bird populations was taken from the Christmas Bird Counts (CBC) and the BC Coastal Waterbird Surveys (BCCWS). The Christmas Bird Counts cover the entire Duncan Region, while the BC Coastal Waterbird Surveys are more specialized by region (eg. Quamichan Lake and Shawnigan Lake have different counts). Therefore the CBC data has been used to compare changes in species populations over time for the whole are (even though it does not cover the Chemainus estuary), and the BCCWS data has been used to look at changes in bird populations for a given region (eg. Cherry Point or Duncan Sewage Lagoons). The data is incomplete and only reliable for the past 10-15 years in the case of the CBC (Marven, 2008). The methods for counting, the number of people counting and the locations of the counts were different in the 1970's and 1980's, making the data unsuitable for a scientific comparison.

For more accurate estimations of how bird populations are changing in the Cowichan Valley, more field work may be required in the form of an organized experiment. This data does not include the Chemainus estuary, so it is impossible to estimate what the effects of habitat loss for migratory birds have been there. However, the data that is available has been used in an attempt to identify general trends and patterns that could form the basis for more detailed work.

2.0 The Estuaries and Wetland Habitats

2.1 Cowichan/Koksilah Estuary, Rivers and Creeks

Environment

The Cowichan/Koksilah Estuary contains the estuary itself, tidal flats which change daily and seasonally, riparian wetlands along the rivers, and seasonally flooded agricultural fields. Treffery Creek and Spiers Creek also drain into Cowichan Bay. The area provides a rich and productive habitat for many different kinds of birds, especially during the winter migration. River sediment, marine deposits, and glacial till materials have created fertile soil, that is ideal for farming (Leigh-Spencer, 1995). The vegetation is largely composed of a variety of grasses and sedges, rushes, algae, and eelgrass beds.

The estuary provides not only waterfowl habitat but is important for fish, such as Chinook, Coho and Chum salmon, trout, smelt, as well as herring spawning and rearing (Leigh-Spencer, 1995). The abundance of fish then attracts more birds, particularly piscivorous ones such as loons and grebes. First Nations have historically used Cowichan Bay for harvesting crabs, clams, ducks, fish, urchins, and other animals, which they used for food and other things (Rideout et. al., 2000).

Birds

The Cowichan/Koksilah Estuary has high populations of fish eaters such as Grebes, and mergansers due to the high amount of fish for food in Cowichan Bay. There are also large numbers of geese and trumpeter swans, which forage in the bay and surrounding agricultural lands (Vermeer et. al., (1), 1994).

The BC Coastal Waterbird Surveys for Cherry Point show high numbers of diving ducks, particularly Bufflehead and Scoters. There are also Horned and Western Grebes, and loons documented frequently. American Wigeons and Mallards were the most common

dabbling ducks. American Wigeons occurred in very high numbers during the winter. The peaks for most waterfowl were during the winter months of November to February.

Problems

The Cowichan Bay area has been put under significant development pressures in the past 20 or more years. Increased recreational use, additional buildings and a growing population all add to the loss of habitat. Dyking for agriculture and draining and filling fields has taken place for much longer, but has also changed the landscape. Other issues have come from log storage and water pollution (Leigh Spencer, 1995) and hunting.

Log booms in particular can have negative impacts on estuarine ecosystems. The sediments and organisms under the logs can be affected during long term storage from shading, and the decomposition of bark chips, which uses up oxygen and can create local anoxic conditions (Frith et. al., 1993). There can also be pollution from antisapstains, hog fuel, dioxins, and furans (Frith et. al., 1993). However, the habitat loss due to log storage is more easily repaired than that caused by pollution or landfills (Frith et al., 1993), which has been demonstrated in Cowichan Bay from the various restoration projects that have gone one there.

There is hunting permitted in some areas of Cowichan Bay. However, it has been suggested that some fields have in the past been opened to hunters without permission. Although hunting has declined in the area, the hunting season timescale has increased to a longer period of time, causing disturbance to ducks in particular. Sporadic hunting for most of the year rather than one short hunting season has resulted in birds being pushed from the area (Marven, 2008).

Water quality issues in Cowichan Bay have been studied by Rideout et. al. (2000). It was found that the water in the bay is unsafe for drinking unless treated due to high levels of fecal coliform bacteria. This may have effects on waterfowl. Crabs and shellfish, which are bird food as well as human food sources, can no longer be commercially harvested as a result of water contamination from sewage and other sources.

Management

Compared to other areas in the valley there have been many efforts to restore the wetland environment of the Cowichan/Koksilah Estuary. The CCLT has been involved with several management plans and projects such as the Eelgrass Restoration project, all which help, indirectly or directly, to improve waterfowl habitat. The Pacific Estuary Conservation Project has also contributed to the conservation of waterfowl in Cowichan Bay.

The Cowichan Estuary has been designated an Important Bird Area (IBA, 2004). It is considered globally significant for congregating or migratory species, and nationally significant for colonial waterbird concentrations (IBA, 2004). The species of interest by the Important Bird Areas program include Mute Swans, Pacific Loons, Red-necked and Western Grebes, and Trumpeter Swans.

Notes on the Rivers

Although many of the waterfowl discussed in this report prefer marine or estuarine environments, there are some a few species as Canada Geese and some ducks that inhabit riparian areas. The Cowichan and Koksilah Rivers are large bodies of water with extensive wetland habitats along them, which may provide space for many different birds. There are issues associated with pollution and contamination that might be relevant to this project.

Lake Cowichan/Cowichan River/tributaries

The Cowichan River originates at Lake Cowichan and drains down towards Cowichan Bay. The Town of Lake Cowichan resides at the top and there is a weir which controls the downstream flow (Rideout et. al., 2000). It is approximately 47 km from the Lake to the Bay, and the total watershed is 939 km^2 (Rideout et. al., 2000). The discharge rate is approximately 53 m^3/s.

The Cowichan River is important as a productive fish habitat, including coho, chinook, chum, trout and steelheads. It is used by the forestry and agricultural industries in the area, for drinking water, recreation and other purposes.

Along the Cowichan River there are 5 provincial, parks and other regional or municipal parks (Rideout et. al., 2000). However, some sections are very developed such as the Duncan section, where storm drain water and sewage are emitted into the river (Rideout et. al., 2000). This has resulted in high levels of fecal coliform bacteria that would make it unsafe for drinking

.

Koksilah River and tributaries

The Koksilah River originates south of the Cowichan Valley on Waterloo Mountain, about 44kilometers from Cowichan Bay. Its tributaries include Fellows, Kelvin and Glenora Creeks (Rideout et. al., 2000).

The Koksilah River is much smaller than the Cowichan; for comparison, its flow is about 10 m^3/s and the total watershed size is 302 km^2 (Rideout et. al., 2000). Forestry and agriculture also occur along this river, but there is much less urban development and no authorized dumping or discharge. However, unauthorized dumping does occur, and there have been cases of pollution by farming or industrial activities, and unsafe levels of bacteria have been documented (Rideout et. al., 2000).

Other uses for the Koksilah River include recreation, irrigation and drinking water, but it is not as heavily depended on as the Cowichan. Since the flow of the Koksilah River is not controlled by a large body of water, it reacts much more quickly to storms or droughts, and has a high risk of flash floods and very low summer flows (Rideout et. al., 2000).

2.2. Somenos Lake/Marsh and Creeks

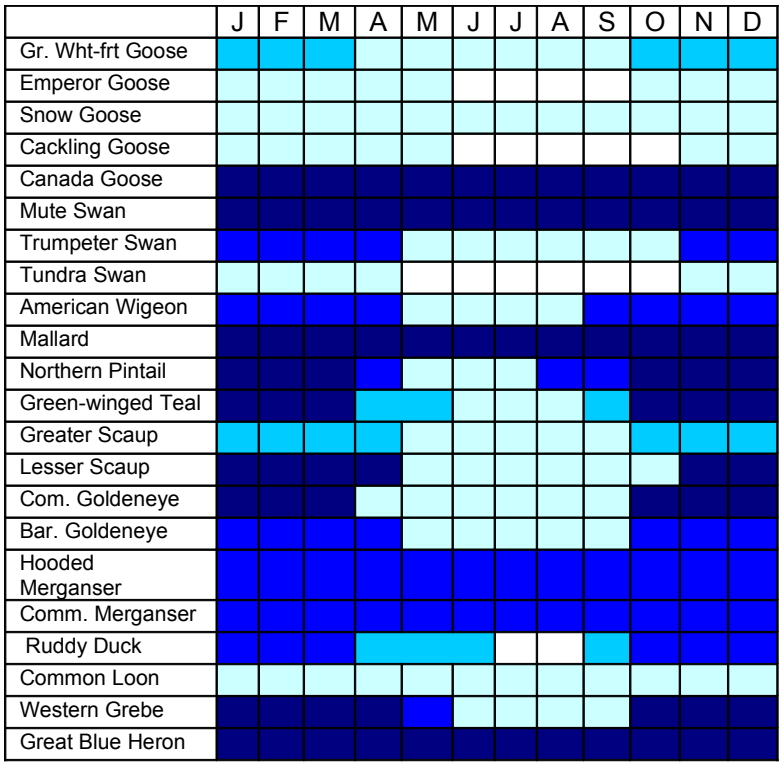
Environment

Somenos Lake is located north of Duncan. It is a small, shallow lake surrounded by marshy wetlands, and Richards, Averill and Bings Creek. The lake is bordered by private homes, farms, and land owned by the Nature Trust and Ducks Unlimited (Isbister, 2008). The majority of this is Agricultural Land Reserve (Leigh-Spencer, 1995). Somenos Lake provides important habitat for many waterfowl and fish including: trout, Coho, catfish, sculpin and sicklebacks (Leigh-Spencer, 1995).

Birds

During the winter, Somenos Marsh is significant habitat for dabbling ducks including teal, Northern Pintail, and wigeon (Leigh-Spencer, 1995), and also for Mute Swans, Common Goldeneyes, and mergansers (Badzinski et. al., 2005). The nearby Duncan Sewage Lagoons also provide habitat for dabbling ducks and other birds. The use of the Somenos Lake by Trumpeter Swans and Greater White-fronted Geese has been increasing as well.

Bird	Presence at Somenos Marsh



(previous page) Figure 2.1. The yearly distribution of waterfowl in Somenos Marsh.
Source: Somenos Marsh Wildlife Society

Legend
Abundant – can be found easily
Common – easily found in specific habitats
Uncommon or Localized – must be looked for in specific habitats
Rare – not seen every year

The Duncan Sewage Lagoons are located near Somenos Lake, and are a common habitat for waterfowl, especially dabbling ducks. The BC Coastal Waterbird Surveys show high numbers of Mallards and American Wigeon in particular. There are also Northern Shovelers, Wood Ducks and Green-winged Teal observed in the lagoons, along with low and seasonally varying numbers of diving ducks such as Lesser Scaup and Ring-necked Ducks. Canada Geese and Bufflehead were seen occasionally in low numbers.

Problems

Human activities and development are the major causes of habitat loss in Somenos Marsh. Urban expansion can be seen driving past the marsh; the new development across the highway has increased the amount of paved areas and polluted runoff into the lake. The effects of land use changes have been a decline in cavity nesters, bats, and raptors that have already been documented (Williams and Radcliffe, 2001).

Resource use and development of lands around Somenos Lake have destroyed much of the wildlife and agricultural lands in the Somenos Basin. The result of this has been that waterfowl move into neighbouring farmer's fields, causing problems for farmers and subsequent degradation of their crops (BioAyer, 1999). Farmer's fields, school grounds, parks, golf courses and lawns have all been damaged, because the loss of available habitat is concentrating the populations of birds into smaller and smaller areas (Williams and Radcliffe, 2001).

Another issue at Somenos Lake is eutrophication, which has occurred from the build up of

organic matter in the marsh and then the lake (Isbister, 2008). Waste from the surrounding residential areas and dairy farms has contributed to this (Leigh-Spencer, 1995). The wetland is in a basin which will eventually fill in naturally, but humans are speeding up this process (Williams and Radcliffe, 2001).

The water levels in Somenos Lake have been changing. Part of the cause of this is deforestation, and part of it is because the confluence between Somenos Creek and the Cowichan River was increased, causing backflow in both the creek and the river, and subsequent increased erosion (Isbister, 2008). Changes in water levels, water quality, soil, and vegetation all have impacts on the wildlife that use the marsh as habitat.

The species composition of the area has been affected by introduced species such as squirrels, frogs and starlings (Williams and Radcliffe, 2001). Exotic vegetation includes yellow-flag iris. The spread of these species is exacerbated by people dumping their lawn clippings or garbage into Richards Creek and other nearby areas that drain into the Somenos area. The result of this can be a decline in biodiversity (Rehbein, 2004) if birds stop using the habitat.

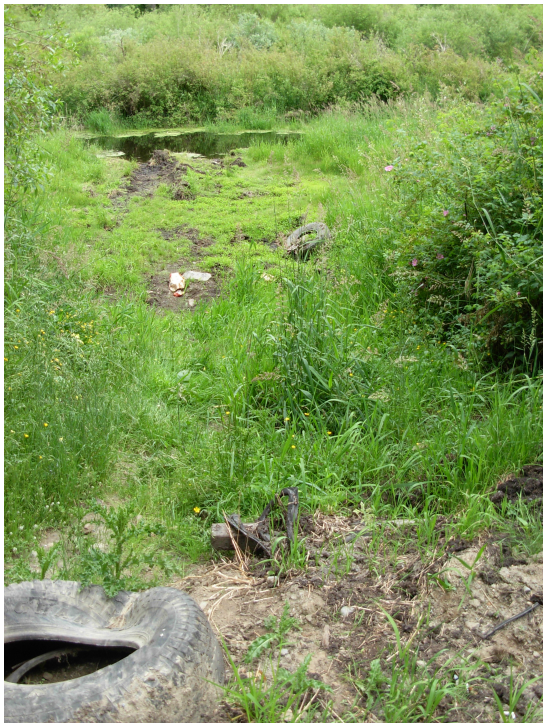


Figure 2.2. Garbage dumping in Richards Creek.

In the summer of 2008, the CCLT has received complaints from landowners about garbage dumping in many of the creeks and rivers that feed into the estuaries and wetlands. The photo above depicts a place where a car was pulled out of Richards Creek. Several months later, a different landowner had to call the police to get another car pulled out of the Koksilah River. There have also been reports of garbage dumping next to Bings Creek and other areas of the Valley.

Management

Somenos Lake has also been designated an Important Bird Area by IBA Canada (IBA, 2004). It is considered globally significant for congregating or migratory species, and

nationally significant for several threatened species. The Trumpeter Swan populations and the number of waterfowl that use the area exceeded the IBA standards for designation (IBA, 2004).

Although this is positive for bird conservation, having the Cowichan Estuary and Somenos Marsh only as IBA's fails to recognize that the entire Cowichan Valley supports large numbers of migratory waterfowl.

Management of the lake is by multiple stakeholders, including the Somenos Marsh Widlife Society, Ducks Unlimited Canada, the Ministry of Environment, the Nature Trust of Canada, and private owners. It could be argued that this approach lacks having one group or person in charge to make decisions.

Figure 2.3. Map of Somenos Lake and Creeks
Source: Somenos Marsh Wildlife Society, 2008

2.3 Quamichan Lake and Creeks

Environment

Quamichan Lake is located next to Somenos Lake near Duncan. It is a smaller, lowland, mature lake that supports fish such as trout and salmon (Burns, 1995). The tributaries include Stone Creek, Tzouhalem Creek, Elkington Creek and Bird's Eye Cove Creek (Burns, 1995). Development issues similar to those occurring in Somenos have happened in Quamichan Lake.

Birds

Quamichan Lake is shallow and becoming increasingly eutrophic. It supports a wide variety of fish and vegetation that provide food for up to 10% of the Cowichan Valley's dabbling ducks (Burns, 1995), most commonly Mallards and American Wigeons (BCCWS). It also contains many rare birds such as the Ruddy Duck, which are not found in such high numbers in many other places in Canada (Marven, 2008).

The BC Coastal Waterbird Survey taken at Quamichan Lake from 1999-2003 also showed high numbers of diving ducks, including scaup and mergansers most commonly. There were also Bufflehead, Goldeneyes and Canvasbacks noted in the winter, as well as Mute Swans and Canada Geese.

Problems

The main issue at Quamichan Lake is eutrophication, which has occurred from the build up of organic matter and nutrients from dairy farms and nearby residences (Leigh-Spencer, 1995). It is one of the most eutrophic lakes on Vancouver Island, due in part also to its very small catchment area and inward flow relative to its size (Burns, 1995). Another cause of high organic matter in the lake may also be from the resident bird populations, which put fecal coliform into the lake (Holms, 1996).

Management

Although the environmental issues in Quamichan and Somenos Lakes are quite similar, the management approaches are separate and different (Isbister, 2008). A program is already in place to aerate and try to restore Quamichan Lake (QLWWG, 2008). The Quamichan Lake Watershed Working Group (QLWWG) is currently creating a management plan that will include bird and wildlife conservation aspects (QLWWG, 2008).

2.4 Chemainus Estuary, River and Creeks

Environment

The Chemainus Estuary is where the Chemainus River and Bonsall Creek flow into the ocean, in front of the nearby Shoal Islands. It is somewhat less disturbed than other wetlands in the Cowichan region, which could be why there have been fewer studies done. However, the Chemainus Estuary was designated a "Critical Waterfowl Habitat" in 1993 (Leigh-Spencer, 1995). The Chemainus River watershed is about 359 km2, with a mean discharge of 19.2 m3/s (Craig, 2004). For comparison, this is smaller than the Cowichan but larger than the Koksilah River.

The Chemainus Estuary is located north of Duncan, and differs from the Cowichan Estuary in that the Shoal Islands protect the area from the oceanic currents in the Stuart Channel (District of NC, 2008). The river itself has a bedrock bottom, which results in lower productivity than the Cowichan River (Craig, 2004). The estuary and surrounding wetlands, such as Swallowfield Farm, are important habitats for many types of wildlife. For example there is a heron rookery in the Shoal Islands area. The tidal flats themselves are habitat for fish, ducks and other waterfowl.

Figure 2.4.

The Chemainus River Estuary
Source: District of North Cowichan

Birds

The Chemainus Estuary has large populations of Greater Scaup, Surf, and Scoters, due to high amounts of bivalves, fish and snails, which these birds feed on (Vermeer et. al., (1), 1994). Up to 1000 waterfowl per day have been recorded there during the winter (DUC, 2003). However, compared to the Cowichan Estuary there have been very few studies done about the composition and populations of waterfowl that use the area as a migration stopover or a wintering habitat.

Problems

The most significant environmental issues in the Chemainus Estuary and surrounding wetlands involves the Crofton mill, local agricultural practices and logging. The Crofton Mill is located in Osborne Bay, which is near to the estuary. Pollution from the mill has included dioxins and furans from the incineration of waste and pulp and paper processing (Frith et. al., 1993). It has also contributed to air pollution in the area.

The log booms near the estuary have also had detrimental effects at the shipping port. They have created anoxic conditions in some places, resulting in the loss of fish (Frit et. al., 1993). The ferry terminal, wharf and industrial areas are badly degraded in respect to wildlife habitat (District of NC, 2008).

Management

The coastline near the Chemainus Estuary is mainly used for residential and recreational purposes. The main use of the Chemainus watershed is forestry (Craig, 2004). The Crofton Mill is located near the estuary, and Catalyst Paper owns 500 acres of land next to it. At this time, this land is being sold to Ducks Unlimited Canada, who will be putting conservation covenants on it (Vessey, 2008). The land will be leased to farmers and continue to be used. There is also a landfill owned by the mill that is near the estuary, but it is no longer in use and all of the waste has been treated (Vessey, 2008). This site is planned to be subdivided. Other stakeholders near the estuary include TimberWest, private landowners and farmers.
There have been several restoration projects done in the Chemainus Estuary. One was by Ducks Unlimited (2003) on a piece of land which was then owned by Norske Skog Canada Ltd., where they installed a dyke and created more stream channels to the estuary. There is a group dedicated to improving the air quality in the Crofton area. The District of North Cowichan (2008) has also been working to discourage private development along the waterfront and to phase out water based log storage offshore.

2.5 Overall Summary and Major Issues

Summary of the Cowichan Valley's Bird environment etc.

"In combination with the nearby Cowichan Estuary [the Chemainus Estuary] forms a habitat complex of international waterfowl and other birds using the coastal migration corridor" Ducks Unlimited Canada, 2003.

These two major Estuaries combined with Somenos and Quamichan Lakes form a network of connected wetlands that create very large amounts of waterfowl habitat. The composition of birds varies in the differing habitats. It is in fact this diversity of habitats that are all connected, from the perspective of local wildlife, and all contained within one area that makes the Cowichan Valley so unique. These areas, however, have been designated by humans as separated regions. It does make sense to have different approaches to managing different areas within the region, but it all needs to be consolidated into one main effort.

Species	Cumulative Numbers Identified	Percentage of all birds counted
American Wigeon	**42 672**	**15.6**
Western Grebe	**33 194**	**12.1**
Mallard	**20 111**	**7.4**
European Starling	13 570	5.0
Common merganser	**10 940**	**4.0**
Northwestern Crow	10 085	3.7
American Coot	9 726	3.6
Northern Pintail	**9 682**	**3.5**
Mew Gull	9 637	3.5
Glaucous-winged gull	8 363	3.1
Total	167 980	61.5

Figure 2.5. Ten most abundant species of birds counted during 52 surveys between December 27, 1974 and December 18, 1975
Source: Blood et. al., 1976

Species	Abundance	Percentage of all Birds Counted
Pine Siskin	6103	16.3
Canada Goose	**3756**	**10.0**
Mallard	**2700**	**7.2**
American wigeon	**2564**	**6.8**
European Starling	2166	5.8
Dark-eyed Junco	1903	5.1
Northern Pintail	**1674**	**4.5**
Glaucous-winged Gull	1588	4.2
Ruddy Duck	**1103**	**2.9**
Trumpeter Swan	**990**	**2.6**
Total	24 547	65.5

Figure 2.6. Ten most abundant species of birds counted during Christmas Bird Counts, 2007
Source: Christmas Bird Counts, 2007

The data for figures 1 and 2 were taken during different lengths of time (the first, over a year and the second, only over one day). Although the numbers themselves are not

comparable, the relative abundances are. Canada geese don't even appear in the first graph, which indicates they were not very abundant, while they were the second most commonly seen birds during the 2007 Christmas Bird Counts, and the first most common if only waterfowl are included. American Wigeons and Mallard ducks were common during both surveys. Northern Pintail and Glaucous-winged gulls did not appear to change, however the addition of Trumpeter Swans in the 2007 chart supports the data that indicate the rise of that population. Western Grebes were the second most common in 1975 study and did not appear in the 2007 ten most abundant species. The species that are highlighted in the figure are the ones that are discussed in this report.

Factors influencing bird populations

Since migratory birds are often stopping on their journey further south, the most significant factor that influences their populations is food availability (Vermeer (b), 1994). The reason that migratory birds need these staging locations is to refuel their fat stores in order to be able to complete their migration. The availability, distribution and type of food has a direct influence on the types of birds that will be found in a given area. Feeding conditions on pastures, grass, marshes and fields are indicators of the species that will be present (Vermeer et. al. (1), 2004).

The type of habitat is also strongly influential, and is linked to the types of food that will be found. Wetland habitats can be divided into offshore subtidal, tidal flats, estuaries, grassy fields, marshes, lakes, swamps, bogs, and others. Within these habitats, factors that account for variance are feeding areas and loafing sites (Vermeer et. al., (2), 1994). Salinity is a major reason for the different types of vegetation (Vermeer et. al., (3), 1994), which then determines the types of wildlife that will be there.

Main Problems

Population Increases

The rising populations of resident Canada Geese and migratory Trumpeter Swans are a concern for many landowners in the Valley.

Combined with increasing development and loss of habitat, there has been a concentration of geese and swans into private lands. Not only does this cause damage to properties (CWS, 1992), there are avian diseases that become more prevalent with increasing densities and outbreaks are a concern (Marven, 2008). However, it could also be argued that this is nature's way of balancing a population which cannot be supported by the available habitat and resources. Therefore, the loss of habitat needs to be slowed to prevent this from happening (Marven, 2008).

The numbers of breeding Canada Geese have been a particular concern for many landowners in the Cowichan Valley. When foraging for food, geese can damage many types of property, and also pull out eelgrass, which is the base of many species food sources and is already in decline (Chatwin, 2008).

Development/Habitat Loss/Other Uses of estuaries

The human population on Southeast Vancouver Island is growing rapidly. In doing so, the developments are taking some of the most valuable waterfowl habitat in the region (Marven, 2008), including coastal, lakeside and riverside properties. Residential, industrial and recreational developments all have these impacts. Tourism is also growing, which brings more people and the need for more space.

The use of estuaries and wetlands in the Cowichan Valley has taken on a variety of forms. In Cowichan Bay, around Somenos and Quamichan Lakes, along Richards Creek and the Cowichan and Koksilah Rivers are areas with large amounts of residential housing. Industrial development in the form of log storage, pulp mills, shipping ports and marinas has occurred in both estuaries, resulting in a 30% decline in available estuarine habitat along the coast of Southeast Vancouver Island (Vermeer et. al., (2), 1994).

Agriculture has also played a bit part in land use changes in the Valley. (See "Farming" section below). Draining fields that were previously marshlands for agricultural purposes can reduce waterfowl habitat for many species (Blood et. al., 1976) while creating habitat for other species. Dyking reduces the input of tidal energy and nutrients to the land, which reduces productivity and biodiversity, and this has to be made up by artificial means (Blood et. al., 1976). In other cases, some birds have adapted themselves to these man-made habitats; for example, the extensive use of booms and pilings by seagulls, and the reliance on farm fields by ducks, trumpeter swans and geese (Blood et. al., 1976).
Habitat and the vegetation and species that grow there will essentially determine the composition of waterfowl that are seen in the Cowichan Valley. In changing it we run the risk of losing species and impacting the ecosystem as a whole.

Invasive Species in Wetlands

Wetlands are particularly susceptible to invasive species, since they are low-lying and usually downstream from major creeks and rivers, estuaries being the most downstream point (Zedler and Kercher, 2004). These riparian areas with moving water are an efficient way for seeds to be transported long distances, increasing the chance for exotic species introduction. Wetlands are also often near or downstream from developed or agricultural areas (Zedler and Kercher, 2004).

It might seem unlikely that an invasive flower would have any impacts on waterfowl. However, invasive species, especially aggressive ones, often end up decreasing biodiversity of the given region. A study by Mensing et. al. (1998) showed that a decline in plant biodiversity can decrease animal diversity. Invasive plants can affect habitat structure by changing the basic composition of plants, subsequently changing productivity and nutrient cycling (Zedler and Kercher, 2004). For foraging birds, this means different food sources of both vegetation and animals like fish and aquatic invertebrates.

Two common invasive species found in the Cowichan Valley wetlands are yellow-flag iris and purple loosestrife. Purple loosestrife has been shown to reduce quality of habitat for waterfowl in wetlands (Blossey et. al., 2001). In the study the example of pied-billed grebes was used. In Comox a removal plan took place where they removed thousands of these wetland-destroying plants. Somenos Lake has had several programs to remove yellow-flag iris, which takes over in a similar way, from the marshes.

Figure 2.7. Yellow-flag iris on the banks of Richards Creek.

Farming

There are several conflicting issues regarding agriculture and waterfowl in the Cowichan Valley. Some farming practices (draining of wetlands, dyking) have had negative impacts on the quality of wetland habitat. However, flooded fields have also created alternate habitat for different types of birds. Flooded farmlands are important sources of food and habitat for bird populations, and in order to continue supporting them, farmlands need to be protected as well as "natural" wetlands (Vermeer et. al., (3), 1994). They are particularly important in areas that are losing this "natural" habitat, as they provide reliable habitat and food sources for waterfowl (Colwell, 1997).

In addition to this, farming practices in the Cowichan Valley have been changing. There has been an increasing the production of hay and corn rather than potatoes and vegetables, which birds prefer to eat (Marven, 2008).

Damage to crops by birds is another issue. Trumpeter Swans in particular dig large holes in the fields where they are foraging (CWS, 1992), ruining fields of crops. For the farmers, there is a choice: to save their crops or to protect waterfowl habitat, and for most keeping their livelihood would be more important. Swans can eat several kilograms of grass per day as well (Environment Canada, 1994), which is another loss to farmers.

One study suggests an agricultural technique for wetlands that involves combining food production and the conservation of wildlife habitats by integrating different resources, rather than separating land into "habitat" and "farmland". The use of wild and native plants as crops was the main focus (Rehmein, 2004).

Lack of Data for Chemainus estuary

The aim of this report was to include the Chemainus Estuary and Cowichan Estuary as one wetland system. There is much less data on bird populations in the Chemainus Estuary making it difficult to know what is happening there in regards to waterfowl.

For the purposes of this report, these issues are put under separate headings. However, they are all interrelated problems and each area of concern has impacts on other areas. The effects of population growth are worsened by habitat loss, for example, and this makes more problems for farmers. At the same time, it is likely that some species are in decline

and this needs to be addressed as well. When addressing one problem, all the others will have to be considered at the same time.

