



PACIFIC BIRDS HABITAT JOINT VENTURE

Conservation of Migratory Bird Habitat in the Fraser River Delta: A Guide for Local Governments



Fraser River Delta: Alaksen National Wildlife Area with Richmond and North Shore Mountains [Photo Credit: Sean Boyd]



August 2024

Partner Organizations of the Pacific Birds Habitat Joint Venture (British Columbia)



Environment and
Climate Change Canada
Canadian Wildlife Service

Environnement et
Changement climatique Canada
Service canadien de la faune



This special report was prepared by members of the Pacific Birds Habitat Joint Venture (BC) and Canadian Intermountain Joint Venture Science and Technical Committee.

Principal Authors:

Kathleen Moore – Canadian Wildlife Service – Environment and Climate Change Canada
Kazlyn Bonnor – Upland Agricultural Consulting
Madeline Edmonds – Canadian Wildlife Service - Environment and Climate Change Canada
Andrew Huang – Canadian Wildlife Service - Environment and Climate Change Canada
Adam Lee – Canadian Wildlife Service - Environment and Climate Change Canada
David Bradley – Birds Canada
James Casey – Birds Canada

Special Contributions:

Research and Writing Assistance:

Vincent Steinfeld – PhD Student, University of British Columbia

Document Layout:

Samantha Lam – Geospatial Co-op Student from the University of British Columbia

Food Web Figure:

Adapted from an illustration produced by Laura Redmond and Lesley Evans Ogden, including illustrations from Nola Johnston (*Discover Your Estuary*, Environment Canada, 1992) and photographs from Adobe Stock Photos. Special thanks to Lesley Evans Ogden, Freelance Science Journalist.

Dr. Robert W. Butler:

His landmark reports on the birds of the Fraser River Delta both informed and inspired the present report: ***The birds of the Fraser River delta: populations, ecology and international significance (1987)*** and ***The status, ecology and conservation of internationally important bird populations on the Fraser River Delta, British Columbia (2021)*** are essential reading for anyone interested in the birds of the Delta and have done invaluable service to bird researchers for decades.

Financial support for the writing of this report partially provided by The Sitka Foundation

Suggested citation: Pacific Birds Habitat Joint Venture (2024). Conservation of Migratory Bird Habitat in the Fraser River Delta: A Guide for Local Governments. Available at [Resources - Pacific Birds Habitat Joint Venture](#)

TERRITORIAL LAND ACKNOWLEDGEMENT

The Pacific Birds Habitat Joint Venture (PBHJV) acknowledges that the lands on which we work are the traditional lands of many different Indigenous nations across British Columbia. The act of acknowledging these lands, and the signed treaties where applicable, is an act of reconciliation with Indigenous peoples and an expression of respect and gratitude for the land. This action is to remind us that our places of work, where we live and where we gather, are on the traditional lands of First Nations, Inuit and Métis people who historically resided here and still presently do. It is also a recognition that all of us are accountable to these relationships on a daily basis. The aims of the PBHJV involves the conservation, protection and enhancement of wildlife and habitat that directly impacts Indigenous communities. We acknowledge the need for meaningful consultation with Indigenous communities throughout the implementation of this plan.

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LIST OF ACRONYMS

PBHJV	Pacific Birds Habitat Joint Venture
BC	British Columbia
FRD	Fraser River Delta
NGO	Non-government Organization
WMA	Wildlife Management Area

Executive Summary

The Fraser River Delta (FRD or the Delta) is a focus for the conservation partners of the Pacific Birds Habitat Joint Venture (PBHJV) due to its exceptional ecological significance for migratory birds. The interconnectedness of estuarine, intertidal, and floodplain habitats through complex food webs, along with its sheer size has resulted in high levels of productivity that supports diverse and abundant bird populations. This area annually attracts some 263 species of birds, including the largest wintering population of birds of prey and the highest concentration of wintering shorebirds, waterfowl, and raptors in all of Canada. A total of 14 bird species that depend on the Delta are listed under the federal *Species at Risk Act*, and many more are provincially listed. Including these avian Species at Risk, the PBHJV has identified a longer list of focal bird species based on conservation concern and significant population usage, 55 of which commonly occur in the Fraser River Delta. The extraordinary numbers of birds that use the Fraser River Delta as a migratory stopover site make it one of only a handful of similar sites along the West Coast of the Americas. As a result, the Delta has been recognized as an important habitat by multiple international designations. Consequently, PBHJV partners have developed this guide to provide strategies and tools for local governments to support conservation actions in the FRD, particularly focused on these Priority Habitat Types: agricultural land, riparian forest, nearshore shallow marine, freshwater wetlands, and estuarine habitats.

Despite its ecological value, troubling trends show declines in bird populations and habitat. Urban and agricultural expansion now covers 75% of the original extent of natural vegetation in the 1800s, with ongoing losses. Wetlands and wildlife-compatible agricultural lands have also diminished, impacting habitat and energy supply for wintering waterfowl. Habitat availability is further threatened by some land management practices such as early haying, shoreline armoring and pesticide use as well as habitat degradation from contaminated urban runoff and invasive species. Bird collisions with glass structures and predation by cats also contribute significantly to bird mortality. The PBHJV has identified six categories of threats to the FRD: residential and commercial development, invasive non-native alien species and problematic native species, non-compatible agriculture (i.e. greenhouses, blueberries), other key threats, climate change and severe weather, and pollution (effluents, oil spills and overuse of pesticides).

While the PBHJV partners have been actively acquiring conservation areas and supporting agricultural stewardship programs, the scale of threats to the FRD is beyond what the partnership alone can solve. Local governments can contribute to addressing the threats to FRD habitats and species by implementing these strategies and tools:

Residential and Commercial Development

- Establishment of conservation areas
- Land-use planning and regulations
- Land management
- Habitat restoration
- Habitat monitoring
- Public communication and education
- Coordinated conservation planning

Invasive Non-native Alien Species and Problematic Native Species

- Invasive Species Control

Non-compatible Agriculture

- Agricultural stewardship and conservation planning

Other Key Threats

- Reducing bird collision mortality
- Reducing biodiversity impacts from feral and free-ranging cat predation

Climate Change and Severe Weather

- Sea level rise mitigation

Pollution (Effluents, Oil Spills, and Overuse of Pesticides)

- Reduce and mitigate pollution

Amid growing urban pressures, successful conservation will require effective integrated regional planning, Indigenous leadership, and sustainable funding mechanisms in order to protect the Fraser River Delta's rich biodiversity, and the ecosystem services they provide. Given the population of Metro Vancouver is anticipated to reach 3.8 million people by 2050, there is an important role for local governments to play in the Delta to make progress on international efforts toward the conservation of migratory birds.

Introduction

The Pacific Birds Habitat Joint Venture (PBHJV) is a partnership between government and non-governmental groups established to conserve birds and their habitat along the west coasts of Canada and the United States.¹ It includes the Pacific coastal areas of British Columbia (BC), Washington, Oregon, and Northern California, as well as all of Alaska, Hawaii, and the Pacific Islands (**Figure 2**). Estuaries are a key focus of the PBHJV partnership because of their tremendous ecological value to migratory birds. Estuarine waters are places where rivers mix with the ocean, where deltaic sediments are deposited, and where rich ecologies form. For the purposes of this report, “delta” and “estuary” are used interchangeably and refer to the unique ecosystem of both the Delta and its adjacent estuarine waters. These areas are among the most productive ecosystems and are seasonally or annually important to an estimated 80% of all coastal wildlife. Estuaries provide breeding, rearing, and foraging opportunities as well as water filtration, detritus breakdown, and nutrient recycling.²



Figure 2. PBHJV boundary (not shown in the international boundary (green) are the Hawaii and U.S. Pacific Islands)

Out of 436 estuaries along the British Columbia coast, the Fraser River Delta has the highest ecological importance to migratory waterbirds, based on a 2019 assessment by the PBHJV.³ A key 2021 report by Butler et al., *The status, ecology and conservation of internationally important bird populations on the Fraser River Delta, BC* provides significant detail on bird population trends in the FRD and an in-depth discussion of threats.⁴ This complementary guide summarizes the key findings of that report, with a focus on important bird habitats in the Fraser River Delta as recognized by the PBHJV. Also included in this guide are a suite of strategies and tools that local governments can take to protect these habitats.

¹ Key Canadian Members are - Birds Canada, Ducks Unlimited Canada, Nature Conservancy Canada, Nature Trust British Columbia, Wildlife Habitat Canada, and Environment and Climate Change Canada (Canadian Wildlife Service).

² Pacific Birds Habitat Joint Venture Technical Team (2020). *Pacific Estuary Conservation Program Identified Estuaries of British Columbia Mapping and Ranking Project: 2019 Update*. https://pacificbirds.org/wp-content/uploads/2021/01/PECP-Estuary-Ranking_Public-Report_20210120.pdf

³ Pacific Birds Habitat Joint Venture Technical Team (2020)

⁴ Butler, R. W., D. W. Bradley, & J. Casey (2021). *The Status, Ecology and Conservation of Internationally Important Bird Populations on the Fraser River Delta, British Columbia, Canada*. *British Columbia Birds*, vol. 32, pp. 1-52, <https://bcbirds.bcof.ca/wp-content/uploads/2021/04/bc-birds-volume-32-fraser-complete-web.pdf>

International Ecological Significance

The Fraser River Delta is a unique region in BC and in the world (**Figure 3**). Estuaries make up less than 3% of the coastline in BC. The Fraser River estuary is by far the largest, containing approximately 36% of all estuarine habitat found in the province.⁵



A **Figure 3:** Fraser River Delta in the context of the Salish Sea dynamic mosaic of marine, freshwater and terrestrial habitats—forests, wetlands, mudflats, and nearshore shallow waters—estuaries are highly productive sites that they attract migratory wildlife from hundreds of kilometers away. The Fraser River Delta is visited annually by 263 species of birds and supports the largest wintering population of birds of prey and the highest concentration of wintering shorebirds, waterfowl, and songbirds in Canada.⁶ The intertidal areas and adjacent farmland of the Delta provide crucial habitat for these birds, which use both marine and farmland habitats on a daily and seasonal basis.⁷

The Delta also provides vital stopover habitat for migratory birds that travel from the Amazon Rainforest,

⁵ Pacific Birds Habitat Joint Venture Technical Team (2020).

⁶ Butler, R.W. and R.W. Campbell (1987). *The birds of the Fraser River delta: populations, ecology, and international significance*. Occasional Paper Number 65. Canadian Wildlife Service.; and See National Audubon Society [Audubon Christmas Bird Count](#).

⁷ Lovvorn, J. R., & J. R. Baldwin (1996), "Intertidal and Farmland Habitats of Ducks in the Puget Sound Region: A Landscape Perspective." *Biological Conservation*, vol. 77, no. 1, pp. 97-114. [https://doi.org/10.1016/0006-3207\(95\)00136-0](https://doi.org/10.1016/0006-3207(95)00136-0).

the Atlantic and Pacific Coasts, the Canadian High Arctic, Russian Far East, and points in between. Up to 1.4 million shorebirds, 240,000 waterfowl and 61,000 seabirds are supported.⁸ Critically, these include twenty-nine species which occur in globally, continentally, or national significant numbers.⁹ The Fraser River Delta has such national and international significance that it has received the following designations from various international conservation organizations (**Figure 4**).

Current designations include:

- Ramsar Wetland of International Importance¹⁰
- Important Bird and Biodiversity Area¹¹
- Western Hemisphere Shorebird Reserve Network¹²
- Key Biodiversity Area¹³
- Sea Duck Key Site¹⁴

Importantly, bird tracking data indicates that the Fraser River Delta and the deltas in Puget Sound (in the US PBHJV) are a functionally integrated complex, as demonstrated in the Important Bird Areas on both sides of the border (**Figure 5**).¹⁵



Figure 4: Fraser River Estuary Key Biodiversity Area, designated in 2022, includes a wide range of habitats from tidal floodplain to upland. Local governments can utilize many strategies to support the conservation of this internationally important area for migratory birds and other wildlife.

Several sensitive species use the FRD habitats. To date, those listed under the federal *Species at Risk Act* that have Critical Habitat in the study area include Barn Owl, but also seven non-avian species such as Southern Resident Killer Whale and Western Painted Turtle. Species at Risk protection and recovery in BC is a shared responsibility amongst the Federal and Provincial governments; the Federal government leads for SARA listed species that are on federal lands, aquatic species or migratory birds, otherwise the province of BC leads. Federal *Species at Risk Act* designations are based on COSEWIC (Committee on the Status of Endangered Wildlife in Canada) assessments.¹⁶ The Province of BC employs a separate listing system and criteria through the BC Conservation Data Centre which categorizes species and ecosystems as “red” or “blue” listed. These separate assessments sometimes result in differing lists. Provincially there is one red-listed bird (Western Grebe) and thirteen other non-avian species including White Sturgeon in the Fraser River Delta. In addition, there are six Provincially blue-listed birds (American Avocet, American Bittern, Double-crested Cormorant, Great Blue Heron (fannini subspecies), Green Heron and Western Screech-Owl (kennicotti subspecies), nine non-avian species including Northern Red-legged Frog and Labrador-tea, and several red-listed and blue-listed ecosystems occurring in Burns Bog.¹⁷

⁸ Butler et al. (2021).

⁹ Butler et al. (2021).

¹⁰ Ramsar Sites Information Service (2012). *Fraser River Delta Site Profile*. <https://rsis Ramsar.org/ris/243>

¹¹ Important Bird Areas Canada (2000). *Fraser River Estuary Site Summary*. <https://www.ibacanada.com/site.jsp?siteID=BC017>

¹² Western Hemisphere shorebird Reserve Network (2005). *Fraser River Estuary Site Profile*. https://whsrn.org/whsrn_sites/fraser-river-estuary/

¹³ KBA Canada (2022). *Site Profile: Fraser River Estuary*. <https://kbacanada.org/site/?SiteCode=BC017>.

