# Status and Distribution of Marine Birds and Mammals in the Fraser River Estuary, British Columbia 2016-2017

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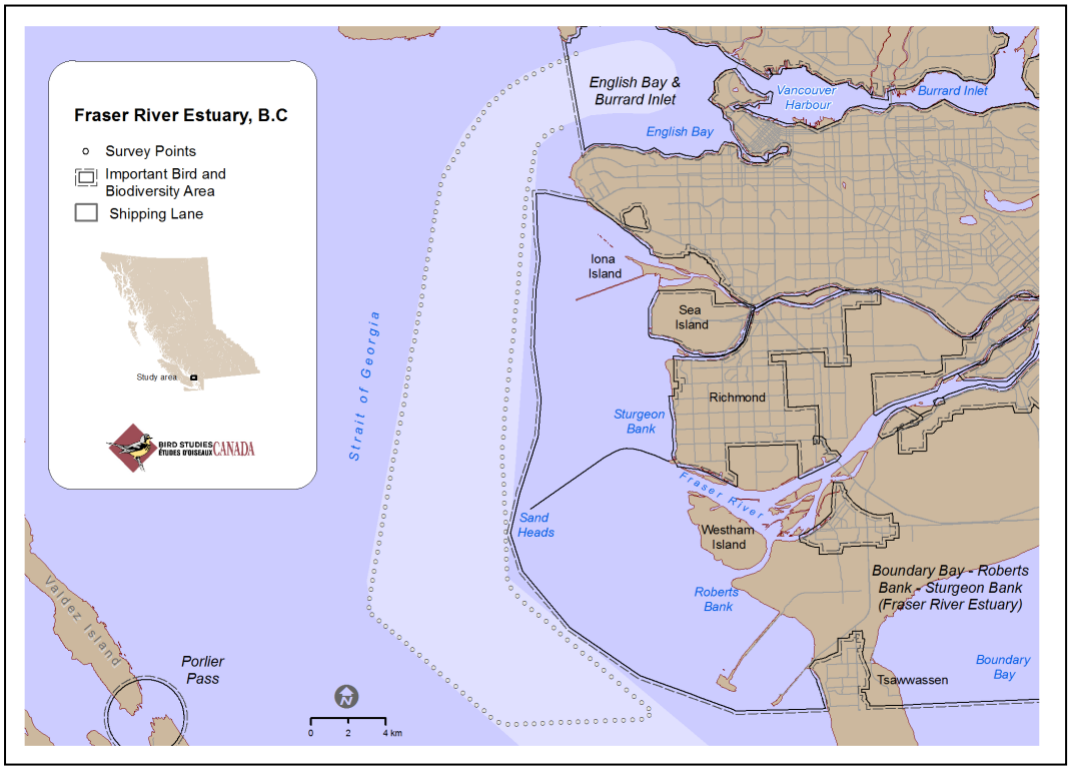


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BIRD STUDIES CANADA ÉTUDES D'OISEAUX

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The data from this survey are publicly available for download at www.naturecounts.ca

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# Executive Summary

The near coastal water from 1 to 4 nautical miles beyond the low tide of the Fraser River delta, and referred to here as the Fraser River Estuary, is part of the west coast's busiest shipping lane and an extension of one of Canada's most important natural resources on the Fraser River delta (Butler and Campbell 1987). We report on a systematic, boat-based survey conducted every month between 10 November 2016 and 23 October 2017 along the inbound and outbound shipping lanes in the Fraser River estuary.

A total of 3447 birds and mammals were recorded in a 200m wide transect of which the greatest number occurred in January (1236) and the fewest in June (75). Assuming the same density in surveyed and unsurveyed portions of the estuary, we estimate that as many as 32,000 birds could have been present in January and 1950 in June over the entire Fraser River Estuary. Seabirds and seals were respectively the most numerous birds and mammals.

A distinguishing feature of the estuary surveys was the number of federally designated Endangered, Threatened, or Special Concern, and provincially Red- or Blue-listed species that were present. Of 27 annually occurring birds and 4 mammals, nearly half (14) were designated as Endangered, Threatened, or Special Concern by either the federal or provincial government designations.

Our purpose was to document the seasonal abundance and distribution of marine birds and mammals through a year. We compare the results with existing information on the distribution, abundance and trends of marine birds and mammals in the region. Our key findings indicate:

- The deep water of the Fraser River estuary is used by several federally-listed and provincially-listed species including Pacific Brant, Surf Scoter, Double-crested Cormorant, Brandt's Cormorant, Pelagic Cormorant, Western Grebe, California Gull, Parasitic Jaeger, Caspian Tern, Common Murre, Marbled Murrelet, Ancient Murrelet, Harbour Porpoise, and transient Killer Whale. Special attention should be directed to these species with an aim to secure and recover their populations.
- A large number of Marbled Murrelets present in winter suggests that the Fraser River Estuary serves as an important location for the most perilous population, the South Coast murrelets. Regular annual use by this species needs to be confirmed. The ecological factors drawing Marbled Murrelets to the estuary should be a research priority with the aim of securing the ecological function that supports the large numbers observed.
- More frequent surveys to establish the baseline number of Harbour Porpoises against which to measure any effects from increased shipping traffic is recommended. The observation of a 'superpod' is of particular interest.

# 1. Introduction

## 1.1 Background and context

The Fraser River estuary has been occupied by birds and mammals long before the written record began. Remains from harvesting activities of Musqueam (xʷməθkʷəy̓əm) and Tsawwassen (*sc̓əwaθən məsteyəxʷ*) indigenous people residing in the estuary reveal the presence of fish, shellfish, birds and mammals for thousands of years (Hobson and Driver 1989). Many of the current place names in the Fraser River Delta were assigned by early explorers and settlers (Walbran 1971; Akrigg and Akrigg 1997) who settled, diked, and farmed there in the late 19th century. Hundreds of thousands of people reside on the delta today accompanied by concomitant environmental change from industrial and urban development. Jetties and river retaining walls on the intertidal portions of the delta altered the flow and sedimentation patterns in the estuary.

The Fraser River Estuary is an extension of the Georgia Strait ecosystem, more recently known as the Salish Sea ecosystem that holds several globally and internationally important numbers of birds (Butler and Vermeer 1989). The intertidal marshes of the Fraser River Delta are recognized with many conservation designations as a nursery and resting place for millions of fish and migratory birds (Butler and Campbell 1987).

Several studies report that the Salish Sea region has experienced a significant decline in bird species (Bower 2009, Anderson et al. 2009, Crewe et al. 2012). Vilchis et al. (2015) found long term declines most pronounced among some seabirds (alcids) and grebes that specialized on small fish for prey. They posited that the changes in bird numbers might signal large ecological changes to the food web. Gaydos and Brown's (2011) review of the potential threats to wildlife in the Salish Sea included human disturbance, underwater acoustics and oil spills from increased shipping to and from ports in Vancouver and Washington, and a variety of ecological changes. There has been heightened public attention over the potential for increased spills from ships, most notably a higher number of oil tankers. Despite an abundance of studies of birds on the Fraser River Delta, there is a paucity of information on the birds and mammals in the subtidal region of the estuary.

The purpose of this report is to present the results of a weekly year-round census from 2016-17 and to compare them with historical information on the distribution and abundance of marine birds and mammals in the Fraser River Estuary, and the broader Salish Sea. The project builds on similar work conducted within the Southern Gulf Islands of British Columbia (Davidson et al. 2010), Burrard Inlet and Indian Arm (Butler et al. 2015), and Howe Sound (Butler et al. 2018).

Table 1. Regularly-occurring marine bird and mammal species of conservation priority in the Fraser estuary. (SC=Special Concern, T=Threatened, E=Endangered, N =No concern; *Transient ecotype, **Southern Resident ecotype; Red= at risk of being lost (extirpated, endangered or threatened), Blue= special concern )

| Species | COSEWIC | SARA | BC Provincial ranking |
|---|---|---|---|
| Ancient Murrelet | SC | SC | Blue |
| Pacific Brant | N | N | Blue |
| Brandt's Cormorant | N | N | Red |
| California Gull | N | N | Blue |
| Caspian Tern | N | N | Blue |
| Common Murre | N | N | Red |
| Double-crested Cormorant | N | N | Blue |
| Harbour Porpoise | SC | SC | Blue |
| Killer Whale | T*E** | T*E** | Red |
| Marbled Murrelet | T | T | Blue |
| Parasitic Jaeger | N | N | Red |
| Pelagic Cormorant | N | N | Red |
| Surf Scoter | N | N | Blue |
| Western Grebe | SC | N | Red |

## 1.2 Previous studies

The indigenous people who hunted and fished in the Fraser River Estuary for thousands of years left behind a valuable archeological record of its birds and mammals (Hobson and Driver 1989). The waterbird species uncovered in the middens are still present today. The written record of the estuary begins with early Spanish and English explorers who crossed the estuary but did not confirm the presence of the Fraser River. Despite Captain George Vancouver's route following close to our transect, neither he nor Archibald Menzies who served as naturalist referred to bird or mammal life in the estuary (Vancouver 1798).

Data on birds along the shore of the Fraser River delta is voluminous. Benson (1961) described the foreshore marshes and the seasonal use by waterfowl. Butler and Campbell (1987) summarized what was known about the birds on the Fraser River Delta, including the estuary portion, and subsequent surveys (Vermeer and Levings 1977, Butler and Cannings 1989) filled an important gap in the abundance and seasonality of birds in the intertidal portion of the delta. There is a large body of research into distributions and habitat associations of the major waterbird species along the shore including the BC Coastal Waterbird Survey and papers by many authors (Butler 1994, Ydenberg et al. 2004, Shepard and Lank 2004, Pomeroy 2006, Evans Ogden et al. 2008, Drever et al. 2014, Jimenez et al. 2014).

In contrast to the shoreline, information on birds far from shore is scant. Robertson (1977 conducted a year-round survey from ships and ferries of seabirds utilizing the pelagic waters of the Strait of Georgia. The densities of birds estimated for the shoreline by Vermeer et al. (1994) and the offshore by Robertson (1977) were strikingly different. Shoreline bird densities were two orders of magnitude greater than that of the pelagic waters. Robertson (1977) concluded that the density of seabirds using the pelagic waters was minimal and their ecological role was insignificant. The birds and marine mammals using the estuary waters between the intertidal portions of the delta reported by Vermeer et al. (1994) and the pelagic waters of the Strait of Georgia surveyed by Robertson (1977) have not been surveyed to our knowledge and are the subject of this report.

# 2. Study Area and Methods

## 2.1 Study Area

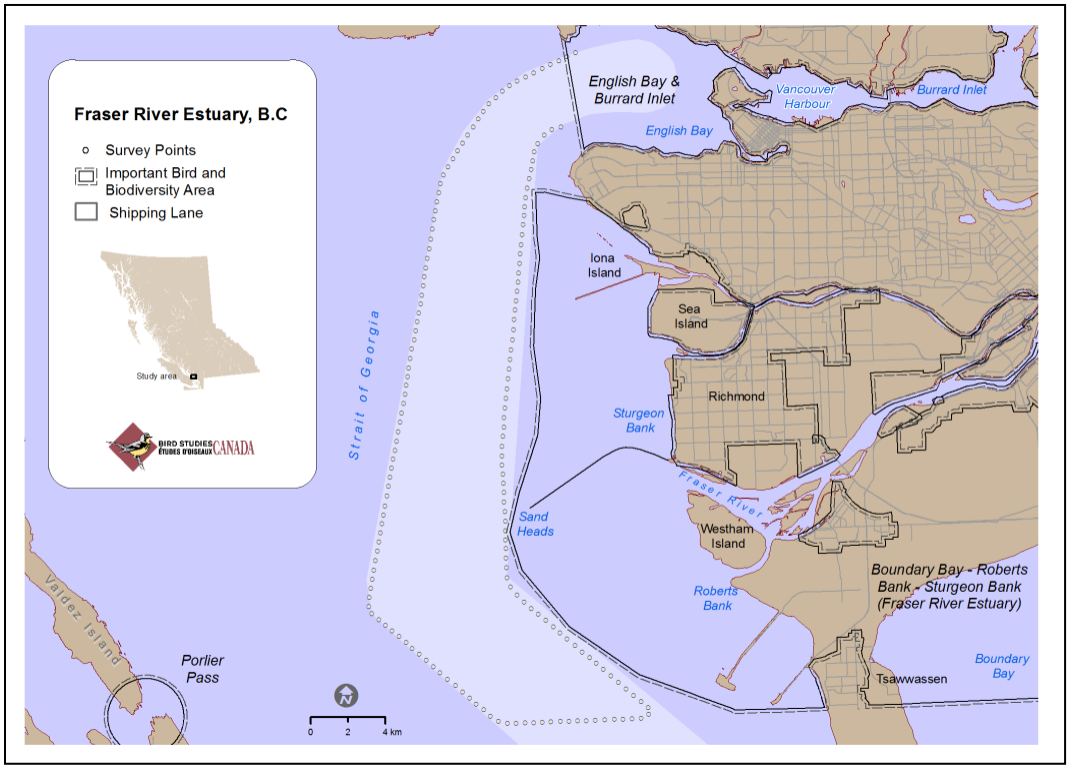


Fig. 1 Fraser River Estuary study area

The study area includes the waters approximately 1 to 4 nautical miles from shore extending from the Point Grey bell buoy off Point Grey south along the inside (eastern edge) of the inbound shipping lane to the US-Canada International border, west along the International border and north along the outside (western edge) of the outbound shipping lane, to Point Atkinson (Figure 1).

## 2.2 Transect Route and Field Protocol

Survey methods designed to estimate population size and distribution of seabirds in large open waters use a sampling method based on a fixed transect width (Tasker et al. 1984). We surveyed a transect along the eastern and western boundary of the shipping lane. The eastern boundary was closer to shore and near the drop off of the delta, while the western boundary was closer to the middle of the Strait of Georgia.

We surveyed approximately once each month from November 2016 to October 2017. For the purpose of this report, counts of birds and marine mammals were made from a 7 m long aluminum boat moving at 12 knots within a 200 m (100m on either side) wide transect parallel to the shoreline. We also recorded the number of birds and mammals seen beyond 100 m of the boat. These data were archived in the data set but not included in the mapping and abundance estimates we present here.

Two observers scanned for birds and mammals on either side of the boat. We included in the tally any flying birds that crossed the transect. One observer called out waypoints approximately every 500 meters while the other observer recorded the data. Binoculars were used to assist in counting and identifying distant birds and mammals. In most situations, birds and mammals were counted individually. Flocks of more than about 100 individual birds were estimated by summing the number by groups of 10s of individuals. Previously, we compared our field estimates against the number counted from a photograph of the same flock and found our precision to be similar to other studies (Prater 1979). Rappolt et al. (1985) concluded that over and underestimates canceled each other out.

## 2.3 Kernel and Cluster Mapping Techniques

Kernel analysis is widely used in wildlife research to visualize patterns of species distributions and density. Kernel analysis creates a smooth surface on which the estimated values are highest at the locations of the known data points and diminish with increasing distance from these points, reaching zero at the predefined search radius distance from this point (ArcGIS 9.3, ESRI 2009).

## 2.3.1 Kernel Analysis

We applied a kernel estimator to determine the spatial distribution pattern of each species of interest using effort-corrected counts. A cell size of 50 metres (resolution) and a search radius of 1500 metres were used to define the kernel settings. Next, we normalized each raster layer into groups using a “natural breaks” classification method. This method creates classes by identifying naturally occurring breaks in the distribution of data values. It attempts to reduce variance within groups and maximize the variance among groups. To allow comparison among species, we labeled highest values as high density areas, the second highest values as medium density areas, and the third highest as low density areas. One further tier of (lowest) values was

excluded from visual representation on the species maps to minimize distraction from areas of higher importance.

### 2.3.2 Clustering Analysis

In order to determine the distribution of groups of interest (e.g. SARA-COSEWIC species), the respective species rasters needed to be combined. In order to make the rasters comparable, it was important to use a common measurement scale and weights that allow us to make calculations of standardized criteria among several kernel rasters. To do this, we assigned numerical weights to the categories described above. High density areas, medium density areas, and low density areas were assigned weights of 10, 6 and 2 respectively. After scaling the kernel raster datasets, the selected species were overlapped and summed together. The resulting rasters were displayed using "equal interval" classification which divides a dataset into groups at regular intervals containing equal ranges of values. In this way, a clustering degree was identified where high, medium and low density areas represent the species abundance and spatial distribution (and the lowest tier of values was excluded as before).

It is important to note that the maps in this report show the results of applying kernel analysis within 200 m of the waypoints along the survey transect route only; the analysis does not extrapolate beyond 200 m either side of the transect line. There are shortcomings of applying this technique to waypoints along a transect line, including spatial autocorrelation not being accounted for. The maps represent only the data collected during this survey, and do not reflect an absence of birds or mammals >100 m away from the transect line.

## 2.4 Other Observations

We included observations of birds and marine mammals counted within about 1 km of the boat while transiting English Bay between First Narrows and the Point Grey bell buoy. We also included other incidental observations made by us or other people in the Estuary during our surveys.

# 3. Results

## 3.1 English Bay Records

We tallied 15 species of birds and three mammals while transiting across English Bay (Table 2). The Marbled Murrelet, Western Grebe and Harbour Porpoise are federally listed Species at Risk.

Table 2. Number of birds and marine mammals seen each month in transit through English Bay between First Narrows and Point Grey bell buoy. Dates correspond with transect survey dates.

| Species | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | *Total* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Surf Scoter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 2 | 4 | 0 | *11* |
| White-winged Scoter | 0 | 0 | 0 | 0 | 0 | 105 | 0 | 0 | 0 | 0 | 12 | 0 | *117* |
| Western Grebe | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | *7* |
| Common Murre | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | *1* |
| Marbled Murrelet | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 2 | *10* |
| Bonapartes Gull | 12 | 40 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 334 | 107 | 0 | *496* |
| Mew Gull | 11 | 54 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | *91* |
| California Gull | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 8 | 0 | 0 | *11* |
| Glaucous-winged Gull | 4 | 0 | 2 | 0 | 3 | 9 | 7 | 3 | 27 | 3 | 2 | 11 | *71* |
| Caspian Tern | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *1* |
| Parasitic Jaeger | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | *4* |
| Red-throated Loon | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *1* |
| Brandt's Cormorant | 2 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 17 | 1 | *39* |
| Double-crested Cormorant | 1 | 0 | 3 | 0 | 0 | 35 | 1 | 0 | 0 | 0 | 2 | 12 | *54* |
| Pelagic Cormorant | 1 | 2 | 4 | 0 | 3 | 2 | 0 | 1 | 0 | 1 | 0 | 0 | *14* |
| Harbour Seal | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 3 | 5 | 3 | *14* |
| Dall's Porpoise | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 8 | 0 | *13* |
| Harbour Porpoise | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | *4* |
| *Total* | *31* | *102* | *35* | *5* | *6* | *151* | *14* | *17* | *27* | *370* | *171* | *30* | *959* |

## 3.2 Summary of Monthly Surveys

Twelve surveys were conducted between November 2016 and October 2017, totalling 3447 individuals of 29 marine bird and 3 marine mammal species (Table 3). The most abundant birds were Mew Gull, Common Murre, Glaucous-winged Gull, Bonaparte's Gull, California Gull and Marbled Murrelet. The most abundant marine mammal was the Harbour Porpoise. Notable numbers of Marbled Murrelets were seen in January. Also of note was the presence of Species at Risk designated as *Threatened*: Marbled Murrelet and Transient Killer Whale; *Special Concern*: Western Grebe, Ancient Murrelet, and Harbour Porpoise; BC *Red listed* species: Western Grebe, Pelagic Cormorant, Brandt's Cormorant, Parasitic Jaeger, Common Murre, and Transient Killer Whale; BC *Blue listed* species: Pacific Brant, Long-tailed Duck, Surf Scoter, Double-crested Cormorant, Caspian Tern, Marbled Murrelet, Ancient Murrelet, and Harbour Porpoise.