3.0 Management

3.1 International

North American International Waterfowl Management Plan and Pacific Coast Joint Venture

The North American International Waterfowl Management Plan (NAWMP) is an international body covering Canada, USA, and Mexico, composed of different ventures and organizations. It focuses on habitat restoration, monitoring, purchases of land and conservation covenants, and other projects (NAWMP, 2008). The Pacific Coast Joint Venture is a part of NAWMP and "helps to ensure the long-term maintenance of coastal wetland ecosystems" (PCJV, 1996), through projects in British Columbia, Washington and Oregon.

Ramsar Convention on Wetlands

The Ramsar Convention originated in Ramsar, Iran, near the Caspian Sea, in 1971. It is an intergovernmental treated officially titled "The Convention on Wetlands of International Importance especially as waterfowl habitat" (Ramsar, 2008). There are presently 1753 sites, amounting to 161 million hectares of protected wetlands.

The Ramsar Convention follows three main "pillars":

1. "Wise use of wetlands through water allocation and conservation and river basin management,
2. Management through the List of Wetlands of International Importance,
3. International cooperation – trans-boundary water resources, wetlands and wildlife."

The "wise use" of wetlands means that the countries responsible have to adopt national wetland policies, develop programs for inventory and monitoring, and take action at wetland sites to support these management goals.

Criteria are very interesting, as some of them apply to the Cowichan Valley. In general "wetlands should be selected for the list on account of their international significance in terms of ecology, botany, zoology, limnology, or hydrology – in the first instance, wetlands of international importance to waterfowl at any season should be included".

Criterion number 5, from Group B of the criteria, 'Sites of international importance for the conservation of biodiversity', states that "A wetland should be considered internationally important if it regularly supports more than 20,000 water birds." Criterion number 6 from the same group states that "A wetland should be considered internationally important if it regularly supports more than 1% of the individuals in a population of one species or subspecies of a waterbird".

It should be noted that the Cowichan area has been noted to support more than 4% of the trumpeter swan populations in recent years (Aldcroft, 2002), and if Chemainus were included in the Christmas Bird Counts there may be well over a population of 20000 waterfowl. FIX THIS

Important Bird Areas Program

The Important Bird Areas (IBA) Program is an international cooperation of countries around the world.

The Canadian IBA Program identifies the following aims:

1. "identify a network of sites that conserve the natural diversity of Canadian bird species and are critical to the long-term viability of naturally occurring bird populations
2. determine the type of protection or stewardship required for each site, and ensure the conservation of sites through partnerships of local stakeholders who develop and implement appropriate on-the-ground conservation plans; and
3. establish and support ongoing local involvement in site protection and monitoring." (Booth, 2001)

The following criteria are used to identify IBAs:

1. "Sites regularly holding significant numbers of an endangered, threatened or vulnerable species.
2. Sites regularly holding an endemic species, or species with restricted ranges.
3. Sites regularly holding an assemblage of species largely restricted to a biome.
4. Sites where birds concentrate in significant numbers when breeding, in winter, or during migration." (Booth, 2001)

3.2 National/Federal

Ducks Unlimited Canada

Ducks Unlimited Canada (DUC) is a national organization that has many projects in the Cowichan area. For example, 75% of Cowichan River estuary under "conservation efforts", which total 740 protected acres in one of British Columbia's most important overwintering areas for waterfowl (DUC, 2008).

In this area, conservation efforts began in the early 1980's and methods have since included: land purchases, conservation covenants, tidal restoration projects, farm improvements to optimize forage, and others (DUC, 2006). Now most intertidal and adjacent farmlands are managed for conservation in some way by DUC in the Cowichan Estuary (DUC, 2006). They are also purchasing a large piece of land next to the Chemainus Estuary (Vessey, 2008). There is a DUC managed section of Somenos Lake as well.

Pacific Estuary Conservation Program

The Pacific Estuary Conservation Program (PECP) is funded by multiple organizations including the Nature Trust of BC, Ducks Unlimited, and the Department of Fisheries and Oceans (Kereki, 1999). It helps in the management of 407 estuaries on the BC coast by: land acquisition, crown land transfer, licensing agreements, stewardship (cover cropping, set aside grasslands), habitat enhancement and restorative measures, public outreach/education and partnerships (Govt of Canada, 2007). These areas contain crucial habitat used by 80% of all coastal wildlife, including deer, elk, bears, seals, otters, salmon, and waterfowl (Government of Canada, 2007).

The PECP considered the Cowichan Valley to be "internationally significant waterfowl wintering ground and migration corridor" (Government of Canada, 2007). PECP owns 246 hectares in the Cowichan Valley and provides public access while managing for conservation (Kelsey, 1995)

3.3 Provincial

There are few or no provincial migratory bird plans, as most of the regulations are by the federal government (Chatwin, 2008). The provincial parks are protected habitat but are not aimed directly at waterfowl.

Chemainus Provincial Park/District of North Cowichan

Management issues include: increasing and unregulated use, loss of habitat and water from logging operations. Proposed solutions include gates, boundaries, and working with forestry companies. (BC Parks, 2008)

Cowichan Provincial Park/CVRD

Management issues include: lack of long term direction for the park, private land development next to the park, and increased use. The Cowichan River has Heritage River designation, which gives extra reason for protection (BC Parks, 2008).

3.4 Regional

Cowichan Valley Naturalists

The Cowichan Valley Naturalists are a local group of which some members are interested in waterfowl protection. Some representatives would like to see management strategies put into place including:

- A Wildlife Management Area established including both the Cowichan and Chemainus estuaries plus the other wetlands in the area,
- The WMA providing food and water, resting and preening areas, wildlife viewing and hunting, and compensation for crop loss,
- The use of examples of other projects, for example the Comox Valley project, where money was given to the farmers,
- Egg addling of resident geese and the allowance of more hunting of this species.

(Aldcroft, 2002).

Comox Valley Waterfowl Management Project

The Comox Valley Waterfowl Management Project (CWMP) began in October 1991. The Comox Valley is north of the Cowichan Valley, but contains similar habitat types, development and environmental issues, and similar high numbers of migratory birds. It provides a good example of ways to manage waterfowl.

The Comox Valley hosts 10% of Pacfic Trumpeter Swans, and these huge flocks were having an economic and social impact (Fowler, 2007). Damage being done by the swans included: loss of livestock forage, reduced drainage in fields, removal of newly seeded forages, craters in the fields, and weed growth in areas cleared by birds (Fowler, 2007).

To slow the damage from waterfowl, 500 acres of extra cover crops were planted in otherwise unused fields. The program aimed to monitor Trumpeter Swan habitat by weekly counts from October to March, and to initiate the “hazing” or scaring away of swans from sensitive crops that can be damaged easily (Fowler, 1995).

This program was successful in decreasing the use of farmers’ fields by Trumpeter Swans. Improved field drainage keeps swans away, as they prefer very wet fields, and the plants that were planted were intentionally less palatable to the swans. Hazing was done by dogs, electronic avian deterrents, noise devices, flags and other types of decoys (Fowler, 2007)
In other cases, the success of hazing is not 100%, as it is dependent on field size, location, drainage and surrounding tree cover, (Fowler, 2007), but likely that there are similar conditions in Cowichan Valley to Comox Valley and the strategy might also work here if necessary.

Delta Greenfields Project

The Delta Greenfields Project is based in the Fraser River Estuary. Its objectives are: to improve soil quality and protect from erosion, increase cover crop production, waterfowl monitoring, public education, research and to provide liaisons among conservation groups and agencies (Muir, 2008). Part of the program is to contribute financially to the cost of cover crops because wigeon and other birds have been increasing the cost of farming in Delta. These are costs which are not seen by consumers and have to be compensated for (Muir, 2008).

There is also a monitoring program which identifies factors affecting grazing intensity such as timing of planting, type and height of cover crops, and the amount of surface water on the fields. Communication strategies such as school visits, farm tours, and brochures were used (Muir, 2008)

Somenos Marsh Widlife Society
Quamichan Lake Watershed Working Group

There are many different organizations that include wetland and waterfowl protection in their goals or aims. This is not an all inclusive list but gives a general idea at where most of the support comes from in this area.

4.0 Birds

In order to develop a plan for waterfowl management, the biology of the relevant species should be understood. The most common waterfowl in the Cowichan Valley are Trumpeter Swans, Canada Geese, dabbling ducks, and diving ducks. Each species or group of species has different preferences for habitat and food sources, and different factors to consider for its conservation.

4.1 Swans

Trumpeter Swans *Cygnus buccinator*

Habitat

Approximately 40% of North American Trumpeter Swans overwinter on the south coast of BC, particularly on Vancouver Island (Environment Canada, 2004). During winter, they inhabit wetland areas including marshes, tidal flats, sheltered bays and agricultural fields (Nature Serve, 2005). Trumpeter Swans breed and nest in Northern Canada and Alaska.

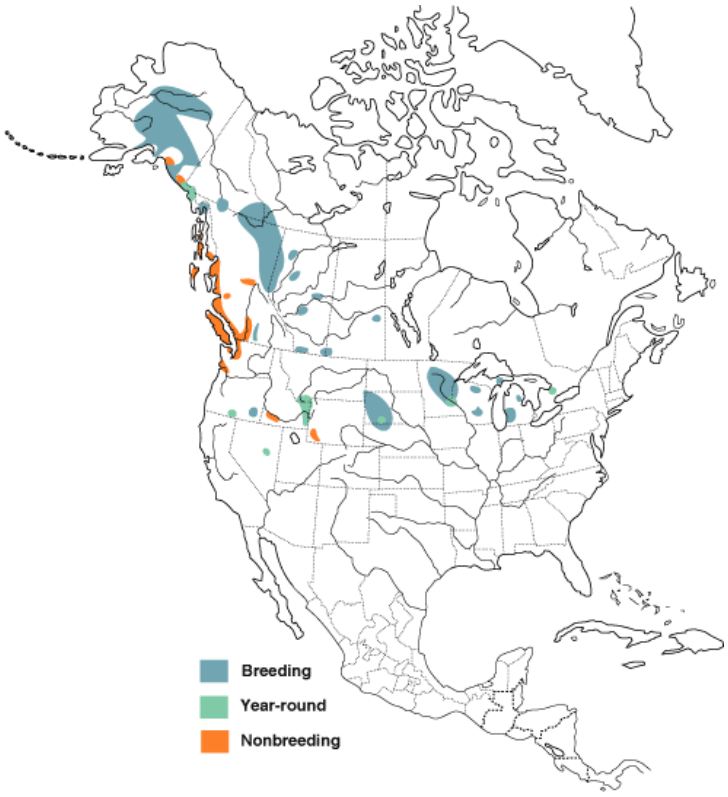


Figure 4.11 Distribution of Trumpeter Swans throughout North America
Source: Mitchell, 1994

Feeding

Adult Trumpeter Swans eat mainly aquatic vegetation and terrestrial plants, while the young will feed on aquatic insects and crustaceans (Nature Serve, 2005). Trumpeter Swans prefer emerged vegetation such as bulrushes, (Vermeer et. al.(a), 1994).

Since the population of Trumpeter Swans has been increasing so dramatically, new sources of food have been necessary (Environment Canada, 2004). Agricultural lands are now critical for sustaining these populations, as the swans benefit from increased foraging areas (Mitchell, 1994) such as harvested vegetable fields, pastures, and cover crops. Potatoes are a preferred crop (Leigh-Spencer, 1995). .

Population Trends/Status

Trumpeter swans were near extinction just 80 years ago in the 1930's (CWS, 1992). For the past 30 years, however, conservation strategies have been in place and the populations all over North America have been increasing (Hawkings et. al., 2002). A survey of both breeding and overwintering Trumpeter Swans was conducted by Hawkings (2002) with information from 1970 to 2000. In 2000, there were approximately 23600 individuals in North America, compared to a total of 66 in the entire USA in 1933 (Hawkings et. al., 2002). CWS Surveys indicate a 615% increase from 1971 to 2001 as well (Environment Canada, 2004). Along with population size, the swans' distribution has also expanded, as their wintering ranges have grown over the last 50 years (Environment Canada, 2004).

In most areas, Trumpeter Swan populations are still recovering, but their overwintering habitat is being lost, which threatens their long term status (Nature Serve, 2005). Because of this, the BC Ministry of Sustainable Resource Management has kept Trumpeter Swans on the "blue list" for threatened wildlife. Locally, populations are high, but the total numbers are still thought to be lower than they were historically. In the Duncan area, the Christmas Bird Counts show a significant increase since the 1970's.

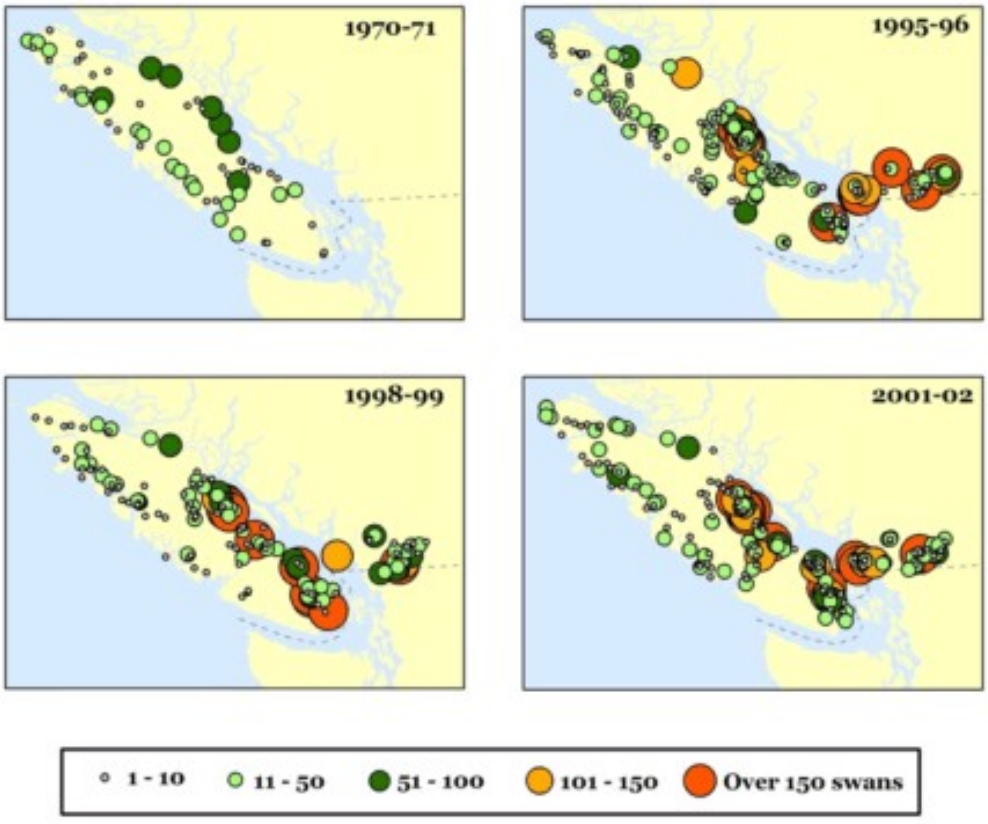
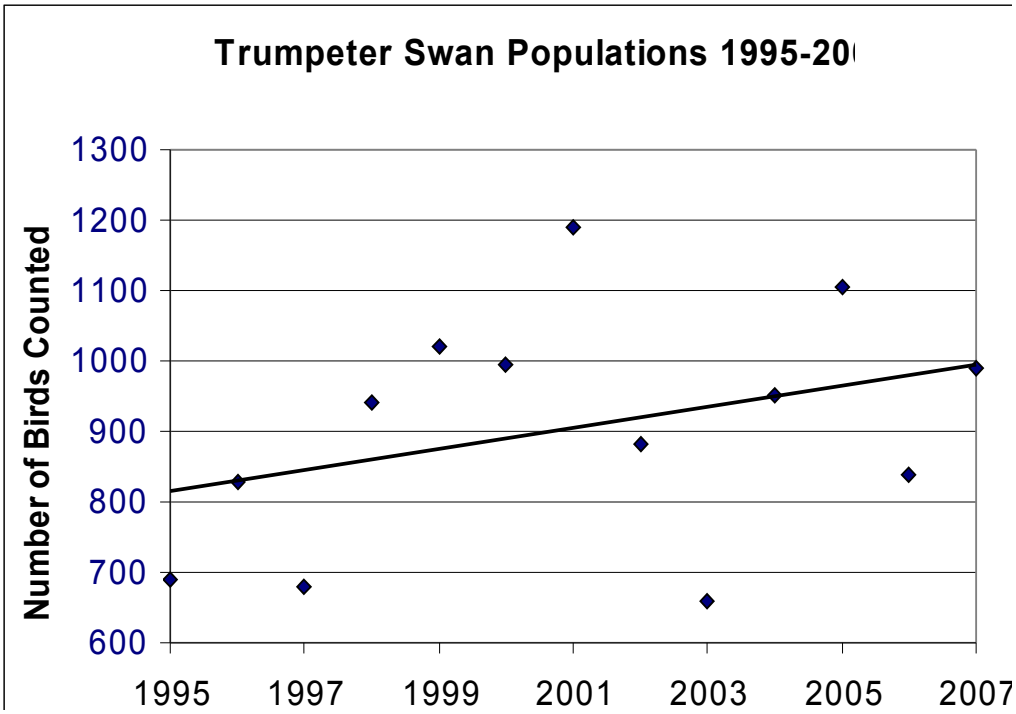


Figure 4.12: Distribution of Trumpeter Swans on the SW Coast of B.C.
Source: Environment Canada.



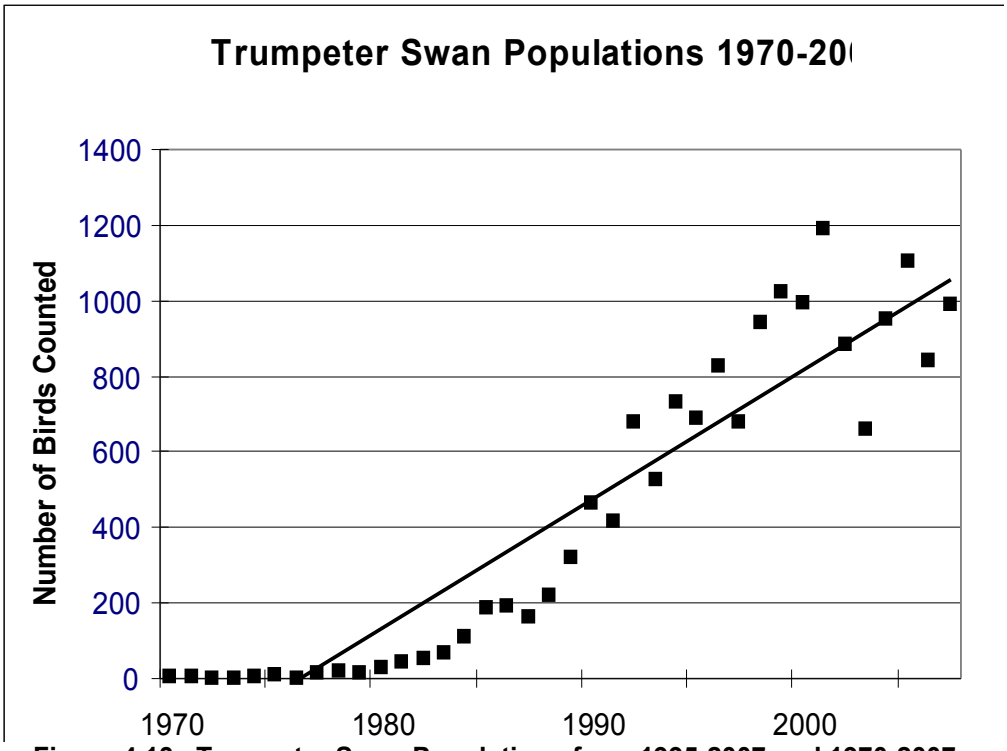


Figure 4.13. **Trumpeter Swan Populations from 1995-2007 and 1970-2007.** Source: Christmas Bird Count Data

It can be seen in Figure Y that Trumpeter Swan populations have increased dramatically since the 1970's. However, the data from the pre-1990's is said to be relatively unreliable (Marven, 2008) due to small numbers of people doing the Christmas Bird Counts and differences in counting techniques. Figure Y shows the bird count data from 1995-2007.

The change here is not as apparent but does show some increase in the past 12 years. It is possible that the populations are now beginning to level off, but are not decreasing.

Conservation Issues

As with most of the bird species discussed in this report, the major factor influencing swans in the Cowichan Valley is the loss of habitat for overwintering birds. The Pacific Coast population of Trumpeter Swans is threatened by human development which causes habitat losses (Nature Serve, 2005). In areas such as the Cowichan Valley, the increasing populations combined with smaller and smaller potential habitats results in a heavier reliance on agricultural and private lands for the swans' feeding grounds.

The recent recovery has been positive, but there are some complicating issues. Increasing populations have also caused bulrush decline, higher consumption of crops, and dispersion further inland than usual (Boyd, 1994). Trumpeter Swans are exceptionally good at foraging in agricultural fields, and can dig up roots up to 1 m deep, causing damage to fields, especially when they occur in large numbers. Farmers often find large craters dug into their fields (CWS, 1992), which complicates Trumpeter Swan conservation. Swans can eat up to 1.2 kg of grass per day, which can result in economic losses to farmers (Environment Canada, 2004).

Threats to swans other than habitat loss are minimal in overwintering grounds. In their nesting areas, human disturbance has been documented, (Henson and Grant, 1991) and has a negative impact on nest abandonment, egg mortality and predation. Intrusions by humans on foot and in vehicles to wetlands that provide nesting sites has caused the relocation of nests (Henson and Grant, 1991). Other types of disturbance include boating, floatplanes, photography, and any nearby human activity or habitat modification (Nature Serve, 2005). Trumpeter Swans, especially when nesting, are quite sensitive to disturbance and pollution.

Management

In 1916 the Migratory Bird Convention was initiated, and control over hunting and other human uses of birds was mandated (Environment Canada, 2004). In 1984 the North American Management Plan for Trumpeter Swans began legal protection, reintroduction, feeding programs, and land acquisitions (Environment Canada, 2004). In BC there is currently the Comox Valley Waterfowl Management Project, the Fraser River Delta Greenfields Project, and the Pacific Estuary Conservation Program, which cover the management of Trumpeter Swans.

The main priority for Trumpeter Swan protection is habitat conservation (Mitchell, 1994), and finding ways to do this without detriment on farmers. The restoration of wintering habitats along the migration pathways is essential to maintain swan populations (Nature Serve, 2005). In addition, monitoring and research needs to continue on topics such as those that have been suggested by Boyd (1994), including: recruitment rates, swan-geese-bulrush interactions, movement and dispersion and swan and crop interactions.

Tundra Swans *Cygnus columbianus*

Habitat

Tundra Swans (*Cygnus columbianus*, previously known as Whistling Swans) are similar to the Trumpeter Swans (CWS, 1992) in feeding and habitat. They inhabit wetlands, marshes and agricultural fields (Limpert and Earnst, 1994), and have similar issues regarding damage to crops. The Christmas Bird Count Data from Duncan shows a very small

population, at least relative to the Trumpeter Swans, that overwinter in the Cowichan Valley. However, the southern tip of Vancouver Island is one of the only places in Canada where these birds overwinter.

Figure 4.14 Distribution of Tundra Swans in North America.
Source: Limpert and Earnst, 1994

Population Trends and Status

According to the Christmas Bird Count Data, the population of Tundra Swans in the Cowichan Valley is small, but has not changed very much since the 1970's. The trendline in Figure OIU shows little or no change over the years, though some peaks and lows have occurred.

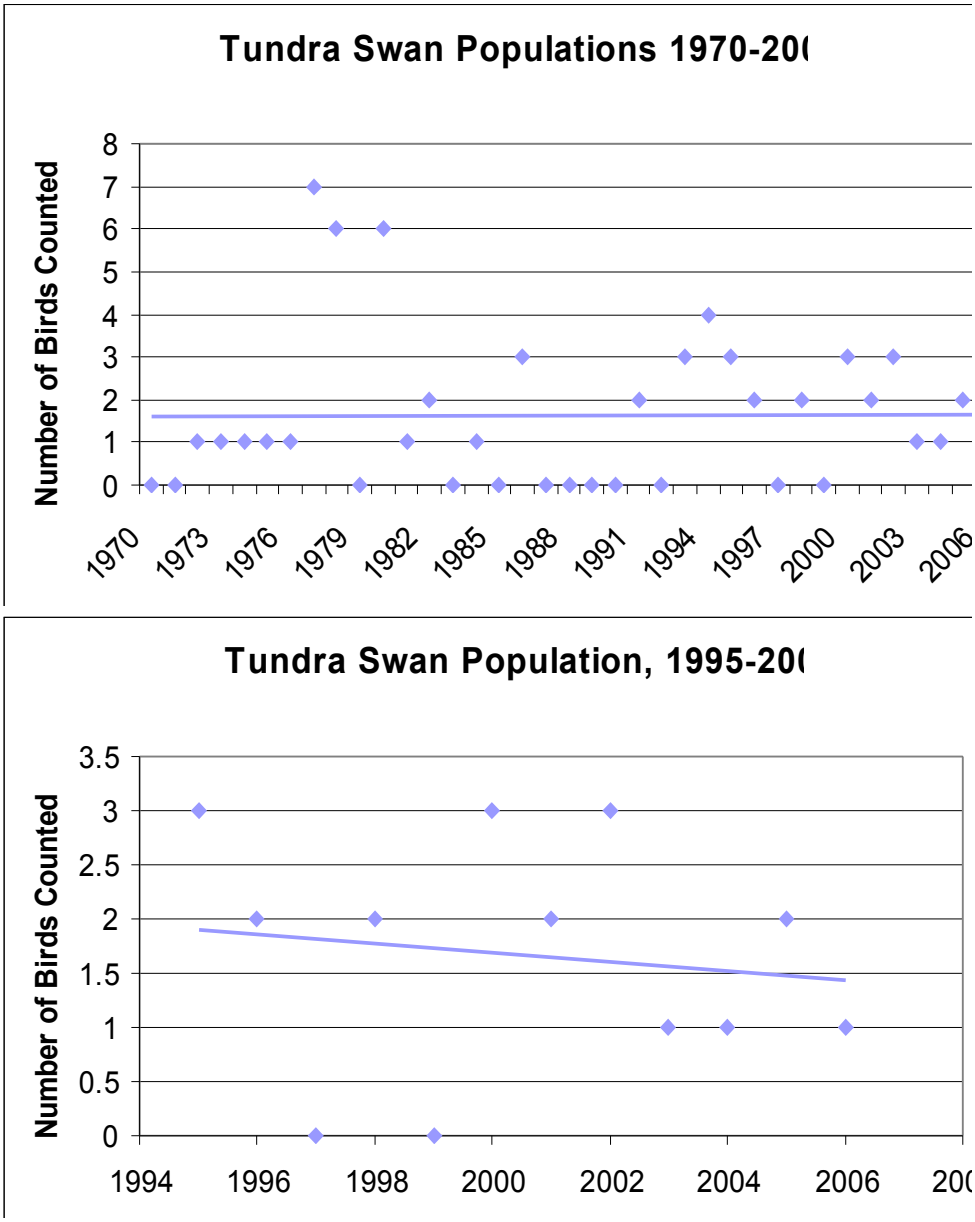


Figure 4.15 Tundra Swan Populations, 1995-2006 and 1970-2006.
Source: Christmas Bird Counts

In the more recent graph, which shows data from 1995-2006, there appears to be a slight decline in tundra swans. However, the scale of change is very small (0.5 of a bird) over this time so perhaps more monitoring should be done to try to reverse this trend. Tundra swans are native to Canada and their range here is quite limited.

4.2 Geese

Canada Goose *Branta Canadensis*

The Canada goose species was recently divided into two: Canada geese are now considered a separate species from *Branta hutchinsii*, the Cackling goose, which is a smaller bird (Mowbray et. al., 2002).

Habitat

In the 1950's Canada Geese were imported from the east coast of North America in an attempt to attract native migratory geese. British Columbia's native geese population had previously been extirpated by hunting (Chatwin, 2008). Unfortunately, this attempt was unsuccessful, but the non-native geese were able to establish here (Aldcroft, 2008).

Canada Geese now inhabit most of North America, in bays and estuaries, tidal flats, wetlands and riparian areas (Nature Serve, 1994). They are migratory birds, and overwinter and breed on Vancouver Island and in the Strait of Georgia (Trethewat et. al., 1987). The migratory and non-migratory populations are difficult to separate (Mowbray et. al., 2002), but there has been suggestions that the breeding population is on the rise (Aldcroft, 2008). The Duncan area has been thought to be one of the major nesting sites on Vancouver Island (Bell and Kallman, 1976).