¹⁴ Sea Duck Joint Venture (2022) *Key Site 2: Salish Sea, Washington, and British Columbia*. https://seaduckjv.org/atlas/pdf/narrative_site2_508.pdf

¹⁵ Pacific Birds Habitat Joint Venture (2021). *The PBHJV Implementation Plan 2020-2030*. <https://pacificbirds.org/wp-content/uploads/2022/01/PBHJV-ImplementationPlan-jan14.pdf>

¹⁶ British Columbia (2023). *Species at Risk – Federal and Provincial*. <https://www2.gov.bc.ca/gov/content/transportation/transportation-infrastructure/engineering-standards-guidelines/environmental-management/reference-documents/environmental-regulatory-compliance/species-at-risk-federal-provincial>

¹⁷ British Columbia Conservation Data Centre. (2024) *Species and Ecosystems at Risk - Publicly Available Occurrences - CDC - Datasets - Data Catalogue* ([gov.bc.ca](https://www2.gov.bc.ca)).

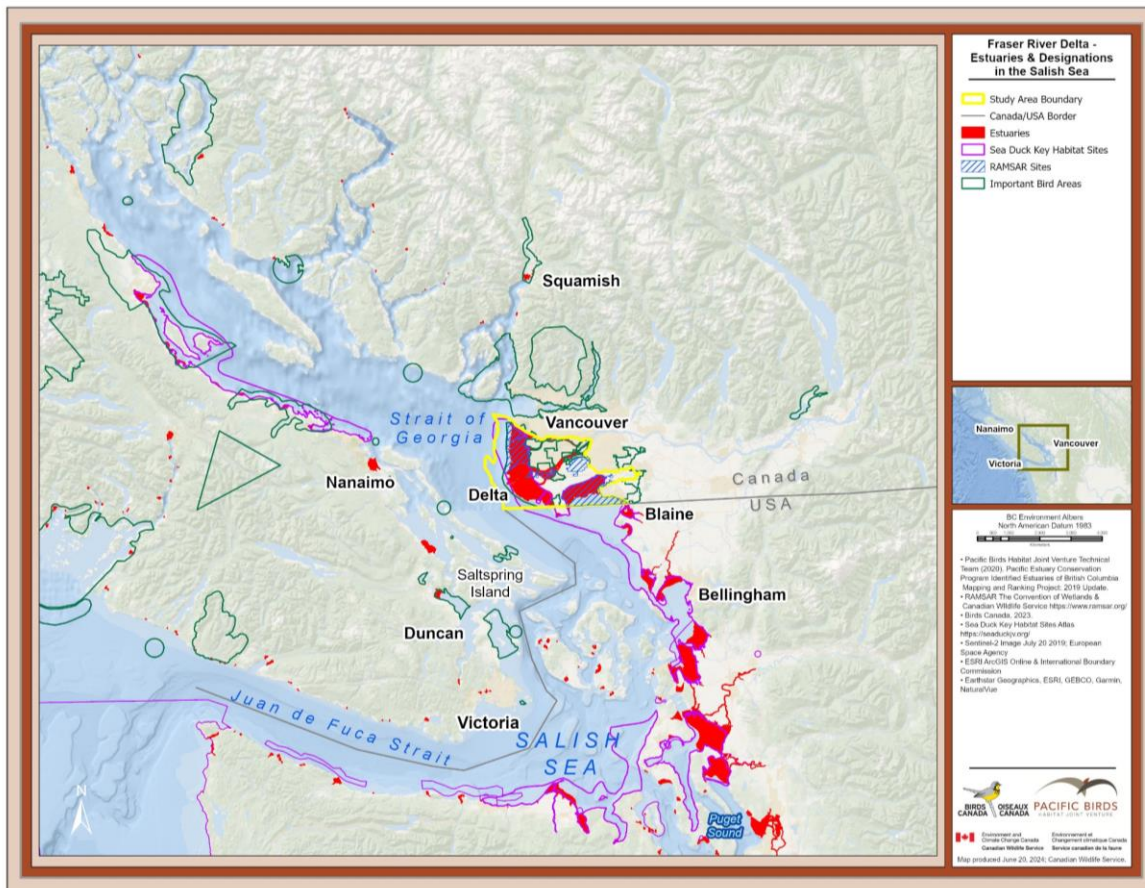


Figure 5: Estuaries (red) and Important Bird Area designations (green outline) in the Salish Sea. Note overlapping designations in the Fraser River Delta study area.

The nutrient-rich waters and sediments in the Fraser River support rich benefits and complex linkages between land, water, birds, people and fish, as described in this simplified food web diagram (Figure 6). Phytoplankton, zooplankton, and insects are food sources for increasingly more complex species in each portion of the estuary and delta. Not only are components of the riverine, intertidal and farmland food web connected, but so are the food webs themselves. These complex and dynamic connections make the Delta an ecologically valuable area on an international scale.

Migratory Bird Habitats

The Fraser River Delta study area is comprised of 88,500 ha and can be divided into three primary habitat zones: the floodplain zone, the tidal flats zone, and the estuarine zone (Figure 7).¹⁸

¹⁸ Our study area is based on the following reports: Clague, J.J., J.L. Luternauer, & R.J. Hebda (1983). "Sedimentary Environments and Postglacial History of the Fraser Delta and Lower Fraser Valley, British Columbia." *Canadian Journal of Earth Sciences*, vol. 20, no. 8, pp. 1314-1326. <https://cdnsiencepub.com/doi/10.1139/e83-116>; and Butler, R.W. & R.W. Campbell (1987); and Butler et al. (2021).

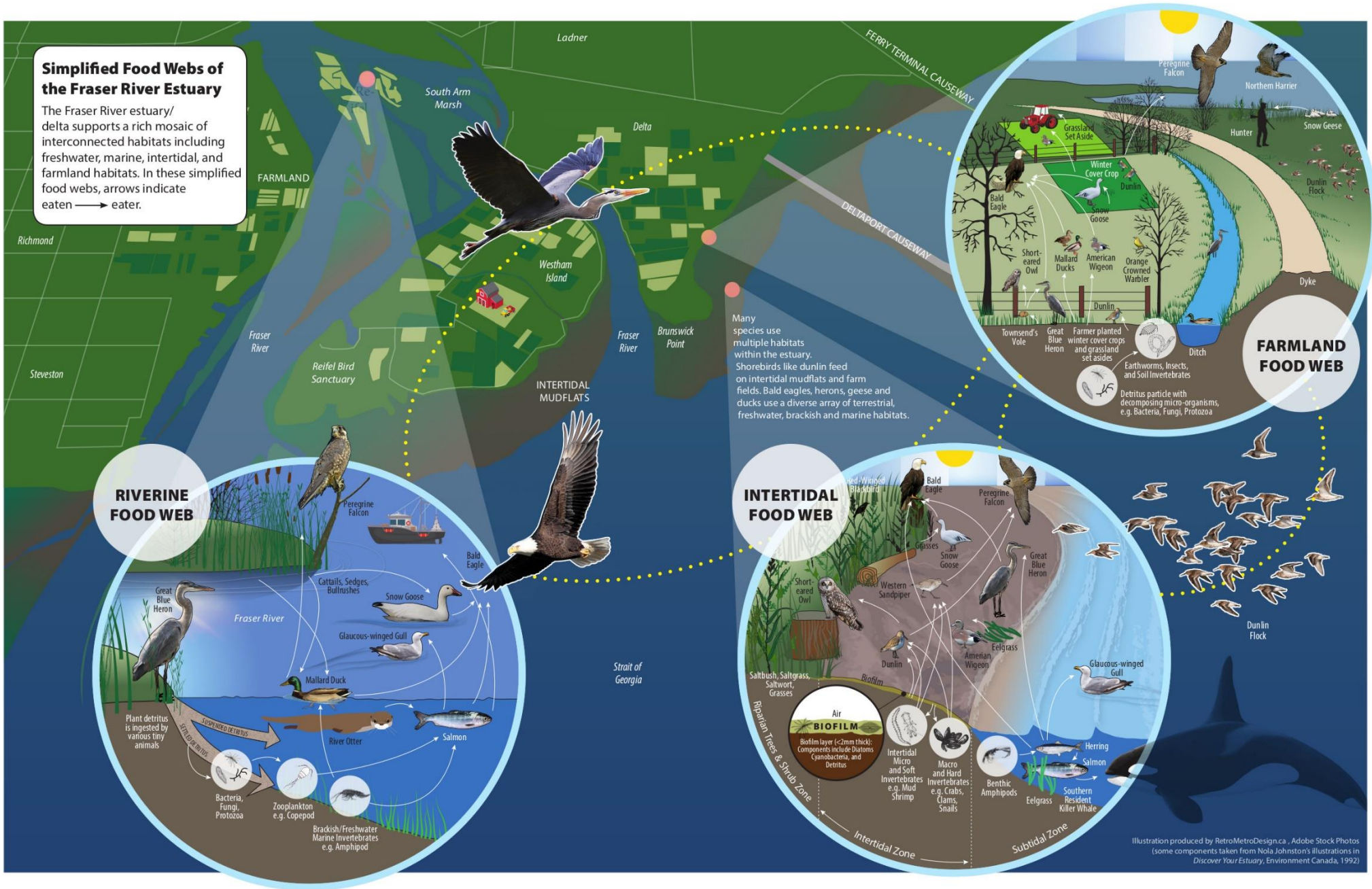


Figure 6: The complex and dynamic connections between the Riverine, Intertidal and Farmland food webs within the Fraser River Delta are illustrated in this Simplified Food Web. Adapted from an illustration produced by Laura Redmond and Lesley Evans Ogden, including illustrations from Nola Johnston (Discover Your Estuary, Environment Canada, 1992) and photographs and images from Adobe Stock.

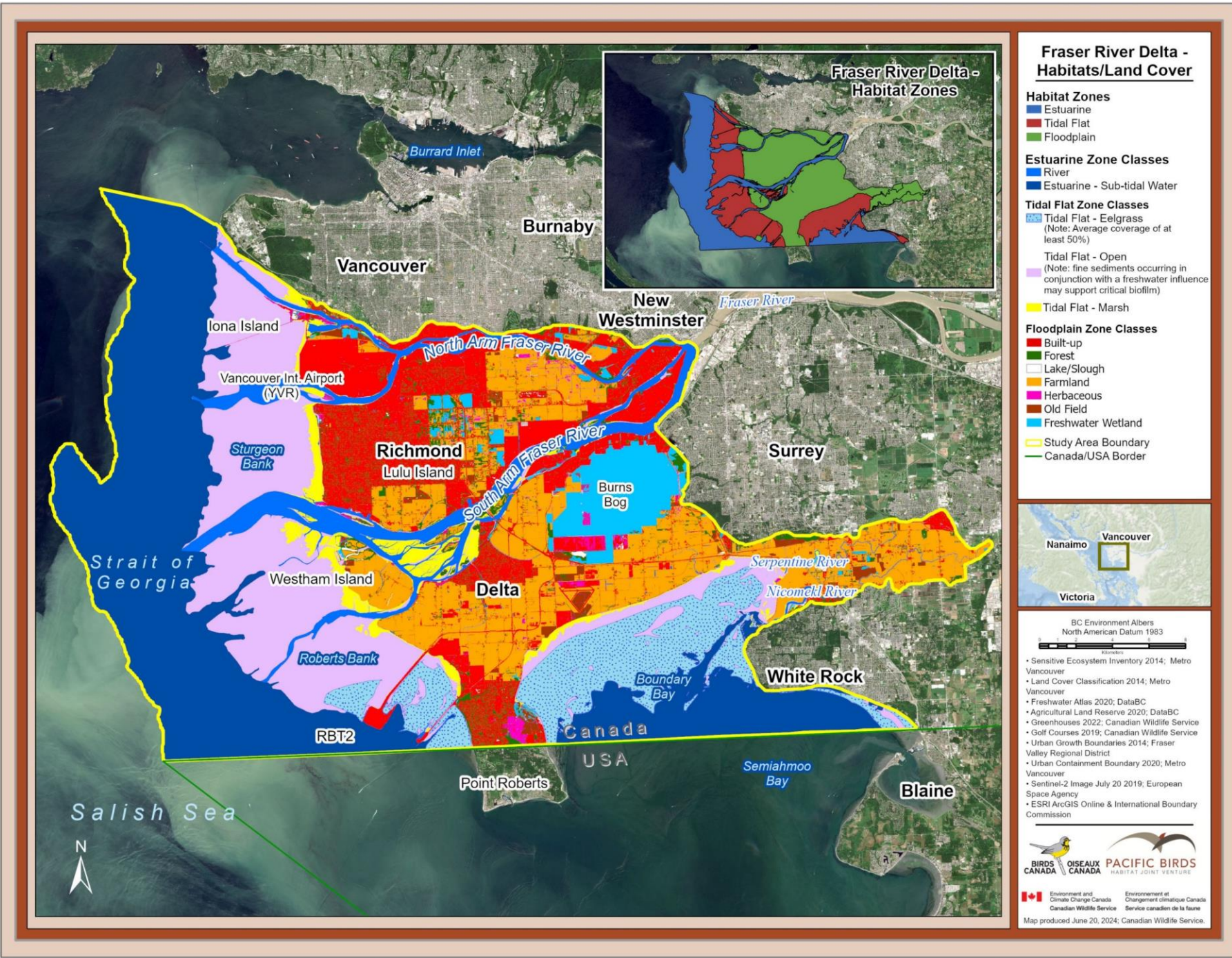


Figure 7: Habitat/land cover classes within each zone in the Fraser River Delta.

Figure 7 displays the habitat/land cover classes within each habitat zone.¹⁹ The proportion of each class within the study area are in **Table 1**.²⁰ The largest proportion of the study area is in the estuarine zone – subtidal water represents 28%. The other main component in the estuarine zone is the Fraser River channel. The tidal flat zone consists of three habitat classes, specifically unvegetated sand and mud flats (16.8%), eelgrass beds (7.7%), and brackish/salt marshes (2.5%). In some parts of the mudflats biofilm occurs (**Figure 8**), which is a surface layer of microbes, organic detritus, and sediment in a viscous matrix that plays a critical role in the diet of many sandpipers, especially during migratory stopovers.²¹ The floodplain zone consists of 11 classes of which farmland is the largest percent (15%), followed by built-up (buildings, pavement, urban grasses) (14.5%), and freshwater wetland and forest (each are just over 3%). The remaining habitats in the floodplain zone are each less than 1% of the study area.