Our study area included the water from 1 to 4 nautical miles beyond the lowest tide on the Fraser River Delta and therefore was 3 nautical miles (5.4 km) wide. The survey transect was 200 meters wide within the 5.4 km width leaving (5400 m – 200 m) 5200 m that was not surveyed. The unsurveyed area was therefore (5200m/200m=) 26 times greater than the surveyed area. By assuming the same density of birds in unsurveyed and surveyed areas, there could have been (1236 birds X 26=) 32,136 birds present in the Fraser River Estuary in January when birds were most numerous and 1950 birds in June when birds were least numerous.

Table 3. Number of marine birds and mammals counted during 12-200 m wide line transect surveys (*i.e.* within 100 meters either side of survey vessel) in the Fraser estuary, British Columbia, 2016-2017. Numbers in parentheses indicate total number of waypoints surveyed.

| Species | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | *Total* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (174) | (121) | (174) | (174) | (174) | (174) | (115) | (174) | (174) | (174) | (174) | (174) | |
| Alcid | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *2* |
| Ancient Murrelet | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | *2* |
| Bald Eagle | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *3* |
| Bonaparte's Gull | 1 | 0 | 0 | 39 | 0 | 0 | 0 | 0 | 161 | 93 | 22 | 0 | *316* |
| Pacific Brant | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *7* |
| Brandt's Cormorant | 42 | 2 | 20 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 10 | 17 | *101* |
| Canada Goose | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | *1* |
| California Gull | 0 | 0 | 0 | 5 | 47 | 50 | 26 | 45 | 17 | 24 | 25 | 0 | *239* |
| Caspian Tern | 0 | 0 | 0 | 0 | 0 | 5 | 1 | 1 | 0 | 0 | 0 | 0 | *7* |
| Common Murre | 303 | 4 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 3 | 15 | 264 | *592* |
| Cormorant sp. | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *3* |
| Dall's Porpoise | 6 | 5 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | *26* |
| Double-crested Cormorant | 2 | 3 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 4 | *11* |
| Ducks | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | *2* |
| Dunlin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 | 0 | 0 | *24* |
| Fork-tailed Storm-petrel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | *1* |
| Gulls | 103 | 0 | 0 | 1 | 0 | 0 | 76 | 0 | 0 | 0 | 0 | 0 | *180* |
| Glaucous-winged Gull | 136 | 33 | 24 | 11 | 45 | 10 | 9 | 65 | 85 | 24 | 32 | 28 | *502* |
| Harbour Porpoise | 74 | 0 | 1 | 1 | 1 | 7 | 1 | 3 | 1 | 27 | 0 | 6 | *122* |
| Harbour Seal | 12 | 0 | 2 | 4 | 0 | 1 | 0 | 4 | 1 | 7 | 3 | 2 | *36* |
| Herring Gull | 0 | 0 | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *33* |
| Iceland Gull | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | *18* |
| Killer Whale | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *3* |
| Marbled Murrelet | 237 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | *242* |
| Mew Gull | 247 | 76 | 167 | 38 | 4 | 0 | 0 | 0 | 3 | 46 | 9 | 141 | *731* |
| Northern Pintail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | *5* |
| Parasitic Jaeger | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | *2* |
| Pacific Loon | 4 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *6* |
| Pelagic Cormorant | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | *2* |
| Pigeon Guillemot | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *1* |
| Pomarine Jaeger | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *1* |
| Red-breasted Merganser | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *1* |
| Rhinoceros Auklet | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | *7* |
| Red-throated Loon | 1 | 2 | 3 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | *27* |

| Species | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | *Total* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Surf Scoter | 1 | 0 | 0 | 28 | 0 | 0 | 0 | 0 | 8 | 1 | 0 | 0 | *38* |
| Western Grebe | 37 | 0 | 0 | 26 | 0 | 0 | 0 | 0 | 0 | 75 | 0 | 14 | *152* |
| White-winged Scoter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | *1* |
| | | | | | | | | | | | | | |
| *Total* | *1236* | *129* | *251* | *195* | *100* | *75* | *114* | *125* | *283* | *326* | *121* | *492* | *3447* |

## 3.3 General findings for species of conservation concern

Fourteen species we observed were listed either by COSEWIC, the Federal Species at Risk Act or Provincially (Red or Blue-listed) including Surf Scoter, Pacific Brant, Pelagic, Double-crested and Brandt's Cormorants, Parasitic Jaeger, California Gull, Common Murre, Caspian Tern, Ancient Murrelet, Marbled Murrelet, Transient Killer Whale, and Harbour Porpoise, and Western Grebe (Table 1). The distributions of the listed birds and mammals combined are shown in Figure 2, while the distributions of the listed birds only are shown in Figure 3. While all listed species are assumed to have declining populations, the causes are diverse and not well known and warrant specific studies to develop appropriate targeted conservation actions.

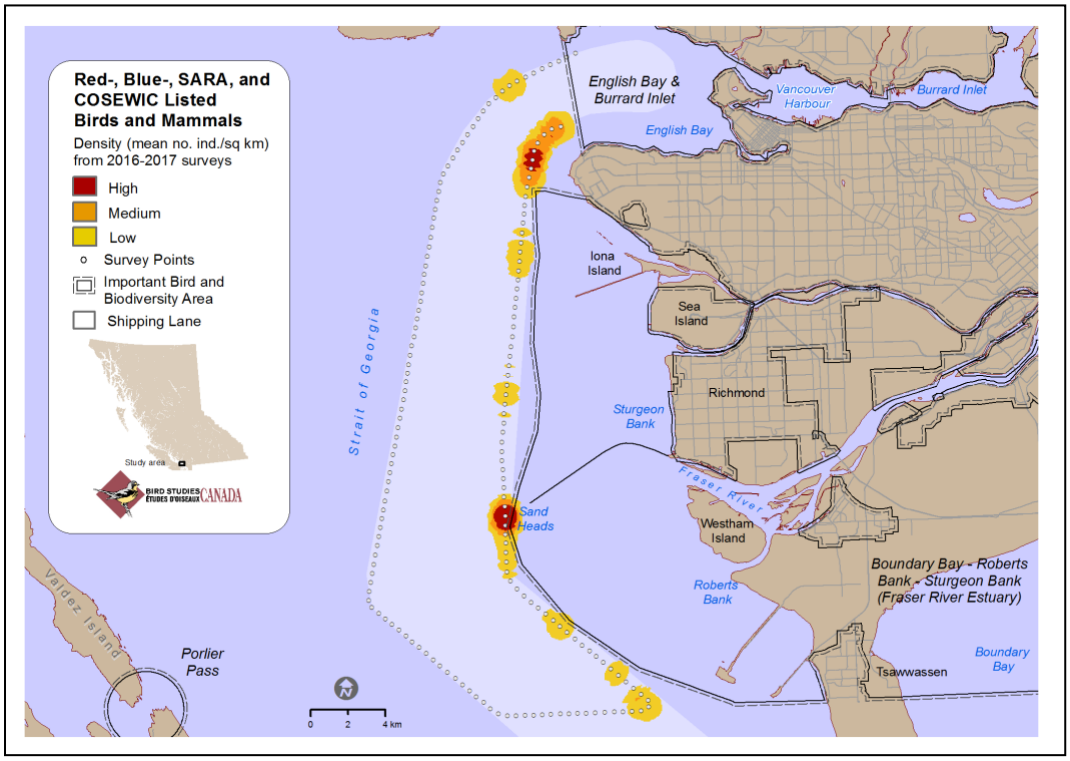


Fig. 2. Primary, secondary and tertiary areas for all federal and provincial marine bird and mammal Species at Risk along the transect route in the Fraser River Estuary, based on spatial clustering analysis of all survey records of SARA-COSEWIC and Ministry of Environment Red- and Blue-listed marine bird and mammal species.

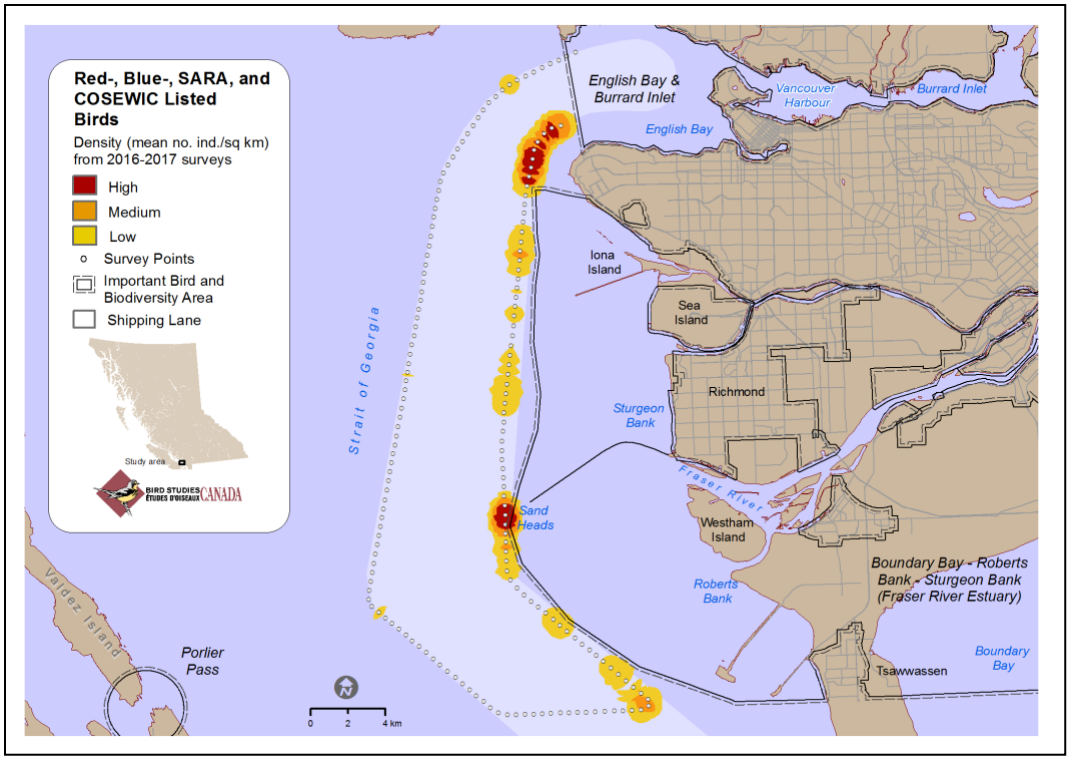


Figure. 3. Primary, secondary and tertiary areas for all federal and provincial marine bird Species at Risk along the transect route in the Fraser River Estuary, based on spatial clustering analysis of all survey records of SARA-COSEWIC and BC Ministry of Environment Red- and Blue-listed marine bird species.

# 4. Discussion

A goal to sustain birds and mammals regardless of their conservation designations requires a functioning ecosystem that can supply them with food, shelter, nest sites and safe resting locations. Restoring and sustaining habitats while minimizing pollution will be required. Most of the species of birds and marine mammals observed on the surveys were fish eaters, drawn to the mouth of the Fraser River for the fish that inhabit the riverine marshes and spawn upriver. Maintenance of eelgrass beds, estuaries, salt marshes, mudflats, and salmon-bearing streams is an important component for all species of birds and mammals. For example, a herring spawn event took place on 25 March 2017 on Point Roberts that attracted several thousand birds. Ilya Povalyaev reported to eBird that 2000 Pacific Brant, 1100 Greater Scaup, 1600 Surf Scoters, 50 White-winged Scoters, 27 Black Scoters, 125 Double-crested Cormorants, 200 Sanderlings, 400 Mew Gulls, 30 California Gulls, 30 Western X Glaucous-winged Gull hybrids and 50 Glaucous-winged Gulls were present.

We noted birds and mammals were particularly numerous near the mouths of the North and South Arms of the Fraser River. The reasons are not understood but might be related to the presence of fish prey. Over 50 species of fish inhabit the lower Fraser River, including Sturgeon and Roberts Banks and the adjacent waters (Levings 2003).

## 4.1 Precision of Estimates

We assumed a high ability to detect and count most birds present on the water during our surveys. We also assumed that a single survey each month would represent the abundance of waterbirds. This assumption is likely valid for the majority of species that remain for the winter but less so for passage migrants like the Bonaparte's Gull and California Gull that move through in a short period of time. Our assumption that a monthly snapshot would represent the distribution of birds likely under represented the overall distribution and abundance.

## 4.2 Conservation Priority Species

Figures 2 and 3 clearly show that the majority of federal and provincial species of conservation concern are clustered along the drop off of the Fraser River Estuary and near the eastern edge of the incoming shipping lane. Whether the presence of ships impacts any of these species was outside the purview of this study. Nevertheless, our snapshot surveys suggest that the Fraser River Estuary is an important extension of the Fraser River Delta that should be incorporated into the Boundary Bay-Roberts Bank-Sturgeon Bank (Fraser River Estuary BC 017) Important Bird and Biodiversity Area (Bird Studies Canada). Moreover, we recommend that more work be done to explicitly investigate interactions between rare species and ships with a goal of ensuring the safety, persistence and recovery of these species. These interactions might include direct disruption of feeding flocks of birds and mammals by the presence of vessels, or indirect effects of the vessels on the distribution of the fish prey of birds and mammals. Also, continuation of prevention and rapid cleanup of deleterious substances from ocean-going vessels, commercial shipping vessels, fishing vessels, ferries and recreational boaters in the Estuary should be a priority.

## 4.3. Recommendations

Our study has established a baseline against which change, including recovery, can be measured. We also identified species of conservation priority that will require specific management actions. At a broader level, the maintenance of the most abundant species will require reducing pollution and sustaining species habitats. A better understanding of the ecological functions that support the diversity and abundance of birds and mammals of the Fraser River Estuary would greatly assist us in sustaining them. As an example, the hypothetical linkage between biofilm on estuarine mudflats and birds needs to be examined (Sutherland et al. 2013).

Management recommendations include:

1. **Reduce chronic pollution** of marine waters from upland sources (i.e., through stormwater runoff), plastic waste, and minor spills from commercial and recreational vessels and operations. These actions would benefit all bird species – including bird species at risk – using the Fraser River Estuary. Reducing pollutants may be especially beneficial to species such as White-winged Scoter and Surf Scoter that eat shellfish that concentrate pollutants in their tissues.

2. **Protect and enhance spawning habitat** for forage fish such as herring, sandlance, surf smelt, and shiner sea perch that support a suite of estuarine specialists, and their spawning locations need to be located and protected. This action would benefit fish-eating bird species, including several bird species at risk, such as Western Grebe, Caspian Tern, Common Murre, and Marbled Murrelet, as well as Harbour Porpoise. Opportunities to consider are the enhancement of estuarine habitats for forage fish such as marshes, seagrass meadows, and restoration of riparian edges.
3. **Continue efforts to reduce the risk of large-scale spills** in the marine environment and to improve spill response measures. Any of the bird species that use the Fraser River Estuary could be affected by a large scale spill depending on the time and location including Surf Scoter, California Gull, Common Murre and Marbled Murrelet.

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# Appendix 1. Species Accounts

Conservation Data Centre: Red List = at risk of being lost (extirpated, endangered or threatened), Blue List = special concern, Yellow List = least concern )

## BIRDS

**Canada Goose *Branta canadensis***

Conservation Status — Conservation Data Centre: BC Yellow List

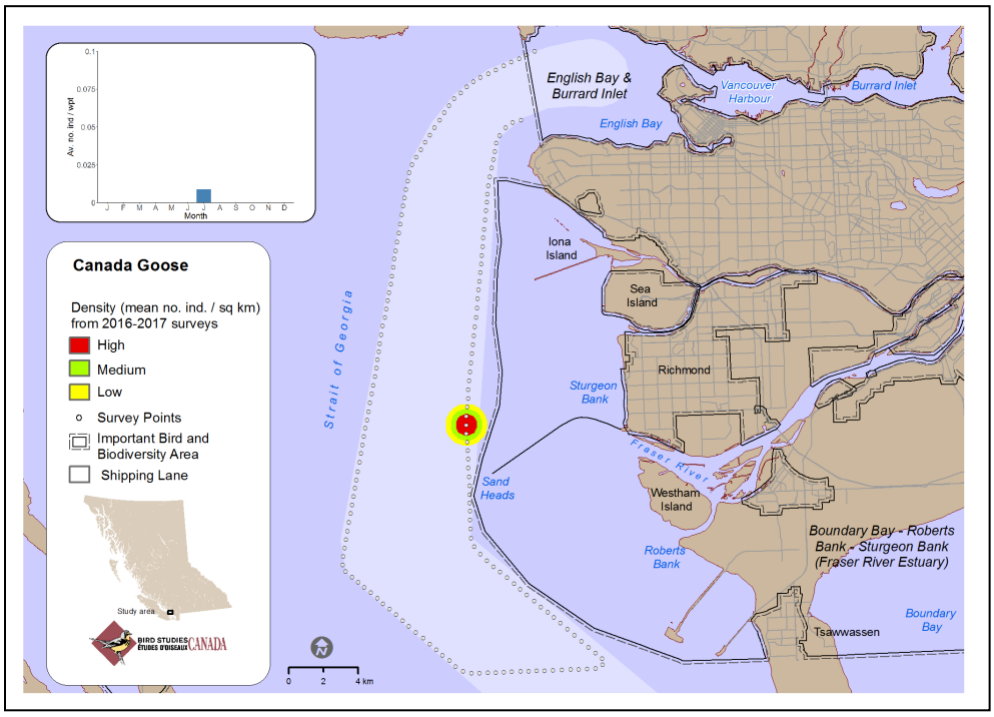


Fig. 4 Spatial distribution and seasonal abundance of Canada Goose in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The number of resident exotic Canada Geese tallied during the BC Coastal Waterbird Survey increased significantly averaging annually 3.8% between 1999 and 2011 (Crewe et al. 2012). This upward trend was mirrored in Puget Sound (Crewe et al. 2012). A native subspecies of Canada Geese, referred to as the Dusky Canada Goose (*B. c. occidentalis*), transits the region between winter quarters in the Willamette Valley, Oregon and breeding grounds in the Copper River, Alaska (Campbell et al. 1990).

Canada Geese in the lower mainland were largely migratory and a summer visitor until the 1970s (Campbell et al. 1990, Dawe and Stewart 2010, Martell 2015a). Small resident flocks were reported to breed in 1970 but most geese were in transit (Campbell et al. 1972b). The migratory native Canada Geese pass through the region in spring and autumn, often at high elevation. Starting in the 1970s, Canada Geese of several subspecies from other parts of Canada and the USA were shipped to the lower mainland by fish and game organizations from which arose the burgeoning resident exotic population in the Salish Sea, including Burrard Inlet and Indian Arm (Campbell et al. 1990).

**Survey Records**

We saw one flock of geese.

**Conservation Issues**
The Canada Goose would not be expected to spend much time in the open water of the Fraser River Estuary. No recommendations.