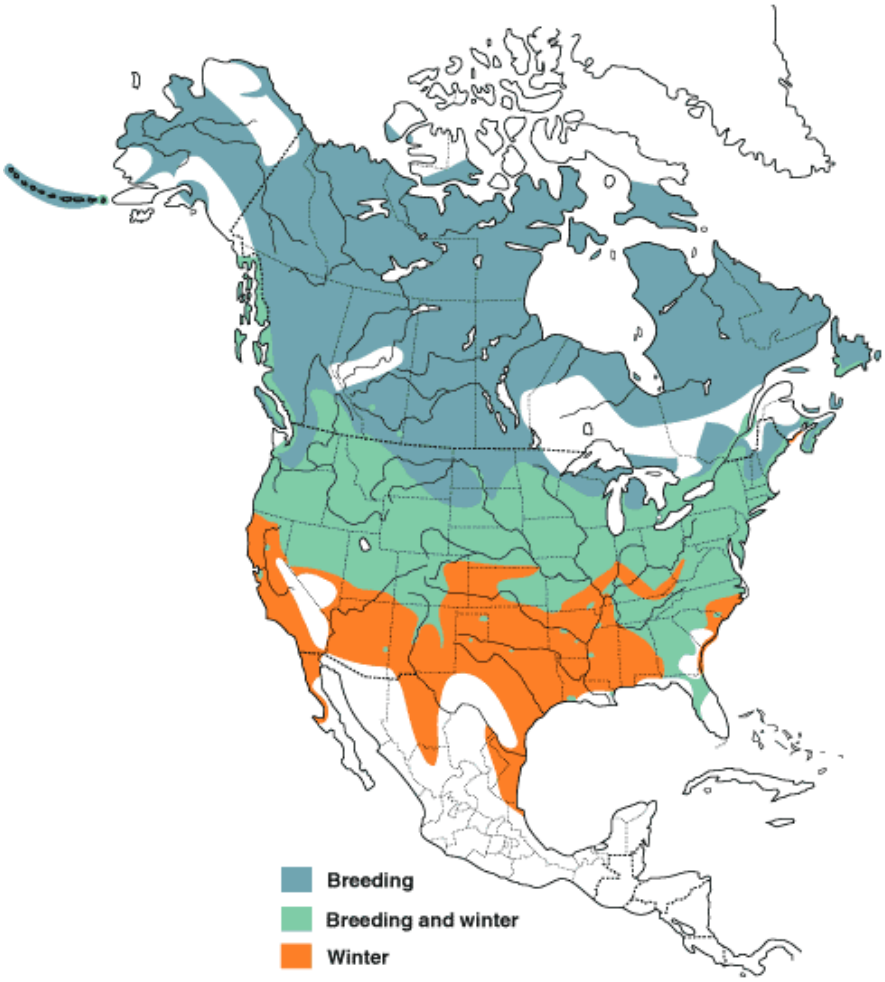


Figure 4.21 Distribution of Canada Geese in North America.
Source: Mowbray et. al., 2002

Feeding

Canada Geese are granivores and herbivores, and vegetarians (Myrfyn, 1990), preferring to eat marsh grasses, grain, wheat, bulrushes and other wetland vegetation (Nature Serve, 1994). Unlike swans that dig, geese will pluck or cut vegetation to access it (Kereki, 1999).

Population Trends/Status

Across North America, most populations of Canada Geese are stable or increasing, and of low conservation concern (Nature Serve, 1994). In overwintering areas, the highest populations can be seen during winter, from December to February (Blood et. al., 1976).

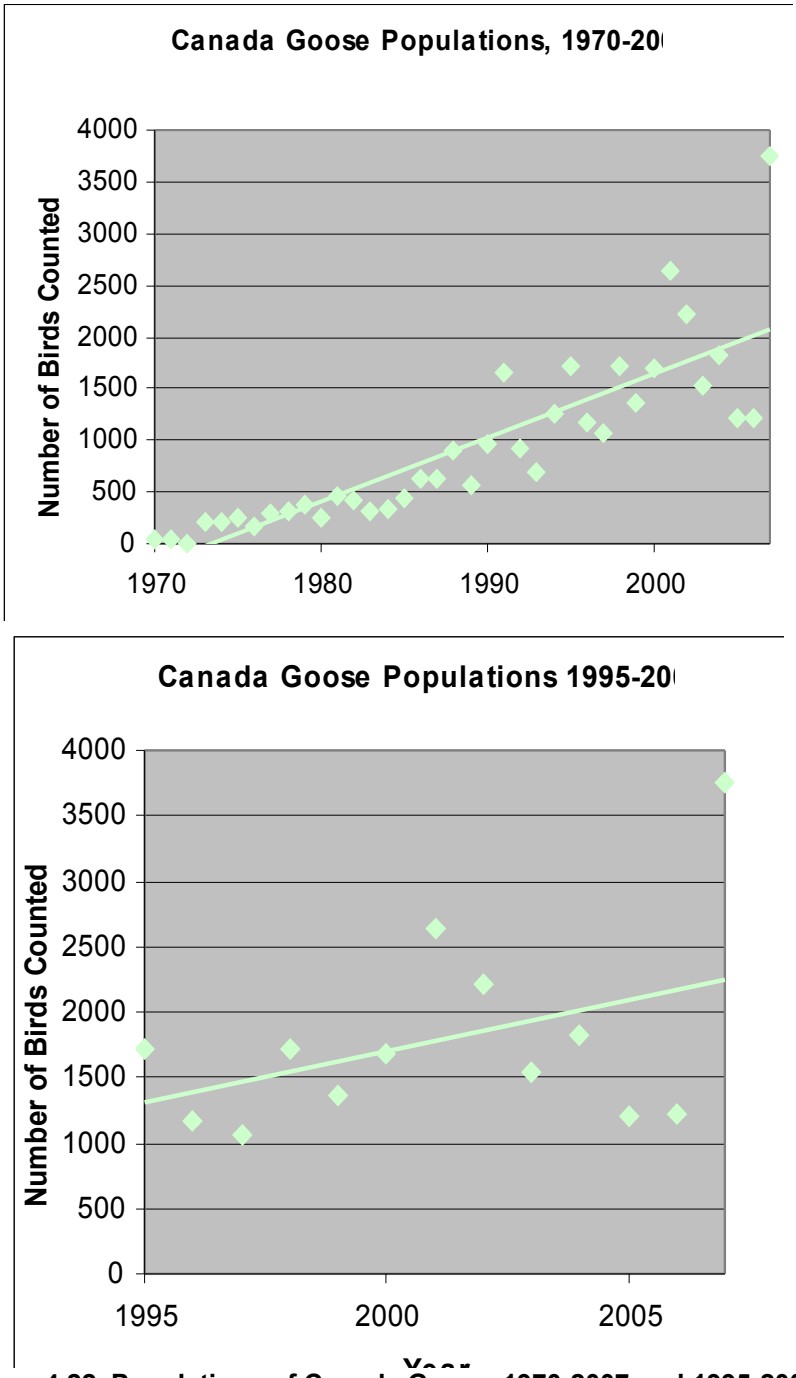


Figure 4.22 Populations of Canada Geese, 1970-2007 and 1995-2007.
Source: Christmas Bird Counts

Though Canada Goose populations vary from year to year, a general increasing trend can be seen from the graphs. Data from pre-1990 is unreliable, but even from 1995 onward

there has been a population increase. In addition, land stewards from Lake Cowichan and Somenos Lake have made personal observations of increases in the numbers of geese.

Conservation

Canada geese have increased to such numbers that they have become a pest to farmers, agriculturalists (Williams and Radcliffe, 2001), and landowners. They wreck lawns, leave feces on grass and public areas, and in water supplies. There has been a noticeable reduction in bulrushes and other vegetation in some areas, as seen in a study done in the Fraser River Delta (CWS Waterfowl Committee, 2007). Geese also pull out eelgrass (Chatwin, 2008), which is in decline itself and provides important habitat for countless marine species and other birds as well, such as Brant and Great Blue Herons. The increase in Canada Goose populations in the Cowichan Valley has mainly had negative impacts, and some measure have been taken in the past to try to stabilize or reduce the numbers.

Management

Canada goose population reduction can be done by habitat modification, egg addling, scaring, and increased hunting (Nature Serve, 1994) (CWS Waterfowl Committee). It is easy to get rid of Canada Geese, they can be hunted in spring when they are at their weakest state and before spring nesting and reproduction. However, this is not "politically correct", and little action has been taken in the Cowichan Valley. (Aldcroft, 2008) Many people claim that awareness of the problems that geese cause needs to be raised and a more specific plan of action should be made.

Figure 4.23 Canada geese near Richards Creek.

Brant *Branta bernicula*

Habitat

Brant are marine geese (Booth, 2001) that are closely related to eelgrass ecosystems (Vermeer et. al. (1), 1994). They breed in the Arctic and winter on the North American coast, including the east coast of Vancouver Island (Reed et. al., 1998).

The populations of Brant can be limited by the presence of eelgrass meadows, which are found close to the coast of Vancouver Island. Brant also inhabit marshes, mudflats and

estuaries during the winter (Nature Serve, 1994), and staging areas usually include protected shorelines (Reed et. al., 1998), which are also related to eelgrass beds.

Figure 4.24 Distribution of Brant in North America.
Source: Reed et. al., 1998

Feeding

In contrast to many waterfowl which have moved to consuming more and more agricultural crops, (Moore et. al., 2003), Brant have quite a specialized diet. They primarily feed on eelgrass, other species of seagrass, and sea cabbage (Nature Serve, 1994).

Population Trends and Status

Some studies have shown a decline in the BC population of Brant (Nature Serve, 1994). However, there is limited data on their population size and exact distributions. In the Cowichan area, Brant are usually seen only during the northward migration stopover in March or April (Blood et. al., 1976). They would be more likely to occur at the Chemainus or Cowichan estuary regions and are very unlikely in any of the lakes. They definitely occur further north up the coast in the Parksville region.

Conservation

Since Brant rely so heavily on eelgrass, eelgrass restoration and conservation is important to their conservation. Eelgrass is in decline in many parts of Vancouver Island (Vermeer et. al. (1), 1994) and being replaced by invasive japonica (Moore et. al., 2003) in many areas, and the invasive species does not grow well in winter unlike native eelgrass. Eelgrass beds have also been reduced from the impacts of development. This affects habitat

availability, and subsequently, bird condition and reproductive success (Nature Serve, 1994)

Brant are more susceptible to decline than other waterfowl as they rely on specific plants for food (CWS Waterfowl Committee, 2007), and are very easily impacted by changing environmental conditions.

Management

The most important aspect of Brant conservation is the restoration of eelgrass beds and habitat protection. Many efforts to do this have already been made and are continuing. It would be interesting for further research to include eelgrass and waterfowl associations.

Lesser Snow Goose *Anser caerulescens caerulescens*
Greater White-Fronted Goose *Anser albifrons*
Emperor Goose *Chen canagica*

These geese species have been noted only rarely during the Christmas Bird Counts. The most regularly was the Greater White-fronted Goose, whose population appears to be very low but not changing. Emperor Geese are spotted very rarely and lesser snow geese not very often either.

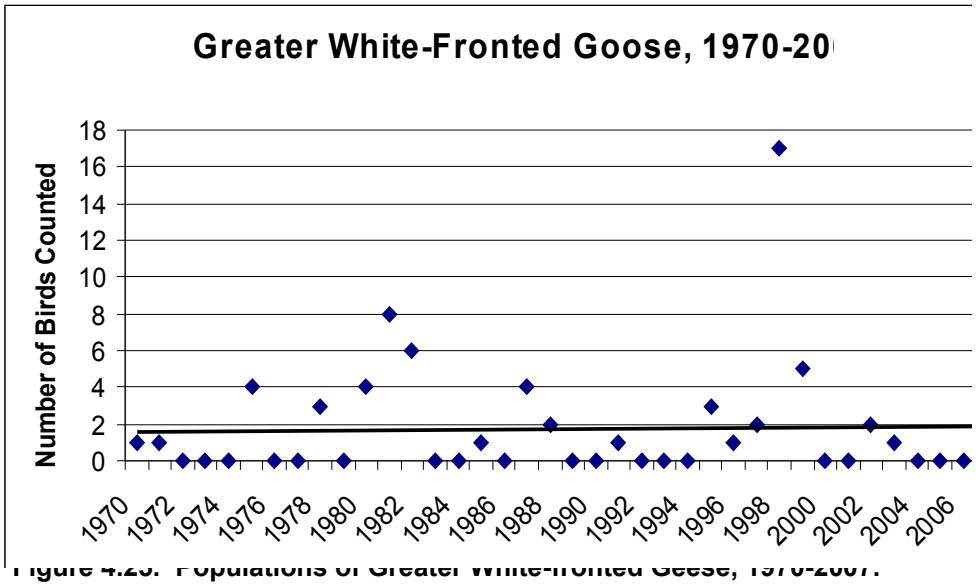


Figure 4.23: Populations of Greater White-fronted Geese, 1970-2007.

Source: Christmas Bird Count data.

4.3 Dabbling Ducks

Mallard Duck *Anas platyrhynchos*

Habitat
Mallards breed in the Strait of Georgia (Tretheway et. al., 1987 and Blood et. al., 1976), but are still migratory (Johnson, 1995) and the Cowichan Valley provides both nesting and overwintering grounds. They prefer a variety of habitats including herbaceous wetland, riparian areas, lagoons, tidal flats and shallow water, marshes, and agricultural fields (Nature Serve, 1994). The map below shows their North American distribution, which is nearly the entire continent.

Figure 4.31. Distribution of Mallards in North America.
Source: Drilling et. al., 2002

Population Trends and Status

Mallards are the most common duck in North America and their populations overall are remaining stable (Drilling et. al., 2002)

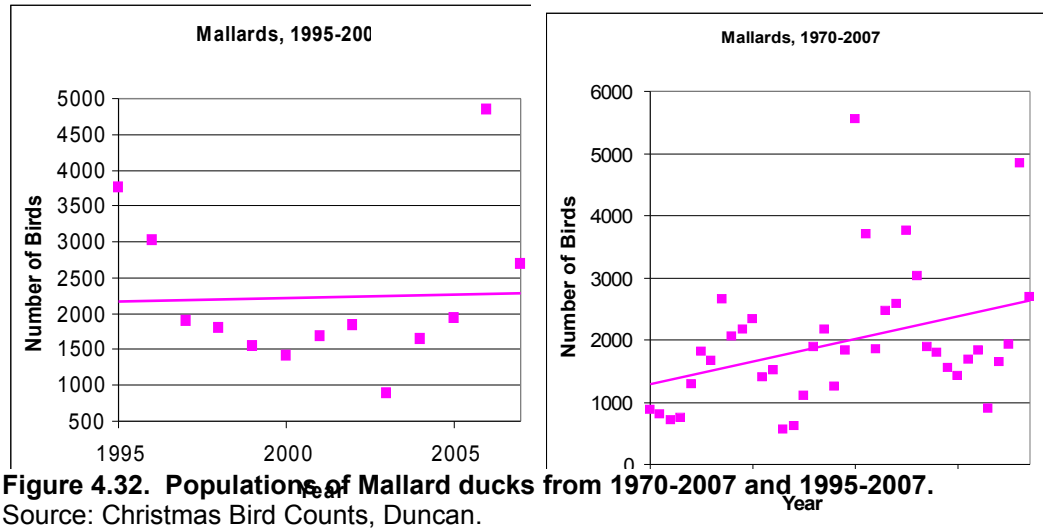


Figure 4.32. Populations of Mallard ducks from 1970-2007 and 1995-2007.
Source: Christmas Bird Counts, Duncan.

Mallard Ducks do not appear to be changing significantly in number since 1995. On the 1970-2007 graph however, there is a large increase and the average nearly doubles. This could be a counting discrepancy or a true increase. Either way, Mallards do not seem to be in decline. Conservation efforts may have to include ways of keeping mallards away from crops.

Conservation and Management

Mallards are the most popular game bird in North America; in Canada, over 50% of all ducks that are hunted are Mallards (Nature Serve, 1994). However, they are also the most abundant duck, so as long as this balance continues they are of little conservation concern.

Like many types of waterfowl, mallard ducks enjoy eating grains that grow in agricultural fields. Buffer grains grown in some areas where there are many mallards to keep them away from crops (CWS, 1992), as they can consume large amounts of food and trample young shoots with their large feet.

American Wigeon *Anas Americana*

Habitat

American Wigeon breed in northwestern and –central Canada, and winter mainly on coastal BC and the United States. Within their wintering range, they prefer wetlands, marshes, and ponds, similarly to most dabbling ducks and waterfowl. They tend to be located in areas that are next to variable agricultural landscapes, such as the Cowichan Valley (Mowbray, 1999).

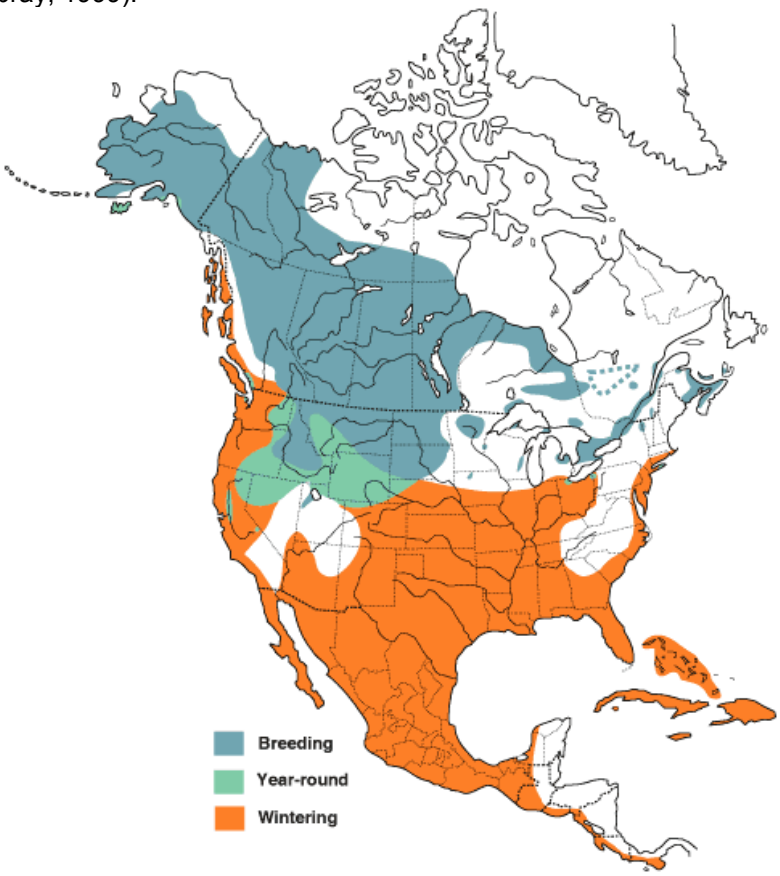


Figure 4.33. Distribution of American Wigeons in North America.
Source: Mowbray, 1999

Feeding

Of all the dabbling ducks, American Wigeons are the nearest to vegetarians (Mowbray, 1999), feeding mainly on grasses and aquatic plants. They are also aggressive feeders, and will swim near diving ducks and eat food that they bring to the surface since American Wigeons are not good divers (Mowbray, 1999)

Population Trends and Status

The BC Coastal Waterbird survey data shows a decrease in American Wigeons at the Duncan Sewage Lagoons but a slight increase at Cherry Point. On the CBC graphs below, a slight decrease can be seen in both scales. According to a study by Hirst and Easthorpe (1981), population changes of bird in the estuaries are usually correlated to changes in agriculture in the surrounding fields.

-

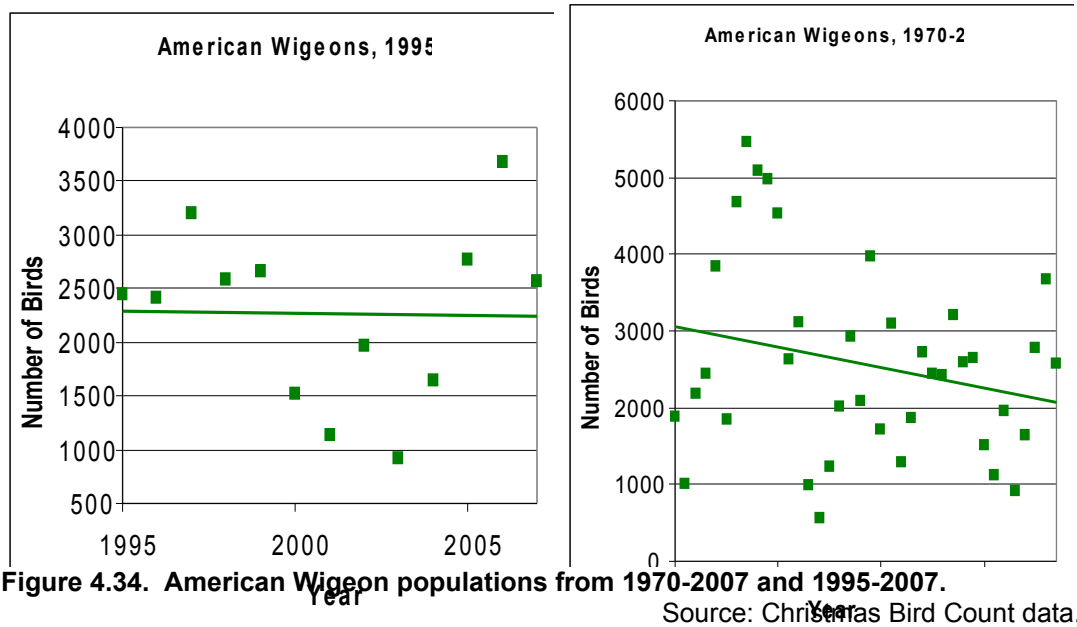


Figure 4.34. American Wigeon populations from 1970-2007 and 1995-2007. Source: Christmas Bird Count data.

Conservation and Management

On the Pacific Flyway, degradation of habitat is of the most concern for American Wigeons (Mowbray, 1999).

Northern Pintail *Anas acuta*

Habitat

Northern Pintails breed in wetlands mainly in Alaska and the prairie provinces, migrating in late summer to areas such as the Cowichan Valley (Austin and Miller, 1995). There is possibly a breeding population here as well as can be seen from the map. Northern Pintails inhabit flooded fields, tidal wetlands and estuaries (Austin and Miller, 1995).

Figure 4.35. Distribution of Northern Pintails in North America.
Source: Austin and Miller, 1995

Feeding

Northern Pintails eat grains, seeds, pond weeds, insects, and snails (Austin and Miller, 1995).

Population Trends and Status

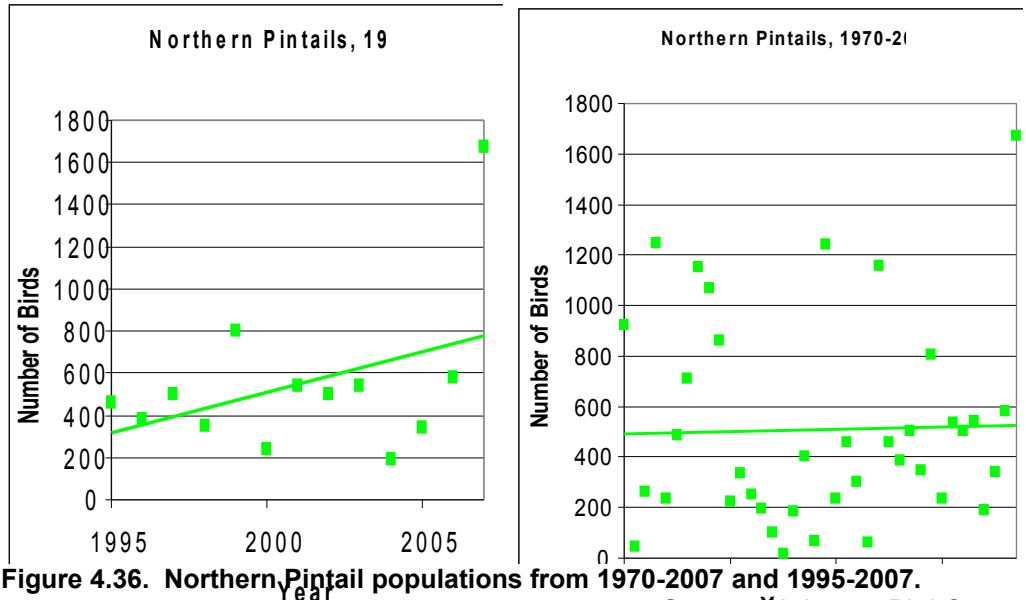


Figure 4.36. Northern Pintail populations from 1970-2007 and 1995-2007.
Source: Christmas Bird Count data.

The North American Waterfowl Management plan does not categorize Northern Pintails as "endangered", but indicates that their population is lower than it has been in the past or "should" be (Austin and Miller, 1995). The Christmas Bird Counts for the Duncan area indicate a slight increase in the Northern Pintail Populations since 1970. Since 1995, the level of change is greater, which could indicate that wetland restoration activities which have already taken place may be having a positive impact.

Green-winged Teal *Anas crecca*

Habitat

Green-winged teals breed in forested areas that are usually far away from human disturbance, which has kept their populations high in most areas. They are affected by a decline in wintering habitat, however, though not as much as many other bird species (Johnson, 1995)
They are known to breed in the Strait of Georgia (Tretheway et. al., 1987 and Blood et. al., 1976) but are still migratory (Johnson, 1995). The Cowichan Valley provides both overwintering and some nesting grounds.

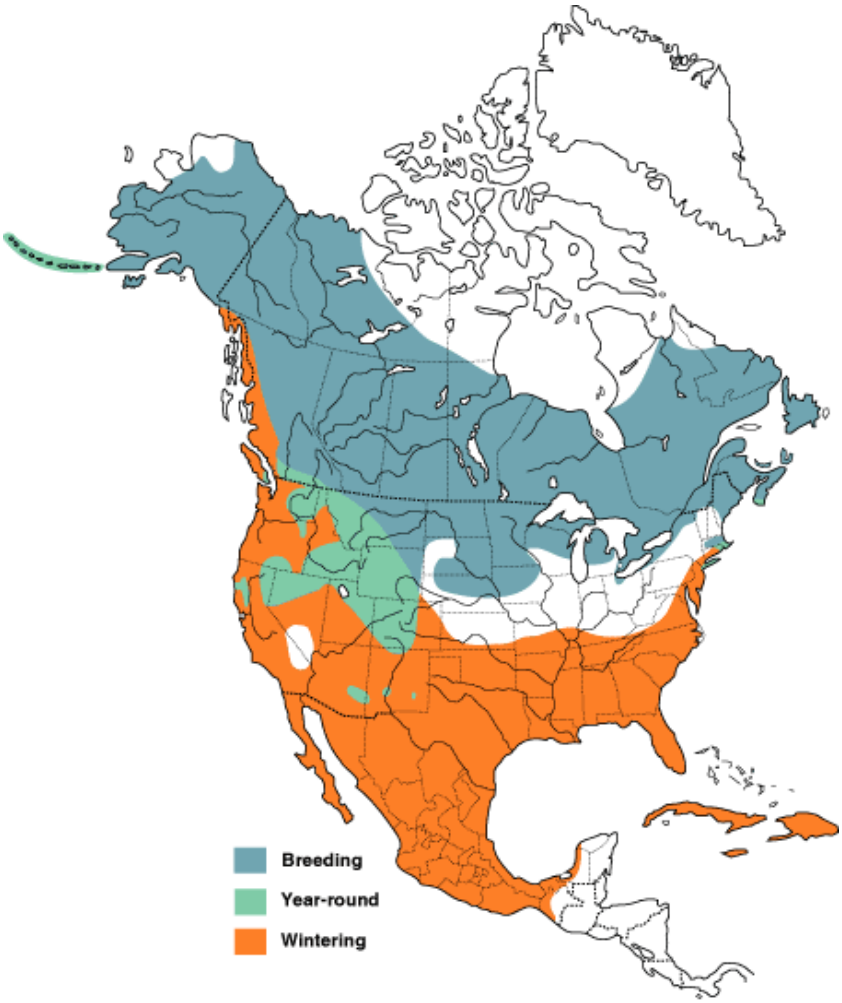


Figure 4.37. Distribution of Green-winged Teals in North America.
Source: Johnson, 1995

Feeding

Green-winged Teals are omnivorous, eating a varied diet of grasses, aquatic plants, sedges, mollusks, insects and aquatic larvae.

Population Trends and Status

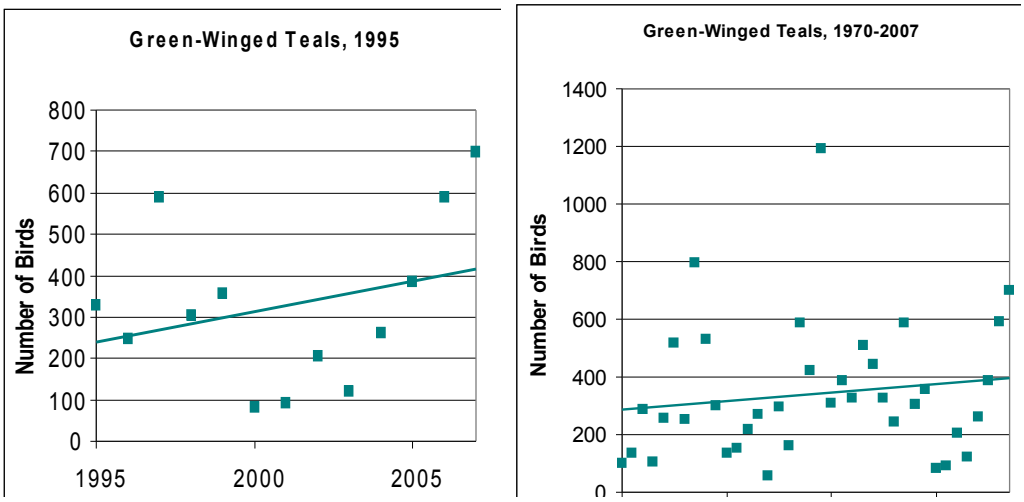


Figure 4.38. Population of Green-winged teals from 1970-2007 and 1995-2007. Source: Christmas Bird Count data.