Table 1. Area of each habitat type within the Fraser River Delta (2015)

Zone	Habitat Type	Area (ha)	Proportion of Total Study Area (%)
Floodplain	Beach/Sand Dune	11	0.0
	Built-up	12,934	14.6
	Farmland	13,300	15.0
	Forest	2,987	3.4
	Freshwater Wetland	3,358	3.8
	Herbaceous	646	0.7
	Lake/Slough	103	0.1
	No data/shadow	53	0.1
	Old Field	668	0.8
	Shrub	257	0.3
		Total Area	34,317
Tidal Flats	Tidal Flat – Eelgrass	6,828	7.7
	Tidal Flat – Marsh	2,216	2.5
	Tidal Flat – Unvegetated <i>(Note: where fine sediments occur, these may support critical biofilm)</i>	14,917	16.8
	Total Area	23,961	27
Estuarine	Estuarine – Sub-tidal Water	24,768	28.0
	Freshwater Wetland	119	0.1
	River	5,385	6.1
	Total Area	30,272	34.2
Total Zone Area		88,550	100

¹⁹ This map was produced by combining several different land cover datasets (specified in the map legend) to yield mutually exclusive classes for Table 1.

²⁰ Statistics were generated from Figure 6 where several different land cover datasets were combined into mutually exclusive classes to eliminate any possible overlap or double counting.

²¹ Jardine CB, Bond AL, Davidson PJA, Butler RW, Kuwae T (2015) “Biofilm Consumption and Variable Diet Composition of Western Sandpipers (*Calidris mauri*) during Migratory Stopover.” *PLoS ONE* 10(4): e0124164. <https://doi.org/10.1371/journal.pone.0124164>; and Butler, R.W. (1994). “Distribution and abundance of Western Sandpipers, Dunlins, and Black-bellied Plovers in the Fraser River estuary”, The abundance and distribution of estuarine birds in the Strait of Georgia, British Columbia. Occasional paper Number 83. Canadian Wildlife Service.; and Drever, M. C., Mogle, M. J., Douglas, T. J., Flemming, S. A., Hamilton, D. J., Liefer, J. D., & Elner, R. W. (2024). “Shorebird Abundance is Associated with Nutritional Quality of Intertidal Biofilm on the Fraser River Estuary.” *Estuaries and Coasts*, 47(2), 519-534. <https://doi.org/10.1007/s12237-023-01280-0>

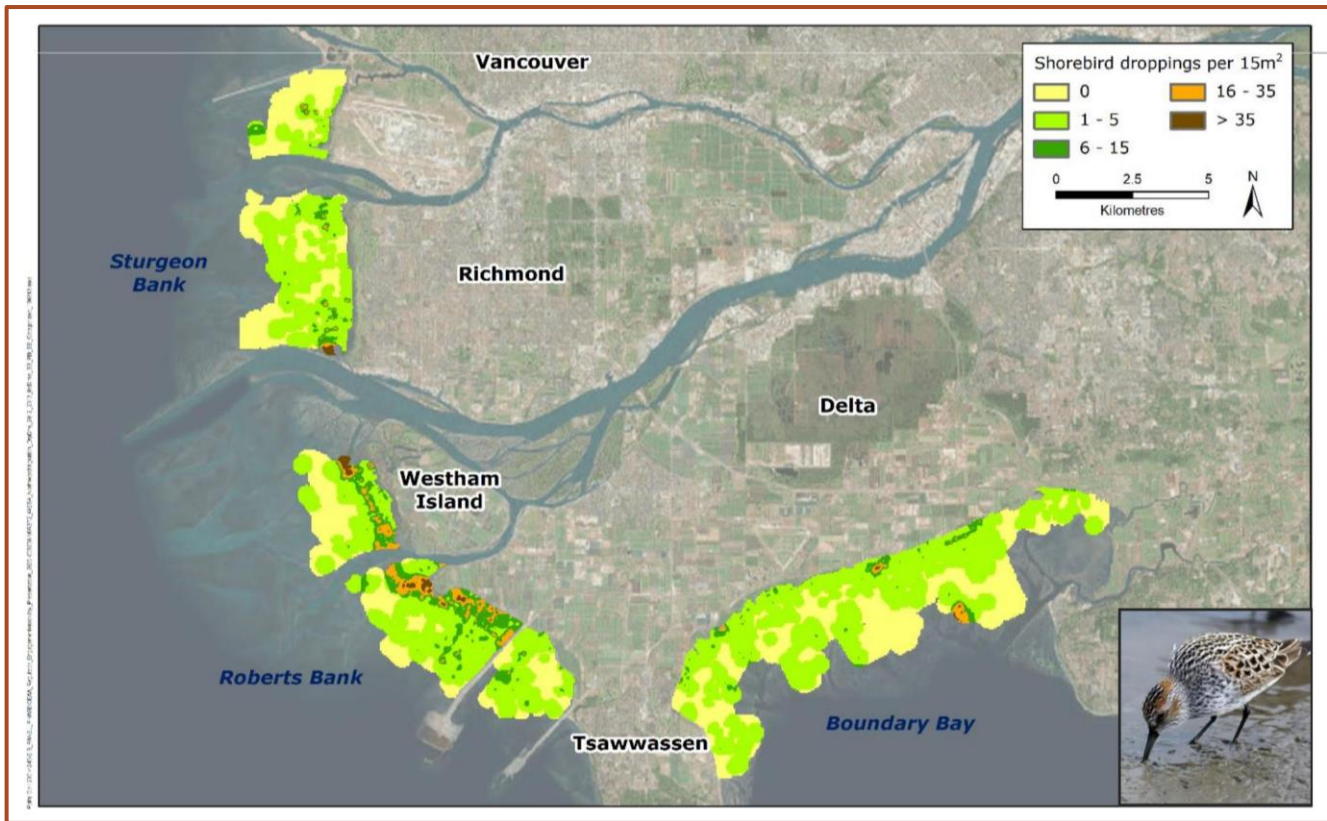


Figure 8: Distribution and abundance of shorebirds surveyed during northward migration in 2012, 2013 and 2014,²² as indicated by density of shorebird droppings, an index of foraging activity. The higher abundance of shorebirds is indicative of High Lipid Producing Biofilm occurring in specific locations on Sturgeon Bank, Roberts Bank and in Boundary Bay.²³

This diversity of productive habitats supports 263 bird species that use the Fraser River Delta annually.²⁴ The PBHJV has identified species priorities for conservation action based on their conservation status and the importance of the Pacific Region to their populations, 55 of which commonly occur in the Fraser River Delta (**Table 2**).²⁵ Of the bird species of conservation concern, some listed under the *Species at Risk Act* will have Critical Habitat identified as well as Recovery Strategies and Management Plans that detail the specific actions needed to recover the species. The BC PBHJV Implementation Plan 2020-2030 describes the selection criteria for these priority bird species and outlines conservation actions and objectives.²⁶ These 55 priority species are a starting point for focusing conservation planning and demonstrates the importance of habitat diversity in the Fraser River Delta for the bird populations of concern. Many of these species use multiple zones and habitat types at different times of year whether nesting, overwintering or while refueling during long seasonal migrations along the Pacific Flyway. As displayed in the simplified food web in **Figure 6**, food for birds in these habitats is abundant and varied. It may consist of grass, seeds, or insects in farm fields, flying insects over marshes and farm fields, leaves or roots in marshes and eelgrass, biofilm or clams on mudflats, small fish or frogs in ditches and shallow water, or even other birds or their eggs. Conservation of the remaining habitats in the Delta is critical to support the significant diversity of bird species and the habitats they rely on.

²² McNulty, S and J. Rourke (2019). *Coastal birds - Western Sandpiper and Biofilm EIS Sections 11.0 and 15.0. Roberts Bank Terminal 2 Project*. Vancouver Fraser Port Authority and Hemmera. Canadian Impact Assessment Registry. Accessed April 2024: <https://iaac-aeic.gc.ca/050/documents/p80054/129839E.pdf>

²³ Jardine et al. (2015); and Butler (1994); and Drever et al. (2024).

²⁴ Butler et al. (2021).

²⁵ Butler et al. (2021); and Pacific Birds Habitat Joint Venture (2021).

²⁶ Pacific Birds Habitat Joint Venture (2021).

Action Urgency			Habitat Zone			Bird Group									Habitats within floodplain							
SARA listed	PIF Priority	Maintain Population	Floodplain	Intertidal flats	Estuary	Aerial Insectivores	Birds of Prey	Forest Birds	Grassland Birds	Habitat Generalists	Seabirds	Shorebirds	Waterfowl	Wetland Birds	Agricultural	Forests	Freshwater wetlands	Open aerial	Riparian Forest	Shrubby Habitat	Urban	Urban forests

Table 2. PBHJV Priority Birds in the Floodplain, Intertidal and Estuarine zones, and the habitat(s) they use.

Common Name																						
Band-tailed Pigeon	X			X				X							X	X						X
Barn Owl	X			X	X				X						X							X
Barn Swallow	X			X				X							X							X
Black Swift	X			X				X								X		X				
Common Nighthawk	X			X				X							X		X			X		
Evening Grosbeak	X			X					X							X						
Great Blue Heron	X			X	X									X	X		X					
Horned Grebe	X				X	X								X								X
Marbled Murrelet	X					X					X											
Olive-sided Flycatcher	X			X				X								X						
Peregrine Falcon	X			X	X				X						X							
Red Knot	X				X							X										
Red-necked Phalarope	X				X	X						X										
Western Grebe	X					X								X								X
Belted Kingfisher		X		X		X								X					X			X
Black-throated Gray Warbler		X		X				X							X				X			
Brewer's Blackbird		X		X					X						X							
Bullock's Oriole		X		X				X							X				X			
California Gull		X		X	X	X								X	X							X
Cassin's Vireo		X		X				X							X							

Action Urgency			Habitat Zone			Bird Group									Habitats within floodplain							
SARA listed	PIF Priority	Maintain Population	Floodplain	Intertidal flats	Estuary	Aerial Insectivores	Birds of Prey	Forest Birds	Grassland Birds	Habitat Generalists	Seabirds	Shorebirds	Waterfowl	Wetland Birds	Agricultural	Forests	Freshwater wetlands	Open aerial	Riparian Forest	Shrubby Habitat	Urban	Urban forests

Table 2. PBHJV Priority Birds in the Floodplain, Intertidal and Estuarine zones, and the habitat(s) they use.

Common Name																						
Chestnut-backed Chickadee		X			X												X					
Common Loon		X																				X
Common Murre		X									X											
Golden-crowned Kinglet		X			X			X								X						
Lesser Yellowlegs		X		X	X							X			X		X					
Long-tailed Duck		X											X									
Pacific Wren		X			X			X								X						X
Pelagic Cormorant		X									X											
Pine Siskin		X			X			X								X						X
Purple Finch		X			X			X								X						X
Rufous Hummingbird		X			X			X							X	X			X			X
Short-billed Dowitcher		X		X	X							X			X							
Short-billed (Mew) Gull		X			X	X	X							X	X						X	
Townsend's Warbler		X			X			X								X						
Varied Thrush		X			X			X								X						X
Vaux's Swift		X			X					X						X		X				
Wandering Tattler		X		X								X										
Western Wood-Pewee		X			X			X								X						
Willow Flycatcher		X			X			X											X	X		

Action Urgency			Habitat Zone			Bird Group								Habitats within floodplain								
SARA listed	PIF Priority	Maintain Population	Floodplain	Intertidal flats	Estuary	Aerial Insectivores	Birds of Prey	Forest Birds	Grassland Birds	Habitat Generalists	Seabirds	Shorebirds	Waterfowl	Wetland Birds	Agricultural	Forests	Freshwater wetlands	Open aerial	Riparian Forest	Shrubby Habitat	Urban	Urban forests

Table 2. PBHJV Priority Birds in the Floodplain, Intertidal and Estuarine zones, and the habitat(s) they use.

Common Name																						
Wilson's Warbler		X		X				X											X	X		
American Wigeon			X	X	X								X		X							
Barrow's Goldeneye			X		X								X									
Black Scoter			X		X								X									
Bufflehead			X	X	X								X									
Cackling Goose			X	X									X		X							
Canada Goose			X	X									X							X		
Harlequin Duck			X	X	X								X									
Hooded Merganser			X	X									X			X						
Lesser Snow Goose			X	X									X		X							
Mallard			X	X									X		X						X	
Northern Pintail			X	X									X									
Pacific Brant			X	X	X								X									
Trumpeter Swan			X	X									X		X							
White-winged Scoter			X		X								X									
Wood Duck			X										X		X							

Key Threats to Migratory Bird Habitats

In 2022, it was reported that the United States and Canada have lost 3 billion breeding birds since 1970, a loss of 1 in 4 birds.²⁷ With a focus on the Canadian specifics of this report on the birds of North America (Figure 9), details included:

- Birds are good indicators of the health of water, air, and land;
- Canada has lost 40-60% of shorebird, grassland bird and aerial insectivore (birds that catch insects in flight) populations;
- 55 of 58 seabird species that use Canadian waters are of conservation concern;
- 1 in 3 Canadian birds depend on forests and many face habitat loss in wintering grounds in South America home and during migration; and
- Waterfowl and birds of prey are recovering thanks to successful investments in conservation.