**Pacific Black Brant *Branta bernicla***

Conservation Status — Conservation Data Centre: BC Yellow list

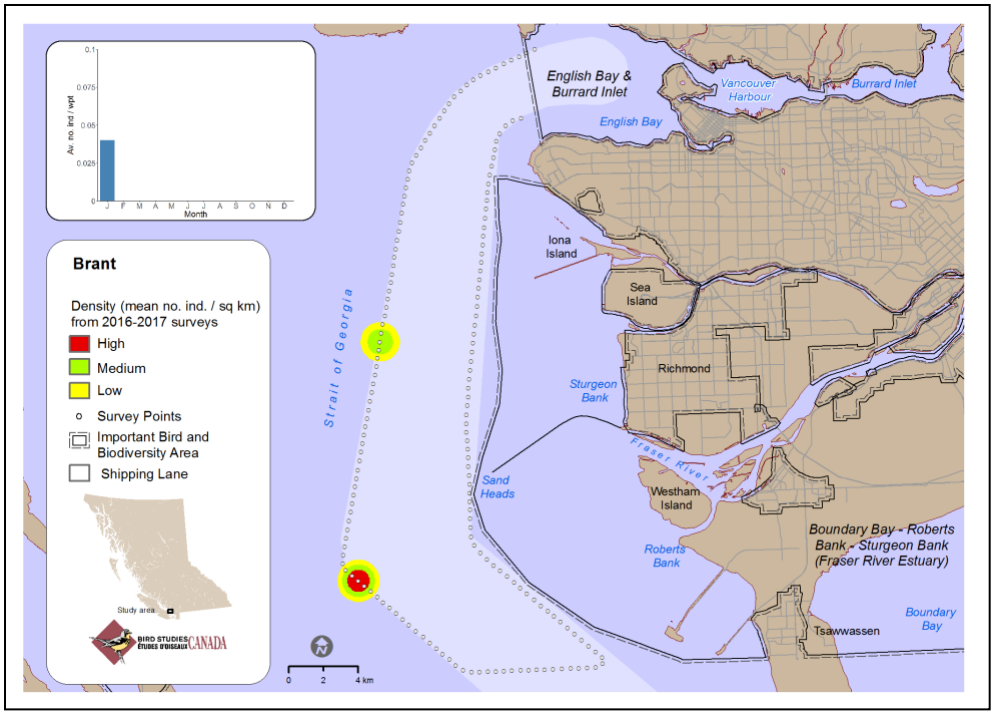


Fig. 5 Spatial distribution and seasonal abundance of Pacific Black Brant in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Fraser estuary provides an important spring stopover site in the migratory pathway of Brant between Mexico and Alaska and winter habitat for several thousand Brant from the High Arctic (Boyd et al. 2013). The number of migratory Brant was stable in the Strait of Georgia from 1999-2012 (Crewe et al. 2012).

Brant closely associate with eelgrass beds including in Boundary Bay and Roberts Bank on the Fraser River Delta. Brant have benefited from the expansion of eelgrass meadows brought about with changes in water and sediment flow following the construction of the BC Ferry and Delta Port jetties.

**Survey records**

Despite large numbers of Brant using the Fraser River delta, we saw them on only two occasions when flocks flew over and briefly alighted on the estuary.

**Conservation Issues and Recommendations**

Pacific Black Brant closely associate with eelgrass beds, including in the Fraser River estuary. The loss of eelgrass beds, human and eagle disturbance, and oil spills on eelgrass meadows are potential threats to migrating and wintering Brant (Pacific Flyway Council 2002).

**Northern Pintail *Anas acuta***

Conservation Status — Conservation Data Centre: BC Yellow list

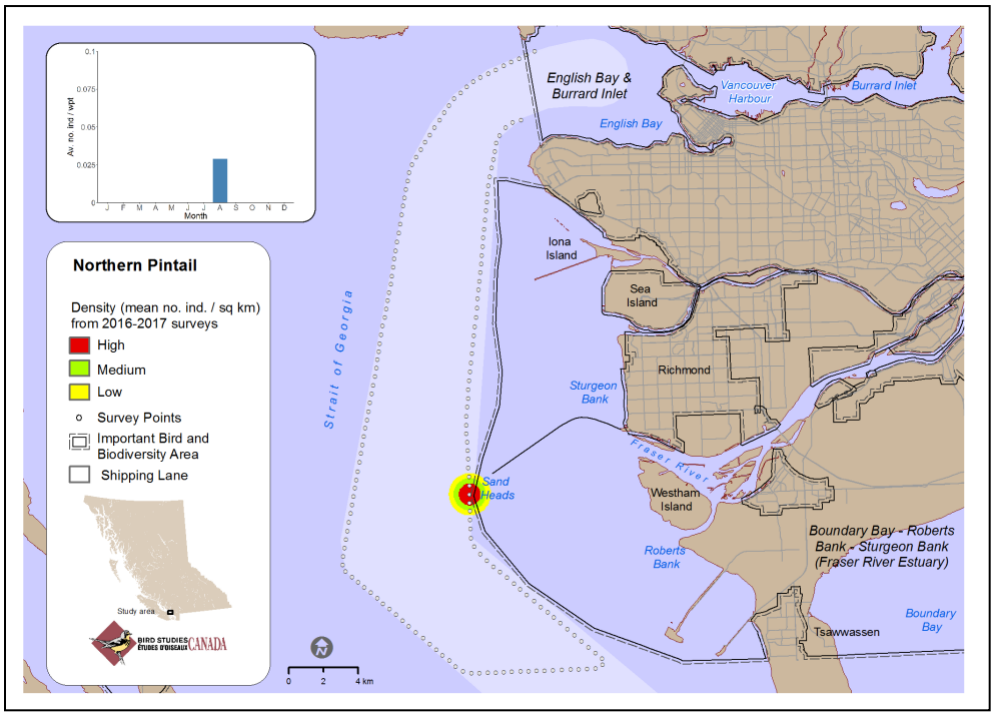


Fig. 6 Spatial distribution and seasonal abundance of Northern Pintail in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Northern Pintail is the third-most abundant of the duck species next to Mallard and American Wigeon, wintering in the Salish Sea with a strong centre of abundance around the Fraser delta (Crewe et al. 2012). Flocks of many thousands graze on farmland and rest in Boundary Bay in winter (Crewe et al. 2012, Middleton 2014). The food is mostly blades, seeds and roots of grasses and sedges eaten in estuarine marshes and agricultural fields around the Fraser River delta.

There has been no significant change in the number of pintails detected in the BC Coastal Waterbird Survey from 1999-2011 (Crewe et al. 2012), Christmas Bird Count data from BC between 1959 and 1988 (Sauer et al. 1996), Padilla Bay, Washington from mid-1970s to mid-2000s (Anderson and colleagues 2009), nor in Puget Sound between 1978-80 and 2003-06 (Bower 2009).

**Survey Records**

We saw pintails only once in August when a flock passed overhead.

**Conservation Issues and Recommendations**

No measures are proposed.

**White-winged Scoter *Melanitta deglandi***

Conservation Status — Conservation Data Centre: BC Yellow list

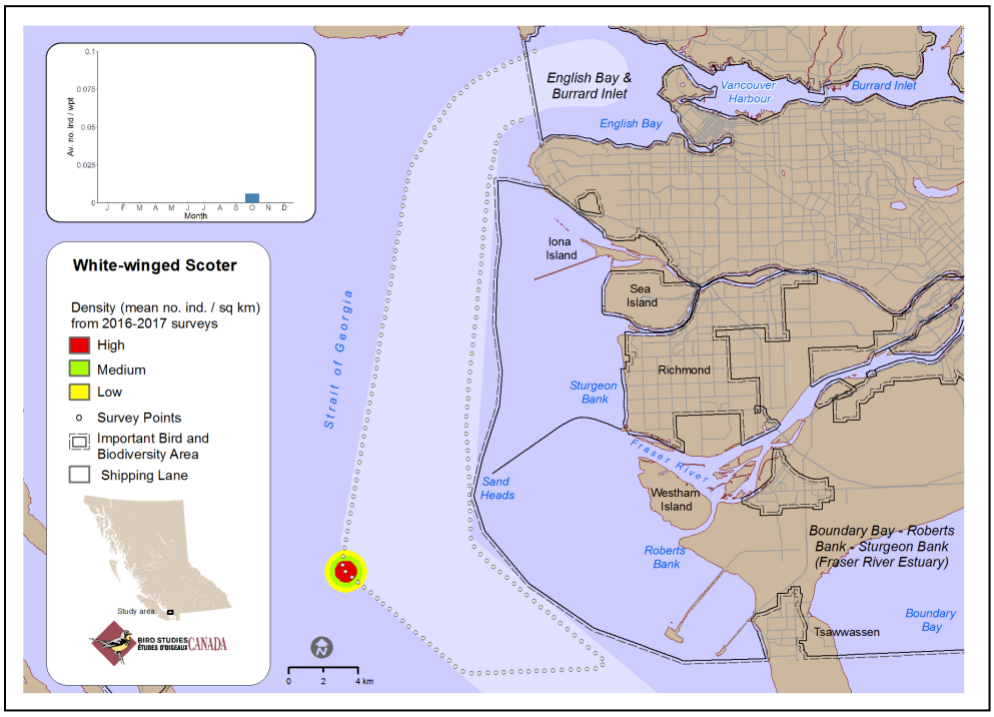


Fig. 7 Spatial distribution and seasonal abundance of White-winged Scoter in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

White-winged Scoters dive for invertebrates in shallow water and assemble in large numbers to eat herring spawn on the east coast of Vancouver Island in late winter and early spring often in association with Surf Scoters (Sullivan et al. 2002a, Lok et al. 2009). Boundary Bay, in the Fraser River delta, is a significant moulting area for White-winged Scoters and the southern Strait of Georgia is one of two centres of winter distribution on the BC coast for the North American population (Campbell et al. 1990).

Campbell and colleagues (1990) described White-winged Scoter occurrences as 'abundant to very abundant' in spring, 'very common to abundant' autumn migrant, 'abundant to very abundant' in winter and 'very common to abundant' summer visitant. The BC Coastal Waterbird Survey showed a declining trend of 7.6% per year from 1999-2011 (Crewe et al. 2012).

White-winged Scoters sometimes gather in large flocks in coastal habitats along shipping routes and recreational boating areas which puts the ducks in potential chronic oil spills (Brown and Frederickson 1997). The large flocks off Spanish Banks near the start of our survey are a case in point (Butler et al. 2015).

**Survey Records**
Despite being abundant in English Bay, we only saw White-winged Scoters once, in October when a flock flew overhead.

**Conservation Issues and Recommendations**
Beaches around the Burrard Inlet, English Bay including Spanish Banks are high priority areas for prevention and containment of oil spilled from boats and ships.

**Surf Scoter *Melanitta perspicillata***

Conservation Status — Conservation Data Centre: BC Blue list

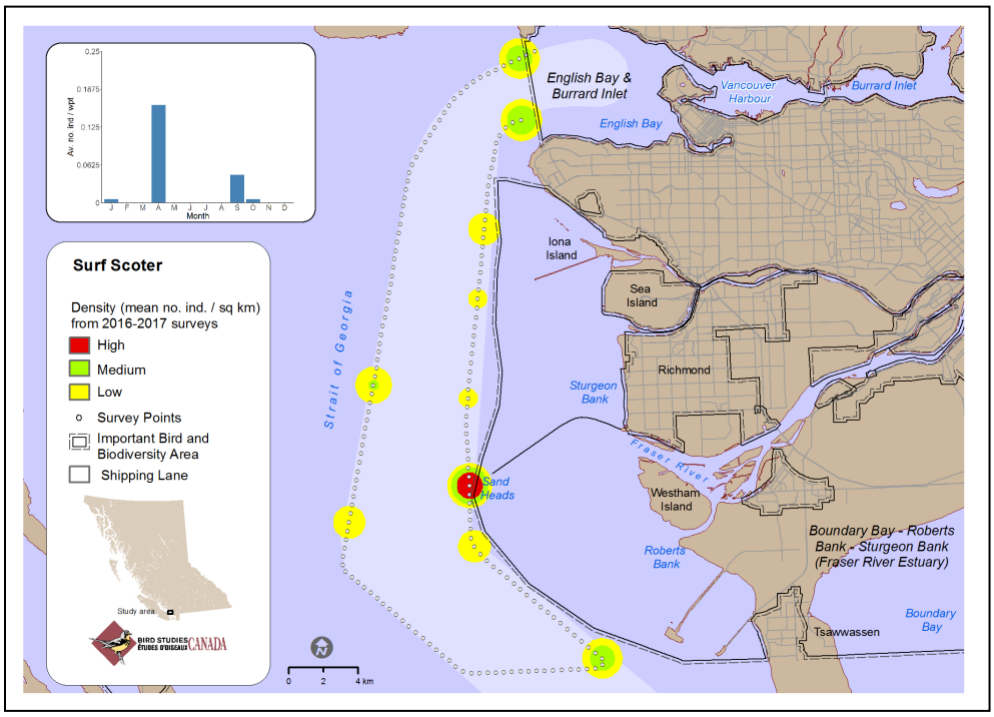


Fig. 8 Spatial distribution and seasonal abundance of Surf Scoter in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The coast of British Columbia is a significant winter destination for Surf Scoters (Burger 2015a). Globally important numbers spend the winter in nearby in Burrard Inlet and Howe Sound (Butler et al. 2017). The Surf Scoter spends its non-breeding season on the coast and migrates to the interior and arctic to breed. Small numbers of non-breeding scoters remain in the Salish Sea where they undergo a feather moult in summer. Surf Scoters can occur in flocks of several thousand birds through the autumn and winter near mussel beds and in late winter and early spring at herring spawning beaches (Sullivan et al. 2002a, Lok et al. 2009). Thousands assemble to eat herring spawn on the east coast of Vancouver Island in late winter and early spring (Sullivan et al. 2002a, Lok et al. 2009).

Despite concerns about declines in North America (Anderson et al. 2015), the Strait of Georgia Surf Scoters did not show a significant change between 1999 and 2011 (Crewe et al. 2012).

**Survey Records**

Surf Scoters were seen on our surveys in January, April, September and October mostly along eastern shipping lane (Figure 8). The scoters were widely distributed there suggesting that the ducks regularly use the shallow water of the Fraser River mouth.

**Conservation Issues and Recommendations**

Providing food and preventing pollution are key to the continued presence of this species in the Fraser River estuary. Surf Scoters are vulnerable to the immediate and long-term effects of oiled beaches (Day et al.1997, Peterson 2003) which makes them a priority species in the Fraser estuary.

**Red-breasted Merganser *Mergus serrator***

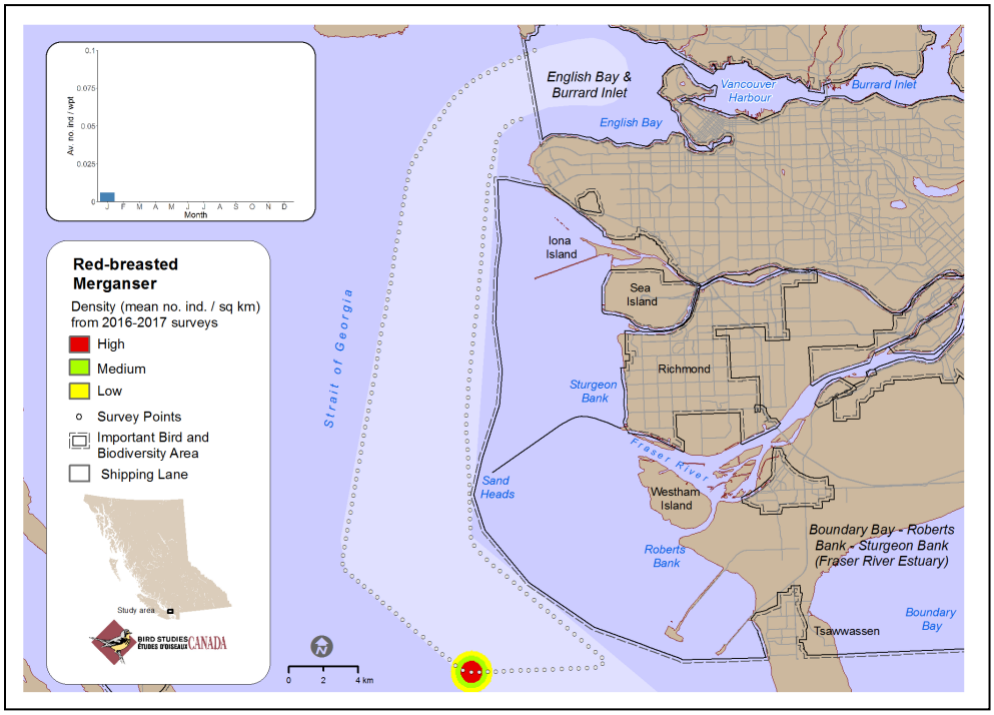


Fig. 9 Spatial distribution and seasonal abundance of Red-breasted Merganser in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Red-breasted Merganser is an abundant winter resident in the Salish Sea, especially in the Fraser River estuary where it dives for fish prey. There was no significant trend in abundance between 1999–2011 period in the Coastal Waterbird Survey (Crewe et al. (2012) or the Christmas Bird Count data from B.C. from the period 1959–1988 (Sauer et al. 1996).

**Survey**

Despite the abundance of this species on the Coastal Waterbird Survey of the Fraser River estuary shoreline, we saw Red-breasted Mergansers only once on our surveys, in January and out to sea.

**Conservation Issues and Recommendations**

No measures are proposed.

**Pacific Loon *Gavia pacifica***

Conservation Status — Conservation Data Centre: BC Yellow list

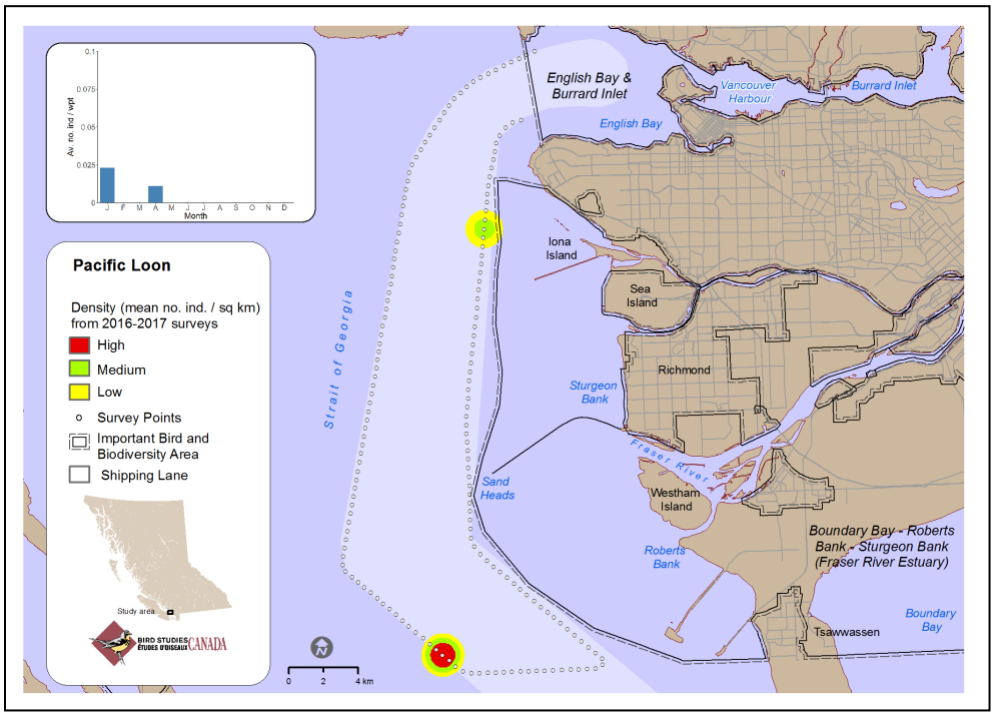


Fig. 10 Spatial distribution and seasonal abundance of Pacific Loon in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

Pacific Loons were once found in large numbers in Active Pass (Vermeer 1977) not far from the mouth of the Fraser River estuary, and still occur in large numbers in spring, around herring spawn sites on the south coast (Sullivan et al. 2002a).