If there is any change in the Green-winged Teal population in the Cowichan Valley it appears to be an increase.

Conservation and Management

Green-winged Teal are the second most hunted duck in North America (Drilling et. al., 2002). Their populations for the most part are stable, and because the nesting grounds usually occur far from where humans are able to access them easily, there has been little work on Green-winged Teal conservation (Drilling et. al., 2002). The main efforts have been general waterfowl habitat restoration.

Northern Shoveler *Anas clypeata*

Habitat

The Northern Shoveler is a dabbling duck that prefers water environments, inhabiting mainly ponds, intertidal areas and flooded fields. This is because they feed only through the water (Dubowy, 1996).

Figure 4.39. Distribution of Northern Shovelers in North America.
Source: Dubowy, 1996

Feeding

Northern Shovelers are filter feeders with specialized beaks. They feed mainly on small invertebrates and seeds, and are mainly vegetarian, especially in winter habitats (Dubowy, 1996).

Population Trends and Status

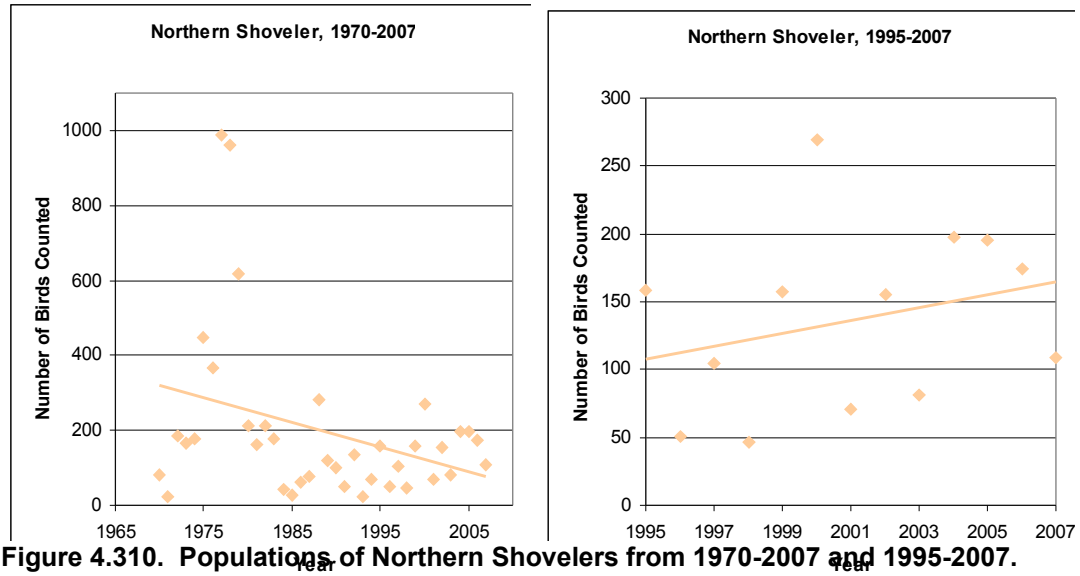


Figure 4.310. Populations of Northern Shovelers from 1970-2007 and 1995-2007.
Source: Christmas Bird Counts.

Through North America, the overall population trend for Northern Shovelers has been a stable one (Dubowy, 1996). In the Duncan Christmas Bird Counts, a decrease is apparent since the 1970's. There were several times during the 70's where populations were over 200, 300 or even 500, but these peaks have not occurred since then. However, in the past 12 years where the data is more reliable, a slight increase can be seen.

Conservation and Management

Because of the usually stable populations of Northern Shovelers, there have been few conservation efforts aimed at them specifically (Dubowy, 1996). They are less likely to be impacted by food shortages because of their specialized bills for foraging

4.4 Diving Ducks

Barrow's Goldeneye *Bucephalia islandica*
Common Goldeneye *Bucephalia clangula*

Habitat

Goldeneyes are diving ducks which, during winter, inhabit common areas for waterfowl, including estuaries, bays, riparian and tidal flats (Hammerson, 1994). Both Common and Barrow's Goldeneyes prefer marine areas and shallow shorelines for foraging (Eadie et. al., 1995). As shown in the graph below, the Common Goldeneye breeding range includes most of central and northern Canada and Alaska. The range of Barrow's Goldeneyes is much smaller (Figure bagillion and 1), and the majority of it is located in Western Canada in BC and the Yukon. The wintering habitats are mainly coastal for Barrow's Goldneyes and this may have implications for its conservation.

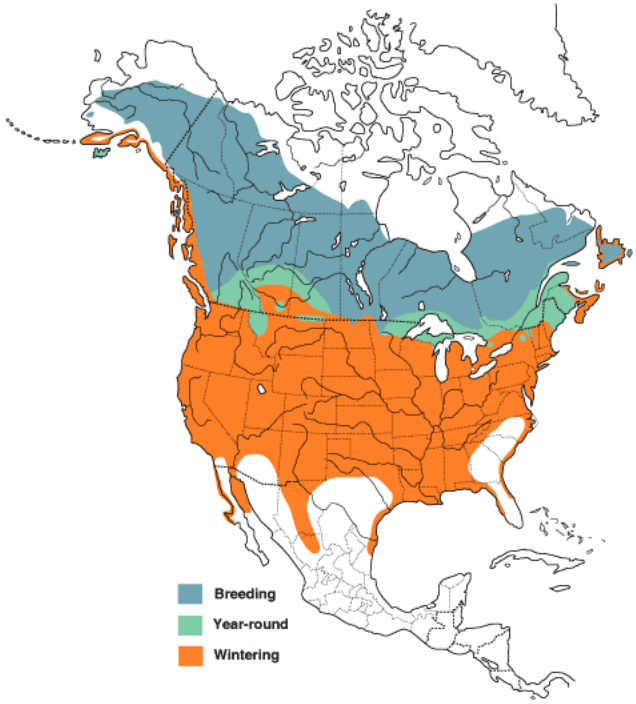


Figure 4.41. Distribution of Common Goldeneyes in North America.
Source: Eadie et. al., 1995.

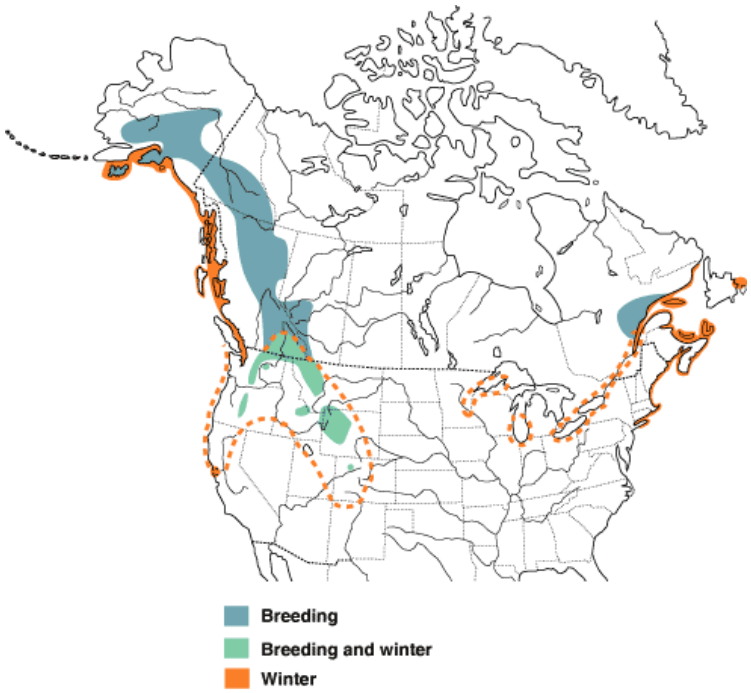
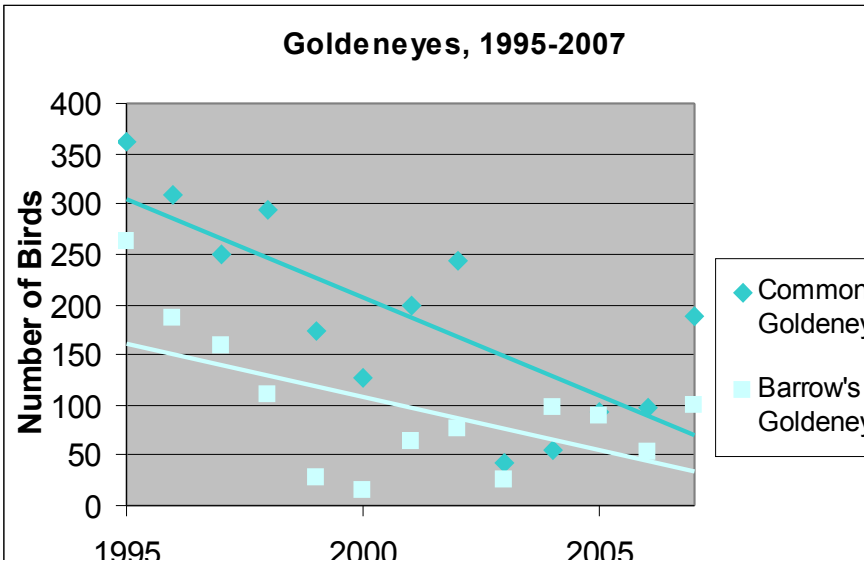


Figure 4.42. Distribution of Barrow's Goldeneyes in North America.
Source: Eadie et. al., 2000.

Feeding

Common Goldenyes eat aquatic insects and crustaceans, fish and fish eggs, molluscs and some vegetation (Hammerson, 1994), (Eadie et. al., 1995). Barrow's Goldeneyes eat a similar diet, but in particular like to feed on mussel beds, usually found on rocky coastlines (Eadie et. al., 2000).

Population Trends and Status



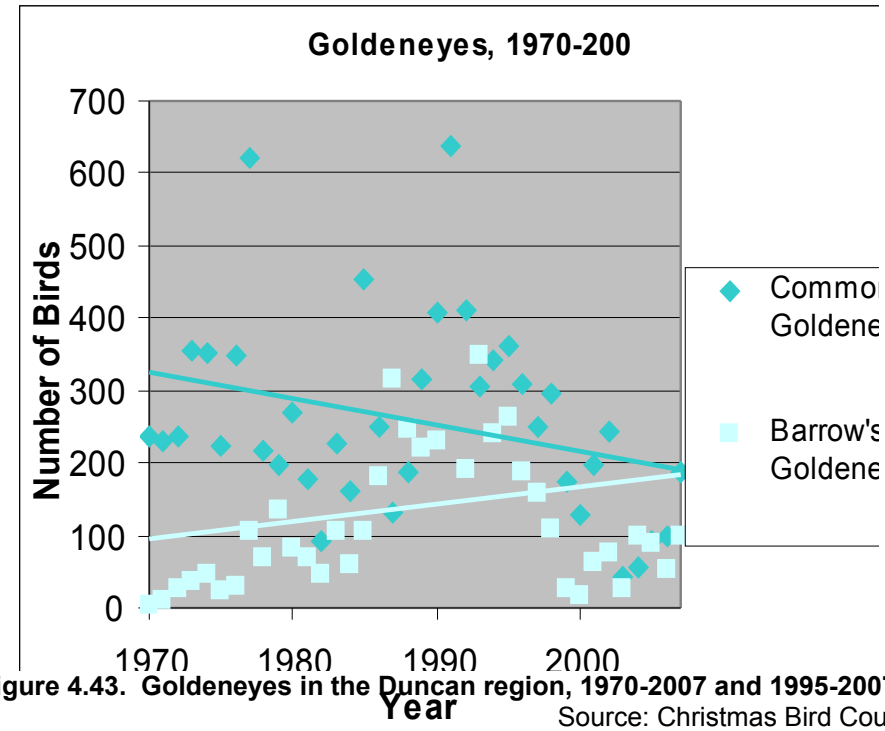


Figure 4.43. Goldeneyes in the Duncan region, 1970-2007 and 1995-2007. Source: Christmas Bird Count Data.

Both graphs in Figure Goldeneyes show a decline in the Common Goldeneye. Barrow's Goldeneyes appear to be increasing marginally since 1970 but declining since 1995. In North America, Common Goldeneyes appear to be stable within the past 50 years (Eadie et. al., 1995). A breeding survey done in Alaska showed a decline in Barrow's Goldeneyes, but they seem to be also stable across North America (Eadie et. al., 2000).

Conservation and Management

Common Goldeneyes are sensitive to loss of nesting cavities for breeding, pollution, and loss of wintering habitat. Conservation suggestions by Eadie et. al. (1995) include monitoring levels of hunting and water quality.

The Pacific Coast population of Barrow's Goldeneyes makes up over 90% of the world's population. Of the world's population, 60% nest and breed in British Columbia (Eadie et. al., 2000). The maintenance and restoration of wintering habitats is also important to Barrow's Goldeneye conservation, as they are also sensitive to wetland losses and water pollution. The nesting sites are of particular concern for Barrow's Goldeneyes, as the loss of tree cavities in central B.C. due to the mountain pine beetle has had a detrimental effect on their survival (Eadie et. al., 2000).

Common Merganser *Mergus Merganser*
Red-Breasted Merganser *Mergus serrator*
Hooded Merganser *Lophodytes cucullatus*

Habitat

Common and Hooded Mergansers breed and overwinter on Vancouver Island, as can be seen from the maps below. Their breeding ranges differ across Canada, but Common Mergansers have been seen nesting the Cowichan Valley (Blood et. al., 1976). Red-breasted Mergansers do not breed here, but overwinter on both coasts of Canada and the United States.

On a local scale, each type of Merganser prefers specific habitat types. Common Mergansers tend to winter on freshwater lakes, rivers and estuaries (Mallory and Metz, 1999), while Red-Breasted Mergansers prefer saltwater for their wintering habitat (Titman, 1999). Hooded Mergansers live in either freshwater or brackish environments (Dugger et. al., 1994).

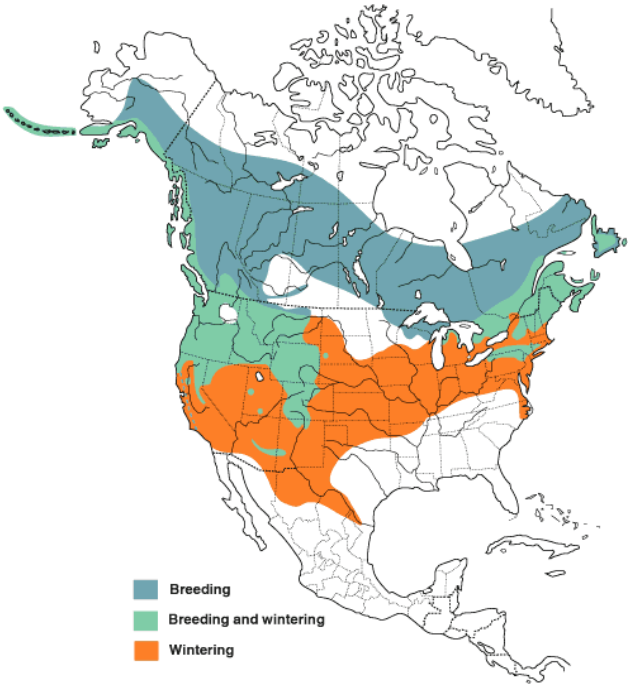


Figure 4.44. Distribution of Common Mergansers in North America.
Source: Mallory and Mentz, 1999

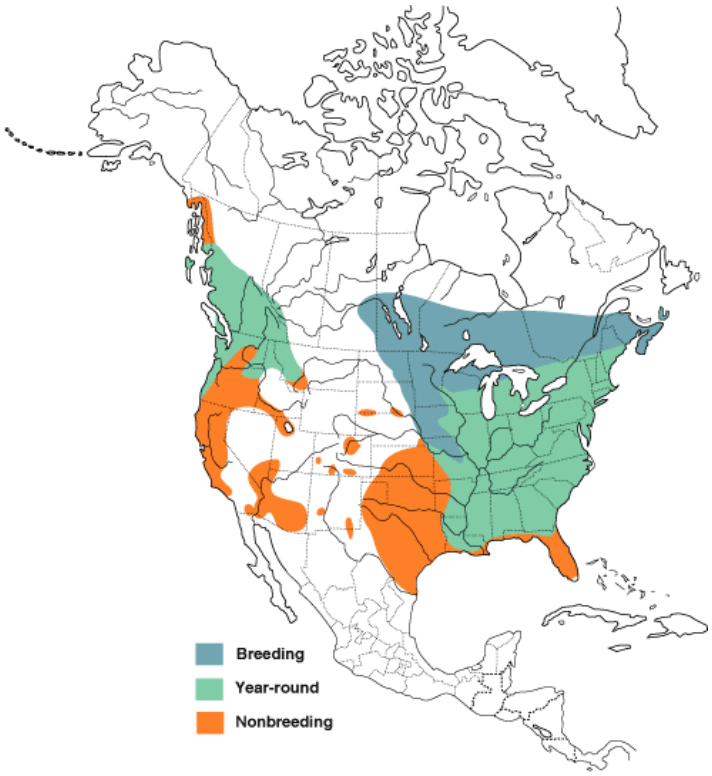


Figure 4.45. Distribution of Hooded Mergansers in North America.
Source: Dugger et. al., 1994

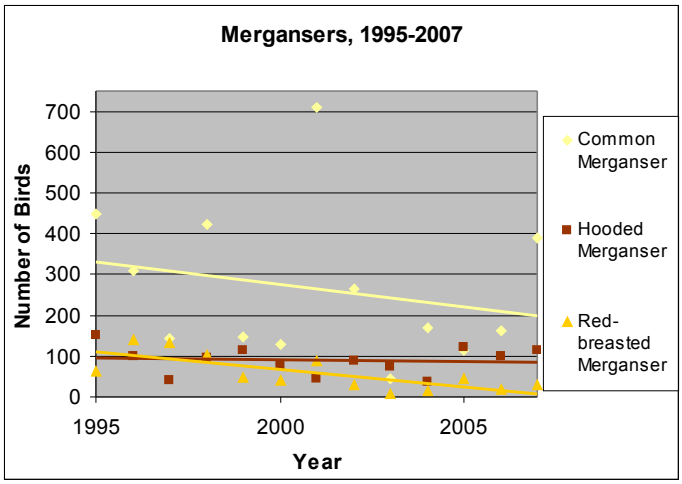
Figure 4.46. Distribution of Red-Breasted Mergansers in North America.
Source: Titman, 1999

Feeding

Mergansers are piscivorous for the most part, but the different species vary in their selected foods (Dugger et. al, 1994). Hooded Mergansers eat the most variable diet (Dugger et. al., 1994), while Common Mergansers and Red-breasted prefer crustaceans, fish, small invertebrates and small mammals in some cases (Titman, 1999).

Population Trends and Status

The graphs in Figure 23408 show a decrease in Common Mergansers over both time periods. More general reports (Hammerson, 1994) show that the North American population of Common Mergansers is stable over, but this could vary on a more regional scale. Hooded Merganser populations do not appear to be changing, though they are not seen in great numbers. The Red-breasted Mergansers have fluctuated over the years of Christmas Bird Counts since 1970. There was a peak time during the early 1990's/late 1980's where very high numbers of Red-breasted Mergansers were seen, but it would be difficult to specify the cause of these changes, particularly with the unreliability of the data. In North American wintering populations, some declines have been seen in Red-breasted Mergansers (Titman, 1999).



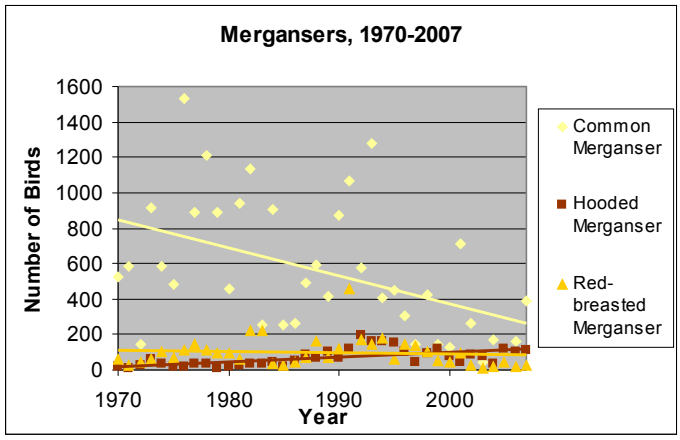


Figure 4.47. Mergansers fom 1970-2007 and 1995-2007.
Source: data from Christmas Bird Counts.

Conservation

Mergansers are not frequently sought after by hunters, so there have been less attention paid to them than some other waterfowl in that sense (Titman, 1999). However, they are considered to be top predators in the marine or aquatic ecosystems that they inhabit, and are sometimes used as environmental indicators in the form of keystone species (Mallory and Metz, 1999). A decline in mergansers can indicate contamination by pollutants, or lake acidification (Mallory and Mentz, 1999). There have also been many studies done on merganser-fish interactions because of the large numbers of salmonids and fish that they consume. This has been considered a threat to fish hatcheries and natural fisheries in many areas of North America (Mallory and Metz, 1999) (Titman, 1999).

Management

In some areas, mergansers, particularly Common Mergansers, have been reduced in attempts to protect salmon populations (Mallory and Metz, 1999). Since most populations in North America are considered to be stable, there have not been a lot of other management plans aimed at increasing their populations. However, since they are very central to aquatic ecosystem nutrient cycles, attention should be paid to Mergansers when developing conservation goals.
Mergansers are dependent on nest cavities and clear ground areas for breeding, and on food (fish) availability in both breeding and overwintering habitats.

White-Winged Scoter *Melanitta fusca*
Surf Scoter *Melanitta perspicillata*

Habitat

Both White-winged and Surf Scoters inhabit estuaries, open coastlines, and shallow marine areas. They prefer, for overwintering habitat, sandy or gravel bottoms with plenty of bivalves (Brown and Frederickson, 1997). The White-winged scoter breeding area encompasses the Yukon, parts of Alaska, and central B.C., Alberta, and the other prairie provinces, and the overwintering habitat is both coasts of North America. Surf Scoters have a more limited breeding range, covering small sections of Northern Canada and Quebec, and a similar overwintering range to White-winged scoters. Black Scoters are also found in the Cowichan Valley, but rarely (Christmas Bird Counts).

Figure 4.48. The distribution of White-winged Scoters across North America.
Source: Brown and Frederickson, 1997.

Figure 4.49. The distribution of Surf Scoters across North America.
Source: Savard et. al., 1998

Feeding

Scoters eat mostly animal foods, such as molluscs, clams, and other gastropods and crustaceans (Brown and Frederickson, 1997). During the herring spawning season, like many waterfowl, scoters will feed on fish eggs and small fish (Savard et. al., 1998).

Population Trends and Status

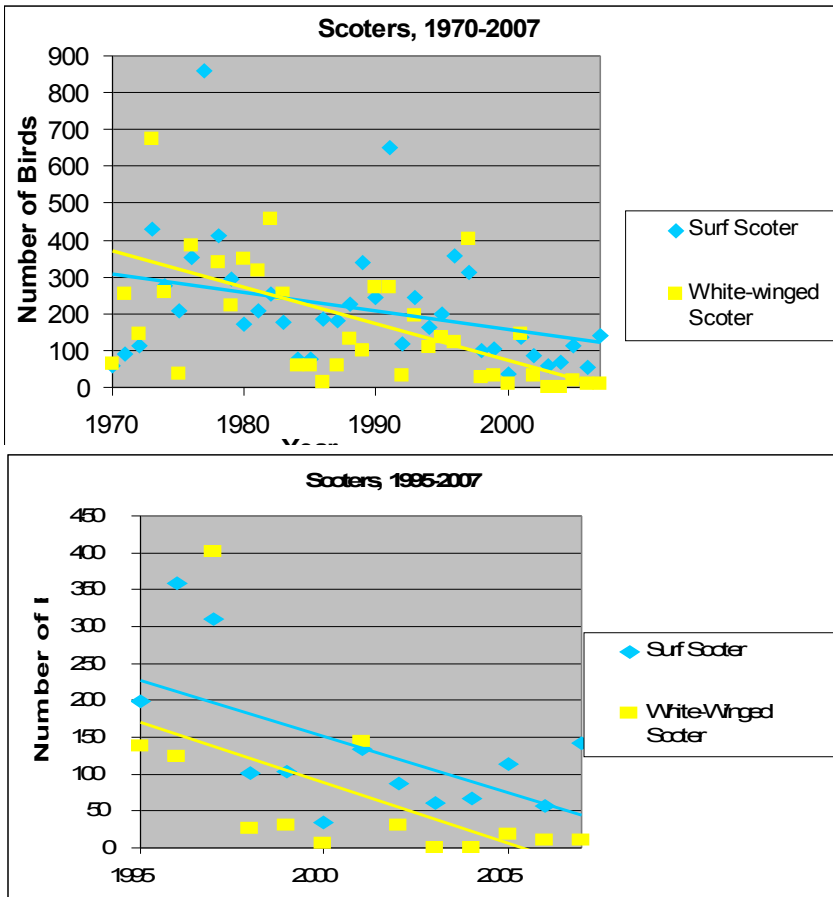


Figure 4.410. Scoter Populations, 1970-2007 and 1995-2007.
Source: data from Christmas Bird Counts

The graphs in figure figure show a decline in both Surf and White-Winged Scoters. This is of particular concern because, although the data is general and does not cover all areas, the decline is for both species, and shows up on both scales.

With respect to the different habitats in the Cowichan Valley, the BC Coastal Waterbird Surveys show the largest populations of scoters to be at Cherry Point compared to the Duncan Sewage Lagoons and Quamichan Lake.

In Western Canada, a decline has also been noted, although causes are generally unknown because the population dynamics of scoters are poorly understood (Savard et. al., 1998). A decreasing trend has been documented in the White-winged scoter breeding grounds of Manitoba as well (Brown and Frederickson, 1997).

Conservation

Scoters, like other diving ducks, play important roles in the aquatic ecosystems which they inhabit. This is due to their large body size, energy-costly feeding mechanisms, and the cold water they live in (Lewis, 2000). The combination of these factors means they have to consume large amounts of food and contribute significantly to nutrient cycling and organism interactions in this way (Lewis, 2000).

The population regulating factors for scoters have not been well studied or documented. Predation of young and lack of nutrients are two possible and common limiting factors (Brown and Frederickson, 1997). They are also sensitive to water contamination and in particular to oil spills, since the habitat of White-winged scoters includes large sections that are parts of major shipping routes (Brown and Frederickson, 1997).

Management

Savard et. al. (1998) suggest more monitoring and research as management strategies to try to better understand the contributions made by scoters to wetland and marine ecosystems. The protection of their nesting and wintering habitats is also of importance.

Greater Scaup *Aythya marila*
Lesser Scaup *Aythya affinis*

Habitat
During winter, Greater scaup prefer protected marine environments such as bays and estuaries (Kessel et. al., 2002). Salinity is known to impact food and habitat choice (Nystrom and Pehrsson, 1988), as it changes the food sources for sea ducks. Lesser scaup will overwinter more frequently in freshwater lakes or brackish water, moving to areas with higher salinity during storms (Austin et. al., 1998). This can be seen on the distribution maps in Figures 2435 and 245, as the range of Lesser Scaup is much farther inland than that of Greater Scaup.

Figure 4.411. Distribution of Greater Scaup in North America.
Source: Kessel et. al., 2002

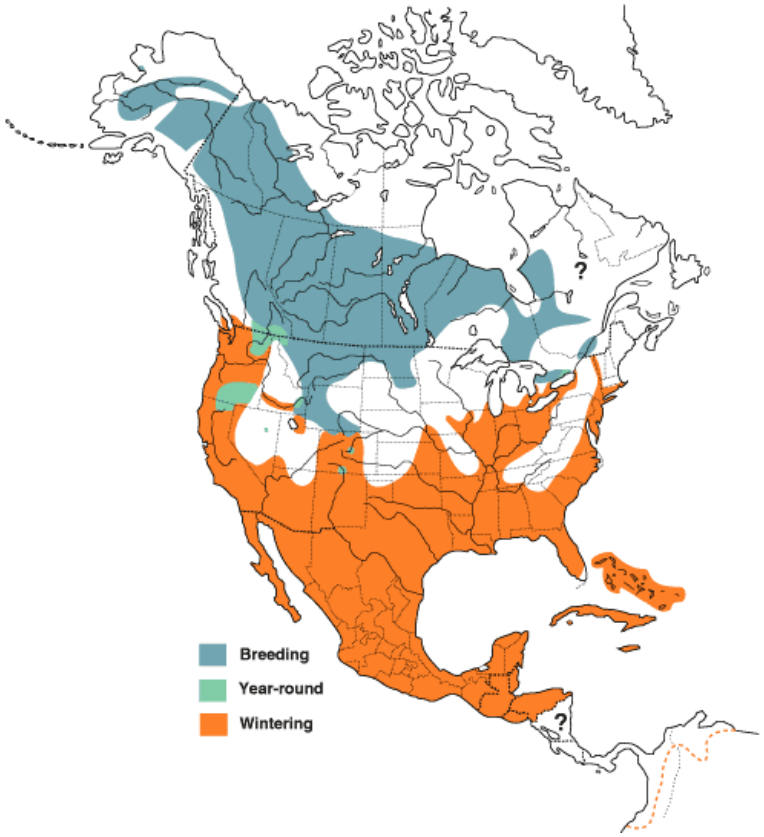


Figure 4.412. Distribution of Lesser Scaup in North America.
Source: Austin et. al., 1998

Feeding

Greater and Lesser Scaup eat bivalves, insects, seeds, aquatic animals and aquatic plants (Kessel et. al., 2002). They eat more vegetation than many of the diving ducks, and plants are an important source of food for them.