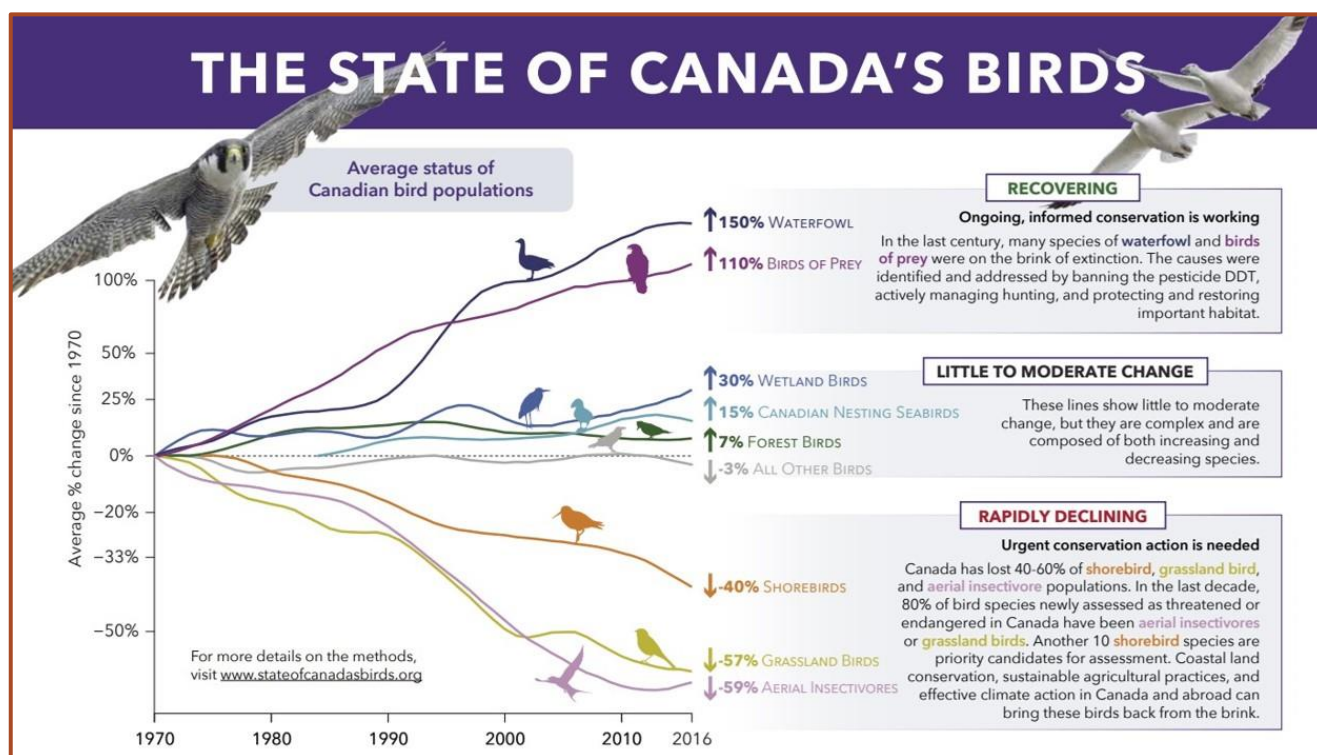


Figure 9: Population trends of 10 bird groups in North America from 1970 to 2016, showing recovery in waterfowl and birds of prey but rapid declines in shorebirds, grassland birds, and aerial insectivores.²⁸

In addition, a 2020 report on waterbird populations in the Salish Sea found that while many (36 of 50) species examined are stable, 12 species displayed significant declines and two significant increases. Waterbirds in the Salish Sea are faring significantly worse than those elsewhere along the outer coastal regions of BC.²⁹

²⁷ North American Bird Conservation Initiative. (2019). *The State of Canada's Birds*. Environment and Climate Change Canada, Ottawa, Canada. www.stateofcanadasbirds.org.

²⁸ North American Bird Conservation Initiative. (2019).

²⁹ Ethier, Danielle, et al. (2020). "Twenty Years of Coastal Waterbird Trends Suggest Regional Patterns of Environmental Pressure in British Columbia, Canada." *Avian Conservation & Ecology*, vol. 15, no. 2, article 20. <https://doi.org/10.5751/ACE-01711-150220>.

Regardless of whether a bird is using the Fraser River Delta to nest, over winter, or refuel during long seasonal migrations along the Pacific Flyway, it is imperative to maintain the diversity, quality and abundance of habitat. To help species in decline, and prevent new species declines, the PBHJV has identified these key threats to bird habitats in the Delta³⁰:

- Residential, Commercial and Industrial Development;
- Non-compatible Agriculture;
- Climate Change and Severe Weather;
- Pollution (Effluents, Oil Spills and Overuse of Pesticides);
- Invasive Non-native Alien Species and Problematic Native Species; and
- Other Key Threats – Window Collision Mortality and Cat Predation.

Importantly, some habitats in the Delta are mere fragments of their historical extent. **Figure 10** shows the habitat mapped by Royal Engineers in the 1800s compared to present-day habitats.³¹ The Royal Engineers ignored the intertidal area and estuarine zones for the most part, and therefore the documented changes in vegetation are mainly restricted to the floodplain zone. Although Burns Bog remains a recognizable feature, most of the original habitats have shrunk to fragments amongst the built-up areas and farmland; urban land cover and agricultural land now covers 75% of the original extent of natural vegetation (**Table 3**).³²

Table 3. Area of habitat types as mapped in 1800s that have been converted to non-natural land cover.³³

Class	1800s	Present Day	
	Area (ha)	Area (ha) converted to non-natural land cover	
		Built-up	Farmland
Bog	8,927	2,107	2,584
Brackish or Freshwater Marsh	476	210	38
Floodplain Forest	3,976	2,550	724
Salt Marsh	831	96	549
Wet Meadows and Shrubs	18,877	6,858	9,111
Total	33,087	24,827 (75%)*	

*Total percent loss due to conversion

³⁰ Pacific Birds Habitat Joint Venture (2021).

³¹ Figure 9 is adapted from North, M. E. A., & J. M. Teversham (1984). "The vegetation of the floodplains of the Lower Fraser, Serpentine and Nicomekl Rivers, 1859 to 1890." *Syesis*, vol. 17, pp. 47-66; and Ward, Peggy (1980). *Explore the Fraser Estuary!* Lands Directorate, Environment Canada, Pacific & Yukon Region, Vancouver, B.C.

³² Statistics in Table 3 were generated by overlaying habitats from Figure 6 with historic vegetation in Figure 9. Importantly, the area mapped by the Royal Engineers does not include the entire study area. The 'Present Day' statistics are only for the portion actually mapped in the 1800s.

³³ Since the mapping in the 1800s was not conducted by wetland ecologists, it is uncertain whether areas they mapped as a specific wetland type would qualify as such under current classification systems. Therefore, Table 3 indicates the area that was previously mapped as wetland and is now identified as either built-up or farmland; the remainder is water or in a natural vegetation.

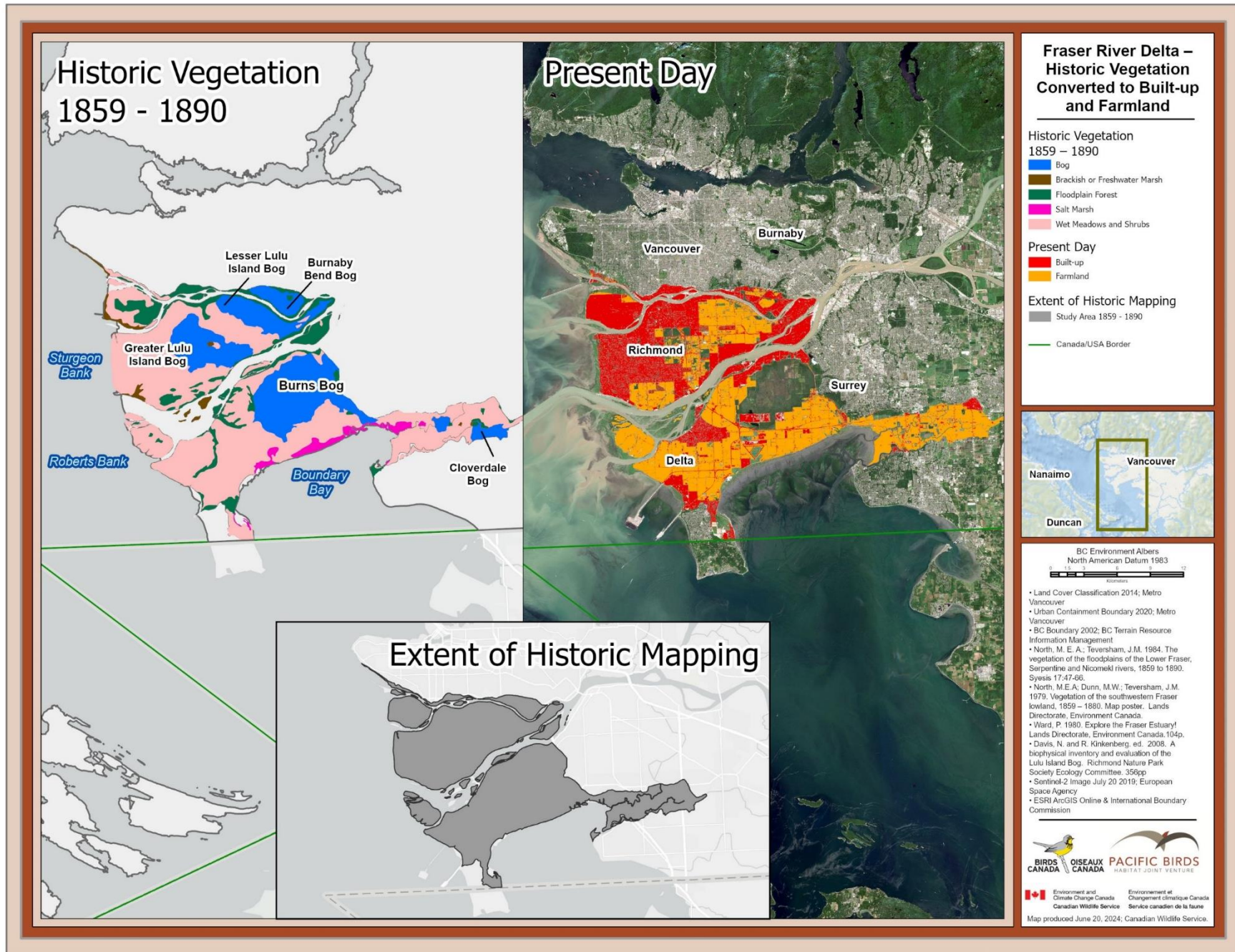


Figure 10: Comparison of the extent of natural vegetation between the 1800s and present day. Burns Bog is still recognizable but 75% of the natural vegetation originally mapped in the 1800s is now in a non-natural state.

Loss to these habitats continues. For example, an assessment of wetlands of the Fraser Lowland (Vancouver to Hope) for three time periods shows continued “nibbling” away at wetland extent primarily due to conversion to agriculture, clearing for urban development (“in transition”), and transportation infrastructure (Figure 11).³⁴ A total of 1,046 ha of wetland habitat were lost during 1989 – 1999, 312 ha were lost during 1999 – 2009, and 163 ha were lost during 2009 – 2019.

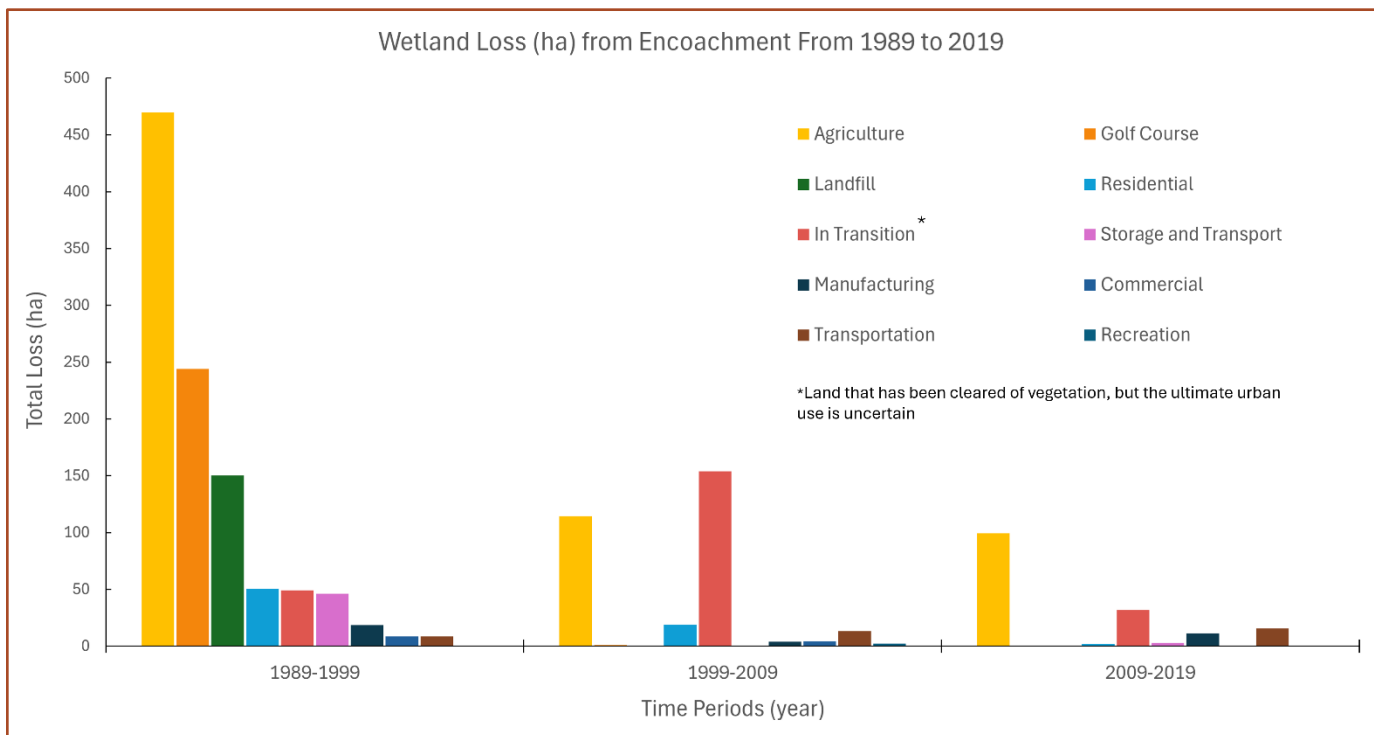


Figure 11: Proportion of wetland habitat (ha) in the Fraser Lowland converted to various causes between 2009 and 2019.