The number of loons in winter in the Strait of Georgia declined by 6% from 1999-2011 (Crewe et al. 2012). Christmas Bird Count data shows declines in BC of 5% from 1959-1988 (Sauer et al. 1996) and 50% declines between 1975-1984 and 1998-2007 for the entire Salish Sea (Bower 2009). However, in nearby Padilla Bay, Washington, density increased from the 1970s to the 2000s, suggesting a shift in the distribution in the southern portion of the species range.

**Survey Records**

The Pacific Loon seldom ventured into the Fraser River estuary. We saw a few loons in January and April, out to sea.

**Conservation Issues and Recommendations**

No measures are proposed.

**Red-throated Loon *Gavia stellata***

Conservation Status — Conservation Data Centre: BC Yellow list

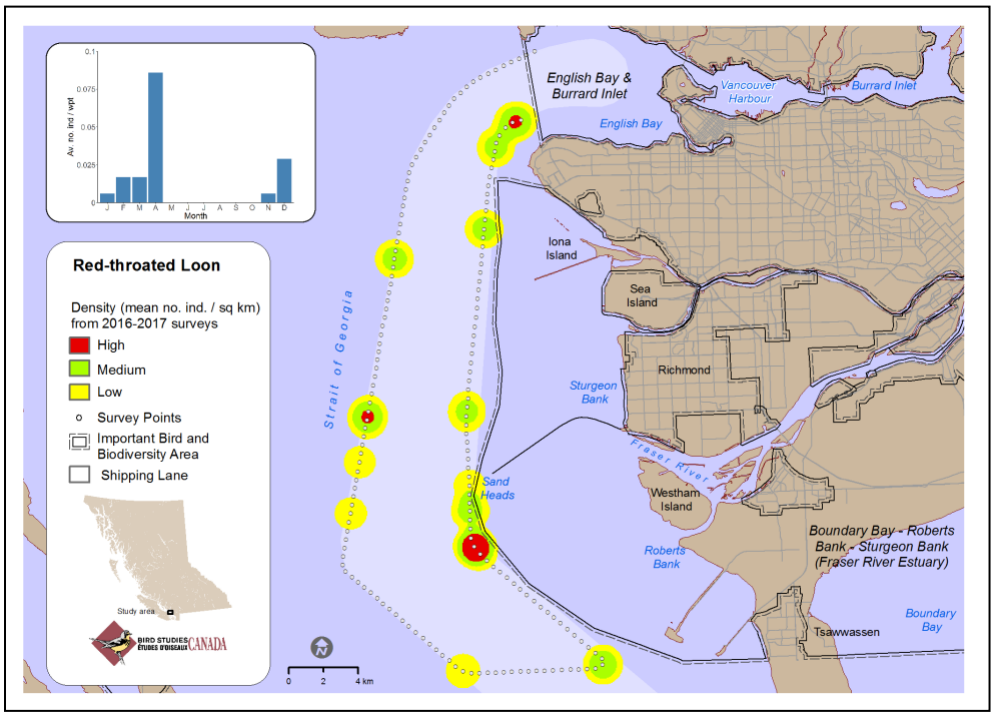


Fig. 11 Spatial distribution and seasonal abundance of Red-throated Loon in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Red-throated Loon nests on small freshwater lakes and ponds near the seashore where it feeds. The number of loons in a region is related to the number of lakes where they can nest but not the water chemistry or fish abundance on the lakes since most food is caught along the seashore (Campbell et al. 1990). Red-throated Loons winter in shallow, sheltered marine waters (Campbell et al. 1990) with strong freshwater influence such as the Fraser Delta, Boundary Bay, Mayne Island and the area between Comox and Campbell River (Crewe et al. 2012).

In Alaska, a steep 53% population decline was detected between 1977-1993 (Barr et al. 2000). A significant decline of 9.3% was reported by the BC Coastal Waterbird Survey between 1999-2011 (Crewe et al. 2012), 73.9% decline between 1978-80 and 2003-06 in Puget Sound (Bower 2009) including significant declines in Padilla Bay (Anderson et al. 2009). Red-throated Loons were widespread but in small numbers along both shipping lanes in the study area (Table 3). The decline of this species is troubling especially since the Fraser River estuary historically held large numbers that likely extended into English Bay. The reasons for the declines are not known and might be related to changes in availability of prey. Using the same survey method, one red-throated loon was detected in Howe Sound and one pulse of 182 birds in December 2012 in English Bay (Butler et al. 2015, 2018).

**Survey Records**
Widespread in small numbers with a peak in December and April characterize this species seasonal abundance in the Fraser River estuary.

**Conservation Issues and Recommendations**
Wintering Red-throated Loons are susceptible to oil spills and being caught in fishing gear (Barr et al. 2000). Large historical numbers might have been related to the spring spawning of eulachons *Thaleichthys pacificus*, in the lower reaches of the Fraser River estuary until the mid-1990s. No measures are proposed.

**Western Grebe *Aechmophorus occidentalis***

Conservation Status — COSEWIC (2014): Special Concern; Conservation Data Centre: BC Red list

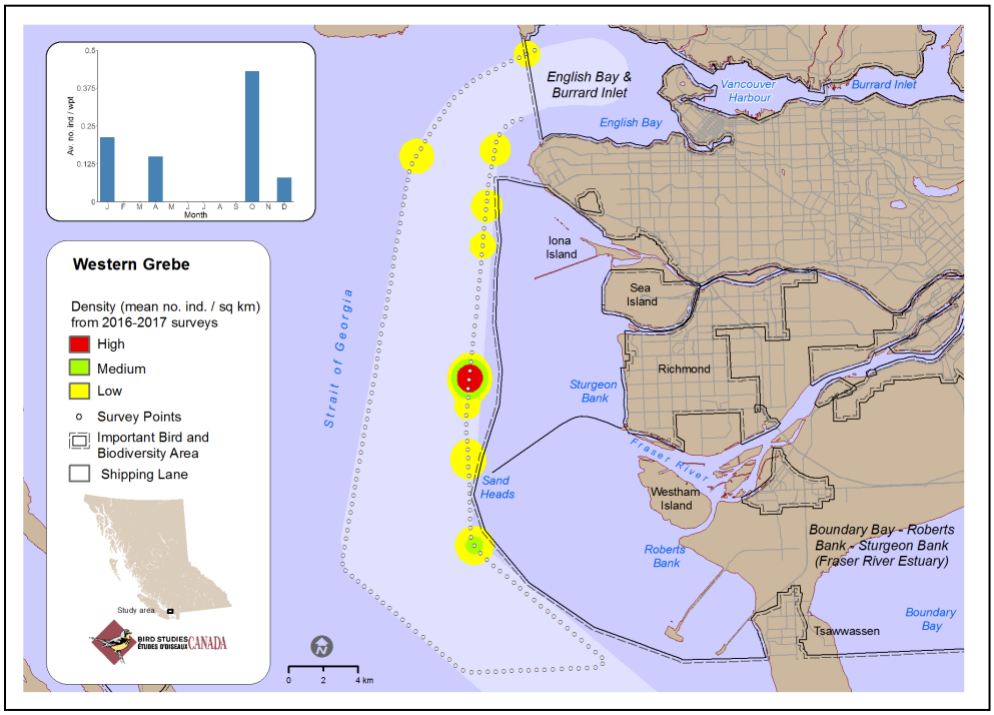


Fig. 12 Spatial distribution and seasonal abundance of Western Grebe in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Western Grebe breeds in western North America and spends the winter along the Pacific Coast (Howie 2015b). The species underwent one of the largest and sharpest declines of waterbirds on Salish Sea surveys in recent years (Crewe et al. 2012).

In 1970s, thousands of Western Grebes were present in English Bay and hundreds were still present in the 1990s (summarized by Butler and others 2015). The number of Western Grebes in the Salish Sea declined by 95% in recent decades while increasing by 300% in California (Wilson et al. 2013). These authors posit that the shift in abundance of Western Grebes reflected a distributional shift in their small forage fish prey. Surveys using the same methods in Burrard Inlet, Indian Arm and Howe Sound showed consistent, small numbers in winter and spring (Butler et al. 2015, 2018). However, 6200 were observed on 15 December 2017 near Comox (A. Martell, pers. comm.) suggesting that the grebes are either recovering or shifted their distribution in the Salish Sea.

**Survey Records**

This species uses the estuary regularly, mostly along the drop off and less so in deeper water.

**Conservation Issues and Recommendations**

Ensuring an abundant supply of small fish, in particular Pacific herring would assist in the return of Western Grebes.

**Fork-tailed Storm-petrel *Oceanodroma furcata***

Conservation Status — Conservation Data Centre: BC Yellow list

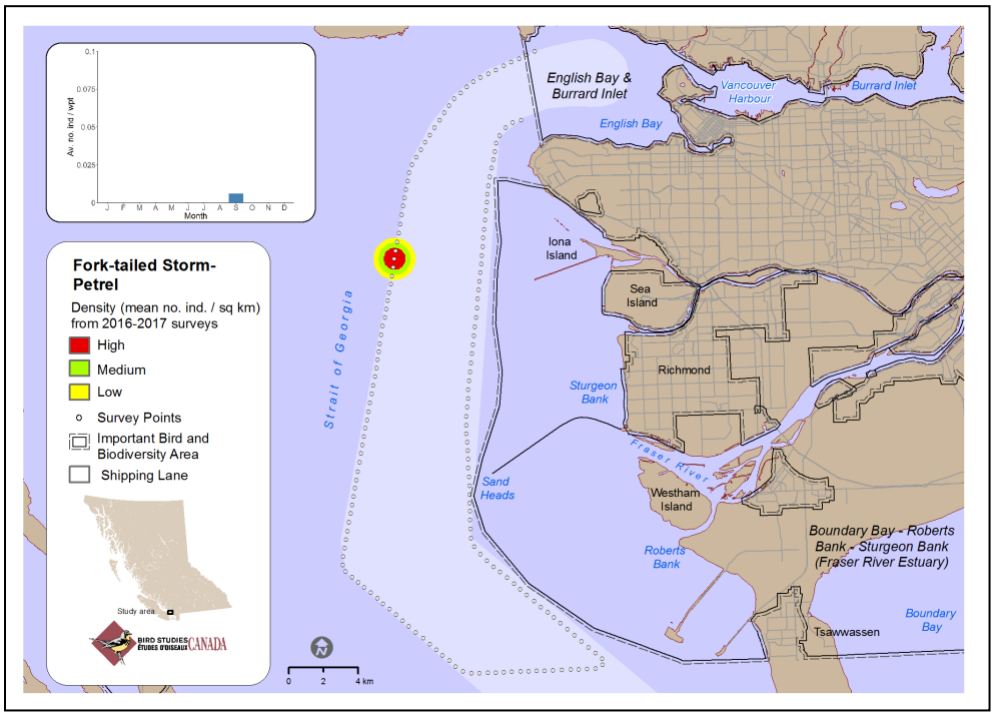


Fig. 13 Spatial distribution and seasonal abundance of Fork-tailed Storm-petrel in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Fork-tailed Storm-petrel is a pelagic seabird that occurs primarily in offshore areas of the Pacific where it forages over cold waters. The species is considered of *casual* occurrence in the greater Vancouver Checklist area (2-20+ records; on average not seen every year; somewhat out of normal range; Nature Vancouver 2013). Occasionally it is seen closer to land, such as the one recorded in this survey. The storm-petrel breeds on offshore islands of the outer BC coast and winters throughout the northern Pacific Ocean (Hipfner 2015a).

**Survey records**

A single bird was seen on 29 September 2017 off Point Grey.

**Conservation Issues and Recommendations**

No measures proposed.

**Brandt's Cormorant *Phalacrocorax penicillatus***

Conservation Status — Conservation Data Centre: BC Red list

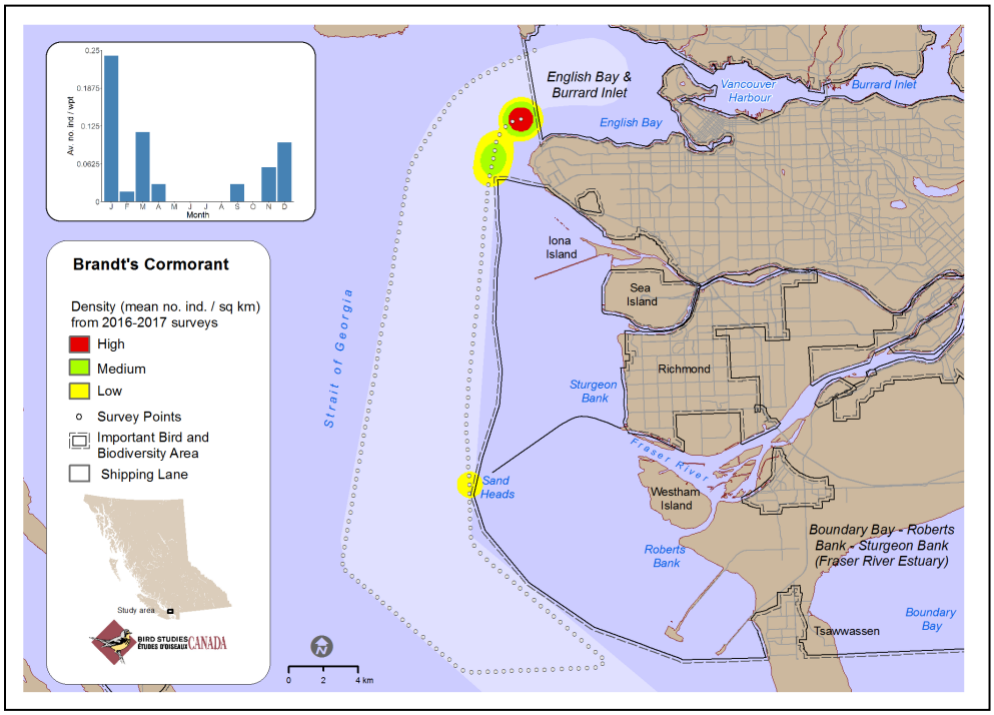


Fig. 14 Spatial distribution and seasonal abundance of Brandt's Cormorant in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

Brandt's Cormorant is an endemic western North America species that frequents the marine water realm (Hipfner 2015b). Large numbers have been reported in the Salish Sea such as from Baynes Sound, the Sunshine coast, Victoria and the east coast of Vancouver Island (Crewe et al. 2012) but few bred in the province (Hipfner 2015b).

Brandt's Cormorant numbers have fluctuated over the years but with no significant trend detected in the BC Coastal Waterbird Survey (Crewe et al. 2012). Campbell et al. (1972a) considered the species to be 'rare' in the Vancouver area. Surveys using the same methods in Burrard Inlet, Indian Arm and Howe Sound found steady low numbers in fall, winter and spring mostly off Point Atkinson and at the entrance to Burrard Inlet (Butler and others 2015, 2018).

**Survey Records**

Brandt's Cormorants were present from September to April and mostly off Point Grey.

**Conservation Issues and Recommendations**

No measures are proposed.

**Double-crested Cormorant *Phalacrocorax auritus auritus***

Conservation Status COSEWIC (1978): Not at risk; Conservation Data Centre: BC Blue list

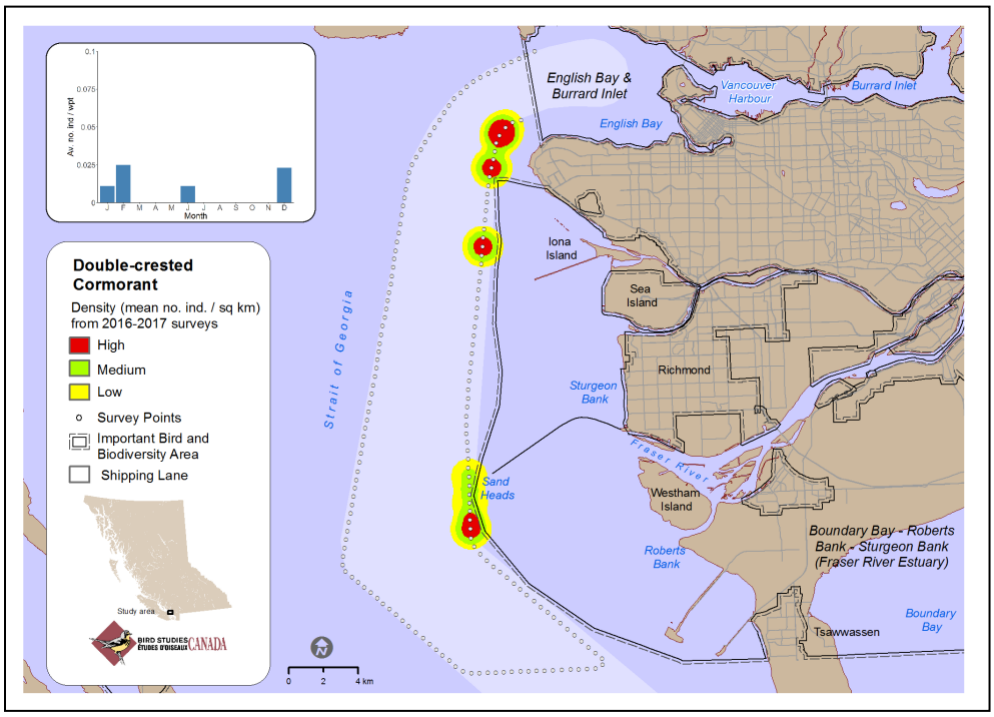


Fig. 15 Spatial distribution and seasonal abundance of Double-crested Cormorant in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Double-crested Cormorant is a year-round resident of the Salish Sea and one of its iconic species. It is often seen diving for fish prey along many beaches or drying its wings on pilings. It breeds on local islands and on human-made structures such as bridges and pilings. The number of nesting cormorants at breeding colonies has fluctuated over the years in the region suggesting the region-wide distribution is dynamic, perhaps in response to local food resources (Butler 2015).

Distribution shifts appear to be a hallmark of this species in the Salish Sea. Chatwin et al. (2002) reported colony counts indicating large declines but the number of wintering double-crested cormorants did not change significantly in the Salish Sea (Crewe et al. 2012). The nearest nesting colonies of cormorants were beneath the Burrard and Granville Street bridges, in Howe Sound and on Mandarte Island. Historically, cormorants nested on river 'dolphins' (pilings) near Sand Heads light station (Moul and Gebauer 2002).

Their food in the Fraser River estuary included Pacific Herring (*Clupea harengus*), Pacific Salmon (*Oncorhynchus* spp.), Threespine Stickleback (*Gasterosteus aculeatus*), Shiner Perch, Pacific Snake Prickleback (*Lumpenus saggitta*), gunnel, Pacific Sandlance (*Ammodytes hexapterus*),

rockfish (*Sebastes* spp.), Pacific Staghorn Sculpin (*Leptocottus armatus*) and Starry Flounder (*Platichthys stellatus*)(Sullivan 1998).

**Survey Records**
Double-crested Cormorants are frequently seen in the Fraser River but our observations suggest only periodic use of the deep water of the Fraser River estuary.