Population Trends and Status

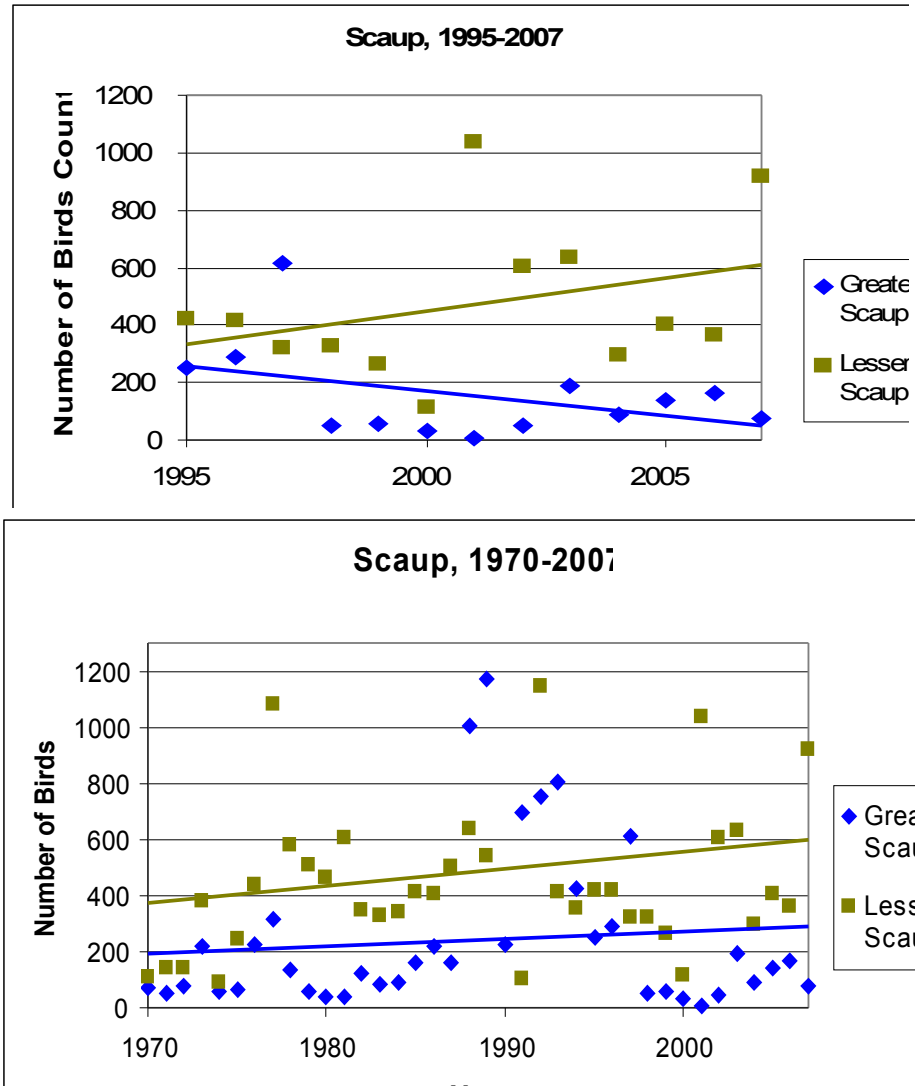


Figure 4.413. The populations of Scaup in the Cowichan Valley, 1970 - and 1995 – 2007. Source: data from the Christmas Bird Counts.

Lesser scaup is the most abundant diving duck in North America (Austin et. al., 1998). It is difficult to distinguish between Lesser and Greater Scaup so in many surveys, the data of both species are combined (Kessel et. al., 2002). The graphs from the Christmas Bird Count data to not appear to show any significant changes, except possibly a slight decline in Greater Scaup since 1995.

Conservation

The main threat to scaup is the loss and degradation of wintering and nesting habitat. Logging in Canada is one of the main issues for loss of nesting sites for many diving ducks. Along migration routes, the drainage of wetlands and alteration of overwintering landscapes can affect scaup as well (Austin et. al., 1998).

Management

Restoration on wintering habitat and harvest limitations have some things done so far by Ducks Unlimited (Austin et. al., 1998).

Bufflehead *Bucephala albeola*

Habitat

The wintering range of Bufflehead includes both coasts of North America and the southern United States, and some parts of Mexico. They breed in central and northern Canada, and Alaska. Buffleheads prefer sheltered coastal areas and inland ponds, lakes or slow-moving riparian areas (Gauthier, 1993).

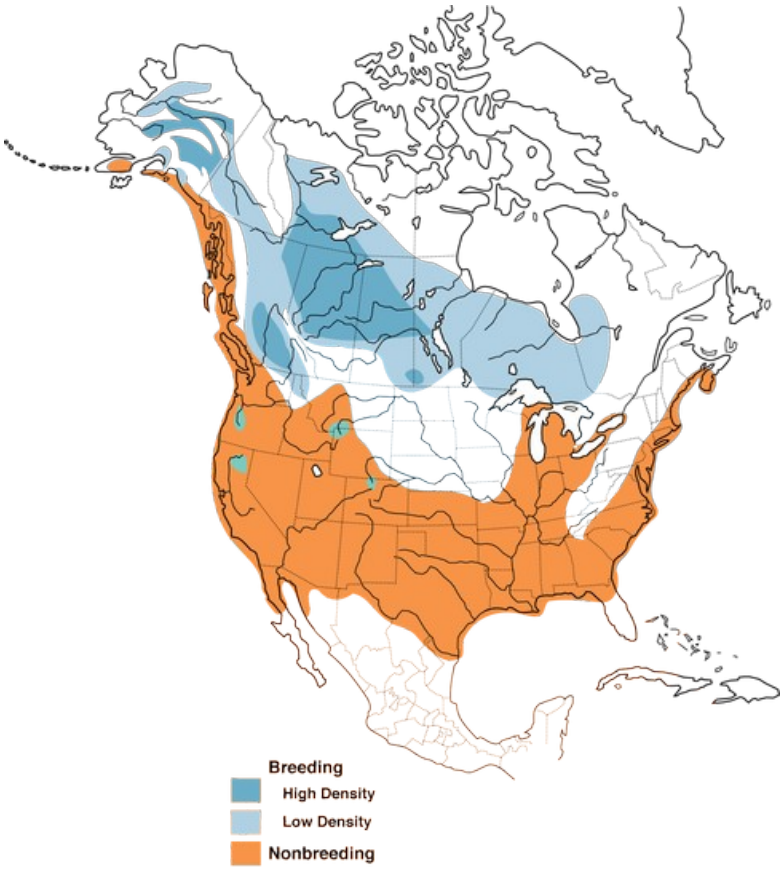
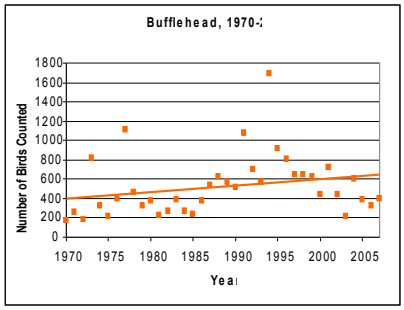


Figure 4.414. Distribution of Bufflehead in North America.
Source: Gauthier, 1993.

Feeding

Buffleheads feed mainly on aquatic invertebrates, and eat seeds if available (Gauthier, 1993).

Population Trends and Status



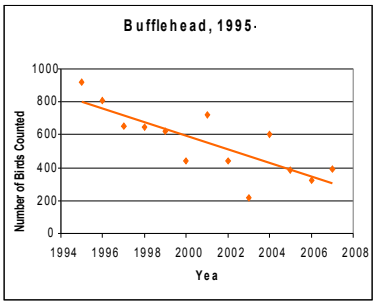


Figure 4.415. Populations of Bufflehead from 1970-2007 and 1995-2007.
Source: Christmas Bird Count Data.

According to the Christmas Bird Count data for Duncan, the populations of Bufflehead do not appear to have changed significantly since the 1970. Possibly they have increased by a marginal amount. However, the graph from 1995-2007 has more reliable data, and shows a clear decline over those 12 years.
In North America, an increase in Bufflehead has been reported for most areas (Gauthier, 1993).

Conservation

It has been suggested that the populations of Bufflehead are regulated by competition somewhat more than other waterfowl. At times they compete for space with each other when populations are high, and with Goldeneyes, which are a very aggressive bird (Gauthier, 1993). They have also been noted to compete with fish for food in some wetlands (Gauthier, 1993).

Management

Bufflehead are particularly susceptible to hunting rates, especially since they show high philopatry to both breeding and overwintering sites (Gauthier, 1993). The protection of coastal areas and wetlands will ensure they have sufficient sources of food along winter and spring migration routes.

Canvasback *Aythya valisineria*

Habitat

The Canvasback inhabits wetland and coastal areas such as lakes and estuaries. They breed mainly in central Canada and the Yukon, and the wintering range encompasses coastal and southern United States and northern Mexico. South Vancouver Island and the coast of British Columbia are the major areas in Canada for overwintering Canvasbacks, as shown in the map below.

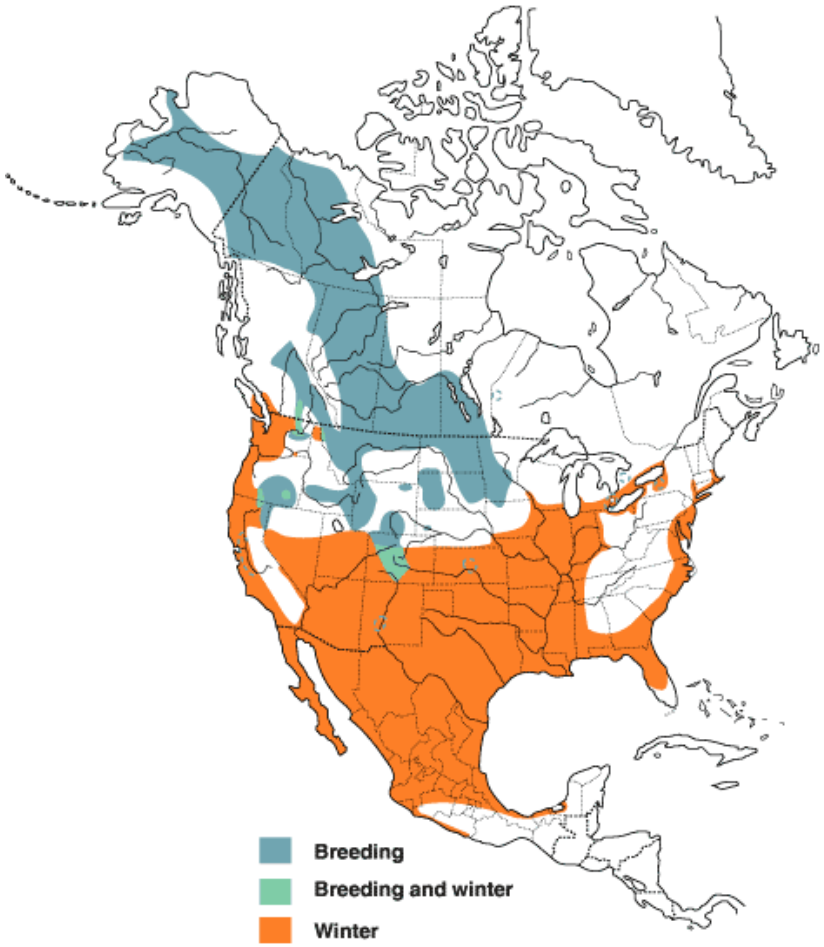
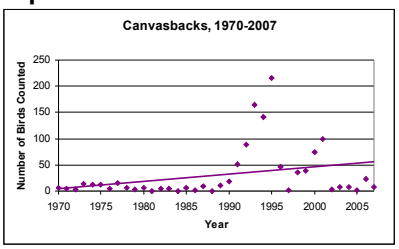


Figure 4.416. The distribution of Canvasback ducks across North America.
Source: Mowbray, 2002

Feeding

Canvasbacks are omnivorous, eating a diet composed of roots, aquatic plant rhizomes, clams, and snails (Mowbray, 2002). During the winter, plants form a greater part of their food intake as they are more easily available.

Population Trends and Status



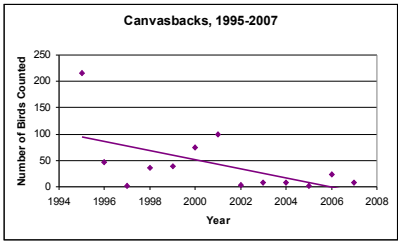


Figure 4.417. The populations of Canvasbacks from 1970-2007 and 1995-2007.
Source: Christmas Bird Counts, data from Duncan.

The Christmas Bird Counts for Canvasbacks show a low population until the 1990's where there was a large peak. Since, then, as the second graph shows, there has been a declining trend in Canvasback populations in the Duncan area.

Conservation

The canvasback duck was on the endangered species "Blue List" in the 1970's but has since recovered in most areas of North America (Mowbray, 2002) due to conservation efforts. The earlier decline was due mainly to loss of breeding habitat in the prairie – pothole regions of Canada (Mowbray, 2002).

Management

Canvasbacks, like other diving ducks, are strongly influenced b hunting pressures and the level of moisture, which determines the amount of wetland habitat available (Mowbray, 2002).

Ring-Necked Duck *Aythya collaris*

Habitat

Ring-necked ducks overwinter in shallow, freshwater wetland areas, such as swamps, marshes and flooded fields (Hohman and Eberhardt, 1998). The BC Coastal Waterbird Survey found Ring-necked ducks to be common in the Duncan Sewage Lagoons.

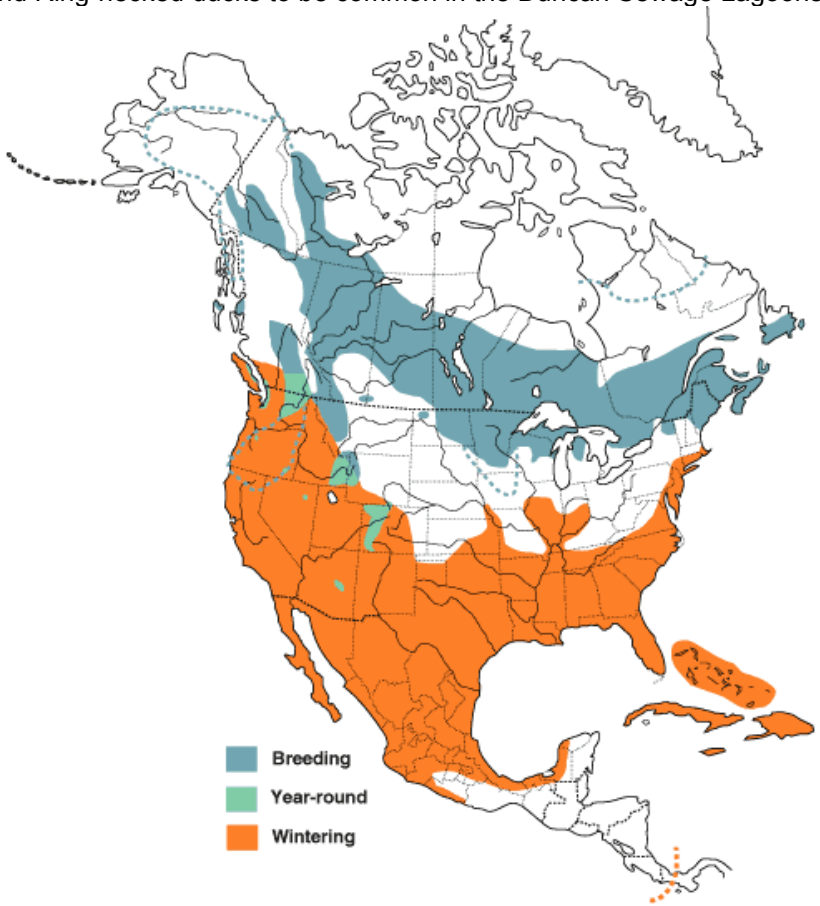


Figure 4.418. Distribution of the Ring-necked Duck across North America.
Source: Hohman and Eberhardt, 1998.

Feeding

Ring-necked ducks are omnivorous, feeding mainly on plant material during the winter (Hohman and Eberhardt, 1998). They eat large amounts of aquatic plants and seeds, and some invertebrates.

Population Trends and Status

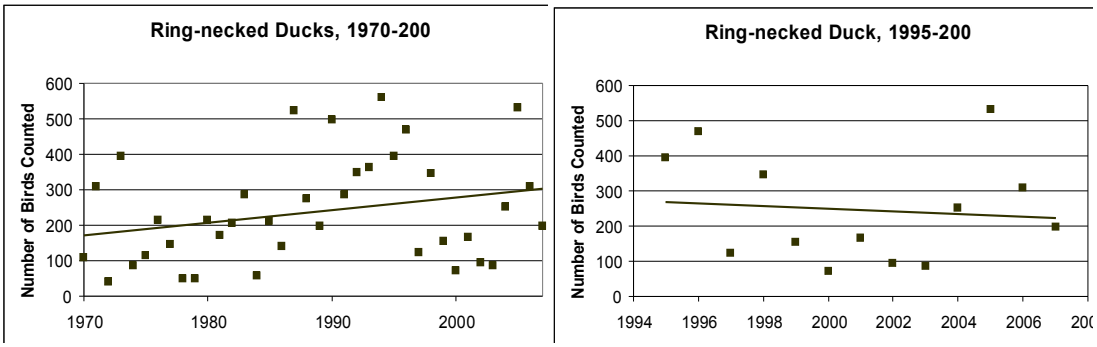


Figure 4.419. Populations of Ring-necked Ducks, 1995-2007 and 1970-2007.
Source: Christmas Bird Counts, Duncan region.

Figure RND shows the change in Ring-necked Duck populations since 1970. There has been some increase since then, and little significant change in the past 15 years or so. In the BC Coastal Waterbird Survey data from the Duncan Sewage Lagoons, there seems to be a slight decrease in the Ring-necked Duck population.

Conservation and Management

Ring-necked Ducks are strongly influenced by competition for wintering and breeding habitats (Hohman and Eberhardt, 1998), particularly since their diet is generalized and similar to that of many other waterfowl. They are also affected by human disturbance and related impacts. The loss of wetlands due to eutrophication, exotic plant invasion, erosion, and other factors has had some effect on Ring-necked Ducks as well (Hohman and Eberhardt, 1998).

Ruddy Duck *Oxyura jamaicensis*

Habitat

Ruddy Ducks breed in the prairie – pothole regions of Canada and the United States. During winter, they prefer freshwater wetlands or brackish water bays and estuaries (Brua, 2002).

Figure 4.420. The distribution of Ruddy Ducks across North America.
Source: Brua, 2002

Feeding

Ruddy Ducks eat mainly aquatic insects and other invertebrates, and a small portion of their diet is composed of vegetation (Brua, 2002).

Population Trends and Status

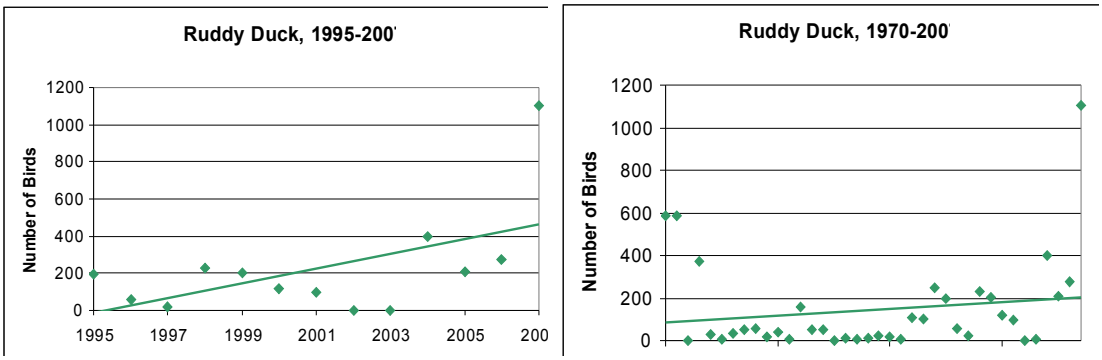


Figure 4.421. Populations of Ruddy Ducks from 1970-2007 and 1995-2007.
Source: Data from Duncan Christmas Bird Counts.

From the Christmas Bird Counts, Ruddy Duck populations in the Duncan area seem to be increasing significantly. Some studies have shown a decrease in the breeding numbers, but the overall trend for North America is unknown (Brua, 2002).

Conservation

Ruddy Ducks have many traits that make them unique to other waterfowl. They are very common in many parts of Europe and are often considered a pest there, but are a favourite for bird-watchers because of the blue bill of the male duck (Brua, 2002). The females lay eggs that are very large in size compared to their body weight, which is very energy-costly during the production and laying of eggs (Brua, 2002). As a result, food shortages may have a stronger impact on Ruddy Ducks and similarly a loss of habitat.

Management

Wetlands are important for both the breeding and wintering of Ruddy Ducks (Brua, 2002). Their protection is the most important for Ruddy Duck and all other waterfowl conservation.

4.5 Loons and Grebes

Common Loon *Gavia immer*
Pacific Loon *Gavia pacifica*
Red-throated Loon *Gavia stellata*

Habitat

In the Cowichan Valley, loons are most numerous in late fall, winter and early spring (Blood et. al., 1976). Common, Pacific and Red-throated Loons overwinter in the Straight of Georgia or on Vancouver Island, or use them as stopovers during migration. Common Loons breed over all of Vancouver Island and Red-throated Loons in the northern half. Loons prefer marine waters that are sheltered from winter storms and disturbance by humans (Barr et. al., 2000).

Figure 4.51. Distribution of Common Loons in North America.
Source: McIntyre and Barr, 1997

Figure 4.52. Distribution of Pacific Loons in North America
Source: Russell, 2002

Figure 4.53. Distribution of Red-throated Loons in North America

Source: Barr et. al., 2000

Feeding

Loons mainly eat fish and prefer subtidal habitats (Vermeer et. al. (2), 1994) They are also predators, who eat fish, crayfish, snails, leeches, salamanders (CWS, 1992)

Population Trends and Status

There have been recent increases in Common and Pacific Loons in coastal British Columbia (Russell, 2002). Red-throated loons, however, have been in decline for the past several years for unknown reasons (Barr et. al., 2000).

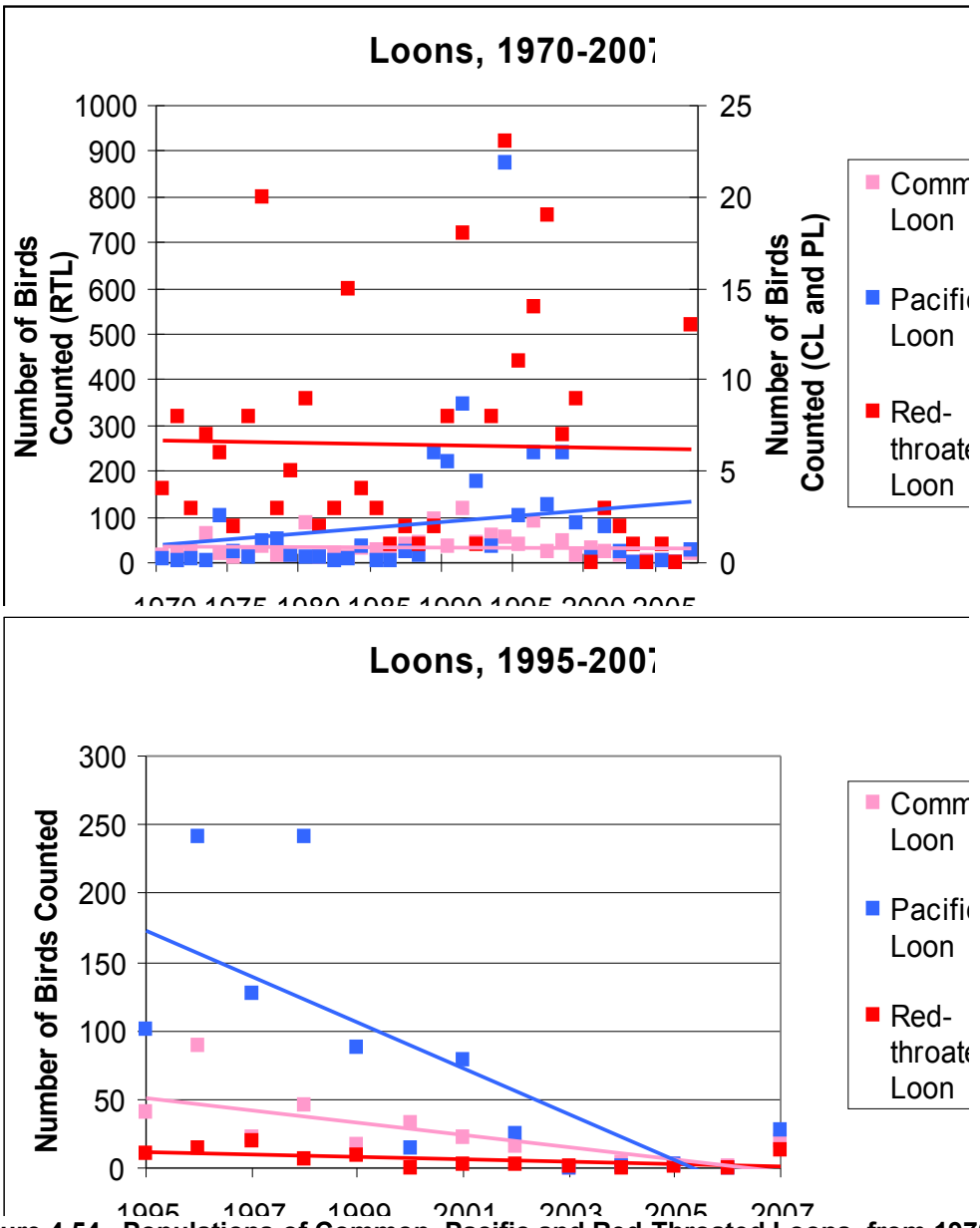


Figure 4.54. Populations of Common, Pacific and Red-Throated Loons, from 1970-2007 and from 1995-2007.

Source: Data from the Duncan Christmas Bird Counts.

The graph from 1970-2007 does not show any significant changes in loon populations. However, the 1995-2007 graph shows a decline of Pacific Loons that may be considered quite significant. Common Loons have possibly declined but Red-throated loons seem to have a stable (though small) population.

Conservation and Management

Loons are very well known compared to many other waterbirds. There was a serious decline in Common Loons in the middle of the century which prompted many active conservation efforts, including a group called the North American Loon Fund (McIntyre and Barr, 1997). There has been a lot of public awareness about the decline of loons. The impacts of people building nest platforms and conserving loon habitat has resulted in some

increase in their populations, though the current status of Red-throated Loons is less clear than the other species.
Loons are susceptible to shoreline and offshore island development, which results in habitat loss (McIntyre and Barr, 1997). They are particularly prone to disturbance because adult Common Loons are flightless for a short period of time during the winter molt. Storms, humans, food shortages and other things thus have a very strong effect on their populations (McIntyre and Barr, 1997).

Western Grebe *Aechmorphus occidentalis*
Horned Grebe *Podiceps auritus*
Red-Necked Grebe *Podiceps grisegena*
Pied-billed Grebe *Podilymbus podiceps*

Habitat

Western and Red-necked Grebes winter on estuarine and coastal waters (Stout and Neuchterlein,1999) on the Pacific Coast of North America. Horned Grebes inhabit similar areas, but are slightly more likely to be found on freshwater lakes as well (Stedman, 2000). These three Grebe species breed in the prairie regions of Canada with some variation. The Pied-billed Grebe differs in that it has a large region where it is non-migratory, including Vancouver Island (Muller and Storer, 1999).