The Regional District of Metro Vancouver has been tracking the loss of sensitive (wetland, estuarine, old and mature forest, riparian, woodland) and modified (young forest, old field) ecosystems in the settled core of greater Vancouver (excluding the undeveloped north shore watersheds), to inform progress on their 2050 regional growth strategy.³⁵ During 2009 – 2014, the regional core lost 1,200 ha (3.4%) of Sensitive and Modified Ecosystems to human activity, and a further 600 ha (1.8%) during 2014 – 2020 indicating similar chronic “nibbling”.³⁶

³⁴ Williamson, Rae Xiao Bao (2020). “Wetland Loss to Human Encoachment in the Fraser Lowland: Results from 2009 to 2019 and Trend Analysis Since 1989.” Unpublished data report for the Canadian Wildlife Service.

https://a100.gov.bc.ca/pub/acat/documents/r59421/FraserLowlandWetlandLoss_2009_to_2019_Metadata_1648146816904_EF464B054A.pdf; and Ward, Peggy, Kathleen Moore, & Ron Kistriz (1992). *Wetlands of the Fraser Lowland, 1989: An Inventory*. Technical Report Series No. 146. Canadian Wildlife Service, Pacific and Yukon Region, British Columbia. https://publications.gc.ca/collections/collection_2015/ec/CW69-5-146-eng.pdf

³⁵ Metro Vancouver (2022). *Metro 2050 Regional Growth Strategy*. <https://metrovancover.org/services/regional-planning/Documents/metro-2050.pdf>.

³⁶ [Regional Planning Committee Agenda Package - September 7, 2023 \(metrovancover.org\)](https://metrovancover.org/services/regional-planning/Documents/metro-2050.pdf)

Some agricultural land in the Fraser River Delta mimics the resources and conditions historically provided by wetlands and seasonal wet meadows to migratory birds prior to the installation of dikes. However, recent changes in crop production have reduced these ecological values for foraging waterfowl, waterbirds, and shorebirds in winter. Crop surveys were conducted by PBHJV partners and the Delta Farmland & Wildlife Trust during 1997 to 2021 within the City of Delta portion of the Fraser River Delta. Results indicate a 21% reduction in wildlife-compatible crops such as grass/forage, grain, and vegetable crop, and a 28% reduction in uncultivated areas. Conversely, wildlife-incompatible crops (for waterfowl, waterbirds and shorebirds in winter), such as blueberries and cranberries increased by over 250% (**Table 4; Figure 12**).³⁷ In addition, the footprint of greenhouses on the agricultural land base increased by over 450%. Greenhouses pose two threats to habitat: permanent removal within their footprint; and fragmentation of the habitat in the surrounding area. Overall, the permanent decline in the total farmable area within the study area was almost 4% during this time period. Also concerning is that the “use outside of agriculture” in the study area increased by 23%; some 850 ha were removed from food production, and areas of high wildlife value were converted to other land uses such as residential and industrial.³⁸

Table 4. Results from crop surveys conducted in Delta, BC between 1997 and 2021

		1997	2021	Change from 1997 to 2021	
		ha	ha	ha	%
Soil-Based Farmable Area	Wildlife-Compatible Crops	6,072.6	4,779.3	-1,293.3	-21.3
	Uncultivated	630.5	450.9	-179.6	-28.5
	Wildlife-Incompatible Crops	377.3	1,328.2	950.9	+252
	TOTAL SOIL-BASED FARMABLE AREA	7,080.4	6,558.5	-521.9	-7.4
Greenhouses		53.0	296.5	243.5	+459.4
TOTAL FARMABLE AREA		7,133.4	6,855.0	-278.4	-3.9
Use Outside of Agriculture		3,706.6	4,558.7	852.1	+23
TOTAL STUDY AREA		11,423.4*	11,423.4*	-	-

*This total includes the sum of total farmable area, use outside of agriculture, wildland, and the area within the study area that was not surveyed.

³⁷ Pacific Birds Habitat Joint Venture (2024). *Fraser River Delta Summer Crop Survey Change Analysis of Wildlife-Compatible Crops, 1997 – 2021*. Unpublished report for the Pacific Birds Habitat Joint Venture.

³⁸ Pacific Birds Habitat Joint Venture (2023).

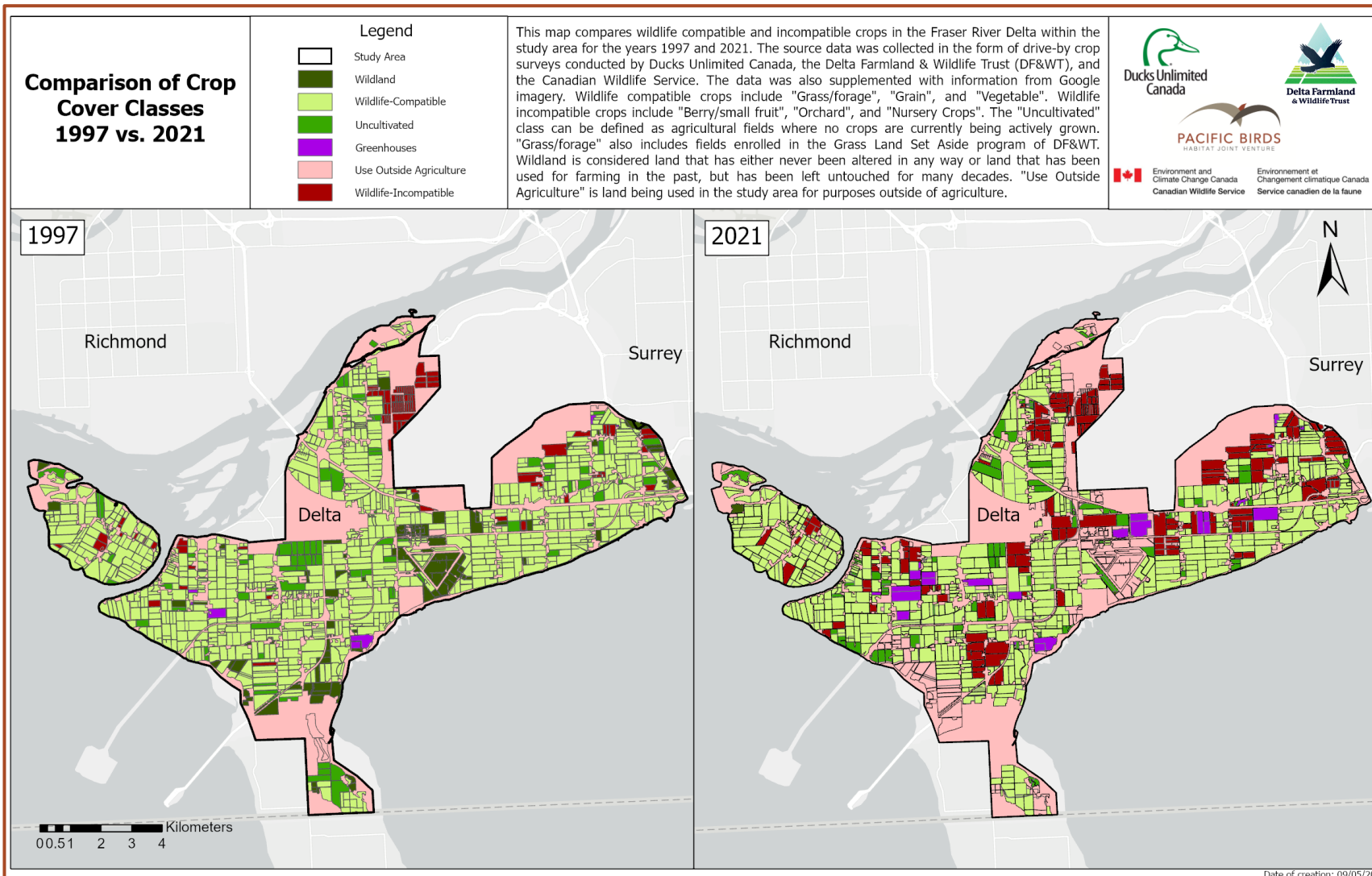


Figure 12: Extent of each crop type within the study area for the years 1997 and 2021. The area that was not farmable (Use Outside Agriculture (light pink) and Greenhouses (purple)), is noticeably larger in 2021 than in 1997. Adding to this is the expansion of wildlife-incompatible crops (dark red). In contrast, the area of **Wildlife-Compatible** crops (light green) and **Uncultivated** (medium green) has visibly shrunk.

These changes in crops have significant implications. This was demonstrated in a habitat-species model developed for the PBHJV that projected the effects of habitat loss on the carrying capacity of the Fraser River Delta for grazing waterfowl in winter. The food (energy) demand by waterfowl varies over the course of the season from September to April, but importantly, the energy supply from the landscape is projected to be insufficient to meet demand from the 2020s to 2030 due to habitat reductions.³⁹ Given the international importance of the Fraser River Delta as a place to refuel along the Pacific Flyway (**Figure 13**), the decrease in carrying capacity of agricultural lands can have significant consequences to species that use these habitats, even those that are now common and abundant.



Figure 13: A flock of Snow Geese foraging on agricultural fields at Alaksen National Wildlife Area during winter. Cover crops are an essential food source for wintering waterfowl in the Fraser River Delta. [Photo credit: Amy Thede]

³⁹ Harrison, B., I. Whitehorn & D. Buffet (2016). Pacific Birds Habitat Joint Venture (BC): Implementation Plan -Waterfowl and Associated Habitats 2015 – 2020. To request access to this report, please contact info@pacificbirds.org.

In addition to the reduction in wildlife-compatible crops, some farm practices can be harmful to birds and wildlife. Mechanical operations such as tilling, early haying and harvesting can destroy nests of birds that use farm fields, including species that are in steep decline such as Killdeer, Savannah Sparrow, and some waterfowl species.⁴⁰

Compounding the effects of habitat reduction due to land conversions, are losses from climate change and severe weather. The Fraser River Delta has been identified as highly sensitive to impacts from sea level rise compounded by winter storms which can result in flooding of salt marshes, salt intrusion in freshwater marshes and shoreline erosion.⁴¹ The Province of BC has directed Metro Vancouver local governments to raise dikes to mitigate the effects of sea level rise. However, often there are no plans to support the resilience of tidal wetlands that can help offset the loss of coastal habitat landward, referred to as “coastal squeeze”.⁴² This is a lost opportunity since tidal wetlands not only provide ecological services but “also slow down water, reduce wave height, and promote sediment buildup outside the dikes, ultimately supporting coastal flood protection”.⁴³

Just as the amount of habitat is important to bird populations, so is the quality of habitat. Contaminants and invasive species can deteriorate habitats for migratory birds, fish, and other wildlife species. Additionally, oil and chemical run-off from urban areas can affect wildlife health.⁴⁴ Also, pesticides used in agricultural areas can be lethal to birds or have sub-lethal health effects such as body weight loss or delayed migration departure.⁴⁵ For instance, high levels of neonicotinoids have been found in Rufous hummingbirds in blueberry crops in southwestern BC.⁴⁶ Furthermore, invasive species can severely degrade habitats. *Spartina* spp. (cordgrass), is an invasive plant of significant concern amongst PBHJV partners in the US Pacific Coastal states as well as BC. *Spartina* changes habitat by outcompeting native vegetation and converting entire tidal marshes, eelgrass beds, and mudflats into pure monoculture stands. Then, once established, these stands change sediment deposition patterns, produce significantly less food for migratory birds, and have been shown to effectively exclude shorebirds and waterfowl from once-productive habitat.⁴⁷ *Spartina* was first detected in Boundary Bay/Roberts Bank in the early 2000s. Field monitoring and removal efforts by PBHJV partners have been conducted annually since then.⁴⁸

⁴⁰ Tews, J., D. G. Bert, & P. Mineau (2013). “Estimated Mortality of Selected Migratory Bird Species from Mowing and Other Mechanical Operations in Canadian Agriculture.” *Avian Conservation & Ecology*, vol. 8, no. 2, article 8. <http://dx.doi.org/10.5751/ACE-00559-080208>.

⁴¹ Pacific Birds Habitat Joint Venture (2021).

⁴² Eric Balke, personal communication, September 2023

⁴³ Eric Balke, personal communication, September 2023

⁴⁴ Butler et al (2021)

⁴⁵ Eng, Margaret L., Bridget J.M. Stutchbury, & Christy A. Morrissey (2019). “A Neonicotinoid Insecticide Reduces Fueling and Delays in Migration in Songbirds.” *Science*, vol. 365, no. 6458, pp. 1177-1180. <https://www.science.org/doi/10.1126/science.aaw9419>

⁴⁶ Bishop, C.A., et al. (2020). “Determination of Neonicotinoids and Butenolide Residues in Avian and Insect Pollinators and their Ambient Environment in Western Canada (2017, 2018).” *Science of the Total Environment*, vol. 737, article 139386. <https://doi.org/10.1016/j.scitotenv.2020.139386>

⁴⁷ Patten, K., and C. O’Casey (2007). “Use of Willapa Bay, Washington, by Shorebirds and Waterfowl After *Spartina* Control Efforts.” *Journal of Field Ornithology*, vol. 78, no. 4, pp. 395-400. <https://doi.org/10.1111/j.1557-9263.2007.00128.x>.

⁴⁸ BC Spartina Working Group. <https://www.spartina.ca/interactive-web-map.html>.