**Conservation Issues and Recommendations**
No measures are proposed.

**Pelagic Cormorant *Phalacrocorax pelagicus***

Conservation Status — Conservation Data Centre: BC Yellow list

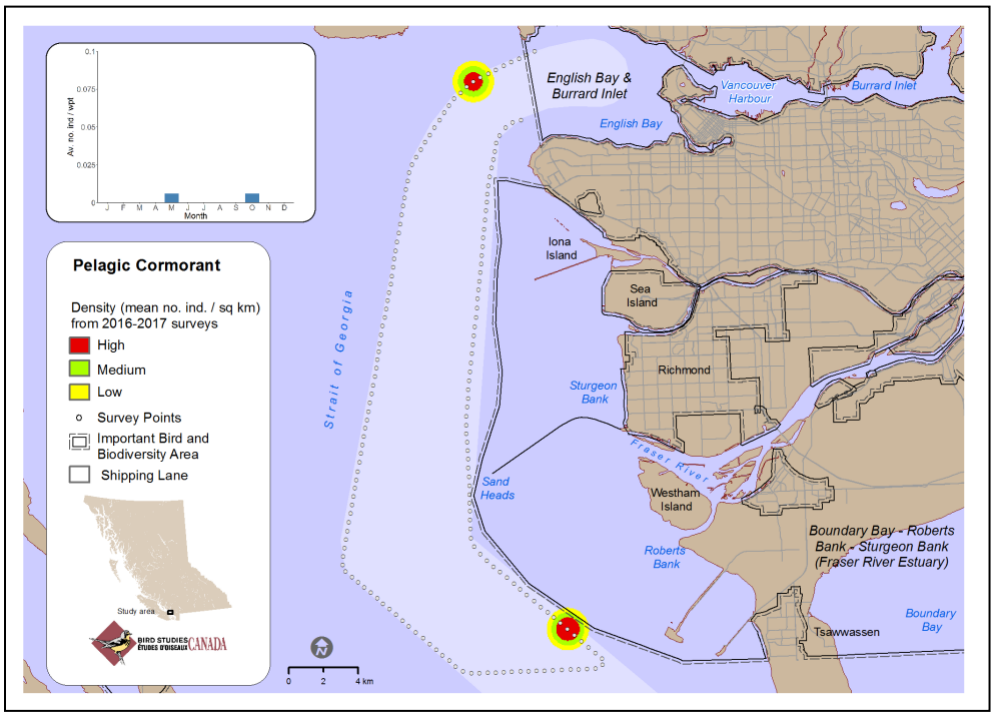


Fig. 16 Spatial distribution and seasonal abundance of Pelagic Cormorant in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Pelagic Cormorant is a resident species on the British Columbia coast where it forages for fish mostly over rocky substrates (Campbell et al. 1990). Nearest nesting locations to the Fraser River Estuary for Pelagic Cormorants were Christie Islet in Howe Sound, and beneath the Burrard Street, Granville Street and Iron Workers Memorial bridges in Vancouver, and on Mandarte Island in the Gulf Islands. More than 200 pairs were reported to nest under the Granville Street Bridge making this colony among the largest in the province (Hipfner et al. 2015c).

Chatwin et al. (2002) reported widespread declines of this species at nesting sites in the Salish Sea although the BC Coastal Waterbird Survey showed no significant change in winter populations (Crewe et al. 2012), and Bower (2009) reported a large increase for Puget Sound. Analysis of Christmas Bird Count from British Columbia revealed no significant change (Sauer et al. 1996). The apparent conflicting results between surveys are difficult to reconcile but possibly reflect the different time scales of surveys or difficulty locating colonies and tallying nesting pairs. Pelagic Cormorants were seen in steady numbers year-round throughout Howe Sound, Burrard Inlet and Indian Arm (Butler et al. 2015, 2018).

**Survey Records**
The Fraser River Estuary sand and mud habitat is not the preferred foraging habitat for this species which is reflected by the two sightings on our survey (Table 2).

**Conservation Issues and Recommendations**
The Pelagic Cormorant is an abundant, widespread, and year-round species of rocky shorelines in the Salish sea and largely absent from the Fraser River Estuary. No actions are recommended.

**Bald Eagle *Haliaeetus leucocephalus***

Conservation Status COSEWIC (1984): Not at risk; Conservation Data Centre: BC Yellow list

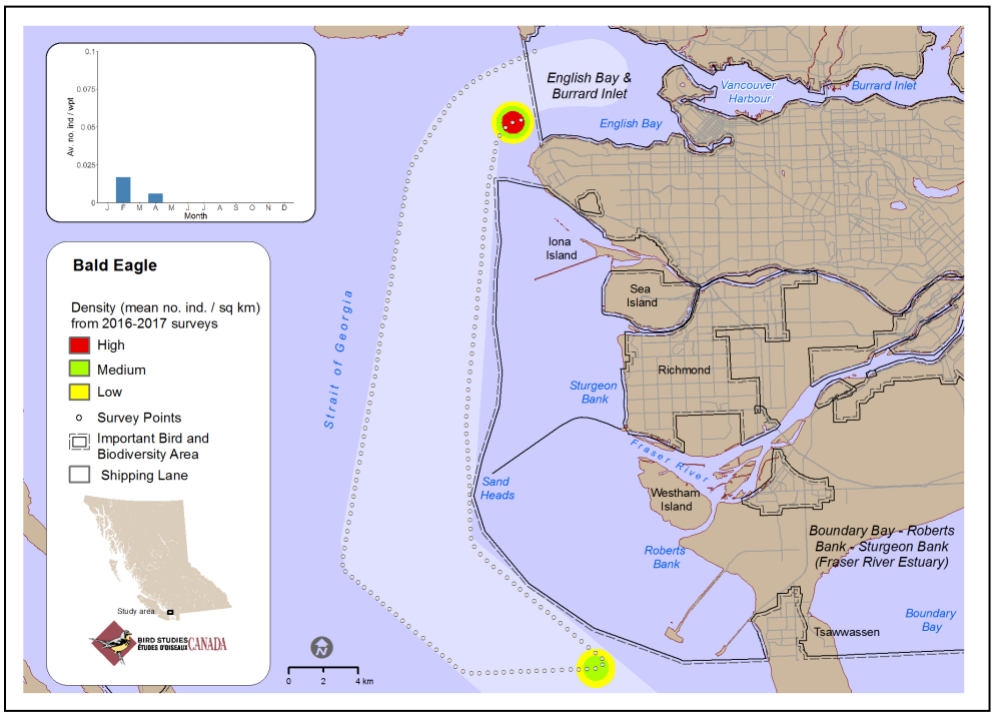


Fig. 17 Spatial distribution and seasonal abundance of Bald Eagle in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Bald Eagle is an abundant resident in the Salish Sea where it scavenges and depredates birds, fish and mammals. Nesting success of urban Bald Eagles in Vancouver is among the highest reported for North America, likely the result of abundant prey through the year (Goulet 2009) and the availability of nest sites. Eagles are important bird predators in the Fraser River Estuary ecosystem and their recovery over the past few decades has had an effect on the distribution and abundance of seabirds and seaducks (Middleton et al. 2018). Bald Eagles were present year-round in Howe Sound, Burrard Inlet and Indian Arm (Butler et al. 2015, 2018).

**Survey Records**

We detected eagles in flight over the estuary on a few occasions but with no platform, the eagles were confined to making brief forays far from shore.

**Conservation Issues and Recommendations**

No actions are proposed.

**Dunlin *Calidris alpina***

Conservation Status — Conservation Data Centre: BC Yellow list

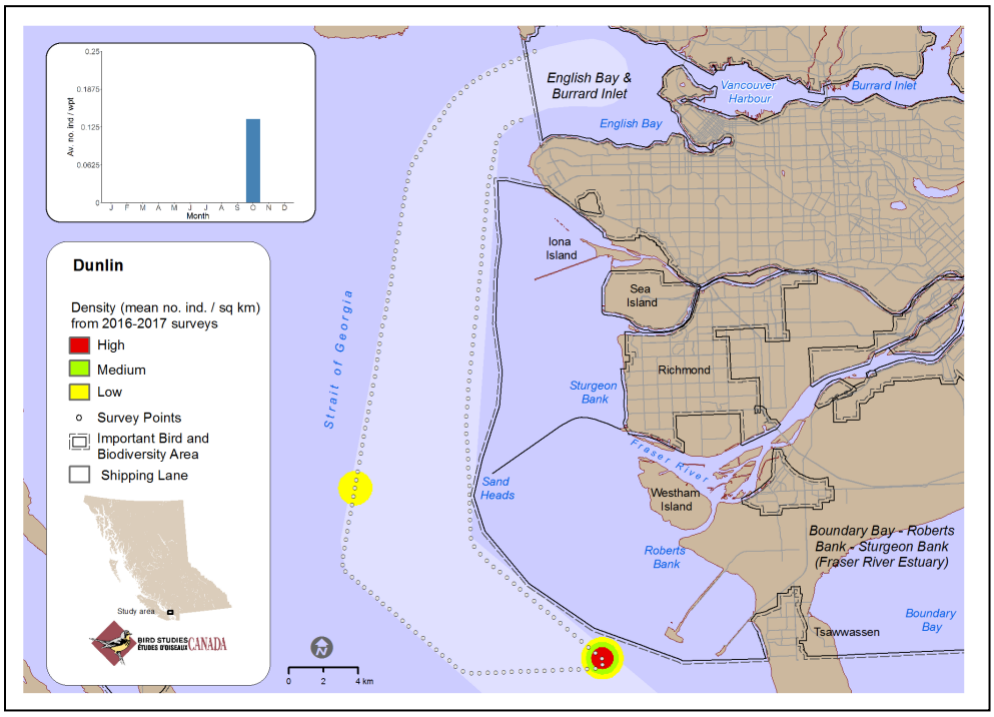


Fig. 18 Spatial distribution and seasonal abundance of Dunlin in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Fraser estuary supports large numbers of Dunlin during spring and fall migration and serves as an important wintering area. Peak numbers occur in April during spring migration and again from November to February during overwintering.

Since 1991, Canadian Wildlife Service has been monitoring Dunlin spring stopover numbers at Brunswick Point. Peak counts of Dunlin typically range from 30-75,000 birds at the end of April. Population estimates for Dunlin passing through the Fraser estuary stand at 145-320,000 per year. The overall trend from 1991-2017 is stable. Throughout the Strait of Georgia, Dunlin declined by 8.9% per year (Crewe et al. 2012) but there is wide variation in the survey data.

**Survey records**

There was no habitat for this species along our survey route and so our only observations were birds in passage.

**Conservation Issues and Recommendations**

The Fraser River delta is a critical stopover site and an important overwintering site for globally important numbers of this species. Canada has a global responsibility to ensure Dunlin habitat in the Fraser estuary is intact and can support the current population. The Fraser estuary is

unique in the Pacific coast of Canada because of its size, its diversity of quality habitats and the adjacency of these habitats. Loss of the ecological integrity of the Fraser estuary would have devastating and far-reaching impacts to not only Dunlin but several shorebird species that rely on it as a stopover site. Because of its importance for shorebirds of the Pacific Flyway, the Fraser estuary is designated as both a Western Hemisphere Shorebird Reserve Network site (at the Hemispheric level) and an Important Bird Area.

Ensuring safety in the transport of dangerous goods along the Fraser River Estuary must be a priority to safeguard an impact on birds that potentially could be felt along the Pacific Coast of the Americas.

**Bonaparte's Gull *Chroicocephalus philadelphia***

Conservation Status — Conservation Data Centre: BC Yellow list

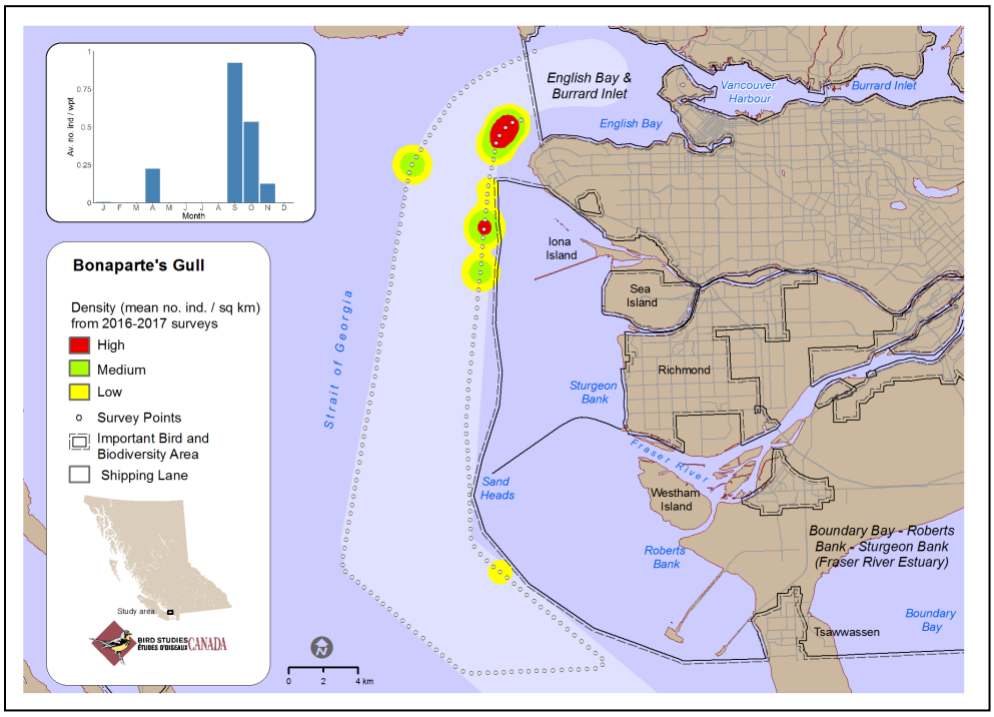


Fig. 19 Spatial distribution and seasonal abundance of Bonaparte's Gull in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Bonaparte Gull migrates through the Salish Sea, including the Fraser River estuary, gathering in large squealing flocks where there is plankton and small fish that they snatch from the water surface (Siddle 2015).

Bonaparte's Gulls are a passage migrant in the south coast of BC typically moving through in quick pulses in spring and late summer. In the Strait of Georgia they congregate in the thousands around upwelling sites and areas with swift tidal currents such as Active Pass and Porlier Pass (Butler et al. 2015).

The number of Bonaparte Gulls in the Strait of Georgia declined 13% per year from 1999-2011 (Crewe et al. 2011). Christmas Bird Count data for the Salish Sea also show long term declines as do monitoring programs in Puget Sound (Bower 2009) and Padilla Bay (Anderson et al. 2009).

**Survey records**

The Bonaparte Gull was the fourth most numerous species on our survey (Table 3). We saw them in April and from September to November.

**Conservation Issues and Recommendations**

Current monitoring programs fail to adequately capture trends for Bonaparte's Gull due to their rapid pulse of movement in spring through the south coast in habitats away from coastal survey locations (Crewe et al. 2012).

**Mew Gull *Larus canus***

Conservation Status — Conservation Data Centre: BC Yellow list

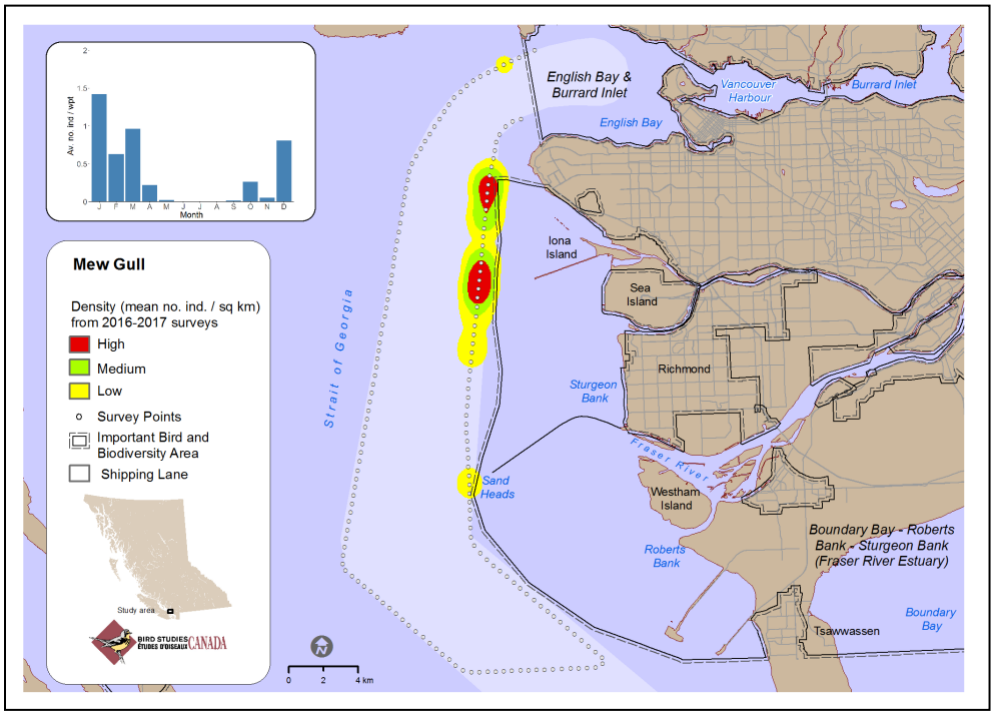


Fig. 20 Spatial distribution and seasonal abundance of Mew Gull in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Mew Gull was the most numerous species on our surveys accounting for about 22% of all birds seen (Table 3). Mew Gulls frequent nearshore coastal waters, estuaries, beaches, harbours and agricultural fields (Campbell et al. 1990). Large concentrations occur in the Salish Sea in March in response to herring spawning events (Crewe et al. 2012). The peak abundance in the Fraser River Estuary was in January.

The BC Coastal Waterbird Survey reported no significant trend from 1999-2011 (Crewe et al. 2012). The Christmas Bird Count in British Columbia from 1959-1988 showed a 3% annual decline (Sauer et al. 1996) whereas a stable pattern was reported throughout the Salish Sea between 1975-84 and 1998-2007 (Bower 2009). Monitoring in Washington State from 1978-80 and 2003-05 showed a 25% decline (Anderson et al. 2009) yet numbers in Padilla Bay, Washington were stable during the same period (Anderson et al. 2009). Mew Gulls were widespread and abundant in Howe Sound, Burrard Inlet and Indian Arm from fall to spring (Butler et al. 2015, 2018).

**Survey Records**

Mew Gulls were concentrated in the northern end of the Fraser River Estuary notably off the North Arm.

**Conservation Issues and Recommendations**

No measures are proposed.

**California Gull *Larus californicus***

Conservation Status — Conservation Data Centre: BC Blue list

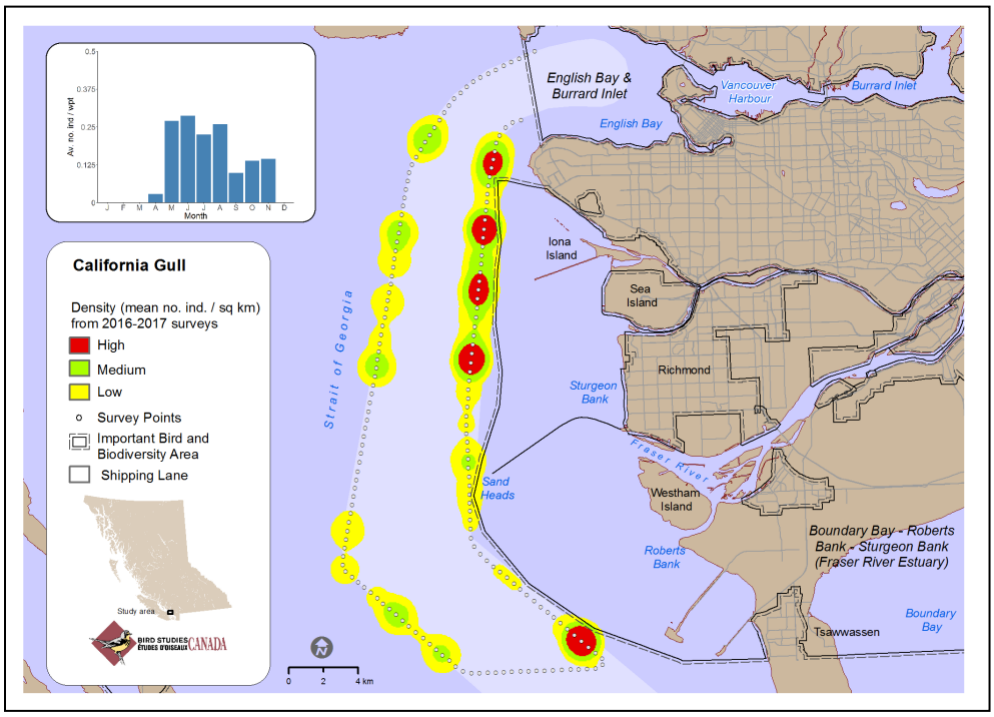


Fig. 21 Spatial distribution and seasonal abundance of California Gull in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

California Gulls use a wide variety of marine habitats from open ocean at the continental shelf to coastal estuaries, river deltas, beaches, mudflats and rocky coastlines (Winkler 1996). They winter in large numbers along the west coast of North America and migrate along the BC coast (Campbell et al. 1990). The California Gull is present year-round in the Vancouver region although it does not breed there (Nature Vancouver 2013).