Figure 4.55. Distribution of Western Grebes in North America.
Source: Storer and Nuechterlein, 1992

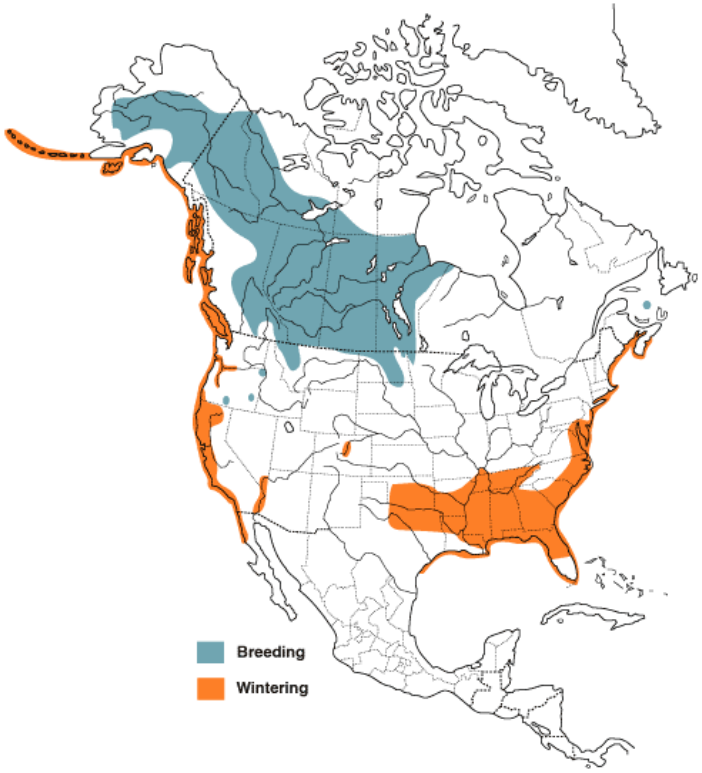


Figure 4.56. Distribution of Horned Grebes in North America.
Source: Stedman, 2000

Figure 4.57. Distribution of Red-necked Grebes in North America.
Source: Stout and Nuechterlein, 1999

Figure 4.58. Distribution of Pied-billed Grebes in North America
Source: Muller and Storer, 1999

Feeding

Grebes are piscivorous birds, eating mainly fish and occasionally crustaceans, aquatic insects and other small invertebrates found in their coastal habitats.

Population Trends and Status

The Western Grebe was the most numerous bird species observed in the Ladysmith-Chemainus region in the winter of 1974-75 (Bell and Kallman, 1976). In the 1970 Christmas Bird Count in Duncan, there were 514 Western Grebes identified, and in 2007, there were 11. There is always variation from year to year, but the trend overall does show a decline. From 1970-2007 and from 1995-2007 the Christmas Bird Counts for all species of Grebe in the Cowichan Valley have decreased at varying rates.

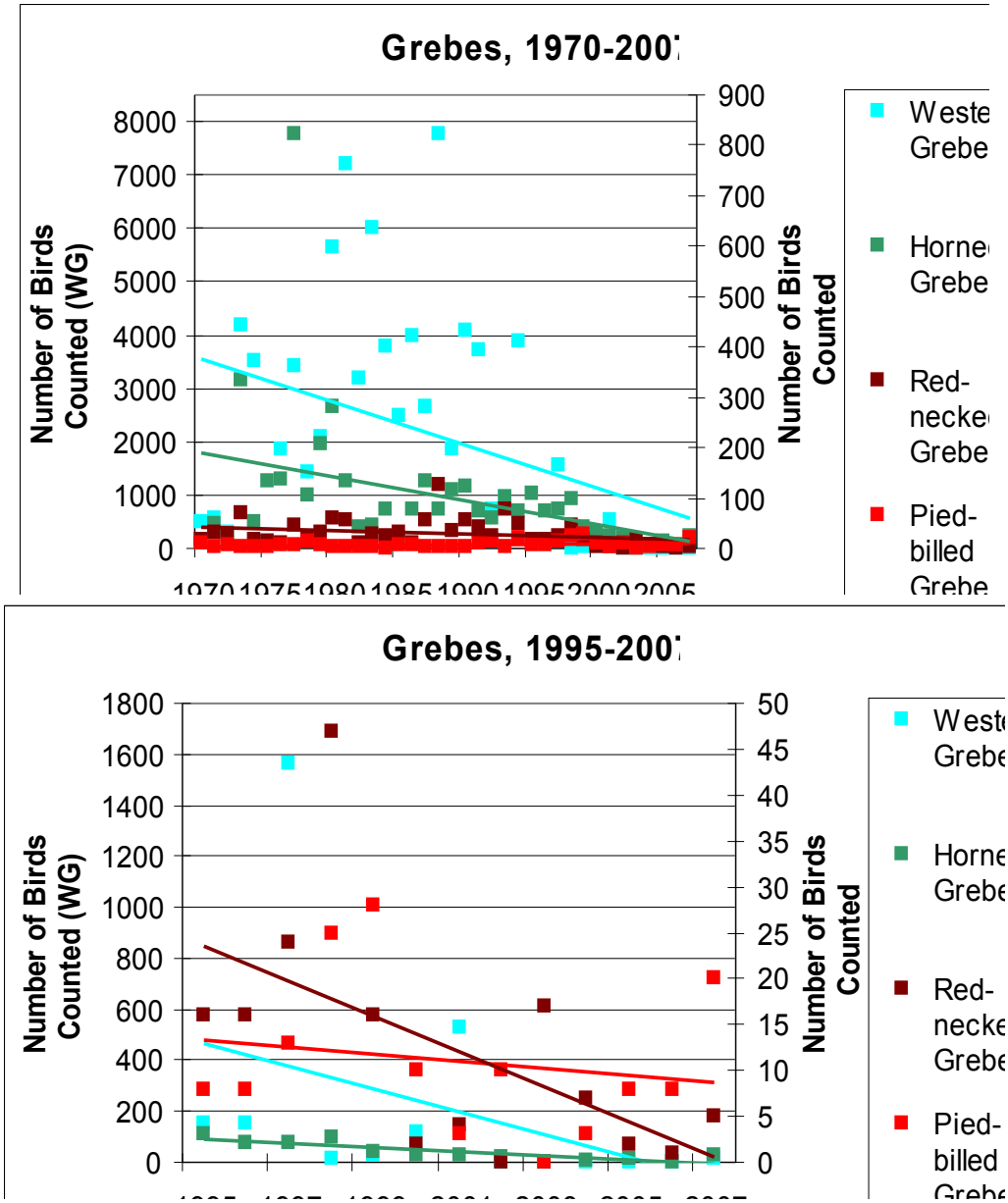


Figure 4.59. Populations of Grebes from 1970-2007 and from 1995-2007. Source: Data from Duncan Christmas Bird Counts.

Conservation and Management

The most important factor regulating Grebe populations is the availability of fish to support them (Storer and Nuechterlein, 1992). Their wintering areas of wetlands are coastal marine habitats are also sensitive to disturbance and may affect Grebes populations. Few detailed studies have been done on current trends in Grebes in North America, and there has been little conservation interest (Stedman, 2000).

4.6 Summary

Type	Bird Species	Preferred Habitat	Preferred Foods	Population Trend from Christmas Bird Count Data
Swans	Trumpeter Swan	Agricultural fields, marshes, tidal flats	Emerged vegetation, vegetables	Increasing
	Tundra Swan			Not changing significantly
Geese	Canada Goose	Bays, estuaries, wetlands, agricultural fields	Grasses, grains, wheat, seeds	Increasing
Dabbling Ducks	Mallard	Variable wetland habitats: Marshes, ponds, fields, intertidal	Aquatic and vegetation	Not changing significantly
	American Wigeon		Grasses, aquatic plants	Not changing significantly
	Green-winged Teal		Aquatic plants and invertebrates	Increasing
	Northern Pintail		Grains, seeds, insects, snails	Increasing
	Northern Shoveler		Small seeds and invertebrates	Not changing significantly
Diving Ducks	Common Goldeneye	Coastal, marine and estuaries	Aquatic insects and crustaceans	Decreasing
	Barrow's Goldeneye	Coastal, estuaries, some freshwater	Aquatic invertebrates, especially mussels	Decreasing
	Common Merganser	Freshwater lakes, rivers, and estuaries	Fish, invertebrates, small mammals	Decreasing
	Red-breasted Merganser	Saltwater and coastal	Fish, invertebrates, small mammals	Decreasing
	Hooded Merganser	Freshwater or brackish	Fish, invertebrates, some vegetation	Not changing significantly
	Surf Scoter	Estuaries, open coastlines	Mollusks, clams, fish eggs, small fish	Decreasing
	White-winged Scoter			Decreasing
	Bufflehead	Lakes, coastal, ponds, riparian	Aquatic invertebrates and seeds	Decreasing
	Scaup	Bays, estuaries, lakes	Aquatic invertebrates and seeds	Not changing significantly
	Canvasback	Lakes, coastal,	Roots,	Decreasing

		ponds, riparian	rhizomes, aquatic invertebrates	
	Ring-necked Duck	Mainly freshwater, agricultural fields	Plants, seeds, invertebrates	Not changing significantly
	Ruddy Duck	Brackish bays and freshwater wetlands	Aquatic invertebrates, insects, some vegetation	Not changing significantly
Loons	Pacific Loon	Marine and subtidal	Mainly fish, also snails, crayfish and leeches	Decreasing
	Common Loon			Not changing significantly
	Red-throated Loon			Not changing significantly
Grebes	Western Grebe	Estuarine and coastal	Estuary, marine, coastal	Decreasing
	Horned Grebe	Estuarine, coastal, some freshwater	Estuary, some freshwater	Decreasing
	Ring-necked Grebe	Estuarine and coastal	Estuary, marine, coastal	Decreasing
	Pied-billed Grebe	Estuarine, coastal, inland	Estuary, some freshwater	Decreasing

Figure 4.61. Summary of Population trends.

The figure summarizes the different types of birds, habitats, food and population trends. Although the data are fairly unreliable, the trend seems to be that the birds who prefer marine habitats are decreasing more than freshwater habitats. Diving ducks and grebes are the main birds that seem to be declining, and they are mainly piscivorous, eating less vegetation and more aquatic invertebrates and fish. Trumpeter Swans and Canada Geese are increasing. Most dabbling ducks are increasing or showing little changes.

These results have conservation implications, as it might be necessary to add focus on marine habitats as well as marshes and lakes alone. The coastal areas are very sensitive as well as inland areas such as Somenos Marsh.

5.0 Field Work

Further Research

It would be very useful to do a census of populations in both the Cowichan and Chemainus estuaries, and more research on bird feeding ecology (Vermeer et. al. (1), 1994). This should take the form of an organized bird count that spans the whole region and over long time periods. The current information is from different areas for varying and short periods of time, making it difficult to determine any trends.

Possible methods

Field work could be done as a separate project or the Christmas Bird Counts, which are a regional count taking place each December, could be expanded to include the Chemainus Estuary.

Specific methods for bird counts

- Vocalization Frequency. The "number of bird calls heard per ten minutes in the early morning has been used as an index to the size of bird populations". (Krebs, 2001)
- Roadside counts "the number of birds observed while driving a standard distance has been used as an index of abundance" (Krebs, 2001).
- Point Counts as already done for CBC and BCCWS.
- Banding could also be used as a way of keeping track of how many of the same birds return each year.

Mapping

In order to understand the distribution of different bird types in the Valley, a mapping project might be very useful. A map of the different wetland habitats and their use by birds in visual format would be a good tool to have, especially for noting changes over time. The regular use of habitat is indicator of food, cover and nesting site availability (Blood et. al., 1976), therefore changes in bird numbers or types in certain areas could be a sign of habitat loss or other factors.

Other Possible Projects

For any species that seem to be increasing, decreasing or changing, it would be useful to do some work on their breeding populations as a comparison. Data is available from the Breeding Bird Surveys, or field work could be done here in the case of Canada Geese. It would be interesting to see if the numbers of breeding Canada Geese are increasing at similar rates to the population as a whole (since there are some geese in the area that only over winter here and some that nest here). This would indicate whether there are any changes in the migratory portion of the population or not. If there are changes in the migratory population this would have implications for habitat loss or other causes.

For any species that is in decline a population viability analysis could be done. Detailed information about the life histories of the species would have to be acquired in order to do this. It would be difficult but useful for any bird that seems to be declining significantly.

Considerations/Difficulties

Trying to document changes in the population of any animal is a difficult task and there are some special considerations when dealing with migratory birds that should be taken into account.

If looking at population trends over short periods of time, 5 years for example, it would be useful to have information on the life stages of the birds that are being counted. 5 years or even 10 is a short period of time to monitor populations that fluctuate quite a lot naturally. However, if the proportion of young or ducklings to reproductive adults was increasing or decreasing this could be a sign of some positive or negative trend.

The issue of area is also important. The Cowichan Valley as a whole is a large and diverse region, with many habitat types, which is why it is so unique. However, this makes it difficult to do any sort of general bird survey. Large areas are difficult to take samples from and a way of equalizing this for any experiments should be considered. For example, if two areas are being compared, there should be the same number of points in each area from which samples are taken.

"Migratory Birds" is also a very general term, which covers swans, geese, many different types of ducks, and others. Using the same methods for each type of bird might not be the best approach. For example, diving ducks can be often missed if they are underwater. Trumpeter swans foraging in a field are easy to spot, but other birds might not stand out so well. In addition, the migration schedules for each category of bird are different, so counts might need to be taken at different times of the year. For relative purposes though, the Christmas Bird Counts are an indication of trends.

It should also be considered that migratory birds, by definition, migrate. This means they only use the resources of the Cowichan Valley for part of their yearly cycle, whether it is wintering, breeding, or as a rest stop. If populations are changing here, such as if a certain type of duck is in decline, for example, and this seems to be correlated to a loss of wetland habitat, it is impossible to make a proper correlation between the two factors. It could be something that is occurring in their northern breeding grounds, a different overwintering site, or it could be simply that part of the population is residing somewhere else for one or more years. Many birds do choose the same site year after year, but it is not always the case.

Even though a direct cause-and-effect on a regional scale (Breault, 2008) might not be able to be identified, wetlands are important as more than just migratory waterfowl habitat. They provide habitat for countless other wildlife species, a broad diversity of plant life, and ecological services to humans. It is certainly worthwhile to conserve the Cowichan Valley's waterfowl habitat and it is likely that this will benefit not only birds, but the ecosystem as a whole.

6.0 Management Recommendations for the Cowichan Valley

The main issues identified have been habitat loss, possible decreases of some species, effects of high birds populations on landowners.

Pacific Coast Joint Venture (1996) suggests the following conservation strategies for wetlands:

- *Securement*: Using land acquisition, covenants, government land transfers, management plans/agreements, and involves landowners that would like to sell, donate or exchange land.
- *Enhancement*: Used to increase biological carrying capacities of secured land by fencing, controlling invasives, nesting boxes/structures, provide water sources, providing food sources, and protection from disturbance.
- *Restoration*: Restoring degraded wetlands.
- *Management and Private Stewardship*: The commitment of private landowners to protecting wildlife habitat.
- *Monitoring, Evaluation and Research*: Keeps track of the progress towards habitat area and quality goals, population goals, and can help identify things like endangered species or species with decreasing populations.
- *Communication and Education*: Increasing public awareness, promoting sustainable resource use, public support for habitat protection.

6.1 Bird Management for Farmers and Landowners

PURPOSE: To reduce the problems between landowners and birds, particularly for those species which have increased substantially (eg. Trumpeter swans).

Cover Crops and Conservation Tillage

To prevent birds from eating or ruining more valuable crops, farmers often use cover crops. They are a tool for sustainable agriculture that can be used to manage wildlife and improve farm quality at the same time (Colwell, 1997). Cover crops are usually not a crop of great value and do not require as much intensive labour, but are preferred food for waterfowl. Short vegetation and frequently flooded areas are better for attracting birds (Colwell, 1997).

Conservation tillage a farming method in which the organic material from clearing the crop is left on the soil rather than cleared away. This allows more water to collect on the field, creating a better habitat for waterfowl.

Scare Tactics

To keep geese, ducks or swans away from lawns or fields, scarecrows and dogs are often used. This prevents damage to property and pollution from the geese, but is not always effective if the birds are present in large numbers. Several landowners in Lake Cowichan have tried this and it did not work.

Hunting Regulations

If there are any species being impacted by hunting, local hunting quotas should be changed (Berris and Gushue, 2005). This is only a control measure for species that are frequently hunted.

Use of vegetation to keep geese away

For landowners with geese problems on their lawns, as documented on Somenos Lake and Lake Cowichan, it may be useful to let the grass grow longer. Geese have been known to prefer shorter grasses, and if let to grow long this might keep them away. It could also be advantageous to use different types of vegetation to attract different birds.

Nest Disturbance for controlling populations of exotic birds

In attempts to reduce the population of breeding Canada Geese, nest disturbance has had good results. In a study on seagulls, egg removal from nests – as opposed to addling or other methods – had the best results, requiring the least time and effort (Ickes et. al., 1998). However this approach would have to have caution because it is controversial and many people might be against it.

Financial Compensation – farmers

The damage caused by geese, Trumpeter Swans or ducks should be documented and recorded if it is not already. This would help in trying to get financial compensation for farmers who have suffered losses to their crops from waterfowl. The protection of agricultural fields for waterfowl habitat is important, but can be an economic loss to farmers. They will need funding to assist them in increasing migratory waterfowl habitat on their properties.

6.2 Habitat Protection

PURPOSE: To conserve habitat for the birds that are in decline or potentially in decline, and also for those that are stable or increasing.

Habitat protection is the key factor in waterfowl conservation. There is a large diversity of habitat types included in the study area that support different kinds of birds. The Christmas Bird Counts indicate that marine environments may be being affected by development, pollution and other factors more than inland wetland environments. This is demonstrated by the decline in diving ducks and marine species such as the grebes.

Even available habitat that may not be currently in use by waterfowl should be protected (Vellend, 2008). This lessens the chance of losing species due to loss of habitat.

Methods for habitat protection include bringing agricultural lands under public ownership as suggested by Blood et. al., (1976). Agriculture provides better wildlife habitat than urbanized land through using sustainable agricultural practices. The best way to preserve habitat would be public communication and outreach (see below).

6.3 Public Communication

PURPOSE: To make sure that people know how important the region is to migratory waterfowl.

Workshops

A workshop is to be held this winter in early 2009. Along with presentations by guest speakers it will be useful to have a discussion and make plans for restoring waterfowl

habitat and other tasks. A workshop for the public will be a good way to get people involved by volunteering and contributing to the project, and learning about birds.

Education

The workshop will be a good place to start in educating people about wetlands and waterfowl. To take this further, current or future conservation or restoration projects in the area could incorporate what they learn about birds into their management plan. Some ideas for this include stream and lake restoration, eelgrass restoration, land stewardship, (see below) any projects involving schools, the Young Naturalists Club, etc. People from various groups could be invited to take part in the workshop.

Landowner contact/Stewardship

In continuing with the Stewardship Support Project, the CCLT could make a point to visit people in sensitive waterfowl habitat. A brochure could be made to give people who live near wetlands. Bird conservation guidelines and awareness could be included, as well as ways to preserve the habitat.

6.4 Notes on Non-Migratory Birds

There are many species of waterfowl that nest in the Cowichan lowlands area. These include Mute Swans *Cygnus olor,* which migrate only small distances within their breeding ranges (Ciaranca et. al., 1997). These are an introduced species of swan that nest on Vancouver Island (Bell and Kallman, 1976). Other examples are Double-crested Cormorants and Wood ducks that are mainly non-migratory along the Pacific Flyway

Conservation of Migratory- and Non-migratory birds is different in that there is no focus on protection of breeding sites in particular for migratory birds that overwinter here and do not breed here. However, the two are related because they use similar habitats and resources. Any measures taken to protect overwintering habitat will likely benefit breeding and nesting areas at the same time.

6.5 Suggestions for Further Research

- A complete census of migratory waterfowl including as many areas as possible but definitely both the Cowichan and Chemainus Estuaries.
- Investigations on the ages of birds over several years would help to indicate population trends.
- A study looking into the proportion of geese who nest here vs. those that overwinter here.
- The impacts of hunting on waterfowl in the valley.
- How much habitat is being lost or changed and at what rate?

7.0 Conclusions

This report was intended to form the basis for a project that would improve protection for waterfowl and their habitat in the Cowichan Valley. The types of habitat are well understood, and for most areas the types of waterfowl that use these particular habitats are also understood.

The Christmas Bird Counts and BC Coastal Waterbird Surveys have provided enough information to determine trends in some populations. The Trumpeter Swan and Canada Goose populations are stable or increasing which poses problems to many landowners and farmers. Dabbling ducks do not seem to be changing significantly according to this data. The species that seem to be most in decline are those that prefer marine habitats, such as Grebes and diving ducks. However, to understand clearly the abundance and distribution of waterfowl in the entire region it would be best to undertake some kind of census that is aimed at this directly and includes all areas. A defined management plan could then be written.

"*Continued development of uplands and floodplain lands in the [Cowichan Valley] seems inevitable, and additional demands for estuarine and foreshore development can be expected. Thus it is important to document the relative use of various sub-units of habitat by aquatic birds, and to assess maximum and average abundance, seasonal trends, and species composition. Hopefully, this information, together with other environmental inputs, will allow planners to channel necessary development into areas where ecological damage is least*." (Blood et. al., 1976)

As stated by Blood et. al., the rates of development and population growth in the valley are increasing. With this we have seen a loss of habitat that is very important for migratory birds along the Pacific Flyway. Methods for habitat protection include most importantly education and awareness of the issues. Landowner stewardship on private lands is also necessary, and acquiring more wetlands to be placed under legal protection is another goal. Most importantly, it will not be enough to use one method for waterfowl and habitat protection. Social, economic, political and environmental aspects should all be considered.

Annotated Bibliography

BACKGROUND INFORMATION

Bell, Leonard M. and Ronald J. Kallman, 1976 'The Cowichan-Chemainus River Estuaries: Status of Environmental Knowledge to 1975', *Report of the Estuary Working Group,* Special Estuary Series No. 4, Department of the Environment Regional Board, Pacific Region

Abstract: The coastal waters here have a great diversity of geographical configurations and offer a wealth of opportunities for commerce and recreation. Coal mining has left its mark in slag piles deposited in Ladysmith Harbour, and Crofton still exhibits the remnants from a copper concentrator located there after the turn of the century. The forest industry has provided a basis for employment in logging since the late 19th century in nearby Vancouver Island forests, and in pulp mills at Harmac, just north of Dodd Narrows, since 1950, and at Crofton since 1958. One only needs to visit the Forest Museum to obtain a flavour of early logging activities in Vancouver Island. Then one must not neglect to recall that agriculture has been practiced since the white man arrived in the low-lying Duncan-Chemainus area, one of the few suitable farming areas on Vancouver Island. One cannot help but be impressed by the typical "English-countryside" pastoral scene that one still encounters (though it is rapidly vanishing with increasing urbanization) along the Island Highway, and particularly along the side roads from Ladysmith to Chemainus and from Duncan to Cowichan Bay.

Recreational values are perhaps the greatest assets and potentials of this coastal area, however. Cowichan Bay is famous for its Chinooks and Cohoes. Oysters are found virtually along the whole coastline, including the islands, both on commercial leases and in the wild state. Unfortunately, many of these are contaminated by sewage and industrial effluents. Marinas dot the coastline offering boaters havens for tying up overnight or for longer periods. The protected waters offer unparalleled scenery (except for being marred by the industrial emissions from pulp and paper mills), and opportunities for comparatively safe sailing. The waters are relatively clear and are rich in diverse flora and fauna, attracting scuba divers from the mainland and Vancouver Island. Because the waters are generally stratified, unlike the waters of the San Juan channels, they tend to warm up at the surface in summer and can actually be quite pleasant for boating and water skiing.

Development has already marred industrialized areas such as Crofton. Log storage in booms covers valuable sections of estuary and delta from Ladysmith to Cowichan Bay, in order to feed local sawmills and pulp mills. Sections of the Cowichan River estuary have already been developed for industry, e.g. Slegg Forest Products with about 65 acres. Conflicts arise in flood control. Recognizing some of the problems in estuarine use and developments, the provincial government made suggestions for further study.

The Cowichan and Chemainus estuaries are highly important migrant waterfowl resting and/or overwintering areas. Avian wildlife is particularly diverse and abundant on and around these estuaries, and it attracts considerable consumptive and non-consumptive recreational activity. The Cowichan River estuary supports intensive waterfowl hunting, as it is highly accessible and close to urban centres. The mammalian fauna is less diverse than that of birds, and is sensitive to development in the area. Both the Cowichan and Chemainus watersheds support considerable deer and upland fame bird hunting. The

wildlife of the study area is a valuable recreational resource and is dependent on the preservation of natural habitats for its continued existence.

Frith, H. Russ, Blair Humphrey, Peter Wrainwright and Karl English, 1993, 'Cowichan Estuary State of the Evironment Report', *LGL Limited*, Environmental Research Associates

Abstract: Cowichan Bay is located on the east coast of Vancouver Island, 45 km north of Victoria and 6 km Southeast of Duncan. The area of the bay is approximately 13.5 km squared consisting of 4.9 km squared of intertidal and backshore areas at the outlet of the Cowichan and Koksilah Rivers and 8.6 km squared of subtidal waters. Water depth increases from the intertidal marsh environment at the head of the bay to approximately 55 m in the centre of the bay and increases further to a maximum of approximately 95 metres at the mouth of the bay near Separation Point. Cowichan Bay waters can directly exchange with waters in Satellite Channel without any impediment from a sill at the mouth of the bay.

A number of industrial activities (e.g. log booming), physical effects of the industrial activities (e.g. habitat loss), pollutants from industrial and municipal activities (e.g. antisapstains, dioxin/furan, and coliform) and resources affected by pollution or habitat destruction are of concern with regards to the resultant or potential effects of these activities on productivity, community structure and the health of the Cowichan Bay estuarine environment. In addressing these issues, monitoring data for pollutants discharged into Cowichan Bay and the vicinity was summarized and reviewed, literature on the effects of these pollutants on marine organisms was reviewed, the changes in land and water use by industry and their effects on the amount of available habitat was reviewed, and the state of the marine environment in Cowichan Bay summarized.

Contaminants entering Cowichan Bay from rivers will tend to remain inshore to a greater degree in summer when flows are light than in winter when flows are heavy and wind generated mixing is greater. However, many factors affect the concentration of contaminants in an area. Upon entry of contaminants into Cowichan Bay, their potential for dilution or concentration will depend in part on their chemical composition. Animals that inhabit estuarine environments and feed on benthic organisms in these environments may be directly exposed to contaminated sediments and may ingest contaminants contained in benthic food organisms. Substances that remain in the water column have a greater potential for dilution and transport out of the bay. Substances from pollution sources outside of the bay may be transported into the bay through tidal mixing, estuarine transport and wind driven circulation. Other land derived sources of pollution in addition to river inputs include atmospheric transport and surface runoff directly into the estuary.

Radcliffe, Gillian and Pamela Williams, 2001, 'Somenos Management Plan', *Madrone Consultants*, Ltd., Duncan, BC

Abstract: Somenos Marsh, a wetland complex lying within the Cowichan Valley, is an area of exceptional wildlife,wetland, and fisheries values. Increasing pressures from human development has resulted in numerousimpacts on this system. In response to increasing concerns, the Somenos Steering Committee wasestablished to guide future management of the area and its resources.

This Management Plan is one product resulting from this initiative; it was developed under contract to Ducks Unlimited Canada, acting on behalfof the Somenos Steering Committee. The Management Plan Area is restricted to the lake and the surrounding adjacent land parcels that are owned by the province or one of the participating groups on the Steering Committee. The overriding Vision and primary goal of management of the area is to protect

the ecological values of Somenos Marsh and sensitive uplands while allowing human use which does not compromise these values.

Some of the more significant natural values include overall high biodiversity, and important plant, fish and wildlife populations. Five rare (red-listed) and two threatened (blue listed) plants have been identified within the area, most within the relatively rare deep soil Garry oak ecosystem on the southeast side. Wildlife, especially waterfowl, populations are exceptional, and include an internationally significant population of wintering Trumpeter Swans, as well as high numbers of Great Blue Herons. Numerous other birds, including many waterfowl and a wide range of migratory songbirds, nest and feed in the marsh, and many waterfowl also overwinter. The site has received international recognition as an Important Bird Area. Other wildlife values are also high; for example, a number of relatively rare butterflies have been recorded at the marsh. The lake and marsh complex, including the seasonally flooded agricultural fields, also provide
important coho and trout rearing and wintering habitats. Despite the identified high values of this area, good existing baseline information for most of the natural values is lacking, inadequate, or contradictory. A priority over the next decade should be to clearly identify and establish the baseline parameters in order to chart an appropriate future course of action. We need to clarify the ranges of natural fluctuations of the values we seek to manipulate; the water, sediment, nutrients, and the associated biological resources. Only then can we set more objective and realistic goals and select
the appropriate management actions required to achieve them. Maintenance of a sustainable ecological system is the overriding long-term goal, and where conflicts arise between different users, it is essential that the ecological considerations will be given precedence.

In the meantime this plan attempts to establish some broad goals and principles for management of the area, as well as recommend some more specific resource-based actions to move towards the overriding goals. For practical management purposes this plan proposes that the area be subdivided into five main management zones, based on their different ecological functions and sensitivities to management. The zones comprise:
i. the lake
ii. marsh areas
iii. agricultural fields
iv. forests and woodlands
v. riparian areas.