Quality of habitat can also be affected by locally high numbers of migratory birds that have been concentrated into remnant habitats. For example, increasing numbers of grazing Lesser Snow Geese and Canada Geese that winter in the Fraser River Delta are considered to be one of several factors⁴⁹ that have resulted in a loss of 160 ha of lower elevation tidal marsh on Sturgeon Bank and additional marsh off of Roberts Bank.⁵⁰ This loss is visible as a receding leading edge.⁵¹ Other causal factors include alteration of sediment flow from river training structures, dredging and diking, as well as sea level rise.⁵² The loss of these marshes is illustrated in **Figure 14** and **Figure 15** where the loss of 200-700m of tidal marsh in front of the dike is apparent.⁵³ Similar trends have been found in the tidal wetlands in the river portion of the Fraser River Delta. Areas of substantial marsh gain occurred over the 20th Century, particularly in the sheltered side of river training structures and log storage sites,⁵⁴ but marsh recession remains an issue. A recent report assessed 78 created tidal marshes projects in the estuary and found that over 50% of them have receded, equating to over 2 ha or 10% of the created marsh area.⁵⁵ The authors attributed these losses to grazing resident Canada Geese, the negative impacts of which are further heightened in already habitat-deficient areas of the upper estuary by boat wakes, and by altered natural processes.



Figure 14: Comparison of tidal marsh leading edge on Sturgeon Bank between 1986 and 2016.⁵¹

⁴⁹ Maxwell, Lexi. (2021). *A Vision for a Restored Lower Fraser - Visualizing the Opportunity to Improve Community Resilience and Ecological Health at Sturgeon Bank*. Report prepared for Rivershed Society of BC. [2020-070_Vision_For_A_Restored_Lower_Fraser_Maxwell.pdf \(ubc.ca\)](https://www.rivershed.org/2020-070_Vision_For_A_Restored_Lower_Fraser_Maxwell.pdf)

⁵⁰ Maxwell (2021); and Balke, Eric (2017), "Investigating the Role of Elevated Salinity in the Recession of a Large Brackish Marsh in the Fraser River Estuary." Master's Thesis, Simon Fraser University and British Columbia Institute of Technology. <https://circuit.bcit.ca/islandora/object/repository%3A759.>; and Eric Balke personal communication, September 2023.

⁵¹ McDonald, John D. (2018). "Sturgeon Bank Marsh Recession: A Preliminary Investigation into the Use of Large Woody Debris as a Tool for Restoring a Degraded Foreshore Marsh." Master's Thesis, Simon Fraser University and British Columbia Institute of Technology. <https://circuit.bcit.ca/islandora/object/repository%3A996.>

⁵² Maxwell (2021)

⁵³ Balke (2017); and McDonald, John D. (2018).

⁵⁴ Hales, Wendy J. (2000). "The Impact of Human Activity on Deltaic Sedimentation, Marshes of the Fraser River Delta, British Columbia." PhD Dissertation, University of British Columbia. <http://hdl.handle.net/2429/11433>; and Daniel Stewart, personal communication, 6 October 2023.

⁵⁵ Stewart, D., Lievesley, M., Paterson, J.E. et al. (2024). "Factors Influencing the Resilience of Created Tidal Marshes in the Fraser River Estuary, British Columbia." *Wetlands*, vol. 44, article 53. <https://doi.org/10.1007/s13157-024-01802-x>



Figure 15: Marsh off Lulu Island (Richmond). Sea level rise mitigation projects are attempting to maintain marshes such as these in the Fraser River Delta. [Photo Credit: Dan Stewart]

In addition to the loss of bird habitat due to urban development, the expansion of built infrastructure also results in increased direct bird mortality due to collisions with glass-sided buildings and glass railings.⁵⁶ In Canada this amounts to an estimated 16 – 42 million birds annually and may be ecologically significant for some vulnerable species.⁵⁷ For example, a survey of just eight buildings of various sizes on the University of British Columbia campus found that bird strikes resulted in fatalities of 360 birds over 225 days of collision monitoring (**Figure 16**).⁵⁸ The highest mortality occurred in the fall but was also notable in winter and spring reflecting the multi-season importance of the Fraser River Delta area to many species of migratory birds.



Figure 16: Special applications break the reflection of trees that lures birds into lethal window strikes. In response to a survey showing significant lethal bird collisions with windows on campus (De Groot et al. 2021), the University of British Columbia has developed Bird Friendly Design Guidelines for Buildings as part of a Green Building Plan ([Bird friendly art saves feathered lives \(ubc.ca\)](http://www.ubc.ca/bird-friendly-art-saves-feathered-lives)).

Some species were particularly vulnerable to window collisions such as the Varied Thrush, an iconic bird in the area, that collided with windows at 77 times the rate of other species, when accounting for their relative abundance.⁵⁹ Another significant source of mortality to birds is predation by pet and feral cats which has been estimated at between 100 and 350 million birds per year nationally, which can have local population impacts for some species in southern Canada.⁶⁰ Other sources of direct bird mortality are collisions with vehicles and aircraft⁶¹ as well as nest loss due to vegetation clearing and maintenance during the breeding season.⁶² Anthropogenic bird mortality such as these can exert pressures on some particularly vulnerable populations of birds.

⁵⁶ Machtans, C.S., C.H.R. Wedeles, and E.M. Bayne (2013). “A First Estimate for Canada of the Number of Birds Killed by Colliding with Building Windows.” *Avian Conservation & Ecology*, vol. 8, no. 2, article 6. <http://dx.doi.org/10.5751/ACE-00568-080206>; and De Groot, K.L., et al. (2021). “Year-round Monitoring at a Pacific Coastal Campus Reveals Similar Winter and Spring Collision Mortality and High Vulnerability of the Varied Thrush.” *Ornithological Applications*, vol. 123, no. 3, duab027. <https://academic.oup.com/condor/article/123/3/duab027/6308198>

⁵⁷ Machtans et al. (2013); and North American Bird Conservation Initiative. (2019).

⁵⁸ De Groot et al. (2021).

⁵⁹ De Groot et al. (2021).

⁶⁰ Blancher, Peter (2013). “Estimated Number of Birds Killed by House Cats (*Felis catus*) in Canada.” *Avian Conservation & Ecology*, vol. 8, no. 2, article 3. <http://dx.doi.org/10.5751/ACE-00557-080203>; and North American Bird Conservation Initiative. (2019).

⁶¹ Bishop and Brogan (2013).

⁶² The effects of vegetation cutting during nesting season in agricultural areas has been well documented (<https://www.ace-eco.org/vol8/iss2/art8/>). The same activities outside of agricultural areas during nesting season have similar effects but have not been as well documented.

Protecting the Birds and Habitats of the Fraser River Delta

The Pacific Birds Habitat Joint Venture is targeting five Priority Habitat Types for conservation in the Fraser River Delta: agricultural land, riparian forest, nearshore shallow marine, freshwater wetlands, and estuarine habitats. Maintaining the exceptional ecological values of these habitats requires a variety of complementary strategies to address the numerous threats. These include establishing conservation areas, promoting sound stewardship practices on public and private land, and enacting local and provincial government policies that reduce the negative impacts of the aforementioned threats. The PBHJV partners have focused on securing new conservation areas and promoting farmland stewardship, but these strategies are insufficient to stem habitat loss and degradation without action from other levels of government and organizations. The PBHJV is looking to promote wider collaboration and strategic action to steward these Priority Habitat Types and the species that depend on them.

Habitat protection is an initial step towards these goals. Approximately 37% of the Fraser River Delta study area is covered by various legally established conservation areas (**Table 5; Figure 17**).⁶³ This number excludes any overlapping conservation designations, such as where Provincial Wildlife Management Areas (WMAs) overlap with a Nongovernment Organization (NGO) Conservation Area under an agreement. Provincial WMAs comprise the largest portion of conservation areas within the study area (33%). Specifically, these include Boundary Bay, Roberts Bank, Sturgeon Bank and South Arm Marsh WMAs. The next largest portion (4.5%) in conservation area are parks owned by municipalities or Metro Vancouver. Burns Bog Conservancy Area is the largest component. NGO conservation areas account for 0.7% of the study area, followed by lands administered by the federal government including Alaksen National Wildlife Area, Sea Island Conservation Area, and George C. Reifel Migratory Bird Sanctuary (totaling 1% of the study area). In terms of the proportion of each habitat zone that is protected, 85% of the tidal flat, 29% of the estuarine, and 12% of the floodplain zone are covered by a conservation area.

Table 5. Conservation Areas in the Fraser River Delta (2020)

Conservation Area Type	Conserved Area inside study area (ha)	Proportion of Study Area (88,550 ha) (%)	Conserved Area in Estuarine Zone (ha)	Conserved Area in Flood Plain Zone (ha)	Conserved Area in Tidal Flats Zone (ha)	Proportion of Estuarine Zone (30,272 ha) (%)	Proportion of Flood Plain Zone (34,316 ha) (%)	Proportion of Tidal Flats Zone (23,962 ha) (%)
Migratory Bird Sanctuary	376	0.4	5.4	97.2	273.1	0.0	0.3	1.1
National Wildlife Area	363	0.4	17.4	282.8	62.6	0.1	0.8	0.3
Federal Conservation Area	141	0.2	3.0	136.6	1.4	0.0	0.4	0.0
Wildlife Management Area	28,988	32.7	8,663.3	202.3	20,122	28.6	0.6	84.0
NGO Conservation Area	525	0.6	2.5	356.8	165.6	0.0	1.0	0.7
Local Government Park Natural Area*	3,915	4.4	20.9	3,128.5	765.4	0.1	9.1	3.2
All Conservation Areas with no overlap	33,112	37.4%	8,706	3,992	20,414	28.8%	11.6%	85.2%

*Total Government Park Natural Area (2017)

⁶³ Statistics were generated by overlaying study area with the Canadian Protected and Conserved Areas Database (CPCAD) [Canadian Protected and Conserved Areas Database - Canada.ca](#) Accessed 2020; and a Local Government Park Natural Areas Database produced by PBHJV partners in 2017.

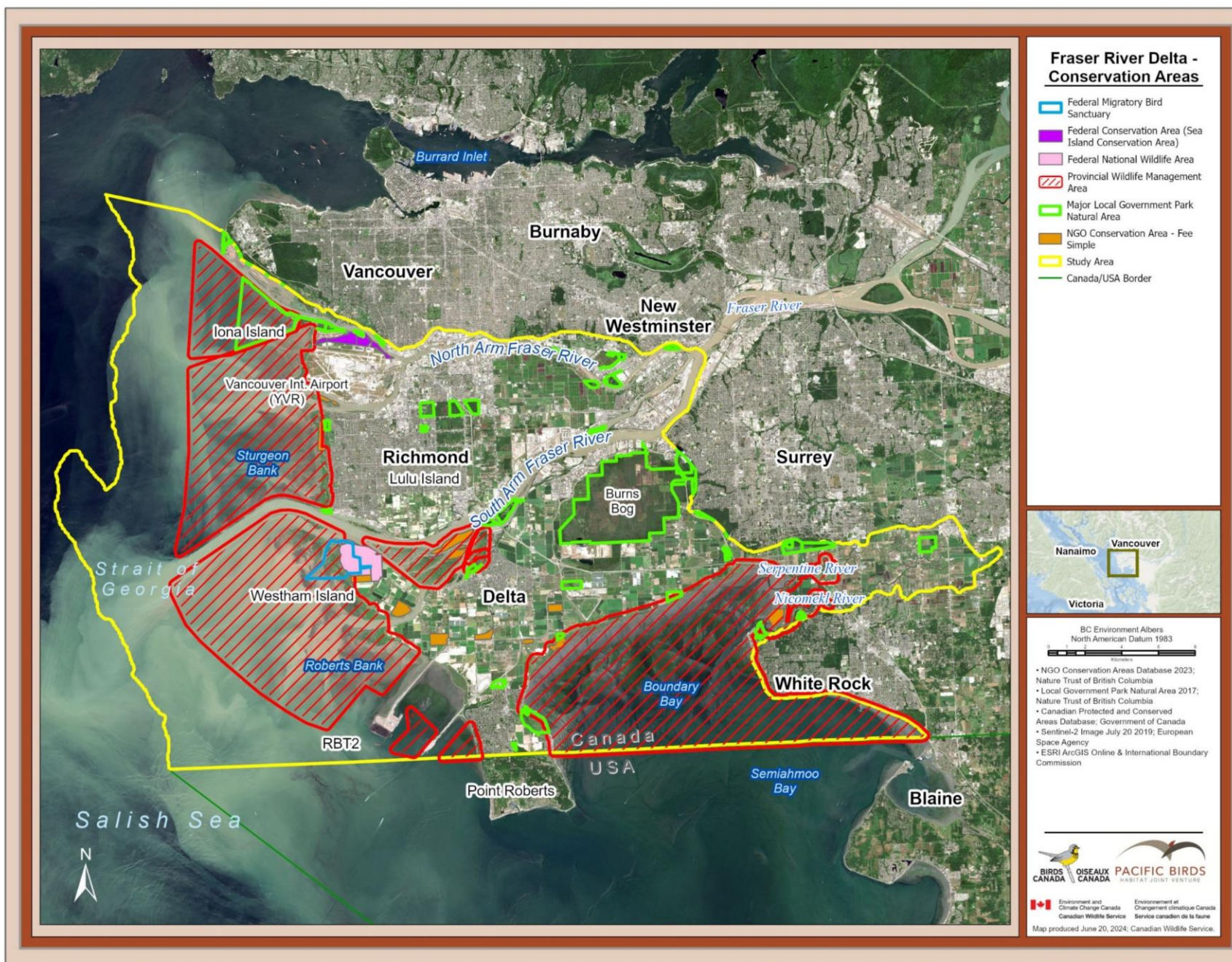


Figure 17: Conservation areas of the Fraser River Delta

Although PBHJV partners have successfully acquired conservation areas throughout the Fraser River Delta habitat zones, current land protection efforts are insufficient to maintain the extraordinary diversity and abundance of migratory birds that use this area for breeding, overwintering and during migration stopovers. High land costs are a significant challenge, particularly in the private land of the floodplain zone, and therefore other conservation strategies need to be implemented. For instance, in the private agricultural land of the floodplain zone, programs to promote sound agricultural stewardship practices through the Delta Farmland & Wildlife Trust (DFWT) have been supported by PBHJV partners for the past three decades.⁶⁴ These programs, including Grassland Set-asides (**Figure 18**), Cover Crops, Forage Enhancements, and planting hedgerows, all assist local farmers in providing wildlife-compatible crops.⁶⁵



Figure 18: Owls and other birds of prey feed on small mammals in this DFWT grassland set aside. This program provides funding for farm fields to be planted in grass mixtures and left to grow up to 4 years which aids in soil regeneration but also supports diverse grassland birds through the creation of habitat for them and their prey. [Photo Credit: Delta Farmland & Wildlife Trust]

⁶⁴ For example, the Delta Farmland and Wildlife Trust stewardship programs: <https://www.deltafarmland.ca/our-programs/>.