In British Columbia, neither the Christmas Bird Count data (Sauer et al. 1996) nor the more recent BC Coastal Waterbird Survey dataset over the period 1999-2011 (Crewe et al. 2012) showed any trend. Similarly, the numbers of California Gulls in Puget Sound, Washington remained stable over the same period (Anderson et al. 2009).

**Survey Records**

The California Gull was our sixth most numerous species in the Fraser River Estuary. The species was present from April to November when it was widespread in the study area. Highest concentrations were along the eastern edge of the survey near the drop off of the delta.

**Conservation Issues and Recommendations**

The California Gull is Blue-listed in BC because the small breeding population is susceptible to

human disturbance and random environmental fluctuations (BC Conservation Data Centre 2015). It is listed as a regional stewardship species in the Bird Conservation Region Strategy for Region 5 (Environment Canada 2013). Potential threats to the wintering population include entanglement in gill nets and longlines, ingestion or entanglement in plastic waste in both marine and terrestrial environments and chronic and catastrophic oil spills (Environment Canada 2013).

**Identification of Large Gulls**

Distinguishing between similar looking large gulls from a moving boat was problematic. Pure forms of Herring Gull, Iceland (Thayer's) Gull, Glaucous-winged Gulls are similar in size and mantle colour. Wing tip colouration of pure Glaucous-winged Gulls is pale grey and similar to the mantle colour. However, Glaucous-winged Gulls hybridize with Herring and Western Gulls giving rise to darkish wing tipped individuals (Sibley 2014). The most numerous large gulls by far were Glaucous-winged Gulls with pale grey wing tips. Large gulls with blackish wing tips were also assumed to be Glaucous-winged Gulls and large gulls with distinctive black wing tips were assumed to be Herring Gulls. Iceland Gulls also had black wing tips but the underwing was paler than both Herring and Glaucous-winged Gull.

**Herring Gull *Larus argentatus***

Conservation Status — Conservation Data Centre: BC Yellow list

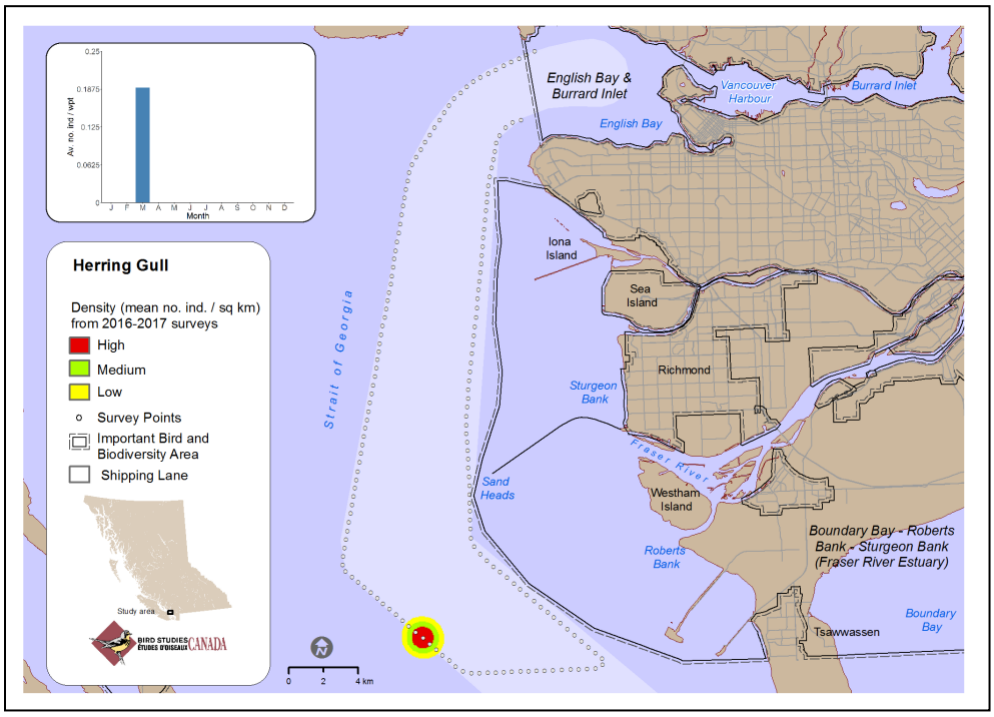


Fig. 21 Spatial distribution and seasonal abundance of Herring Gull in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

This wide-ranging gull is a habitat generalist, found throughout coastal areas near abundant sources of food such as fishing vessels, wharves and garbage dumps. Some Herring Gulls winter along the BC coast including in the Fraser estuary.

**Survey records**

We identified Herring Gulls only in March when 33 birds were noted (Table 3).

**Conservation Issues and Recommendations**

No conservation issues are proposed.

**Iceland (Thayer's) Gull *Larus islandica thayeri***

Conservation Status — Conservation Data Centre: BC Yellow list

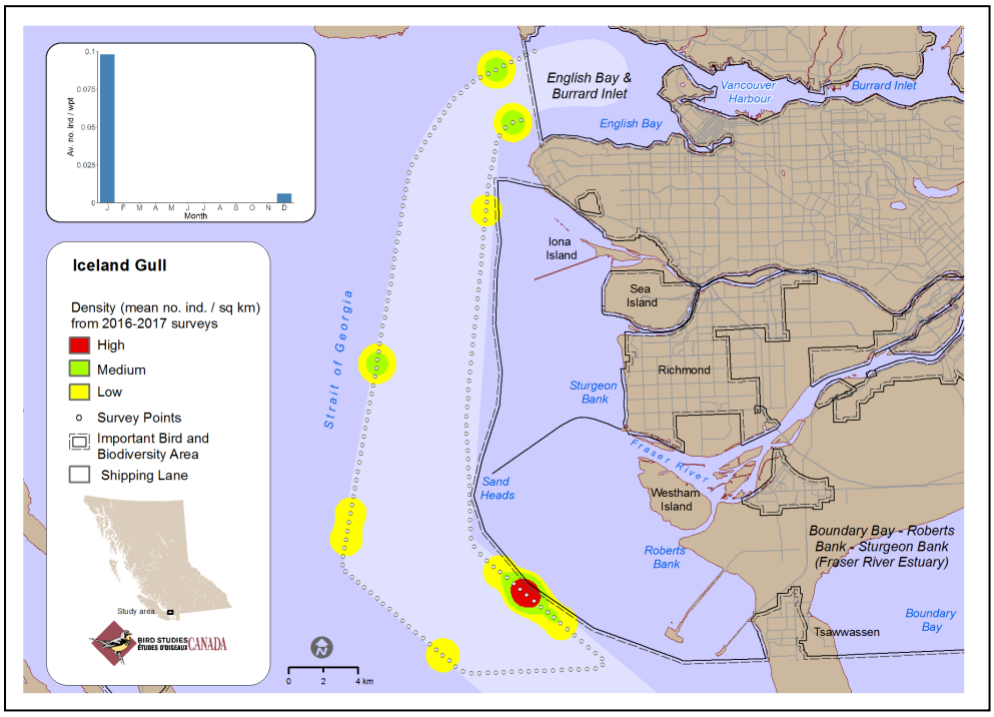


Fig. 22 Spatial distribution and seasonal abundance of Thayer's Gull in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

Iceland Gulls (formerly Thayer's Gull) spend the winter along the north Pacific Coast in protected bays and estuaries. The species frequents the Salish Sea especially along the eastern shore of Vancouver Island from September to April (Nature Vancouver 2013). The BC Coastal Waterbird Survey reported that Thayer's Gulls declined at 4.1% per year from 1999-2011 (Crewe et al. 2012).

**Survey Records**

Small numbers of this species were widespread in the estuary in December and January (Table 3).

**Conservation Issues and Recommendations**

This species breeds and winters in large numbers within in Canada. Establishing a better estimate of the number and distribution of this species would assist in determining the relative importance of the Fraser River to other locations in the Salish Sea.

**Glaucous-winged Gull *Larus glaucescens***

Conservation Status Conservation Data Centre: BC Yellow list

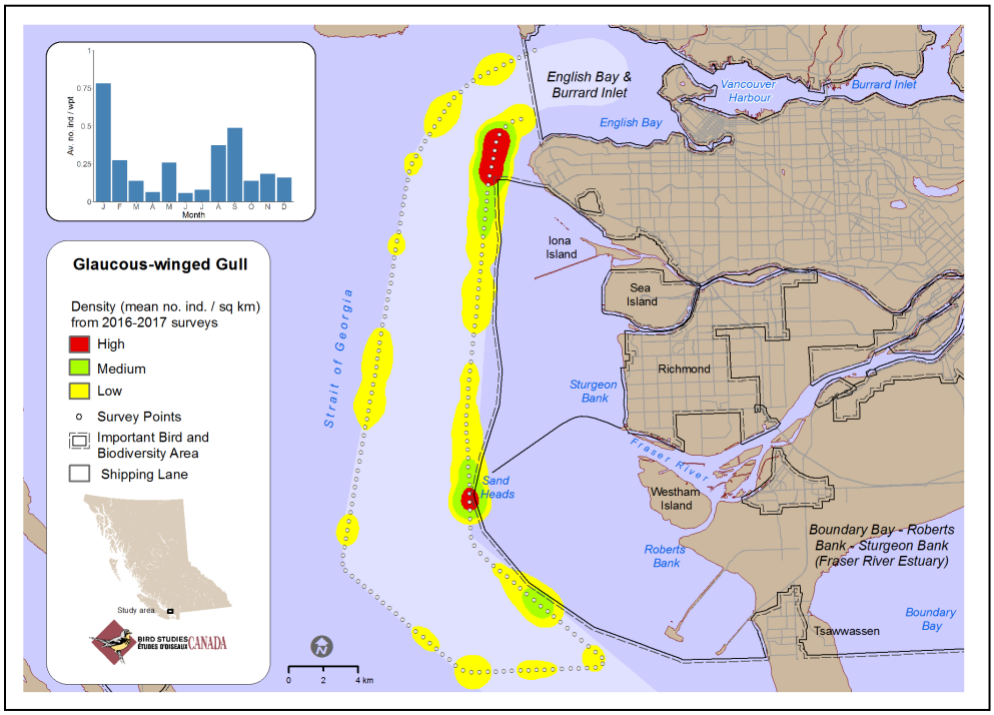


Fig. 23 Spatial distribution and seasonal abundance of Glaucous-winged Gull in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Glaucous-winged Gull is a year-round resident in the Salish Sea. The gull forages in the intertidal zone, estuaries and landfills, and nests on uninhabited, mostly barren islands, rooftops and undersides of urban bridges (Vermeer et al. 1994). Large concentrations are routinely found around cities, following fish, crab and prawn fishing vessels, roosting on beaches and at herring spawning sites.

In the Salish Sea, the number of Glaucous-winged Gulls increased from 1900 to 1973 and began declined thereafter (Blight 2012). Christmas Bird Counts and breeding surveys show declines continued through the 1990s possibly linked to increasing disturbance and predation by rising numbers of Bald Eagles (Environment Canada 2011). Glaucous-winged Gulls showed a significant declining trend of 4.3% in the BC Coastal Waterbird Survey dataset from 1999- 2011 (Crewe et al. 2012). Significant declines of up to 37% were reported from Christmas Bird Count data from the Salish Sea and Puget Sound, Washington, between 1975-84 and 1998- 2007, Puget Sound Monitoring Assessment Program 1978-80 and 2003-05 (Bower 2009) and in Padilla Bay, Washington between 1978-79 and 2003-06 (Anderson et al. 2009). The number of nesting pairs in colonies in the Strait of Georgia shrunk in size by up to 31% from 1986 to 1997-1999

(Vermeer and Devito 1989, Sullivan et al. 2002b) and, by 2010, the Georgia Basin population estimate stood at approximately 5600 pairs (Blight 2012).

The nearby nesting colony in Howe Sound at Christie Islet, Pam Rocks and Passage Island rose from the early records in the 1940s to about the 1980s and then declined. Demographic changes during the nesting season as well as increased predation with rising Bald Eagle numbers can partially explain the decline (Blight 2012). Using similar survey methods as ours, Butler et al. (2018) found that Glaucous-winged Gulls were present year-round in high abundance and widely distributed throughout Burrard Inlet, Indian Arm and Howe Sound.

**Survey Records**

The Glaucous-winged Gull was the third most numerous bird on our survey after the Mew Gull and Common Murre (Table 3). The species was widespread and numerous through the year with a peak in winter and during post-breeding dispersal in August and September.

**Conservation Issues and Recommendations**

Declines in the Strait of Georgia may be attributed to increasing disturbance and predation at breeding colonies as numbers of Bald Eagles rise (Sullivan et al. 2002b) and declines in marine prey availability (Blight 2011). Threats to Glaucous-winged Gulls include entanglement in longlines, ingestion of marine plastic waste, mortality due to PCB exposure and chronic and catastrophic oil spills (Environment Canada 2013). It is a regional stewardship species in the Bird Conservation Region 5 strategy (Environment Canada 2013).

**Caspian Tern *Hydroprogne caspia***

Conservation Status — Conservation Data Centre: BC Blue list

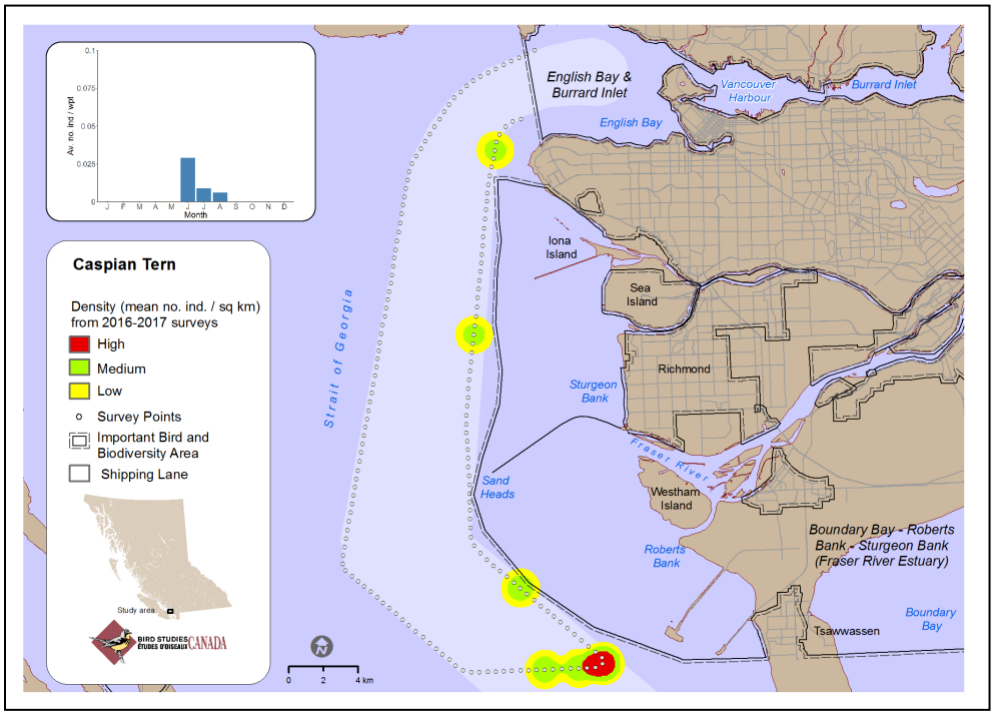


Fig. 24 Spatial distribution and seasonal abundance of Caspian Tern in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Caspian Tern has been present in British Columbia for many decades mostly on the South Coast, and more recently in the interior (Campbell et al. 1990). The first confirmed nesting was in 1984 at Roberts Bank where a pair raised at least one young (Campbell et al. 1990). The first nesting colony in British Columbia was on a roof of a building in the Fraser River delta where several hundred individuals and up to nine eggs were observed (Boyd 2015). Caspian Terns typically nest in open, sparsely vegetated areas adjacent to water often with sand and gravel substrates.

**Survey Records**

We observed 7 Caspian Terns in June, July and August, all along the eastern shipping lane near the drop off of the delta.

**Conservation Issues and Recommendations**

The observation of the first breeding colony of Caspian Terns on the Fraser River delta (Boyd 2015) is an addition to the list of breeding birds in British Columbia. For this species to become a regular breeder, suitable nesting and foraging locations will be required. An assessment of where the species forages would assist in recommendations for its conservation. Although we only saw a few terns, the shallow water of the mouth of the Fraser River Estuary is the most likely foraging location.

**Parasitic Jaeger *Stercorarius parasiticus***

Conservation Status — Conservation Data Centre: BC Red list

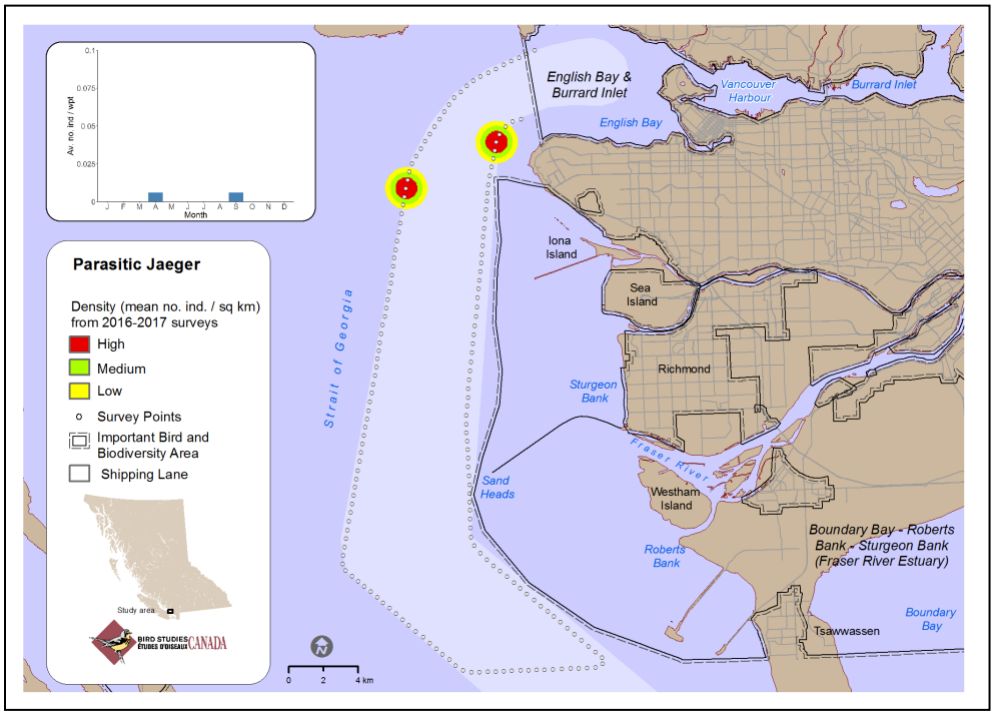


Fig. 25 Spatial distribution and seasonal abundance of Parasitic Jaeger in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Parasitic Jaeger is a passage migrant in the Salish Sea that is rarely seen in spring, and uncommonly seen in September and October (Nature Vancouver 2013).