Within each of the management zones, proposed management objectives and activities are identified for the different natural and human values that the marsh complex supports. Natural values considered for management actions were the water (quantity and quality), soils, vegetation (including plant communities, rare and threatened species, and invasive, non-native species), fish and wildlife. Human values in the form of cultural values, and also activities that bring some economic benefit, including agriculture, education and interpretation, recreation and tourism, were also considered. The existing water levels and the quality of water, including increased flooding in spring and early summer, high nutrient levels, and associated low dissolved oxygen levels during warm summer temperatures, are the key water management issues. Low water flow in later summer is also an issue. These factors in turn are pivotal in effectively managing the vegetation communities, the agricultural productivity, and the fish and wildlife values.

Key recommendations include a nutrient and sediment input study (including checking nutrient status of the soils within the study area), and drainage improvements to lower water levels throughout the growing season starting in June. Specific suggestions to help improve early summer drainage include ditch improvements and clearing Somenos Creek of instream grassy vegetation to assist in improving flow. Beaver dam management is also

recommended. Several rare or threatened plant communities exist in the Management Area, and some significant populations of non-native, invasive plants also occur.

Key threats to the vegetation are human development and recreation impacts and the associated invasions by non-native plant species. Direct threats to rare and endangered species are a key issue, especially in the area of the Somenos Garry Oak Protected Area. Key management recommendations involve improved mapping and inventory of the study area vegetation communities, annual monitoring and management of the invasive plant species, and protection plans for the rare and threatened species (which also would include regular inventory and monitoring). A number of site specific restoration plans are also suggested. These include restoration work within the Somenos Garry Oak Protected Area, development of a mixed woodland on the old boatland property, possible forest development on a parcel at the south end, and enhancement of existing riparian zones with taller species like black cottonwood. Key management issues for wildlife relate to possible declines in biodiversity due to increased human
related impacts, and to maintenance of the high waterfowl values, especially for Trumpeter Swans and Great Blue Herons. Winter food management for these species is a key focus, and there are related issues of waterfowl nuisance on agricultural lands in the valley.

A waterfowl management plan looking at the site as part of the broader complex of wetlands, including the Cowichan and Chemainus estuaries, is recommended. For raptors and many cavity nesters, provision of more perching, nesting and roosting structures are suggested, through improved upland forest and woodland habitat, with a nestbox program in the interim. Adequate visual buffering of sensitive areas (especially winter feeding, roosting areas and summer breeding areas), and establishing some areas as off-limits for human use at certain times, are appropriate management measures. Establishing population and targets for key species is an important step
in guiding future management. The lake and marsh are also very important coho and trout rearing areas, as well as providing excellent winter fish habitat. Most of the fish management issues related directly to water quality and quantity also, with cool, oxygenated rearing habitats being limiting in summer. The management actions recommended to improve the situation will also benefit fish populations. In addition, possible localized aeration is proposed, as well as planting of taller riparian vegetation on the south side of ditches and creeks to assist in shading water and providing cool refuges for fish in the summer.

The area also supports important human values, ranging from important First Nations cultural and historic values, to current economically beneficial activities. The latter include primarily agriculture and wildlife viewing, as well as recreational activities. It is recommended that agricultural management be continued, but with the primary goal of supporting the wildlife values, rather than being managed for economically viable agriculture *per se*. The educational and interpretive opportunities are substantial, but again must not compromise the integrity of the natural values that these activities build upon.

Careful, planned and limited developments within the Management Area are essential, with adequate consideration of potential impacts at every step. Any First Nations sensitive sites and other identified values will be respected and adequately protected. The plan recommends that a partnership represented by a ten member committee be established to see that the plan is implemented and reviewed periodically, and to act as data custodians. Representation is suggested to comprise two members from local naturalist/stewardship groups, one each from: the District of North Cowichan, Department of Fisheries and Oceans, Ministry of Environment Lands and Parks, the Nature Trust of BC/Ducks Unlimited, the Cowichan Tribes, the Cowichan Agricultural Society and one member-at-large. It is also proposed that the Somenos Management Plan should be formally reviewed every five years. In addition, the Management Committee should review the progress of

plan implementation, evaluate management strategies, issues, and coordination activities of all levels of government on an annual basis.

MIGRATORY WATERFOWL AND RELATED ISSUES

Badzinski, Shannon, Richard Cannings, Tasha Smith, and Jason Komaromi, 2005, 'British Columbia Coastal Waterbird Survey', Bird Studies Canada

Abstract: The coast of British Columbia is both an important stop in the migration route for many species of waterbirds and subject to high levels of human activities and development. In response to the need for bird monitoring in this area, the BC Coastal Waterbird Survey was initiated in the winter of 1999/2000. Numbers and distribution of coastal waterbirds from the subsequent five years were collected by coordinated volunteers. Wigeon, Barrow's Goldeneyes and Scoters were more concentrated in the Vancouver area than anywhere else. Brant geese were found to be most abundant in the eelgrass beds of Vancouver Island, which signifies that the Cowichan Valley is very important to the migration of Brant Geese. Canada geese are less habitat – and food – specific and were distributed fairly evenly everywhere. Common Goldeneyes, Harlequin Ducks, Hooded Mergansers, and Common Mergansers were very abundant on Vancouver Island, particularly in the Quamichan Lake area. Quamichan was also an important area for Mute Swans, which are rarer in B.C. Greater scaup were found to be decreasing overall in the past five years. The Duncan Sewage Lagoons provided a significant habitat for Lesser Scaup.

BioAyer Consultants, 1999, 'Somenos Basin Project – Phase One: Restoration Feasibility Report', Canadian Wildlife Service, Ducks Unlimited, District of North Cowichan, Nature Trust of B.C.

Abstract: Conservation of estuaries and wetlands are among the highest regional priorities of resource agencies and many citizens as these areas provide biological diversity and are especially critical habitats for waterfowl and fish species. The Somenos Marsh and Lake are part of the Cowichan Watershed and are adjacent to the Cowichan Estuary. Somenos Marsh is one of Vancouver Island's important coastal wetlands with international significance as part of the Pacific Flyway for waterfowl. The Pacific Estuary Conservation Program (PECP) has recommended that the Somenos Marsh and Cowichan River properties, owned by the Partners of PECP, be highly ranked as a potential Wildlife Management Area (WMA). The process of rehabilitating the historical waterfowl potential of the Somenos Basin, and building partnerships to support these efforts, will play a key role in the success of the WMA. These efforts may also lead towards increasing the number of salmonids produced in the Somenos Basin. The Somenos Basin provides vital rearing and over-wintering habitat for salmonids, especially coho salmon.
Problems Identified in the System:

- Some areas of saturated agricultural land occur in the growing season. High water levels until late in the growing season and at crop harvest time occur frequently. Highest losses for agriculture due to flooding are in the Richards Creek area.
- Decreasing waterfowl forage caused by saturated fields and the inability to maintain hay field production in the lower Somenos Basin conservation lands.
- Waterfowl impacts increasing on neighbouring agricultural lands (ie. deteriorating habitat in the lower Somenos Basin displaces waterfowl onto neighbouring farm lands).
- Decreasing waterfowl viewing opportunities and other recreational activities in the winter in the Lower Somenos Basin conservation lands. Summer fish kills in Somenos Lake due to high temperatures, low oxygen, and nutrient loading etc. There are few cool water refuges and high numbers of coho are known to have been lost (as well as other salmonids).

- Flood threat for the lower Somenos Creek/Beverly Street residential area and on Cowichan Tribes land below Tzouhalem Road bridge.
- Decreasing summer recreational activites (ie. Swimming, boating, sport fishing, nature viewing) on Somenos Lake due to increased summer algae growth.
- Disagreement about the cause of drainage problems and fish losses in the lower Basin. Conflict between neighbours and stakeholders.
- Beaver dams in lower Somenos Creek cause back-watering and decrease the rate of Somenos Lake drainage. Seasonally removed and rebuilt. Several generations of beavers have been killed by trapping.

Blood, D.A., J. Comer and J. Polson, 1976, 'Migratory Bird Use of the Duncan-Cowichan Bay Area in 1975', Canadian Wildlife Service, Environment Canada

Abstract: This report describes the local distribution, species composition, and seasonal abundance of aquatic, wetland and raptorial birds of the Duncan-Cowichan Bay area during 1975. One count per week was carried out in 11 survey areas within the total study area.

A cumulative total of 273 576 birds was counted during the year. Counts on single days varied from 12 827 (Nov. 13) to 1 314 (May 15). The ten most abundance species in descending order were: American wigeon, western grebe, mallard, European starling, common merganser, northwestern crow, American coot, northern pintail, mew gull and glaucous-winged gull. Maximum counts for waterfowl, coots, herons, grebes, loons and cormorants indicate that over 16 000 such birds are dependent on the area for habitat at some time during the year.

Seasonal trends in abundance are described for each species group. The most significant group in terms of number – diving ducks, dabbling ducks, and western grebes – were 20 to 100 times more abundant in winter than summer. Species composition within each group is also analysed. American wigeons were the dominant dabbling ducks, followed by mallards, northern pintails, green-winged teal and northern shovelers; and common mergansers were the most abundant divers, followed by bufflehead, surf scoters, scaup, white-winged scoters, and common goldeneye. Species composition of ducks in the estuary area in winter is compared for 1973, 1974, and 1975. Three hundred fifty-four individuals of eleven species of falconiform birds were identified, of which more than half were bald eagles.

Observations on the brood production are presented for great blue herons, mute swans, Canada geese, mallards, blue-winged teal, wood duck, common merganser, and red-breasted merganser. Cinammon teal, green-winged teal, northern shovelers and American coots are also thought to have nested in the area.

Survey areas were grouped into 5 broad habitat types: flooded fields and swamps; lakes; estuary; small deep marine bays; and open coastline and the distributions of dominant species groups in those types were analysed. Dabbling ducks were the dominant group in three types (flooded fields, lakes, estuary), and grebes dominated the two marine types. Diving ducks came second in lakes, small bays and open coastline, while gulls were second in flooded fields and the estuary. American coots were only abundant in the lake and estuary habitat, and Canada geese only on the lakes.

A map is included which rates habitats on an importance scale of 1 to 4, indicated dominant species groups in each, and whether the area is important for production or wintering. Past and potential impacts on waterfowl habitat in the study area are briefly discussed.

Blossey, B., L.C. Skinner, and J. Taylor, 2001, 'Impact and Management of purple loosestrife (*Lythrum salicaria*) in North America', *Biodiversity and Conservation,* Volume 10, Issue 10

Abstract: The invasion of non-indigenous plants is considered a primary threat to integrity and function of ecosystems. However, there is little quantitative or experimental evidence for ecosystem impacts of invasive species. Justifications for control are often based on potential, but not presently realized, recognized or quantified, negative impacts. Should lack of scientific certainty about impacts of non-indigenous species result in postponing measures to prevent degradation ? Recently, management of purple loosestrife (Lythrum salicaria), has been criticized for (1) lack of evidence demonstrating negative impacts of L. salicaria, and (2) management using biocontrol for lack of evidence documenting the failure of conventional control methods. Although little quantitative evidence on negative impacts on native wetland biota and wetland function was available at the onset of the control program in 1985, recent work has demonstrated that the invasion of purple loosestrife into North American freshwater wetlands alters decomposition rates and nutrient cycling, leads to reductions in wetland plant diversity, reduces pollination and seed output of the native Lythrum alatum, and reduces habitat suitability for specialized wetland bird species such as black terns, least bitterns, pied-billed grebes, and marsh wrens. Conventional methods (physical, mechanical or chemical), have continuously failed to curb the spread of purple loosestrife or to provide satisfactory control. Although a number of generalist insect and bird species utilize purple loosestrife, wetland habitat specialists are excluded by encroachment of L. salicaria. We conclude that (1) negative ecosystem impacts of purple loosestrife in North America justify control of the species and that (2) detrimental effects of purple loosestrife on wetland systems and biota and the potential benefits of control outweigh potential risks associated with the introduction of biocontrol agents. Long-term experiments and monitoring programs that are in place will evaluate the impact of these insects on purple loosestrife, on wetland plant succession and other wetland biota.

Boyd, Sean W., 'Abundance patterns of Trumpeter and Tundra swans on the Fraser Delta, BC', from:
Butler, Robert W., and Kees Vermeer (eds.), 1994, 'The abundance and distribution of estuarine birds in the Strait of Georgia, British Columbia', ***Occasional Paper no. 83*****, Canadian Wildlife Service**

Abstract: Swan populations in the Pacific Northwest increased exponentially at 7% per year during the 1970's and 1980's. Trumpeter Swans *Cygnus buccinator* accounted for most of the increase. Swan numbers near Ladner on the Fraser River delta grew at 15% per year, from 50 birds in the early 1970's to over 700 in the early 1990's. Recruitement of young (at 20%) probably accounted for much of the observed increase. I estimate that swans are responsible for 6-8% of the current grubbing impact on the bulrush *Scirpus americanus* zone on the Fraser River delta. Lesser Snow Geese *Anser c. caerlescens* account for the rest. At their present rate of increase, however, swans could reach 4000 birds by the year 2006 and account for 32-38% of all grubbing. In addition, total foraging intensity would increase by 38-50% over the present level. Bulrush mass would be reduced further, and swans and Lesser Snow Geese might be forced to disperse out of the area or to rely increasingly on farm crops. Studies are proposed to monitor swan abundance and movements and the interaction between swans and their preferred habitats.

Burger, Alan E., Christine L. Hitchcock, Gail K. Davoren, 2004, 'Spatial aggregations of seabirds and their prey on the continental shelf off SW Vancouver Island', ***Marine Ecology – Special Publications,*** **Volume 283**

Abstract: The spatial scales at which seabirds aggregate and associate with prey over the continental shelf of Vancouver Island were investigated. Bird densities and hydroacoustic measures of prey abundance were recorded in all seasons from 1993 to 1995 from a vessel moving along fixed strip transects. Birds were grouped into three guilds: divers, surface-feeders, and shearwaters. Flying birds occurred in smaller aggregations spread

over a wider area than birds on the water. For birds on the water, patch radii were usually 2 to 8 km. The appropriate scale to map and monitor seabirds and seabird-prey associations, and for assessments of the effects of disturbance, is approximately 1 to 10 km. This recommendation could be used if a mapping project for waterfowl was to be undertaken.

Butler, Robert W., K. Vermeer and G.E. John Smith, 'Estimated energy consumption by estuarine birds at different trophic levels', from:
Butler, Robert W., and Kees Vermeer (eds.), 1994, 'The abundance and distribution of estuarine birds in the Strait of Georgia, British Columbia', *Occasional Paper no. 83*, Canadian Wildlife Service

Abstract: The waterbird community in six Strait of Georgia estuaries investigated for one year consisted of herbivores, benthivores, omnivores, and piscivores; the first two bird groups predominated in numbers and energy consumption. It was estimated that all waterbirds consumed 41.7 billion kilojoules of energy in the six estuaries in a year, of which 24.1 billion kilojoules of assimilated energy was necessary to maintain the herbivores; 41.7% was needed by benthivores, 6.5% by omnivores, and 3.4% by piscivores. Over 80% of the energy required by birds in a year was consumed between October and March. These are the months when many birds are overwintering; in the Cowichan Valley this should be taken into consideration. Habitat space and abundant food at migration stopovers is necessary for the survival and health of migratory birds, and action should be taken to protect these resouces.

Czech, HA and KC Parsons, 2002, 'Agricultural wetlands and waterbirds: A review', *Waterbirds,* Volume 25, suppl. 2, pp 56-65

Abstract: Waterbird use of agricultural wetlands has increased as natural wetlands continue to decline worldwide. Little information exists on waterbird use of wetland crops such as taro, hasu, and wild rice. Several reports exist on waterbird use of cranberry bog systems. Informations exists on waterbird use of rice fields, especially by herons and egrets. A wide variety of waterbirds, including wading birds, shorebirds, waterfowl, marshbirds, and seabirds utilize agricultural fields for foraging. In some areas, waterbirds have come to rely upon rice fields and other crops as foraging sites. Species that are commonly found utilizing agricultural wetlands during the breeding season, migration and as wintering grounds are listed. General trends and threats to waterbirds utilizing agricultural wetlands, including habitat destruction and degradation, contaminant exposure, and prey fluctuations are presented.

Hirst, Stanley M. and Christopher A. Easthope, 1981, 'Use of agricultural lands by waterfowl in Southwestern British Columbia', *Journal of Wildlife Management,* Volume 45, No. 2

Abstract: The distribution, abundance and food habitats of overwintering pintails (*Anas acuta)*, mallards, *(A. platyrhynchos)*, and America Wigeon *(A. americana)* in agricultural lands in a portion of the lower Fraser Valley, British Columbia, were investigated in response to proposals to improve land drainage and flood protection. Numbers of birds in fields were strongly influenced by numbers along an adjacent estuary and by the amount of standing surface water in fields. Pintails and wigeon preferred pastures to other land-use types, and wigeon generally avoided hay, cereal or vegetable crop fields. Mallards showed no measurable preferences among types of land use. Pintails made extensive use of week, grass, and sedge seeds and invertebrates in pastures, and also fed upon decaying potatoes. Wigeon were predominantly grazers of green leafy and uprooted vegetation. Mallards were generally nonselective in their food habits in the fields. Waterfowl appeared to use agricultural lands on an opportunistic basis, as an extension of traditional coastal winter habitats.

Holms, G. Bruce, 1996, 'State of water quality of Quamichan Lake 1988-1995', Ministry of Environment, Environmental Protection Division

Abstract: Quamichan Lake is located on southern Vancouver Island 3 km east of Duncan, B.C. The watershed for this large, shallow lake is 16.3 km². This report assesses 5 years of water quality data, 21 years (1973-1995) of fecal coliform data, and makes the following conclusions:

- Spring overturn sampling indicates that in recent years there were less nutrients (e.g., total phosphorus, total dissolved phosphorus, dissolved ammonia) in the water column. These changes in nutrient values may be attributed to a change in the amount of nutrients entering the lake or to a change in lake processes.
- Total phosphorus values from Quamichan Lake:
    - outside the limits (0.005-0.015 mg/L) for aquatic life in 1992 and 1993, but within them in 1994 and 1995; and
    - exceeded the criteria for drinking water and protecting recreational use (0.010 mg/L) in 1992, 1993, and 1995.
- Total phosphorus is the limiting nutrient for algal growth in Quamichan Lake.
- The Central Vancouver Island Health Unit has posted Art Mann Park Beach as being unfit for recreational bathing since 1986, warning of the potential for increased risk to bathers' health. Fecal coliform values increased between 1973 and 1995. This increase may be due to an increasing resident waterfowl population.
- True colour values were constant (5 colour units) since 1993. One value exceeded the criteria for drinking water and for recreation.
- Three water quality indicators (total aluminum, total copper, and total zinc) exceeded the criterion for protecting aquatic life. This increase may be due to the level of uncertainty near their minimum detectable limits.

We recommend that a remediation plan be developed and implemented to improve water quality in Quamichan Lake. We recommend monitoring:

- to determine if aluminum, copper, manganese, and zinc exceed the criteria for protecting aquatic life in Quamichan Lake.
- to identify changes in water quality attributed to activities within the watershed such as urbanization, changes in nonpoint discharge, and biological activity.

Both monitoring programs could be implemented by the Ministry of Environment, Lands and Parks with assistance from a Quamichan Lake stewardship group.

- to determine whether public beaches are suitable for bathing.

The monitoring program will continue to be implemented at Art Mann Beach by the Central Vancouver Island Health Unit.

- to determine whether drinking water from the lake meets the fecal coliform criterion.

The monitoring program should be implemented by the Central Vancouver Island Health Unit, or by a Quamichan Lake stewardship group.

Kereki, Christina J., 1999, 'Optimal migration routes of Dusky Canada Geese: Can they indicate estuaries in B.C. for conservation?' Master's Thesis, Simon Fraser University

Abstract: In response to increasing threats, habitat loss, and degradation of British Columbian (BC) estuaries, the Pacific Estuary Conservation Program (PECP) protects estuaries through land acquisition and stewardship programs. To assist the PECP in prioritizing BC estuaries, I develop a conservation tool that exclusively considers estuarine significance within a reserve network for migrating waterfowl. Using a dynamic state variable (DSV) optimization model, I predict estuary stopovers used by Dusky Canada Geese (*Branta canadensis occidentalis*) during spring migration. The DSV model predicts that only geese beginning migration in poor condition with respect to fat deposition use estuaries to maximize expected fitness. Numerous versions of the DSV model identify the Fraser River Estuary as an important stopover for geese of initially lower energy reserves. Introducing the assumption of density-dependence increases the total number of estuaries used as stopovers. Postulated scenarios of estuarine habitat losses decrease expected fitness more than scenarios of population increases.

Leigh-Spencer, Sally, 'Environmental Planning for the Cowichan Valley: A background information paper', Prepared for Canadian Wildlife Service and Ducks Unlimited Canada

Abstract: The wetlands and lowlands areas, marshes, mudflats and eelgrass beds of the valley provide important feeding and resting areas for millions of waterbirds which migrate along the coast each year. Of the dabbling ducks, mallards, teal, northern pintail and wigeon, are abundant on both Quamichan and Somenos Lakes and the intertidal marshes of both large estuaries. Diving ducks can be observed rafted in the offshore areas and outertidal areas of the estuaries. The Cowichan and Chemainus estuaries and the floodplain areas of Somenos and Quamichan Lake were recognized in 1983 as a "Critical Wetland" of BC. In 1993 these same sites were listed as "Critical Waterfowl Habitats". This area plays an important role in supporting Trumpeter swans, a species of management concern to both federal and provincial wildlife agencies, as 25% of the world's population now winter in the Strait of Georgia area. The protection of the foreshore marshes has been a key management strategy for the species, but in recent years the swans have adopted various feeding strategies in agricultural areas.

Lewis, Tyler, 2000, 'Sea Ducks are significant predators in soft-bottom intertidal habitats: Effects of predation by wintering surf scoters and white-winged scoters on clam abundance', Chapter 2 of 'Foraging behaviours and prey depletion by wintering scoters in Baynes Sounds, British Columbia: Inferring food availability and habitat quality', *Master of Science Thesis*, University of Oregon

Abstract: Recent studies have documented strong, top-down predation effects of sea ducks on mussel populations in rocky intertidal communities. However, the impact of these gregarious predators in soft-bottom communities has been largely unexplored. We evaluated effects of predation by wintering Surf Scoters (*Melanitta perspicillata*) and White-Winged Scoters (*M. fusca*) on clam populations in soft-bottom intertidal habitats of the Strait of Georgia, British Columbia. Specifically, we documented spatial and temporal variation in clam density (clams/m^2), scoter diet composition, and the consequences of scoter predation on clam abundance. Of the three most numerous clams, Manila (*Venerupis philippinarum*) and varnish clams (*Nuttallia obscurata*) were the primary prey items of both scoter species, while clams of the genus *Macoma* were rarely consumed by scoters. Between scoter arrival in the fall and departure in the spring, Manila clams decreased in density at most sample sites, while varnish clam densities did not change or declined slightly. Estimates of consumption by scoters (no. clams) accounted for most of observed declines in combined abundance of Manila and varnish clams, despite the

presence of numerous other vertebrate and invertebrate species known to consume clams. For *Macoma* spp., we detected an over-winter increase in density, presumably due to growth of clams too small to be detected during fall sampling, in addition to the lack of predation pressure by scoters. These results illustrate the strong predation potential of scoters in soft-bottom intertidal habitats, as well as their potentially important roles in shaping community structure.

Lovvorn, James R. and John R. Baldwin, 1996, 'Intertidal and farmland habitats of ducks in the Puget Sound Region: A landscape perspective', *Biological Conservation,* Volume 77, Issue 1

Abstract: In managing coastal ecosystems, adjacent uplands have been considered mainly as sources of materials affecting littoral environments, and not as parts of an integrated system of habitats directly used by semiaquatic fauna. Agriculture is often viewed as detrimental to coastal habitats, but many waterbirds use both marine and farmland habitats on a daily and seasonal basis. We investigated the importance to dabbling ducks (Anatini) of the juxtaposition of farmland and intertidal habitats in the Puget Sound region of USA and Canada.

When feeding in intertidal areas of the Fraser River Delta in British Columbia, wintering dabbling ducks ate mainly the exotic eelgrass *Zostera japonica* and appeared to avoid the native *Zostera marina*. Biomass of *Z. japonica* leaves was insufficient to support herbivorous American wigeon *Anas americana* throughout winter. Intertidal invertebrates might be adequate to support omnivorous northern pintail *A. acutus*, mallard *A. platyrhynchos* and green-winged teal *A. crecca*, but invertebrate biomass declined substantially in winter. A switch by these ducks from feeding in intertidal areas in autumn to farmland in winter might have resulted from inadequate or much reduced food resources in intertidal areas. Throughout the Puget Sound region, intertidal habitats with adjacent farmland supported about 75% of wigeon, 94% of pintail, 93% of mallard and 92% of teal, and few sites that lacked farmland supported substantial numbers of these species throughout winter. Radio-tagged wigeon and pintail moved among coastal sites even in a mild winter, and temperature patterns over 60 years suggest that ice cover on marine bays and flooded farmland forces dabbling ducks to leave the Fraser Delta in about 13% of all winters to seek alternative sites. For dabbling ducks in this region, it appears that farmland adjacent to intertidal areas is an important component of coastal habitat complexes, and a system of alternative sites should be included in regional landscape plans.

Mensing, D.M., S.M. Galatowisch and J.R. Tester, 1998, 'Anthropogenic effects on the biodiversity of riparian wetlands in a northern temperate landscape', *Journal of Environmental Management,* Volume 53, Issue 4

Abstract: Land uses such as forestry and agriculture are presumed to degrade the biodiversity of riparian wetlands in the northern temperate [regions]. In order to improve land use decision making in this landscape, floral and faunal communities of 15 riparian wetlands associated with low-order streams were related to their surrounding land cover to establish which organismal groups are affected by anthropogenic disturbance and whether these impacts are scale-specific. Study sites were chosen to represent a gradient of disturbance. Vascular plants of wet meadow and shrub carr communities, aquatic macro-invertebrates, amphibians, fish and birds were surveyed, and total abundance, species richness and Shannon diversity were calculated. For each site, anthropogenic disturbances were evaluated at local and landscape scales (500, 1000, 2500 and 5000 m from the site and the site catchment) from field surveys and a geographic information system (GIS). Land use data were grouped into six general land use types: urban, cultivated, rangeland,

forest, wetland and water. Shrub carr vegetation, bird and fish diversity and richness generally decrease with increasing cultivation in the landscape. Amphibian abundance decreases and fish abundance increases as the proportions of open water and rangeland increases; bird diversity and richness increase with forest and wetland extent in the landscape. Wet meadow vegetation, aquatic macro-invertebrates, amphibians and fish respond to local disturbances or environmental conditions. Shrub carr vegetation, amphibians and birds are influenced by land use at relatively small landscape scales (500 and 1000 m), and fish respond to land use at larger landscape scales (2500, 5000 m and the catchment). Effective conservation planning for these riparian wetlands requires assessment of multiple organismal groups, different types of disturbance and several spatial scales.

Rideout, Paul, Bernie Taekema, John Deniseger, Russ Liboiron, and Duncan McLaren, 2000, 'A water quality assessment of the Cowichan and Koksilah Rivers and Cowichan Bay', Pollution Prevention, Vancouver Island Region, Ministry of Environment

Abstract: A recent BC Environment Water Quality Status Report for the Cowichan and Koksilah river systems said the water quality is generally considered good with only a few objectives not being met. The objective for fecal coliforms (drinking water) was not regularly met in the Cowichan and Koksilah rivers during the summer. The dissolved oxygen objective was also not regularly attained in the lower reaches of the rivers and chlorophyll-a (a measure of algal growth) has exceeded its objective in the lower portion of the Cowichan River. The report recommended more monitoring to determine sources of coliforms and nutrients.

In 1998 and 1999, BC Environment conducted a project to further assess the water quality in Cowichan River, Koksilah River, and Cowichan Bay. The purpose of the project was to identify sources of coliforms and nutrients with emphasis on non-point sources. Additional substances associated with urban or industrial runoff were also sampled. The short-term goal was to provide information to citizens, agencies, and regulators to assist in protecting water resources. The long-term goal is improvement of water quality to meet drinking water quality objectives in the rivers and shellfish water quality objectives in Cowichan Bay.

This report summarizes the results of this project. Initially a survey of the two rivers was completed to identify appropriate sampling locations. Sampling sites were located on each river and on several tributary streams. In addition, a number of sampling sites were also associated with ditches and stormwater drains located in urban and industrialized areas. Samples were collected and sent to labs where they were analysed for fecal coliforms, nutrients, total and dissolved metals and, in some cases, toxic substances. Environment Canada, through the Georgia Basin Environmental Initiative, assisted in the coordination of the sampling program and paid for a portion of the analytical costs. The assessment revealed that although the Cowichan River frequently exceeded desired levels of fecal coliform bacteria, neither of the two discharges of sewage to the river were significant contributors to this pollution. Other non-point sources appear to have been responsible. The Koksilah River regularly contained excessive fecal coliform bacteria, again attributed to non-point sources. The report concluded that the discharge from the sewage treatment plant, serving the village of Cowichan Bay, is a primary contributor to fecal coliform bacteria pollution in the bay.