⁶⁵ See also <https://deltafarmland.ca/>.

Similarly, PBHJV partners have also supported some invasive species control programs such as *Spartina* removal in Boundary Bay and Roberts Bank. US PBHJV partners found that the *Spartina* monoculture in Willapa Bay significantly reduced the ecological values previously provided by the bare mudflat and undertook removal efforts (Figure 19). These actions have been successful; within a few years, bird surveys showed that shorebirds and waterfowl numbers increased dramatically.⁶⁶ However, successful removal is contingent on the early detection and rapid treatment of the invasive species.



Figure 19: Example of *Spartina* removal in Willapa Bay, USA. The photo left shows monoculture of *Spartina* vegetation, photo right shows positive impact of *Spartina* removal. [Photo credit: Jackie Ferrier]

Additional support is needed from local governments to support bird and wildlife habitat in the Fraser River Delta. Such work is already underway but should be continued and expanded to include additional strategies (Table 6). While most of the strategies and tools that local governments can implement would be focused on the floodplain zone, there are also opportunities to support projects in the tidal flat and estuarine zones as well. Many of these strategies are drawn from a quick guide for local governments produced by the Coastal Douglas-Fir Conservation Partnership in 2022,⁶⁷ the Stewardship Centre for BC,⁶⁸ the South Coast Conservation Program,⁶⁹ and other sources. One approach would be to incorporate these strategies and specific objectives into a “Birds and Biodiversity Plan”, and use bird observation data from NatureCounts to support tracking progress.⁷⁰ For instance, the City of Surrey has recognized the value of monitoring songbirds as part of its commitment to biodiversity given that birds respond to changes in habitat quickly and are therefore excellent indicators of ecosystem health.⁷¹ The collaboration between all levels of government, industry, and non-governmental organizations is required to achieve success.

⁶⁶ Patten & O’Casey (2007).

⁶⁷ “The Coastal Douglas-fir Conservation Partnership (CDFCP) is a collaboration of agencies, organizations and land managers who are interested in promoting and protecting healthy Coastal Douglas-fir and associated ecosystems into the future.” See <https://www.cdfcp.ca/>.

⁶⁸ “The Stewardship Centre for BC... Promotes and delivers stewardship education” and “Develops and champions science-based stewardship practices for land and water in BC.” See <https://stewardshipcentrebc.ca/>.

⁶⁹ South Coast Conservation Program. Resources for Local Governments. sccp.ca/resources/local-governments

⁷⁰ “The NatureCounts platform allows users to collect, archive, interpret and access wildlife data to advance the understanding of bird populations across the Western Hemisphere.” See <https://naturecounts.ca/nc/default/main.jsp>.

⁷¹ City of Surrey Biodiversity Conservation Strategy (2014). [Surrey_Biodiversity_Conservation_Strategy_Report](#)

Table 6. Options for Local Governments to support bird habitats in the Fraser River Delta.

Threats	Strategies and Tools	Local Government Role
	Establishment of Conservation Areas	<p>Integrate PBHJV Priority Habitat Types and Priority Birds as part of criteria for acquiring and establishing new parks.</p> <p>Place multi-year conservation land-use agreements or Conservation Covenants on properties containing sensitive habitat in Environmentally Sensitive Areas.</p> <p>Support the establishment of regional conservation financing mechanisms such as implemented in the South Okanagan and Kootenay Lake that would support land acquisition and conservation projects.</p> <p>Collaborate on establishment of Indigenous Protected and Conserved Areas. See here and here for additional information.</p>
Residential and Commercial Development	Land-use Planning and Regulations	<p>Develop and implement Bird and Biodiversity Plans with specific actions and goals (e.g., City of Surrey Biodiversity Conservation Strategy, Delta’s Birds and Biodiversity Conservation Strategy)</p> <p>Commit to achieving habitat protection targets in Council or Board adopted plans, such as Biodiversity Conservation Strategies, Official Community Plans, and regional growth strategies [i.e. Metro Vancouver 2050’s target to “increase the area of lands protected for nature from 40% to 50% of the region’s land base by the year 2050” (Strategy 1; and Climate 2050 Nature & Ecosystems Roadmap 2023)]. In addition, commit funding to monitor and report on progress towards these targets. Respond to the loss of Sensitive Ecosystems as described in this report by implementing Metro Vancouver 2050 Action 3.2.7.</p> <p>Establish boundaries and guidelines for Environmental Developmental Permit Areas within Official Community Plans as well as Development Permit Areas such as City of Surrey Ecosystems DPAs.</p> <p>Use development tools as described in the Green Bylaws Toolkit and Local Government Tools Supporting Species and Ecosystems at Risk such as zoning, amenity zoning, density bonus, clustering, density transfer, tree removal bylaws.</p> <p>Map riparian setback areas and ensure compliance with provincial Riparian Area Protection Regulations.</p> <p>Develop Natural Asset Management Plans for the full range of municipal natural assets.</p>

Table 6. Options for Local Governments to support bird habitats in the Fraser River Delta.

Threats	Strategies and Tools	Local Government Role
Residential and Commercial Development <i>(continued)</i>		Enact farmland protection policies that discourages agriculturally zoned land from being developed such as the City of Delta’s Agricultural Plan (2023) .
	Land Management	<p>Develop a strategy for parks and conservation areas to optimize for bird and other wildlife species including specific objectives and committed funding to monitor and report on effectiveness. The strategy should include these sample components:</p> <ul style="list-style-type: none"> • Increase hedgerows and urban forests⁷² See more here. • Retain and restore structurally diverse forest patches (i.e. a mix of young, mature, and decaying native tree species, retain gaps in canopy, diverse understory of different native forbs and flowering and fruit-bearing shrubs.⁷³ Contribute to Metro Vancouver goal of 40% tree canopy cover by 2050 with tree planting programs to offset climate change impacts such as urban heat island effects and flood hazards. • Maintain and manage old field habitat.⁷⁴ Promote a mosaic of even small patches of greenspaces, yards and individual mature trees and shrubs that together support connectivity and ecological values. See Figure 20 and Figure 21. • Defer vegetation clearing and management to periods outside of the nesting season. • Exercise due diligence and understand regulatory responsibilities, for reducing bird mortality and ensuring compliance with prohibitions against the killing of birds and destroying of active nests under the federal Migratory Birds Convention Act and associated Migratory Birds Regulations, 2022. For nesting periods, see here. • Promote Environmental Farm Plans or similar policies for city-owned agricultural lands. Assist NGOs in management costs in order optimize the overall ecological values within the mosaic of private/public conservation areas such as removing illegal garbage dumping, coordinating vegetation control, and focusing public access. • Implement long-term effectiveness monitoring programs for conservation and restoration outcomes, defining clear objectives and specific indicators and evaluating these with baseline and follow-up monitoring, allowing for adaptive management.
		Follow mandatory requirements and best management practices for making changes in and about a stream (CIAS) under B.C’s Water Sustainability Act (WSA).

⁷² Butler et al. (2021).

⁷³ De Zwaan et al. (2022). “Balancing Conservation Priorities for Grassland and Forest Specialist Bird Communities in Agriculturally Dominated Landscapes.” *Biological Conservation*, vol. 265, article 109402. <https://doi.org/10.1016/j.biocon.2021.109402>.

⁷⁴ Butler et al. (2021).

Table 6. Options for Local Governments to support bird habitats in the Fraser River Delta.

Threats	Strategies and Tools	Local Government Role
Residential and Commercial Development <i>(continued)</i>		Maintain environmental values during the development of urban and rural lands, refer to the 2014 Develop with Care for more information and the BC Environmental Mitigation Policy . Companion documents can be found here for Raptors , and Amphibian and Reptiles .
	Land Management <i>(continued)</i>	Implement Natural Resource Best Management Practices guidelines to help development projects meet necessary legislation, regulations, and policies. Projects could include wetlands , working in and around streams .
	Habitat Restoration	In suitable locations, fund and implement programs for restoration of habitat in parks and public lands such as planting native trees and shrubs, removing illegal garbage dumps, and installing fencing and signage to educate park users from encroaching on sensitive habitat. See other considerations under “Land Management” above.
		Support establishment of regional conservation financing mechanisms that support NGO restoration projects such as those lead by Ducks Unlimited Canada various estuarine restoration projects.
	Habitat Monitoring	Support high resolution/detailed mapping of wetlands to contribute to the Canadian National Wetland Inventory in order to monitor change, identify restoration opportunities, inform carbon accounting, and identify conservation designation opportunities.
	Public Communication and Education	Lead communication and educational campaigns to residents about the benefits of conserving bird and wildlife habitat, and how to live alongside Environmentally Sensitive Areas and wildlife. See Figure 20 and Figure 21 .
	Coordinated Conservation Planning	Ensure adequate time is allocated for local government staff to participate in regional conservation initiatives and management committees. Provide internal education and training for staff in all relevant departments and encourage system-wide integration and consideration of environmental values. Consider cost-sharing an environmental planner with other local governments or partners.
		Contribute to species at risk recovery by conserving critical habitat and implementing actions outlined in species-specific recovery strategies . Become familiar with the <i>Species at Risk Act</i> – see this SARA 101 primer and understand the role of local governments in species at risk conservation (see this guide for the South Coast of BC).
		Be aware of local species at risk and incorporate their requirements into land management decisions. Join this mailing list for Federal conservation strategies and critical habitat mapping updates
		Clearly communicate conservation objectives and requirements (including permits, standards, and costs) to developers well in advance of projects.
Concentrate urban development within the Metro Vancouver Urban Containment Boundary .		
Support Regional Green Infrastructure Network (RGIN) planning and implementation. See Figure 20 and Figure 21 .		

Table 6. Options for Local Governments to support bird habitats in the Fraser River Delta.

Threats	Strategies and Tools	Local Government Role
		Utilize this Ecosystem Services Toolkit for supporting policies, decisions, and management practices.
		Support the establishment of tax exemption programs for supporting conservation actions on private land such as the Natural Area Protection Tax Exemption Program in the Gulf Islands . Further described in this report .
Invasive Non-native Alien Species and Problematic Native Species	Invasive Species Control	Fund and implement programs in parks and public lands to reduce impacts of invasive species.
		Provide education and funding support to private landowners to control and manage invasive species. See resources from the Invasive Species Council of Metro Vancouver and the Invasive Species Council of BC
Non-compatible Agriculture	Agricultural Stewardship and Conservation Planning	Provide funding for existing organizations such as Delta Farmland & Wildlife Trust and Farmland Advantage that support local farmers to implement on-farm practices such as grassland set asides, cover crops, hedgerows and restoration of riparian vegetation that support wildlife as well as offsetting climate change impacts. Strategies to support regenerative farming are described in the Metro Vancouver 2050 Agriculture Roadmap .
		Support retention of old barns/structures or installation of artificial nesting structures to aid the recovery of aerial insectivore birds such as Barn Swallows and raptors such as Barn Owls.
		Participate in and support the implementation of initiatives of the Fraser River Delta Farmland Protection and Stewardship Working Group consisting of federal, provincial, and local governments and NGOs. A key initiative is the development of innovative conservation financing mechanisms in the region and reiterated in the Metro Vancouver 2050 Agriculture Roadmap .
		Support maintenance of the Agricultural Land Reserve (ALR) boundaries and buffers and minimize road expansion through the ALR to minimize farm field fragmentation.
		Support conservation covenants and agreements involving properties in the ALR that restrict wildlife-incompatible crops. (Page 16)
		Support the development of Environmental Farm Plans and other practices. See Planning for Biodiversity – A guide for BC farmers and ranchers .
Other Key Threats	Reducing Bird Collision Mortality	Develop and adopt mandatory bird-friendly design standards for new buildings and educate residents on mitigating bird collisions with glass on existing buildings. Educate residents on mitigating bird collisions with glass .
		Retrofit municipal buildings with effective solutions to mitigate collisions, prioritizing buildings adjacent to green spaces. See Best Practices for Bird-friendly Glass (City of Toronto) and the University of British Columbia (Figure 16).

Table 6. Options for Local Governments to support bird habitats in the Fraser River Delta.

Threats	Strategies and Tools	Local Government Role
	Reducing Biodiversity Impacts from Feral and Free-ranging Cat Predation	Partner with local veterinarians, humane groups, and conservation groups to educate communities on the benefits of keeping cats indoors
		Implement cat licensing and support for low-income owners to spay and neuter pets.
Climate Change and Severe Weather	Sea Level Rise Mitigation	<p>Develop, fund and implement coastal flood adaptation and sea level rise mitigation plans that integrate nature-based solutions and green infrastructure such as the following (note: as with any restoration or mitigation project, the presence of any pre-existing ecological values must be taken into consideration during planning and design).</p> <ul style="list-style-type: none"> • The Green Shores program was started by The Stewardship Centre for BC – along with its funding partners in 2005. The initiative promotes healthy shore environments that provide significant environmental, economic, and social values to coastal communities. • The Sturgeon Bank Sediment Enhancement Pilot Project that seeks to support tidal marsh resilience by re-using dredged river sediment to replace natural deposition processes that have been degraded by engineered shoreline structures.⁷⁵ • Boundary Bay Living Dike Project that will test options for different sediment types, planting native marsh plants, as well as different foreshore armoring materials to gradually increase the elevation of marshes to adapt to rising sea levels while addressing flood protection.⁷⁶ See more information here and here.
Pollution (Effluents, Oil Spills, and Overuse of Pesticides)	Reduce and mitigate pollution	Promote use of Integrated Pest Management strategies on private and public land, and farmland to reduce impacts on wildlife including aerial insectivores and hummingbirds
		Reduce or eliminate use of cosmetic pesticides on public and private lands.
		Promote use of green infrastructure such as raingardens and bioswales for managing contaminants in storm water.
		Implement marine litter prevention programs designed to raise public awareness in preventing land-based marine litter .