**Survey Records**

Our only records were of a lone Parasitic Jaeger in April and September (Table 3).

**Conservation Issues and Recommendations**

No actions are proposed.

**Pomarine Jaeger *Stercorarius pomarinus***

The Pomarine Jaeger is considered *accidental* in the Vancouver Checklist area (single record; usually far outside normal range; 1-4 days stay; Nature Vancouver 2013).

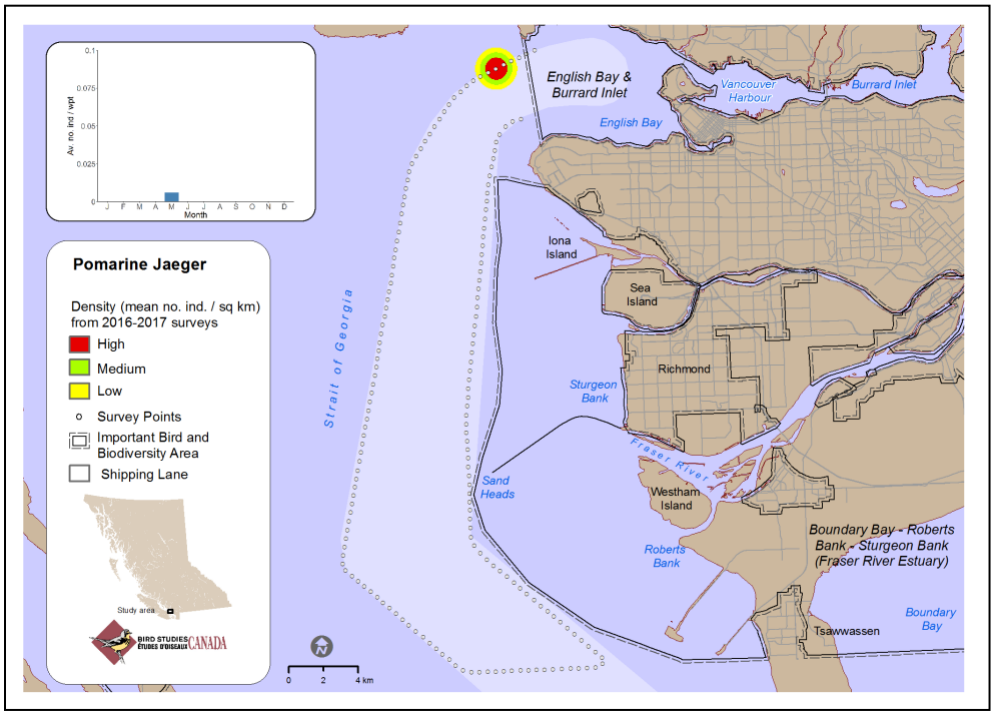


Fig. 26 Spatial distribution and seasonal abundance of Pomarine Jaeger in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

There are only five records of this species in eBird between August and October 1971-2015 in the open waters of southern Strait of Georgia.

**Survey Records**

One Pomarine Jaeger was seen at close range on the water and flying in the entrance to Vancouver Harbour on 24 May 2017. A dark breast band, yellowish nape, brown mantle and wings, and distinctive rounded rectrices were clearly visible to three observers. This is the first record of this species in English Bay. A single Pomarine Jaeger was seen by an anonymous birder the following day off Bowen Island.

**Conservation Recommendations**

No actions are proposed.

**Common Murre *Uria aalge***

Conservation Status Conservation Data Centre: BC Red list

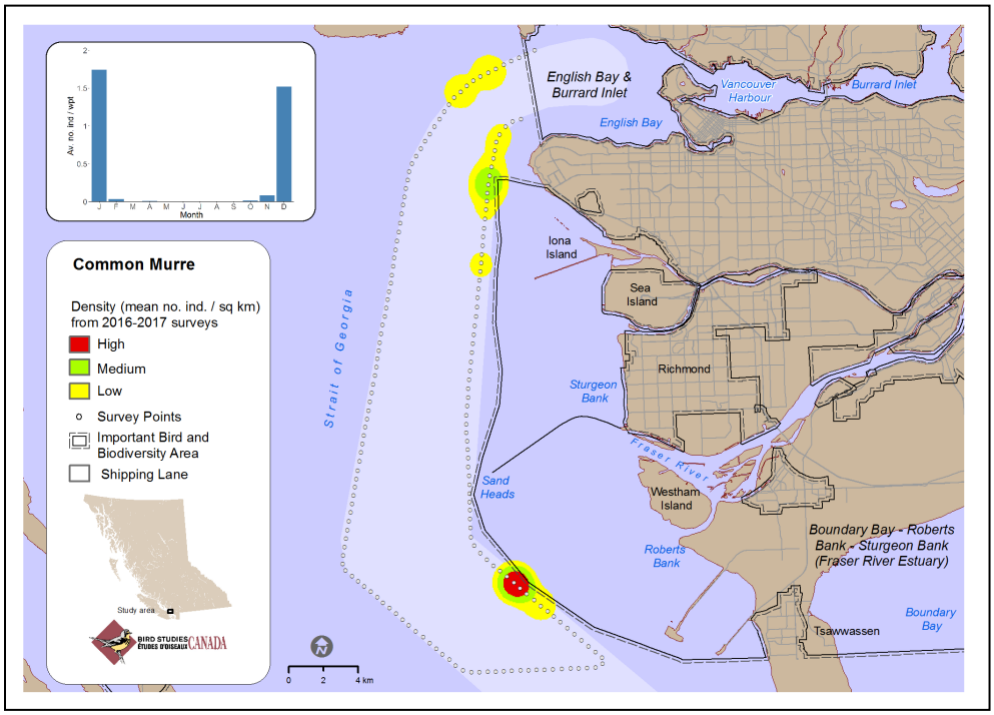


Fig. 27 Spatial distribution and seasonal abundance of Common Murre in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

Large numbers of Common Murre nest along the Pacific Coast outside the Salish Sea. Many of them enter the Strait of Georgia in summer to moult (Thompson et al. 1998). In spring, large numbers congregate around herring spawn sites and move farther offshore over the continental shelf break to overwinter (Morgan et al. 1991, Hipfner 2015a).

Between 1989- 2003 the largest breeding colony in BC at Triangle Island declined by 27% (Hipfner 2005). Common Murres showed no significant trend in BC Coastal Waterbird Survey dataset from 1999-2011, but detection ability may be limited by a chiefly offshore distribution relative to survey locations (Crewe et al. 2012). Steep declines of 83-92% were reported from Christmas Bird Counts in the Salish Sea between 1975-84 and 1998-2007, and in the Puget Sound Ambient Monitoring Program in Washington between 1978-80 and 2003-2005 (Bower 2009). Common Murres are Red listed in British Columbia due to high risk of mortality to oil spills and high susceptibility to fisheries bycatch (BC Conservation Data Centre). Surveys using the same methods detected small numbers of Common Murre, mostly in the western entrance to English Bay and the waters surrounding Bowen Island. (Butler and others 2015, 2018).

**Survey Records**

The Common Murre was the second most numerous bird we encountered next to Mew Gull

(Table 3). We tallied 592 Murres from October to April with a peak in January, mostly near the mouth of the North and South Arms.

**Conservation Issues and Recommendations**

Common Murres are vulnerable to several human-induced mortality factors including oil spills (Burger 1993, Hamel et al. 2009). Therefore, heightened prevention and rapid cleanup response to chronic and catastrophic oil spills in the Fraser estuary is a priority for the persistence of this species.

**Ancient Murrelet *Synthliboramphus antiquus***

Conservation Status — Conservation Data Centre: BC Blue list

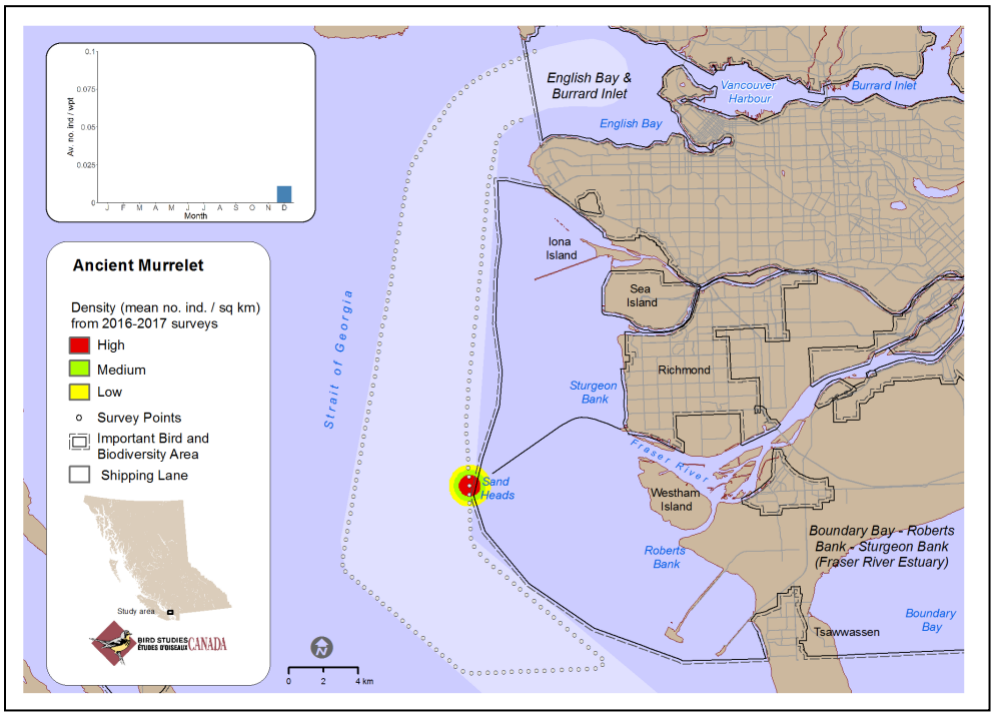


Fig. 28 Spatial distribution and seasonal abundance of Ancient Murrelet in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Ancient Murrelet breeds on offshore islands in northern BC and disperses around the north Pacific in winter, including the south coast of BC (Gaston 1992). It is not well known the size and distribution of the Canadian non-breeding population.

The scant 13 records in eBird of this species between October-February 1979-2017 in the waters surrounding the Fraser River estuary likely reflects the seasonal and pelagic nature of the species. The murrelet is seen uncommonly in October and November near Vancouver (Nature Vancouver 2013). Surveys using the same methods in Burrard Inlet, Indian Arm and Howe Sound did not detect Ancient Murrelets (Butler et al. 2015, 2018) but in the southern Gulf Islands Davidson et al. (2010) did, and in the northern Strait of Georgia eBird reported large numbers in winter.

**Survey records**

We saw two Ancient Murrelets in December off the South Arm.

**Conservation Issues and Recommendations**

Threats to Ancient Murrelets include oil spills, fisheries bycatch, and overfishing of prey species. No actions are recommended.

**Pigeon Guillemot *Cepphus columba***

Conservation Status — Conservation Data Centre: BC Yellow list

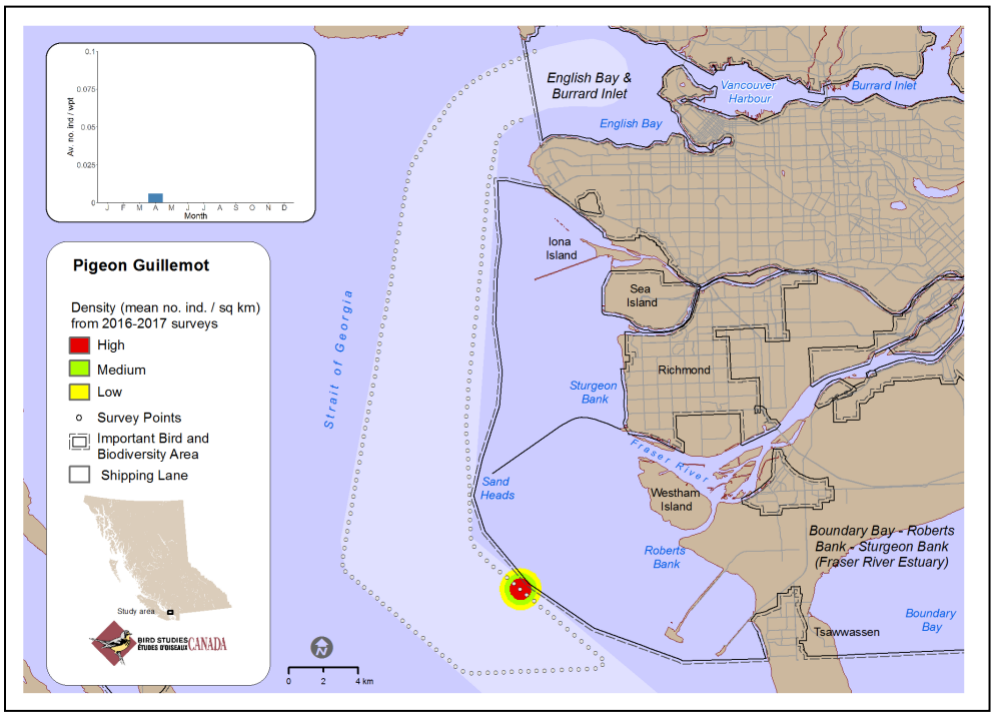


Fig. 29 Spatial distribution and seasonal abundance of Pigeon Guillemot in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Pigeon Guillemot is a resident and endemic to the Pacific Northwest, commonly found in sheltered, rocky inshore waters of the Salish Sea (Hipfner 2015b). It breeds along the British Columbia coast where it lays its eggs in rock crevices, under logs and among pilings and feeds primarily on fish caught in benthic, nearshore waters.

Pigeon Guillemots showed a strong, upward trend of 21.7% per year from 1999-2011 in the BC Coastal Waterbird Survey dataset (Crewe et al. 2012). Most notable were the large uptick in numbers off Victoria and the Saanich Peninsula since 2005 (Crewe et al. 2012). Pigeon Guillemots also showed a large increase in numbers in the Salish Sea Christmas Bird Counts between 1975-84 and 1998-2007 (Sauer et al. 1996) and in Puget Sound Ambient Monitoring Program surveys in Washington between 1978-80 and 2003-05 (Bower 2009). In contrast, aerial surveys in Puget Sound showed declines from 1992-1999 (Nysewander et al. 2001).

The closest nest sites are in Burrard Inlet, Howe Sound (Butler et al. 2015, 2018), Active Pass and Mandarte Island. Pigeon Guillemots were detected in all seasons but mid-winter in Burrard Inlet, Indian Arm and Howe Sound.

**Survey Records**
We saw one Pigeon Guillemot in April (Table 3).

**Conservation Issues and Recommendations**
No actions recommended.

**Marbled Murrelet *Brachyramphus marmoratus***

Conservation Status — COSEWIC (2012): Threatened; SARA Status: Schedule 1, Threatened; Conservation Data Centre: BC Blue list

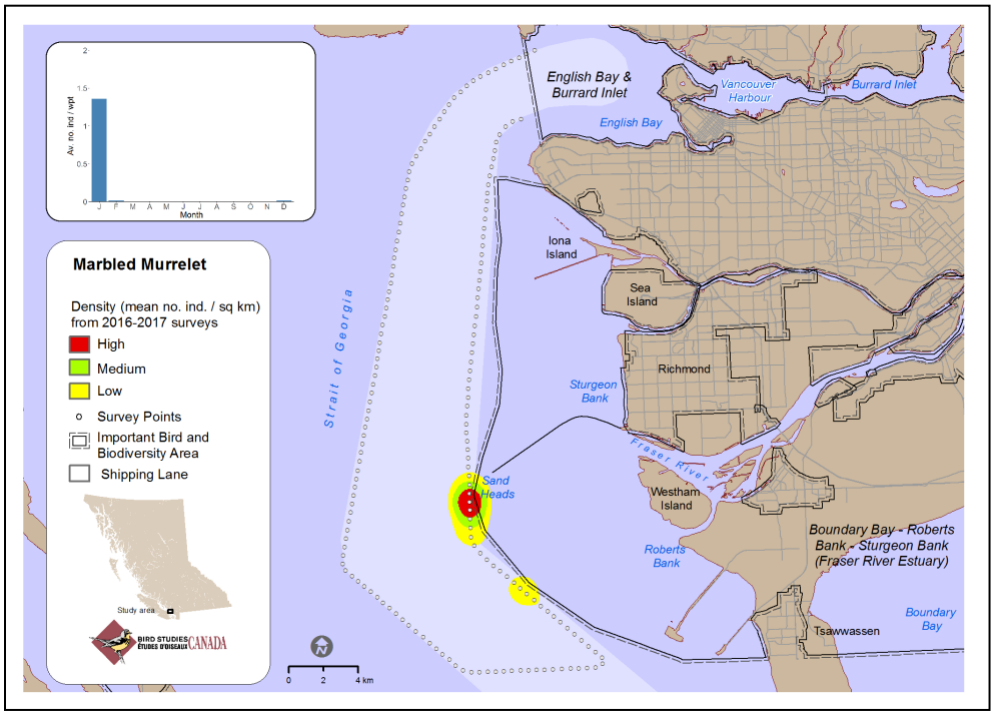


Fig. 30 Spatial distribution and seasonal abundance of Marbled Murrelet in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Marbled Murrelet has become an iconic coastal species reliant on inshore marine habitats for food and old-growth forests for nesting. Murrelets forage year-round on small fish and marine invertebrates such as crustaceans and amphipods (Norris et al. 2007, Butler and MacVicar 2018). Breeding birds carry their prey for many kilometers under the cover of darkness to secretly provision young in nests built on limbs of old-growth trees.

The number of Marbled Murrelets in Canada is estimated to be about 99,000 birds, or about 28% of the estimated global total of 357,900 birds (Environment Canada 2014). In 1971 and 1972, the Marbled Murrelet was a frequent and widespread resident species in the Vancouver area (Campbell et al. 1972 a,b). The murrelet likely bred in forests near Burrard Inlet and Indian Arm in the 1970s based on an adult carrying food in English Bay and many individuals reported from English Bay, including young (Butler et al. 2018). Murrelets underwent a decline by 1995 (Vancouver Natural History Society 1995). The decline was also reported for the Strait of Georgia over the past 40 years (Norris et al. 2007; Crewe et al. 2012). Despite the near extirpation of the Marbled Murrelet from Burrard Inlet and Indian Arm, and Howe Sound as a breeding species, large numbers were present in winter in Howe Sound giving hope the species might return to former haunts (Butler et al. 2018).

**Survey Records**

The Marbled Murrelet was the fifth most numerous species tallied on our survey. We saw the species only in December to February with an exceptionally large number of 237 in January off the South Arm.

**Conservation Issues and Recommendations**

The main threats to the Marbled Murrelet are loss of coastal old-growth forest nesting habitat, oil contamination, entanglement in fishing nets at sea, and disturbance from shipping traffic (Environment Canada 2014). However, Norris et al. (2007) suggested that, until the 1950s, Marbled Murrelets in the Salish Sea were probably limited by factors other than diet quality. Their diet began to change away from small fish to invertebrates in the 1960s. These authors believe that recovery might require restoration of marine, as well as forest, habitats in the Gulf Islands (W. Wartig, pers. comm.). Efforts to recover small forage fish, especially Pacific herring and sandlance might be essential to recover the population.