Excessive nutrient levels in the two rivers result in significant algae growth. This is a concern due to the potential for a negative impact on the natural benthic community and oxygen depletion during die-off, which could affect fish in both rivers.

Levels of metals and other toxics, such as oil and grease and hydrocarbons, in the Cowichan and Koksilah rivers are of little concern, though there were comparatively high concentrations of these contaminants measured in various stormwater conduits in urban and industrial areas. Levels of these substances were found to be typical for urban and commercial areas. On small streams, their impact would be significant, but loadings were small compared to dilution in the two rivers.

Sullivan, TM, RW Butler and WS Boyd, 2002, 'Seasonal distribution of waterbirds in relation to spawning pacific herring, *Clupea pallasi,* in the Strait of Georgia, British Columbia, *Canadian Field-Naturalist,* Volume 116, Issue 3

Abstract: About 3500-3700 waterbirds were present in 23 bays and beaches along 150 km of shoreline on the East Coast of Vancouver Island, British Columbia prior to the arrival of Pacific Herring (Clupea pallasi). Waterbird abundance in the region increased to > 32 500 individuals when herring spawned in March with the greatest proportional increase occurring at the spawn site. Another 140 000 waterbirds were present outside the study site in deep water a few km offshore. Waterbird density in the entire study area increased from a low of about 66 birds/km super(2) prior to the arrival of herring to a peak density of about 616 birds/km super(2) when the herring spawned on the beaches. Waterbird density is clearly related to fish populations; this should be a consideration in the managing of piscivorous birds.

Vermeer, K, Michael Bentley and Ken H. Morgan, 'Comparison of waterbird populations of the Chemainus, Cowichan and Nanaimo river estuaries', from: Butler, Robert W., and Kees Vermeer (eds.), 1994, 'The abundance and distribution of estuarine birds in the Strait of Georgia, British Columbia', *Occasional Paper no. 83*, Canadian Wildlife Service

Abstract: Comparisons of the compositions and densities of waterbird populations were made for the Chemainus, Cowichan and Nanaimo river estuaries, censused in 1989. In all three estuaries, highest densities occurred from October through April. The Cowichan River estuary had higher densities of piscivorous birds, ducks in the genus *Bucephala*, and Mew *Larus canus* and Ring-billed *L. delawarensis* gulls. It was also the only estuary used extensively by the Mute Swans *Cygnus olor.* The Chemainus River estuary had relatively high densities of Greater Scaups *Aythya marila*, Surf Scoters *Melanitta perpicillata*, White-Winged Scoters *M. fusca* and Bonaparte's *Larus philadelphia* and California *L. californicus* gulls. Differences in bird composition between estuaries are thought to be related to food availability, nearness of human refuse, effects of log storage, and adjacent nesting habitat.

Waterbird densities were compared between these three Vancouver Island estuaries and the Fraser River estuary, the largest estuary in British Columbia. The Fraser River estuary had much higher densities of geese and ducks, probably because of the presence of extensive brackish water marshes, eelgrass beds, and nearby farmlands on which waterfowl feed.

Vermeer, K., Ken H. Morgan, G.E. John Smith, and Allen N. Wisely, 'Habitat use by waterbirds in the Cowichan River estuary', from:
Butler, Robert W., and Kees Vermeer (eds.), 1994, 'The abundance and distribution of estuarine birds in the Strait of Georgia, British Columbia', *Occasional Paper no. 83*, Canadian Wildlife Service

Abstract: Use of habitats (subtidal zone, intertidal zone, river mouths, fields, and log booms and pilings) by waterbirds was investigated in the Cowichan River estuary, Vancouver Island, British Columbia. Habitat was the main factor that correlated significantly with the distribution of waterbirds. Most fish-eating birds other than Double-

crested Comorants *Phalacrocorax auritus* occurred over subtidal areas. Dabbling ducks were found mostly in river mouths, whereas diving ducks were most numerous in intertidal areas. Barrow's Goldeneyes *Bucephalia islandica* and Hooded Mergansers *Lophodytes cucullatus* had significantly higher densities on booms and pilings than in any other habitats; Mute Swans *Cygnus olor*, American Wigeons

Vermeer, Kees, 'Waterbird populations in the Courtenay River estuary: a comparison with southern Vancouver Island estuaries', from:
Butler, Robert W., and Kees Vermeer (eds.), 1994, 'The abundance and distribution of estuarine birds in the Strait of Georgia, British Columbia', *Occasional Paper no. 83*, Canadian Wildlife Service

Abstract: The waterbird population in the Courtenay River estuary was censused each month in 1989. Diving ducks constituted on average, 42.5%, diving ducks 25.9%, gulls 23.5%, and loons, grebes, cormorants, alcids, swans and geese the remaining 5.5% of the waterbird population. Waterbird densities in the Courtenay River estuary were compared with those of three other estuaries on southern Vancouver Island. Seasonal trends were similar for the two estuarine regions; diving and dabbling ducks and gulls were also the major bird groups in the southern estuaries. There were also major differences. The Courtenay River estuary had higher densities of Trumpeter Swans *Cygnus buccinators* in winter. Mute Swans *C. olor* were observed only in southern estuaries. Scoter densities were higher in the Courtenay River estuary, with the Black Scoter *Melanitta nigra* being prominent there but not in the south. Oldsquaws *Clangula hyemalis* were observed only in the Courtenay River estuary. Harlequin Ducks *Histrionicus histrionicus* and Bonaparte's Gulls *Larus philadelphia* were much more numerous in the Courtenay River estuary than to the south, whereas the Green-winged Teals *Anas crecca* were more abundant in the southern estuaries. The Courtenay River estuary has suffered much from development and pollution. Similar to cowichan. More research needed.

Zedler, Joy B. and Suzanne Kercher, 2004, 'Causes and Consequences of invasive plants in wetlands: opportunities, opportunists, and outcomes', *Critical Reviews in Plant Sciences,* V23, I5

Abstract: Wetlands seem to be especially vulnerable to invasions. Even though ≤6% of the earth's land mass is wetland, 24% (8 of 33) of the world's most invasive plants are wetland species. Furthermore, many wetland invaders form monotypes, which alter habitat structure, lower biodiversity (both number and "quality" of species), change nutrient cycling and productivity (often increasing it), and modify food webs. Wetlands are landscape sinks, which accumulate debris, sediments, water, and nutrients, all of which facilitate invasions by creating canopy gaps or accelerating the growth of opportunistic plant species. These and other disturbances to wetlands, such as propagule influx, salt influx, and hydroperiod alteration, create opportunities that are well matched by wetland opportunists. No single hypothesis or plant attribute explains all wetland invasions, but the propensity for wetlands to become dominated by invasive monotypes is arguably an effect of the cumulative impacts associated with landscape sinks, including import of hydrophytes that exhibit efficient growth (high plant volume per unit biomass).

MANAGEMENT AND FUTURE RESEARCH

Aldcroft, D., 2002, letter from Cowichan Valley Naturalists Society, Duncan, BC

Abstract: The Cowichan Valley is an important stopover for birds migrating along the Pacific Flyway, accommodating about 4% of the North American Trumpeter Swan population, for example. The requirement for a Ramsar site, a wetland of international importance, is that it must hold 1% of a migratory population, therefore the Cowichan and

Courtenay River estuaries both qualify (Butler and Vermeer, 1994). The Cowichan Valley Naturalists would like to see: A) A Wildlife Management Area established by the Province; B) A Waterfowl Management Plan to be established next, that includes providing the basic needs of birds (food, water, resting areas) and the compensation to farmers from crop loss due to birds; C) Municipal and regional funding for the addling and painting of geese eggs in an effort to reduce the resident Canada Geese population, and increased hunting allowances of Canada Geese as well.

Alexander, Lawrence, 1992, 'Recommendations for the improvement of the Cowichan Estuary Environmental Management Plan', ***West Coast Environmental Law Association,*** **Submitted to the Ministry of Environment and the Cowichan Estuary Environmental Assessment Committee**

Abstract: This report examined the management procedures for the Cowichan Estuary Environmental Management Plan and made suggestions to improve its effectiveness. The main aspect that was identified was public participation. Public participation in decision making is very important, for both moral and democratic reasons, and practical reasons as well. It was stated that social interaction can prevent regulatory conflicts when trying to make decisions as a group; in this case, the goal was environmental protection. It is also important to offer a wide range of opportunities for people to get involved in order to have successful management and decision-making. Other essential factors included easy access to information for the public, funding, and the good accountability of the people in chage.

Booth, Barry, 2001, 'Southern Vancouver Island Marine Waters and Seabird Islands Important Bird Areas Conservation Plan', ***Canadian Nature Federation, Federation of B.C. Naturalists, Wild Bird Trust of B.C., Important Bird Areas Program***

Abstract: The purpose of this conservation plan is to: 1) describe the wildlife values of the IBAs in the waters around southern Vancouver Island and associated Gulf Islands, 2) discuss the issues that may affect those values, 3) introduce and highlight the initiatives that will be re quired to address some of these issues and, 4) to focus and direct future initiatives that could further address identified concerns.

An IBA is a site providing essential habitat for one or more species of breeding or non-breeding birds. These sites may contain threatened species, endemic species, species representative of a biome, or highly exceptional concentrations of birds.

The goals of the Canadian IBA Program are to: 1) identify a network of sites that conserve the natural diversity of Canadian bird species, and 2) ensure the conservation of sites through partnerships of local stakeholders who develop and implement appropriate on-the-ground conservation plans.

Boyd, Levesque and Dickson, 2002, 'Changes in reported waterfowl hunting activity and kill in Canada and the United States, 1985-1998', ***Occasional Paper no. 107,*** **Canadian Wildlife Service**

Abstract: Sales of federal Migratory Game Bird Hunting Permits (hereafter referred to as "Permits") in Canada fell from 375 000 in 1985 to 204 000 in 1998 (-46%). The number of ducks reported shot fell from 2.50 million in 1985 to 1.54 million in 1998 (-38%), while the kill of geese increased from 699 000 to 883 000 (+26%). An increase in the number of non-Canadian hunters, from 18 000 in 1985 to 25 700 in 1998 (+43%), partially offset the effects of the decrease in the number of active Canadian hunters, from 296 000 in 1985 to 160 000 in 1998 (-46%).

Much of the drop in Permit sales is due to fewer young Canadians buying Permits. In 1986, over 78 000 Canadian men aged 15-24 (3.6%) bought Permits; in 1996, only 35 700 (1.6%) did so. The increase in the number of visiting non-Canadian hunters has been greatest, and has had most effect on the kill, in Manitoba and Saskatchewan.

American waterfowl hunting declined in parallel with hunting in Canada from 1985 to 1993, but then revived, especially in the Mississippi Flyway, after the adoption of an "adaptive harvest management strategy" that allowed longer seasons and higher bag limits for most species.
In 1985-1987, about 20% of the total reported kill of ducks and 30% of the geese were shot in Canada. In 1996-1998, only about 9% of the ducks and 21% of the geese reported shot were taken in Canada. These reductions in the impact of hunting by Canadians seem likely to continue, which is a problem for the already high populations of resident Canada Geese.

Canadian Wildlife Service Waterfowl Committee, 2007, 'Population Status of Migratory Game Birds in Canada and regulation proposals for overabundant species', ***Canadian Wildlife Service Migratory Bird Report no. 22***

Abstract: There is concern about the population status of most of the sea duck species (tribe *Mergini*) that breed in North America. Because many breed at low densities in remote parts of the continent and cover a broad geographic area, it is difficult to gather adequate information on their ecology and population dynamics. Consequently, sea ducks are poorly known and few reliable population indices or estimates of annual productivity exist for any of the species. Harvest levels are also poorly understood. In comparison to other waterfowl, sea ducks have low reproductive rates, which means that population maintenance is highly sensitive to adult mortality. There is therefore limited potential for quick population recovery. Because of increasing concern about the status of sea ducks, the NAWMP Committee created the S nea Duck Joint Venture (SDJV) in 1998. The SDJV recently undertook a review of monitoring needs for sea ducks and made recommendations regarding the development and testing of various surveys. As an example, in June 2006 a fixed-wing aerial survey was conducted on King William Island, the Rasmussen Lowlands, and portions of the mainland in the Queen Maud Gulf Migratory Bird Sanctuary as well as northwest of Kugluktuk (Conant et al. 2007). The survey followed a design of systematically placed transects in areas of known or suspected high densities of waterfowl and waterbirds (Hines et al. 2003; Alisauskas 2005).

Over 40% of the continental population of Pacific Coast Trumpeter Swans winters on the coastline, wetlands and agricultural fields of Vancouver Island and the Fraser River Valley; this is the largest wintering Trumpeter Swan population in North America. Aerial surveys of the area's wintering population are conducted every three years over this entire area, to identify regional and habitat-specific trends in swan use. During the most recent survey in January and February 2006, estuaries, coastal marshes, farmland and freshwater lakes were the most important wintering sites on Vancouver Island, and swans were distributed almost equally between tidal marshes and upland habitats in the Fraser River Valley. The survey estimated a total of 7570 swans, an 11.7% decrease over the 6775 swans observed in 2000–2001. During a 2005–2006 survey of snow geese in the Fraser River Delta, swan groups were either counted (< 20) or photographed. Pictures were subsequently analyzed for total count and percentage of young. The 2005–2006 surveys estimated the presence of 503 swans in the Fraser River Delta, 35% below the previous year's count and 26% below the long-term average (1987–2001) of 669 swans. Tundra and Mute swans each accounted for less than 0.5% of all the swans seen (CWS and Ducks Unlimited Canada, unpubl. data).

The Pacific Population (PP) of Canada Geese nests and winters west of the Rocky Mountains from British Columbia south through the Pacific Northwest to California. In Canada, this goose population breeds in central and southern British Columbia and it comprises both migratory and non-migratory (resident) segments. The breeding segment appears to have stabilized, at least in some areas. The B.C. Cooperative Waterfowl survey indicates that the total number of PP Canada geese observed in central B.C. in 2007 was 22% lower than the previous year, and 6% lower than the long-term (1988–2006) average (A. Breault, pers. comm.).The non-migratory segment is concentrated in the urban and suburban areas of southwestern British Columbia (particularly the Greater Vancouver and Greater Victoria areas) and nearby agricultural lands (A. Breault, pers. comm.). Problem populations of resident and urban Canada Geese are primarily controlled by municipalities and through federal hunting regulations. Key management practices include egg addling (operational in the lower mainland of B.C. for over ten years), prevention of nesting, landscape management and relocation of moulting flocks to areas where they can be subjected to hunting mortality. Split hunting seasons have been successful in increasing the number of Canada Geese harvested in some agricultural areas and special permits are issued to protect crops and property (A. Breault, pers. comm.).

Corpe, Cimarron, 2000, 'Coastal zone management: The Cowichan Estuary', ***University of Victoria Geography MA Thesis Defense***

Abstract: Planning strategies for coastal estuarine management were examined in this study. The conditions that allowed plans to be implemented, and lessened the chances of the plans being changed after review, were identified for the Cowichan Estuary. It was found that there are certain factors which influence the success of a plan. In order to have a well carried-out plan, it is necessary to:
1. Explicitly define the terms of reference for the planning process.
2. Explicitly define the capacity, terms and conditions of consensus, in cases where consensus is the goal.
3. Determine the capacity for public involvement at various phases of the planning process.
4. Explicitly define the roles and responsibilities of planning participants.
5. Ensure that the consultative process is open and transparent.
6. Build in mechanisms for conflict resolution when consensus cannot be achieved.
7. Design a flexible plan that can adapt to new information, and/or changing political, economic and social preferences over time (perhaps environmental conditions as well).

Haig, Susan M., David W. Mehlman, Lewis W. Oring, 1998, 'Avian movements and wetland connectivity in landscape conservation', ***Conservation Biology,*** **Volume 12, Issue 4**

Abstract: The current conservation crisis calls for research and management to be carried out on a long-term, multi-species basis at large spatial scales. Unfortunately, scientists, managers, and agencies often are stymied in their effort to conduct these large-scale studies because of a lack of appropriate technology, methodology, and funding. This issue is of particular concern in wetland conservation, for which the standard landscape approach may include consideration of a large tract of land but fail to incorporate the suite of wetland sites frequently used by highly mobile organisms such as waterbirds (e.g., shorebirds, wading birds, waterfowl). Typically, these species have population dynamics that require use of multiple wetlands, but this aspect of their life history has often been ignored in planning for their conservation. We outline theoretical, empirical, modeling, and planning problems associated with this issue and suggest solutions to some current obstacles. These solutions represent a tradeoff between typical in-depth single-species studies and

more generic multi-species studies. They include studying within- and among-season movements of waterbirds on a spatial scale appropriate to both widely dispersing and more stationary species; multi-species censuses at multiple sites; further development and use of technology such as satellite transmitters and population-specific molecular markers; development of spatially explicit population models that consider within-season movements of waterbirds; and recognition from funding agencies that landscape-level issues cannot adequately be addressed without support for these types of studies. Collecting this level of information, for even a few representative species, poses a significant challenge in logistics and funding for most current wetland research. Thus, we hope that theoreticians, conservation biologists, and land managers can join together in solving these obstacles to wetland conservation.

Lambertsen, G.K., 1987, 'Cowichan Estuary Environmental Management Plan', *B.C. Ministry of Environment and Parks*

Abstract: Through removal of habitat or by direct and indirect damage to habitat, each of the various land use activities (log handling and storage, agriculture, port and marina expansion, commercial activity) have, to some degree, diminished the original potential and capacity of the estuary to produce or support the various species of fish and wildlife that rely on the existence of quality estuarine habitat at some point in their respective life histories. Being one of the largest estuaries on the British Columbia coast, it has been postulated that there may be and still could be excess capacity for biological productivity in the estuary. Much more related research would be needed to prove or refute this. Monitoring of the rehabilitation of the disturbed areas and continued research to improve present understanding of the functional relationships between estuarine habitat and certain fish and wildlife species should permit greater certainty in dealing with future land use decisions in the Cowichan Estuary, as well as in other coastal areas.

Longerwell, E.A., N.B. Hargreaves, 1996, 'The distribution of seabirds relative to their fish prey off Vancouver Island: Opposing results at large and small spatial scales', *Fisheries Oceanography,* Volume 5, Issues 3-4

Abstract: We investigated the distribution of common murres, Uria aalge, and shearwaters, Puffinus griseus and P. tenuirostris, relative to their fish prey at two spatial scales, one of hundreds of kilometres and the other of kilometres. Data on oceanographic conditions, the distribution of sea birds and the distribution of fish in the upper water column were collected during three research surveys off Vancouver Island (British Columbia, Canada). At the large spatial scale, we found that both murres and shearwaters were more abundant inshore than offshore of the shelf break and that their fish prey were likewise more abundant in the inshore habitat. At the smaller scale, we investigated the relative importance of fronts and fish density. In contrast to what we expected based on our finding at the large spatial scale, there was a significant negative relationship between fish and both murre and shear-water density. We found that fronts, independent of fish density, did not have an effect on small-scale murre density and had only a weak effect on small-scale shearwater density. We suggest that the negative relationship between fish and sea bird density at the scale of kilometres may have been due to fish diving to escape foraging sea birds and thus avoiding capture in the near-surface trawl used in this study. If this avoidance behaviour is common in pelagic fish, then sea birds may affect fish populations by driving fish away from plankton-rich surface waters and thus negatively affecting the feeding and growth rates of their fish prey

Myrfyn, Owen, 1990, 'The damage-conservation interface illustrated by geese', *Ibis,* Volume 132, Issue 2

Abstract: Changes in legislation, in public attitudes and in shooting practices, both in Britain and overseas, have allowed populations of geese which winter in Britain to increase in numbers. Since 1960 the number of individuals in the seven populations that come into conflict with agriculture has increased almost fivefold. There are serious conflicts between geese and farmers in some localities, where damage is alleged to growing grass, cereals and high value cash crops. Despite extensive studies over 20 years, it has proved impossible to devise precise and cost-effective methods of assessing the damage caused by geese and to provide a fair and workable system of compensation. Farmers and their representatives are calling for a co-ordinated cull to reduce population sizes substantially. There are, however, a number of political and practical problems in undertaking population control, except perhaps in the feral populations of Greylag *Anser anser* and Canada Geese *Branta canadensis* in England. Proposals are put forward for each species, which take into account the international responsibility of each country to safeguard the populations of migratory birds, and which provide solutions to the local serious problems of farmers. These proposals involve the setting aside of land for geese, either by the creation and management of reserve areas or by making payments to farmers to tolerate the birds on their land.

O'Connell, M.J., R.M. Ward, C. Onoufriou, G. Harris, R. Jones, M. Yallop and A.F. Brown, 2007, 'Integrating multi-scale data to model the relationship between food resources, waterbird distribution and human activities in freshwater systems: preliminary findings and potential uses', *Ibis,* Volume 149, Issue s1

Abstract: Understanding and predicting the likely consequences of anthropogenic disturbance on species and ecosystems is a major prerequisite of achieving the sustainable use of natural resources. It is also a key element in the management of sites with statutory designation. During planning and decision-making processes involving potential disturbance issues, land managers and responsible authorities are often required to take account of the needs and views of a diversity of site user groups. The effects and impacts of disturbance can occur over a range of spatial and temporal scales, and research into these consequences must address this problem. This paper provides (1) an overview of the field and analytical methodologies contributing to the development of an integrated method for collecting multi-scale bird, resource and disturbance data in freshwater systems, and (2) an overview of the drivers and need for such data in sustainable resource management. Whilst the results of the bird–habitat–disturbance modelling arising from these data will be published elsewhere, the types of information that will be generated are illustrated and their potential use within planning and decision-making processes discussed.

Pacific Coast Joint Venture (PCJV), 1996, 'The Pacific Coast Joint Venture: The First Five Years, 1991-1995', *North American Waterfowl Management Plan,* Environment Canada and the U.S. Fish and Wildlife Service

Abstract: The Pacific Coast Joint Venture (PCJV) is an international partnership, established in 1991, to help ensure the long-term maintenance of coastal ecosystems. These wetlands and associated uplands are essential to the survival of wintering and migrating populations of waterfowl, shorebirds, raptors, salmon and other marine life, and to the unique biological diversity of the west coast.

Coastal wetlands are in serious decline due to human settlement, industrial development and pollution. Loss of habitat ultimately results in declines of wildlife and fish populations. An estimated three-quarters of historic coastal wetlands have already been lost to urbanization and industrial use. The challenge now is to accommodate human use in concert with conservation of the remaining habitat.

Estuaries are the most ecologically diverse and seriously threatened wetlands on the Pacific Coast. The main priority during the first five years was to conserve the natural integrity of these estuaries near expanding urban centres.

Each state and province has a steering committee that directs planning and coordinates implementation of projects with many other cooperating organizations and individuals. Pooled fiscal resources and management capabilities from all partners are essential to sustain wildlife habitat and coastal wetland ecosystems.

Rehbein, Christina, 2004, 'Remedial Agriculture: Reconciling Ecological Restoration and Agriculture in the Design of a Wetland Complex', Master's Thesis, University of Waterloo

Abstract: Reconciling human landscapes with wildlife needs can demand innovative solutions. Enhancing wildlife conservation in agricultural landscapes requires habitat restoration; returning marginal farmlands to wetlands in a way that remains productive for farmers can aid existing strategies. This study develops and explores the feasibility of an ecological design to rehabilitate wet, poor quality farmland into a wetland that can serve as wildlife habitat while producing a crop.
Research targets methods of biophysical site restoration that are feasible for farmers to initiate; identification of temperate wetland crops with potential to meet economic and ecological criteria; and parameters for meeting farmers′ needs in terms of management and desirability. Scientific literature on wetland and restoration ecology is examined and integrated with agricultural studies and interview responses from landowners involved in alternative food production. Primary data collection for design development centers on coastal British Columbia, where competing land uses have degraded many former wetlands while the region's fertile soils support prolific, diversified farming. Qualitative, semistructured interviews with key informants involved in local food production were conducted as part of a participative research process in order to get input and feedback throughout design development.

A case study site was chosen in a seasonally flooded agricultural watershed outside of Duncan, B.C. A design is proposed that combines five habitat types with a naturalized cropping system. Major findings include the potential use of many wild and native plants as crops, as a way to provide sufficient economic returns and maintain ecological sustainability. Current opportunities for wetland agriculture include niche marketing, added value products, agrotourism, and increasing sales through farm reputation. Possible deterrents include product marketing, and the unfamiliarity of the plants from a farming perspective, where levels of acceptable damage imposed by fluctuating water conditions, weed competition, and herbivory are undetermined.
Participant response was positive overall with regards to the design and preliminary results indicate that such a system could be feasible. Public interest and technical ability to create an agricultural wetland exist; developing creative marketing for such products in North America appears to be the primary challenge. The design is thus proposed as a long-term study to minimize risk for interested landowners. Redesigning human landscapes to include wild species is an important step towards a more sustainable society.

Scott, Ramona, 2004, 'Agriculture and Conservation: Striving for the best of both in one world', *The Land Conservancy* Presentation to "Growing Together" – Canada's Food Security Assembly, Winnipeg

Abstract: Only 5% of British Columbia is productive agricultural land. Ninety percent (90%) of British Columbia's population resides in three southern regions: the Fraser Valley, the East Coast of Vancouver Island, and Okanagan Valley – where the most productive agricultural land in BC occurs. Only one-tenth of the total land in the Agricultural Land

Reserve (ALR) occurs in these three regions, however it is the most productive agricultural land in BC and contributes the greatest amount of dollars to the economy.

BC is the envy of many jurisdictions in North America because of the province's foresight in the 1970's to establish the Agricultural Land Reserve. The ALR is essentially a method of zoning land capable of agriculture. This represents only about 5% of the land in BC. Approximately 6% of the land base of BC is privately owned, of which about 44% is in the ALR. Although the total of 4.5 million ha of ALR set aside in the 1970's remains about the same, the quality and location have changed considerably with the most productive land in the southern portion of the province being eroded away and taken out of the ALR, and more land being designated as Agricultural in the northern parts of the province.

Now there is huge pressure on the remaining highly productive land. Local municipalities needs are being given more consideration in whether applications should be approved for withdrawal from the ALR. Land values are very high, farm incomes are dropping, average age of farmers is near retirement, farmers' equity is in their land so they need to sell for retirement. Farmers' children are not wanting to farm. Even if they do inherit the farm it is not profitable enough for them to keep the land in agricultural production.

In the Fraser Valley, Vancouver Island and South Okanagan there is intense pressure to remove land from the Agricultural Land Reserve (ALR) for residential development, industrial land, recreation facilities, senior care facilities, and transportation infrastructures. There are a number of groups organizing to intervene in applications to remove land from the ALR. Local government is encouraged to establish urban containment boundaries, include agricultural land zoning in official community plans, and create policies and bylaws to support and encourage local food production.

Large–scale agriculture has had major environmental impact through land clearing, drainage of wetlands, alteration of waterways, water pollution from pesticides, air pollution, and soil erosion. Industrial agricultural practices continue to create serious environmental pollution and threats to human health. Nevertheless, today's ranches and small-scale, well managed farms offer significant opportunities to protect and enhance biodiversity and natural ecosystems. Agricultural lands can offer more beneficial habitat values than urbanization. Society must find ways to ensure that farmers and ranchers can continue to be economically viable and to support them in the environmental stewardship of their lands.

Vermeer, Kees, 'Seasonal Changes in waterbird composition and population of the Gorge, and urban estuary', from:
Butler, Robert W., and Kees Vermeer (eds.), 1994, 'The abundance and distribution of estuarine birds in the Strait of Georgia, British Columbia', *Occasional Paper no. 83*, Canadian Wildlife Service

Abstract: The waterbird population in the Gorge estuary was censused once each month in 1989. Seasonal changes in the bird population were similar to those in other Vancouver Island estuaries, but the species composition and densities differed. Piscivores such as Double-crested Comorants *Phalacrocorax auritus,* Common Mergansers *Mergus Merganser* and Hooded Mergansers were widespread at all water depths, whereas other fish-eating species such as Common Murres *Uria aalge,* Marbled Murrelets *Branchyramphus marmoratus,* Red-necked Grebes *Podiceps grisgena* amd Pelagic Comorants *Phalacrocorax pelagicus* were confined to deep, saline waters. Nonpiscivorous waterfowl, such as Canada Geese, dabbling and diving duck species, and coots, on the other hand, had their highest densities in shallow water areas with a high freshwater output. The Gorge has suffered from much eutrophication and pollution, which has affected the Pacific herring *Clupea pallasi*, coho salmon *Oncorhynchus kisutch*, and cutthroat trout *O.*

clarki stocks, and possibly also some piscivorous bird species. Those fish stocks have recently recovered. Reducing the input of raw sewage, halting most wastewater and effluent disposal, removing heavy industry, and restoring the foreshore have likely contributed to the recovery. It is recommended that to totally restore the ecological conditions of the past, the storm drainage system entering the Gorge must be halted.

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