⁷⁵ Eric Balke, personal communication, September 2023.

⁷⁶ Dan Stewart, personal communication, October 2023.

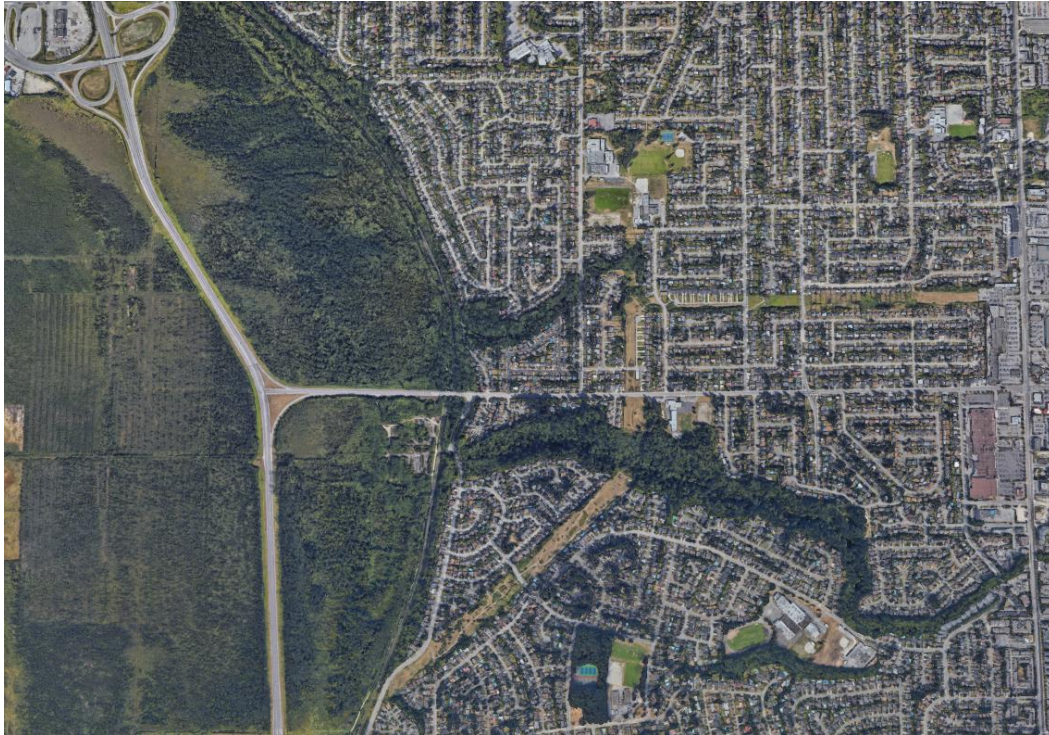


Figure 20: Remnant forests such as those along streams in the Sunshine Hills area of Delta can provide connectivity to larger forest patches for many wildlife species. In addition, street trees and private yards can also provide connectivity for birds during migration and overwintering stages and may provide corridors for breeding bird dispersal.⁷⁷

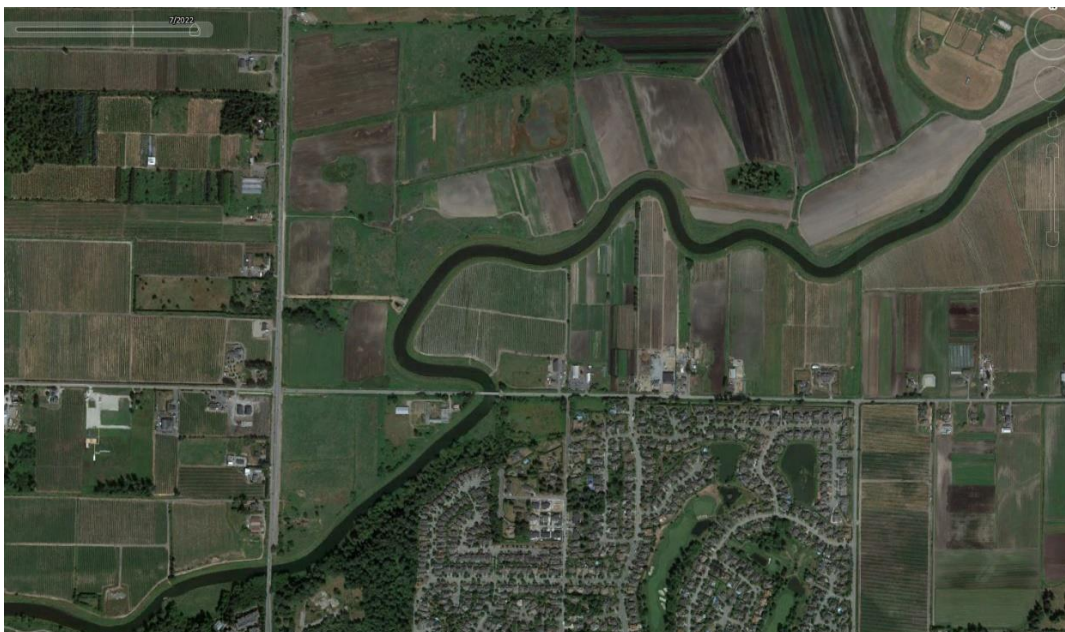


Figure 21: Maintaining abundance and diversity of bird species in an agricultural landscape can be achieved by providing various crop types interspersed with naturalized greenspace.⁷⁸ This view of the Cloverdale area of Surrey shows a mix of vegetable, berry and pasture farm fields with nearby forest patches.⁷⁹

⁷⁷ Google Maps. (2024). Sunshine Hills. Available at <https://www.google.com/maps/@49.1350454,-122.9239032,3144m/data=!3m1!1e3?entry=ttu> (Accessed: April 2024).

⁷⁸ Butler et al. (2021)

⁷⁹ Google Earth Pro 7.3.6 (2022-2024). Cloverdale 49°04'39"N, 122°47'38"W, elevation 0.44M. [Online] [April 2024]

Conclusion

The ecological significance of the Fraser River Delta for migratory birds is exceptional. The interconnectedness of estuarine, intertidal, and floodplain habitats through complex food webs, along with its sheer size has resulted in high levels of productivity that supports diverse and abundant bird populations. This area annually attracts some 263 species of birds, including the largest wintering population of birds of prey and the highest concentration of wintering shorebirds, waterfowl, and raptors in all of Canada.⁸⁰ A total of 14 bird species (**Table 2**) that depend on the Delta are listed under the federal *Species at Risk Act*, and many more are provincially listed.⁸¹ Including these avian Species at Risk, the PBHJV has identified a longer list of focal bird species based on conservation concern and significant population usage, 55 of which commonly occur in the Fraser River Delta. The extraordinary numbers of birds that use the Fraser River Delta as a migratory stopover site make it one of only a handful of similar sites along the West Coast of the Americas. As a result, the Delta has been recognized as an important habitat by multiple international designations.

The PBHJV has identified these key threats to the remaining Delta habitats: Residential, Commercial and Industrial Development, Non-compatible Agriculture, Climate Change and Severe Weather, Pollution (Effluents, Oil Spills and Overuse of Pesticides), Invasive Non-native Alien Species and Problematic Native Species, and Other Key Threats (collisions with windows and vehicles; and cat predation).⁸² In response, PBHJV partners have initiated and support projects and programs to address these threats. For example, they have established conservation areas, funded regenerative farm stewardship to promote wildlife-compatible crops, developed and funded removal programs for invasive plants, funded wetland marsh restoration, monitored the loss of marsh plants from sea level rise and forage damage from over-abundant geese, researched the effects of agricultural pesticides on aerial insectivore birds, and promoted countermeasures for cat predation and window collisions affecting songbird populations.

Although the PBHJV partners have been very active in developing or funding these initiatives, the scale of the threats to the Fraser River habitats and species is beyond what the partnership alone can solve. This report has provided a range of strategies that local governments can implement to support the conservation of habitats in the Fraser River Delta for migratory birds. These will support not only the goals of the PBHJV but also Canada's international commitments under the Kunming-Montreal Global Biodiversity Framework ("30 x 30") in meeting conservation targets.⁸³

⁸⁰ Butler and Campbell. (1987).

⁸¹ Committee on the Status of Endangered Wildlife in Canada (2022). Canadian Wildlife Species at Risk. https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/species/CSAR%20EN%202022.pdf.

⁸² Pacific Birds Habitat Joint Venture (2021).

⁸³ Kunming-Montreal Global Biodiversity Framework (2023). *Canada's 2030 Nature Strategy: Halting and Reversing Biodiversity Loss in Canada* https://publications.gc.ca/collections/collection_2024/eccc/en4/En4-539-1-2024-eng.pdf

Residential and Commercial Development

- Establishment of conservation areas
- Land-use planning and regulations
- Land management
- Habitat restoration
- Habitat monitoring
- Public communication and education
- Coordinated conservation planning

Invasive Non-native Alien Species and Problematic Native Species

- Invasive Species Control

Non-compatible Agriculture

- Agricultural stewardship and conservation planning

Other Key Threats

- Reducing bird collision mortality
- Reducing biodiversity impacts from feral and free-ranging cat predation

Climate Change and Severe Weather

- Sea level rise mitigation

Pollution (Effluents, Oil Spills, and Overuse of Pesticides)

- Reduce and mitigate pollution

In addition to these strategies, there is a need to address a major deficiency that has plagued the Delta for decades - overlapping and uncoordinated jurisdictions. This is particularly true with the demise of the Fraser River Estuary Management Program (FREMP), which previously provided a forum for coordination and planning between federal, provincial, and local government agencies and port authorities from 1985 to 2013.⁸⁴

⁸⁴ See [The Society for Conservation Biology \(wiley.com\)](http://www.societyforconservationbiology.com).

Without further action the compounding effects of historic and ongoing stressors are predicted to result in two thirds of species in the Fraser River estuary having under 50% probability of persistence over the next 25 years.⁸⁵ Local governments can promote and support the re-establishment of regional integrated planning for conserving habitats in the Fraser River Delta. Fundamental to this work is the need for Indigenous vision and leadership in a new co-governance framework involving all the relevant jurisdictions for the floodplain, tidal flats and estuarine waters. Establishing Indigenous Protected and Conserved Areas provides a powerful conservation tool. A novel approach to sustainable funding is required to ensure longevity.⁸⁶ Regional conservation financing mechanisms are one method to help deliver sustainable funding, with long-term benefits. Another potential funding source in the future stems from an international Task Force on Nature-Related Financial which advises corporations on how they can support ecosystems if they have an “interface with sensitive locations” such as the Fraser River Delta Key Biodiversity Area.⁸⁷ In addition to funding, a transboundary recognition could be useful. For example, a transboundary Biosphere Reserve designation incorporating the full extent of the Fraser River Delta, including the Semiahmoo Bay and Drayton Harbor portions, has been suggested since 1992 and would raise the international profile.⁸⁸

Recent public opinion surveys show 95% of residents agree that protecting wildlife habitat improves the overall quality of life and indicate clear support for the protection of the natural environment and species at risk⁸⁹. However, the extraordinary ecological values of the Fraser River Delta and the birds that use them are threatened and need the implementation of coordinated, well-funded and effective habitat conservation programs. Conserving the habitats of the Fraser River Delta benefits not only birds but they also provide vital ecosystem services such as flood control, carbon sequestration, and mitigating heat island effects. An example of the negative effects on bird populations from habitat losses in key locations similar to the Delta have been documented in the East Asia-Australasian Flyway⁹⁰. Rapid population declines in migratory shorebirds have been attributed to the 30% reduction in Yellow Sea mudflats from coastal development and also to degradation from industrial discharges and invasive plants. These losses, as well as any declines in the Fraser River Delta, have international repercussions. Given the population of Metro Vancouver is anticipated to reach 3.8 million people by 2050,⁹¹ there is an important role for local governments to play in the Delta to make progress on international efforts toward the conservation of migratory birds.

⁸⁵ Kehoe, Laura J., et al. (2020). “Conservation in Heavily Urbanized Biodiverse Regions Requires Urgent Management Action and Attention to Governance.” *Conservation Science and Practice: A Journal of the Society for Conservation Biology*, vol. 3, no. 2, article e310. <https://doi.org/10.1111/csp2.310>.

⁸⁶ Kehoe et al. (2020).

⁸⁷ Task force on Nature-related Financial Disclosures - <https://tnfd.global/>

⁸⁸ Boundary Bay Conservation Committee. 1992. *Ours to Preserve: Boundary Bay Biosphere Reserve*. British Columbia, Canada, Washington USA.

⁸⁹ Harshaw, H.W. (2008). *British Columbia Species at Risk Public Opinion Survey 2008: Final technical report*. Vancouver, BC: University of British Columbia Collaborative for Advanced Landscape Planning. https://www.sccp.ca/sites/default/files/species-habitat/documents/BC-SaR-POS_Final-Technical-Report_08-06-24_0.pdf, https://www.sccp.ca/sites/default/files/species-habitat/documents/BC-SaR-POS_SaRCO-MoE_08-06-16_0.pdf; and Ducks Unlimited Canada (2024). “Vancouver residents advocate for conservation in landmark survey” <https://www.ducks.ca/news/provincial/british-columbia/vancouver-residents-advocate-for-conservation-in-landmark-survey/>

⁹⁰ Studds, C., et al. (2017). “Rapid Population Decline in Migratory Shorebirds Relying on Yellow Sea Tidal Mudflats as Stopover Sites.” *Nature Communications*, vol. 8, article 14895, <https://doi.org/10.1038/ncomms14895>.

⁹¹ Metro Vancouver Growth Projections Table (2016). <https://metrovanancouver.org/services/regional-planning/Documents/metro-vancouver-growth-projections-tables.pdf>