**Rhinoceros Auklet *Cerorhinca monocerata***

Conservation Status — Conservation Data Centre: BC Yellow List

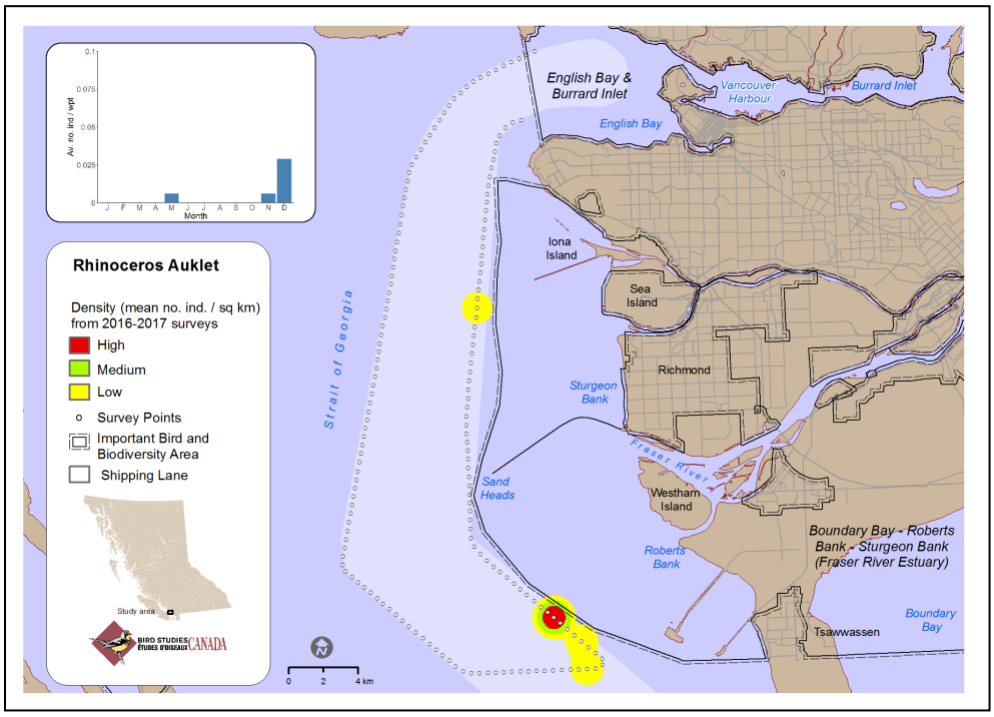


Fig. 31 Spatial distribution and seasonal abundance of Rhinoceros Auklet in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Rhinoceros Auklet forages on marine invertebrates and fish (Hipfner 2015d). The auklet breeds in large colonies along the north Pacific Coast and in the Salish Sea, particularly on Protection Island in the San Juan Islands (Wahl and Speich 1994). Some individuals are present in the Salish Sea during winter. Their winter movement is poorly understood (Hipfner 2015d).

Globally numbers are estimated at 922,000 (Kushlan et al. 2002) of which approximately half breed in British Columbia. The BC Coastal Waterbird Survey detected a 17.6% per year decline from 1999-2011 (Crewe et al. 2012).

**Survey Records**

We detected 7 Rhinoceros Auklets; one was seen in spring and 6 in winter (Table 2).

**Conservation Issues and Recommendations**

The main threats to Rhinoceros Auklet populations in the province include gillnet bycatch (Smith and Morgan 2005) and susceptibility to oil spills. No actions are recommended.

# MAMMALS

**Harbour Porpoise *Phocoena phocoena***

Conservation Status — COSEWIC (2016): Special Concern; SARA status: Schedule 1, Special Concern; Conservation Data Centre: BC Blue list

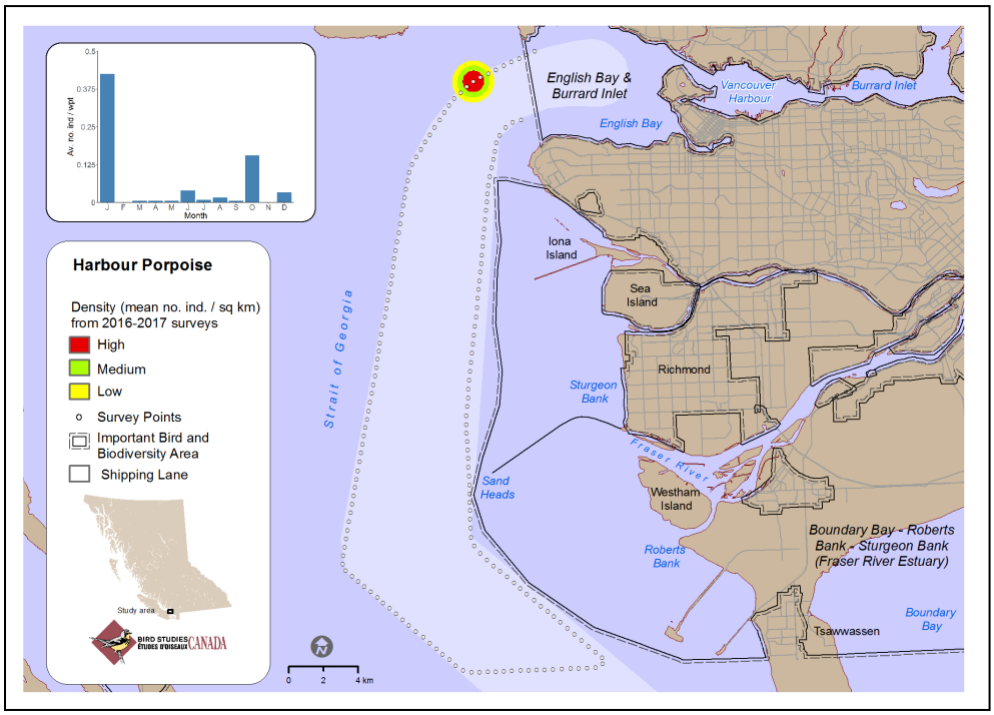


Fig. 32 Spatial distribution and seasonal abundance of Harbour Porpoise in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Harbour Porpoise occurs in British Columbia coastal waters usually less than 150 meters deep, including in the Strait of Georgia (Ford 2014). The species is widespread in the southern Strait of Georgia (Trites 2014) especially where there is strong tidal flow (Hall 2004, Davidson et al. 2010). Harbour Porpoises were detected in fall and winter in Howe Sound and English Bay between Lighthouse Park and Point Grey (Butler et al. 2015, 2018) and we saw them in English Bay in July (Table 2). An estimated 6,200 Harbour Porpoises were present in the Strait of Georgia and Gulf Islands in 2002-03 (Ford 2014). There are no population trends for British Columbia waters (COSEWIC 2016). Harbour Porpoises in the Strait of Georgia eat mostly herring, anchovy, pollock, sand lance, perch, hake and sardines (Trites 2014).

**Survey Records**

One or a few Harbour Porpoises were encountered every month except February and December when none were seen, and in January near Lighthouse Park when 74 porpoises were counted in a 'superpod' (Butler et al. 2017; Table 3). Butler et al. (2017) estimated there could have been in excess of 1,800 animals based on the time porpoises spent on the surface.

**Conservation Issues and Recommendations**

The Harbour Porpoise was designated as Special Concern over a combination of possible anthropogenic threats including habitat degradation due to noise, entanglement in fishing gear, and fisheries, shipping traffic, pollution, pathogens, predation, and habitat loss due to coastal developments (COSEWIC 2016). A comprehensive survey targeting this species and the Dall's Porpoise would assist in delineating a baseline to measure change in the number, distribution and seasonality of porpoises in the estuary. Also helpful would be an understanding of the ecological processes that attract the porpoises and experiments to better understand the importance of interactions with ships.

**Dall's Porpoise *Phocoenoides dalli***

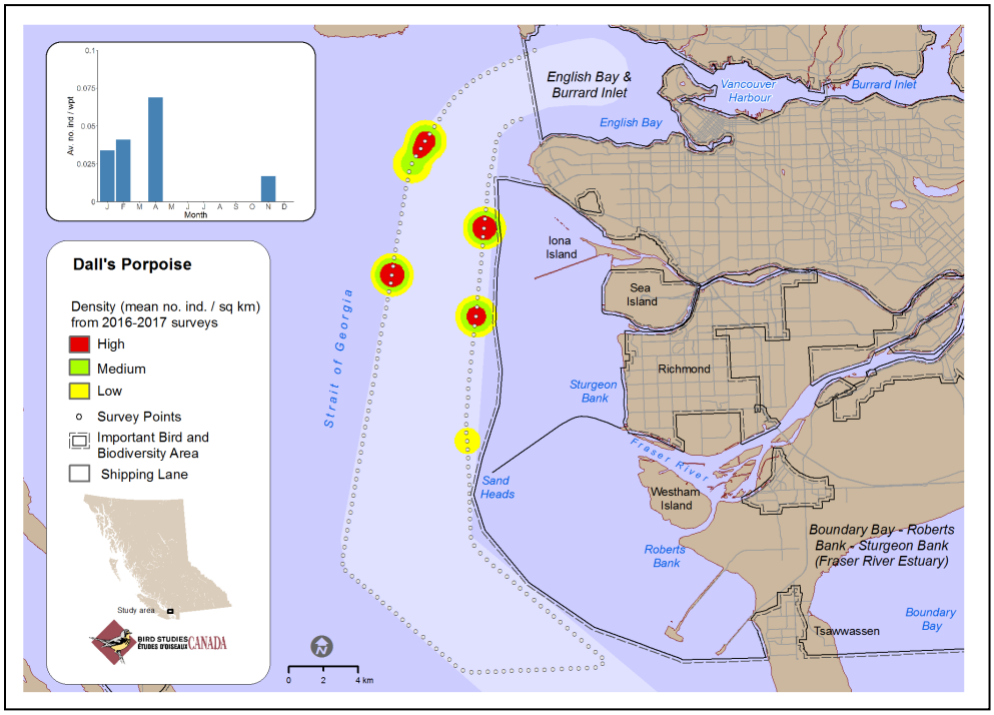


Fig. 33 Spatial distribution and seasonal abundance of Dall's Porpoise in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

Dall's Porpoise is a widespread endemic species of the north Pacific Ocean known to eat herring, pollack and squid in the Strait of Georgia (Ford 2014). The species occurs in small groups of <10 individuals year-round in BC coastal waters, including the Strait of Georgia (Ford 2014). Alison Keple (reported in Ford 2014) conducted a year-round survey of cetaceans from a BC Ferry where she found the densities were lowest in fall and highest in spring. Trites (2014) showed that this species was frequently seen by mariners in deep waters of the Strait of Georgia west of the Fraser River estuary, and in Boundary Pass and Haro Strait.

**Survey Records**

We saw small groups of Dall's Porpoises while we transited the entrance to English Bay in August and November (Table 2), and on the transect surveys in January, February, April and November (Table 3). Ford (2014) wrote that there was some evidence, although not demonstrably clear, that this species shifted between inshore in summer and offshore in winter but did not present any data. Our results show the opposite with sightings in January, February, August and November (Table 2 & 3) mostly off the North Arm and Sturgeon Banks (Fig. 33 ).

**Conservation Issues and Recommendations**

Our findings suggest that the Dall's Porpoise is a year-round resident in the Fraser River estuary, and in particular in the waters off the North Arm. A comprehensive survey targeting this species

and the Harbour Porpoise would assist in delineating the number, distribution and seasonality of porpoises in the estuary. Also helpful would be an understanding of the ecological processes that attract the porpoises.

**Harbour Seal *Phoca vitulina***

Conservation Status COSEWIC (1999): Not at risk; Conservation Data Centre: BC Yellow

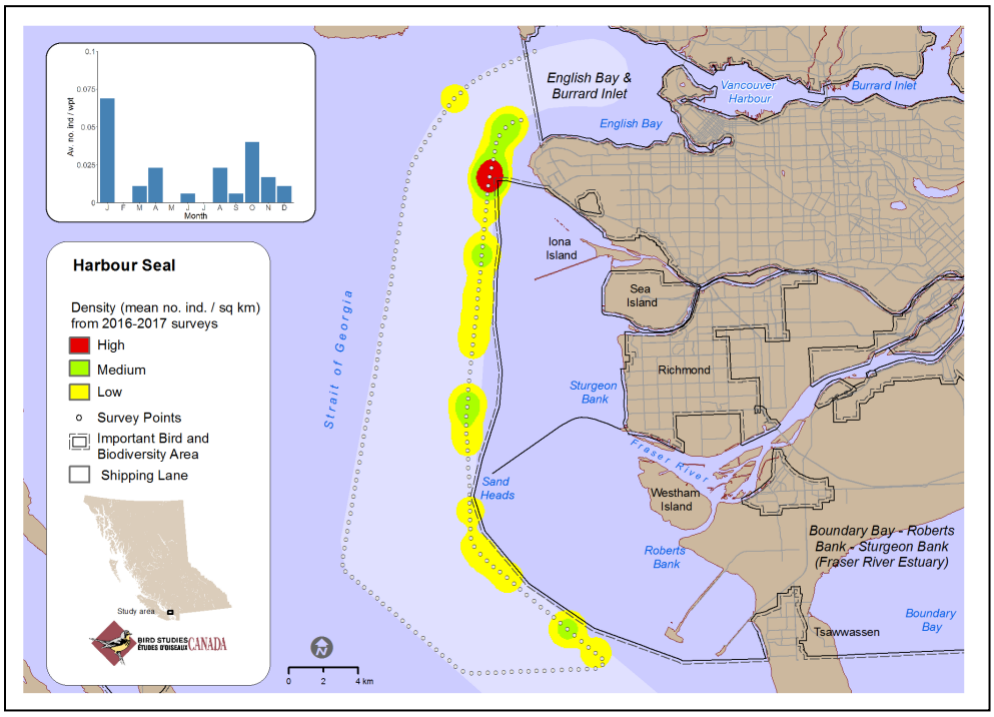


Fig. 34 Spatial distribution and seasonal abundance of Harbour Seal in the Fraser estuary November 2016-October 2017

**Ecology and Regional Trends, Salish Sea Status**

The Harbour Seal is widespread in British Columbia coastal inshore waters and estuaries, and on rocky islands, sandy beaches and log booms as haul out and where females give birth. The seal is a year-round resident of the Salish Sea including the Fraser River as far as Pitt Lake. Salish Sea seals give birth in July to September which is later than in other coastal areas and reflects an ancient lineage of colonization 670,000 years ago (Trites 2014). The diet consists of herring, hake, salmon, eulachon, rockfish, squid, octopus, pollock flat fish, cod, lingcod, dogfish, perch, sculpins, and midshipman (Trites 2014).

Once hunted for their pelts and for bounty, the California-Oregon-Washington-British Columbian Harbour Seal increased significantly over the past 40 years, and the eastern North Pacific population was estimated to number 285,000 individuals (Cresswell et al. 2007). The Harbour Seal is the most numerous marine mammal in the Salish Sea numbering about 40,000 animals, and which have become important prey for transient Killer Whales which is keeping numbers in check (Trites 2014).

**Survey Records**

A small number of Harbour Seals was seen each month except in February and May when none were seen (Table 3). The seal appeared to avoid deep water in favour of the region near the

drop off (Fig. 34).

**Conservation Issues and Recommendations**
No action proposed.

**Killer Whale ("Bigg's" Transient) *Orcinus orca***

Conservation Status COSEWIC (2008): Threatened; SARA (2003) status: Schedule 1, Threatened; Conservation Data Centre: BC Red list

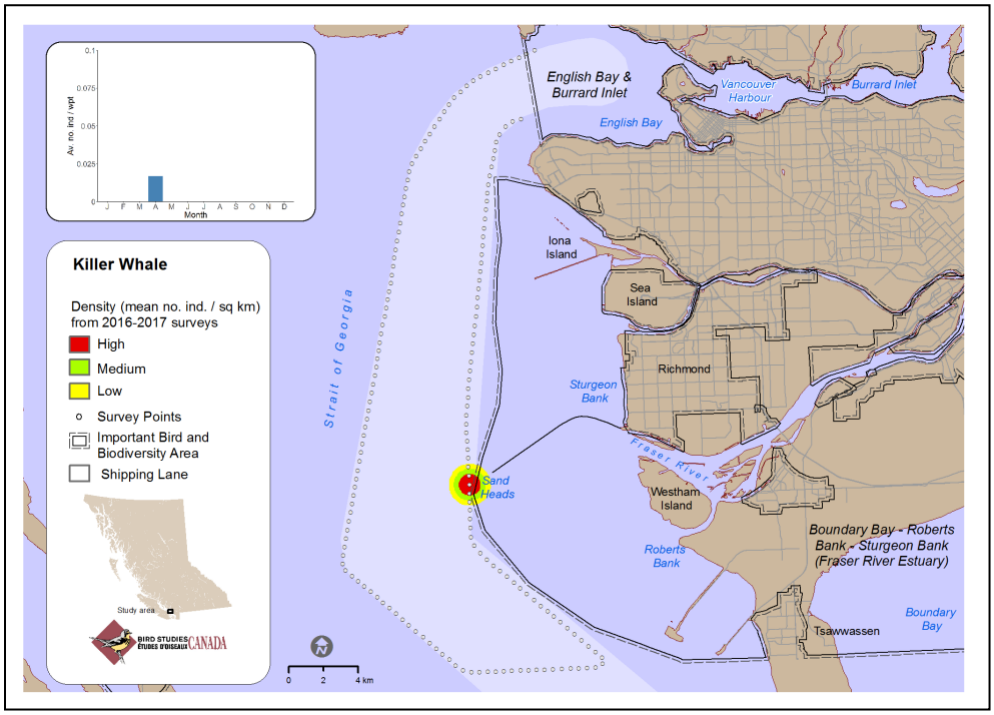


Fig. 35 Spatial distribution and seasonal abundance of Transient Killer Whale in the Fraser estuary November 2016-October 2017

Fig. 36 Transient ecotype Killer Whale T-123 seen during a survey in April 2017 in the Fraser River Estuary.

**Ecology and Regional Trends, Salish Sea Status**

Two Killer Whale ecotypes inhabit the Fraser River estuary. The Resident ecotype pursues mostly chinook salmon in spring and summer and the Transient ecotype hunts marine mammals in the Salish Sea year-round (Ford 2014). The number of Resident Killer Whales in the Salish Sea has ranged from 67 to 95 individuals between 1974 and 2014 and about 250 Transient Killer Whales frequent the Salish Sea (Trites 2014). The Fraser River Estuary is included in the 'Critical Habitat' designation for the Threatened Southern Resident Killer Whales.

**Survey Records**

We saw 3 Transient Killer Whales from matrilineal line T-123 (J. Ford, pers. comm.) on one occasion in April off the Main Arm moving southward along the drop off (Table 3).

**Conservation Issues and Recommendations**

Transient Killer Whales were assigned 'Threatened' status because of their small population, a very low reproductive rate, and concerns over chemical contaminants in their tissues (COSEWIC 2008).

**Other Observations**

**Unidentified Cetaceans**

On 21 April 2017, we briefly glimpsed a large baleen whale blow and disappear beneath the water at waypoint 30. From its size and location toward shore the whale was most likely a Gray Whale (*Eschrichtius robustus*) or possibly a Minke Whale (*Balaenoptera acutorostrata)*.

On 23 October 2017, we saw an unidentified dolphin at waypoint 118 that with a dark back and moving faster and larger than a Harbour Porpoise.