Bird Surveys (Summer 2018) Prior to Wildlife Habitat Restoration at Six Sites Near Lake Saint-Pierre

Berthierville-Maskinongé Area

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1. Introduction

Lake Saint-Pierre and its floodplain, which is the largest in Quebec, is one of the major components of the St. Lawrence ecosystem. With more than 288 resident and migratory bird species and 79 fish species (MDDEFP, 2013), the lake offers an exceptional natural environment which has received international recognition for its rich biodiversity (UNESCO Biosphere Reserve and RAMSAR site).

Agricultural activities have been carried out on the fertile floodplain of Lake Saint-Pierre for several centuries. However, beginning in the second half of the 20th century, perennial crops were gradually replaced by annual crops, even in the shoreline area (Dauphin and Jobin, 2016). Agricultural practices associated with annual cropping have resulted in degradation of natural habitats and reduced the amount of habitat available for many wildlife species (Latendresse et al., 2008; Rioux et al., 2009). Grassland birds (Bobolink, Eastern Meadowlark, etc.), whose populations are in decline (NABCI, 2012), and waterfowl are among the species that have been adversely affected by the disappearance of wet meadows and the conversion of perennial crops to annual crops. The loss of plant substrates due to fall tillage promotes soil erosion during high water periods and results in the destruction of key fish spawning and rearing grounds in the spring. This degradation has played a significant role in the decline of the Yellow Perch population in Lake Saint-Pierre (Magnan et al., 2017). To date, roughly 5,000 ha of potential Yellow Perch spawning habitat has been lost (TCRLSP, 2017).

With the aim of balancing agricultural activities and wildlife protection, an approach for restoring wildlife habitats on the shoreline of Lake Saint-Pierre has been developed (Groupe de travail « Intendance en milieu agricole: culture du littoral au lac Saint-Pierre », 2010). This approach involves stream maintenance (bank reprofiling, planting, etc.) and conversion of annual crops back to perennial crops or natural grasslands. To this end, various enhancements have been carried out since 2017 in the Berthierville and Maskinongé areas to help restore the ecological functions of Lake Saint-Pierre.

Bird surveys were conducted in the summer of 2017 in order to obtain a picture of the avifauna present along four watercourses prior to the restoration work as well as in a wildlife habitat management area (agricultural field). Owing to the high water levels in 2017, the surveys were repeated in 2018, a year with more typical hydrologic conditions, with the goal of accurately characterizing the bird communities that use the various sites. Another wildlife habitat management site was also added. The surveys will provide baseline data that can be used to evaluate the potential benefits of the restoration work for the birds that use these sites.

This approach is part of the project to restore the Lake Saint-Pierre shoreline, which is being carried out jointly by the Canadian Wildlife Service (CWS) of Environment and Climate Change Canada (ECCC) and the Quebec Department of Forests, Wildlife and Parks (MFFP), as part of the 2016–2021 programming for the St. Lawrence Action Plan (SLAP).

2. Methodology

2.1 Location and description of bird survey sites

The bird surveys were carried out in the northwestern part of the Lake Saint-Pierre floodplain, specifically in two wildlife habitat management sites (Segments 1 and 5) and along four watercourses: De Biais Creek, Marais de la Presqu'île, Chenal du Nord and Fossé de la Baie. See **Figure 1** for the locations of these sites.

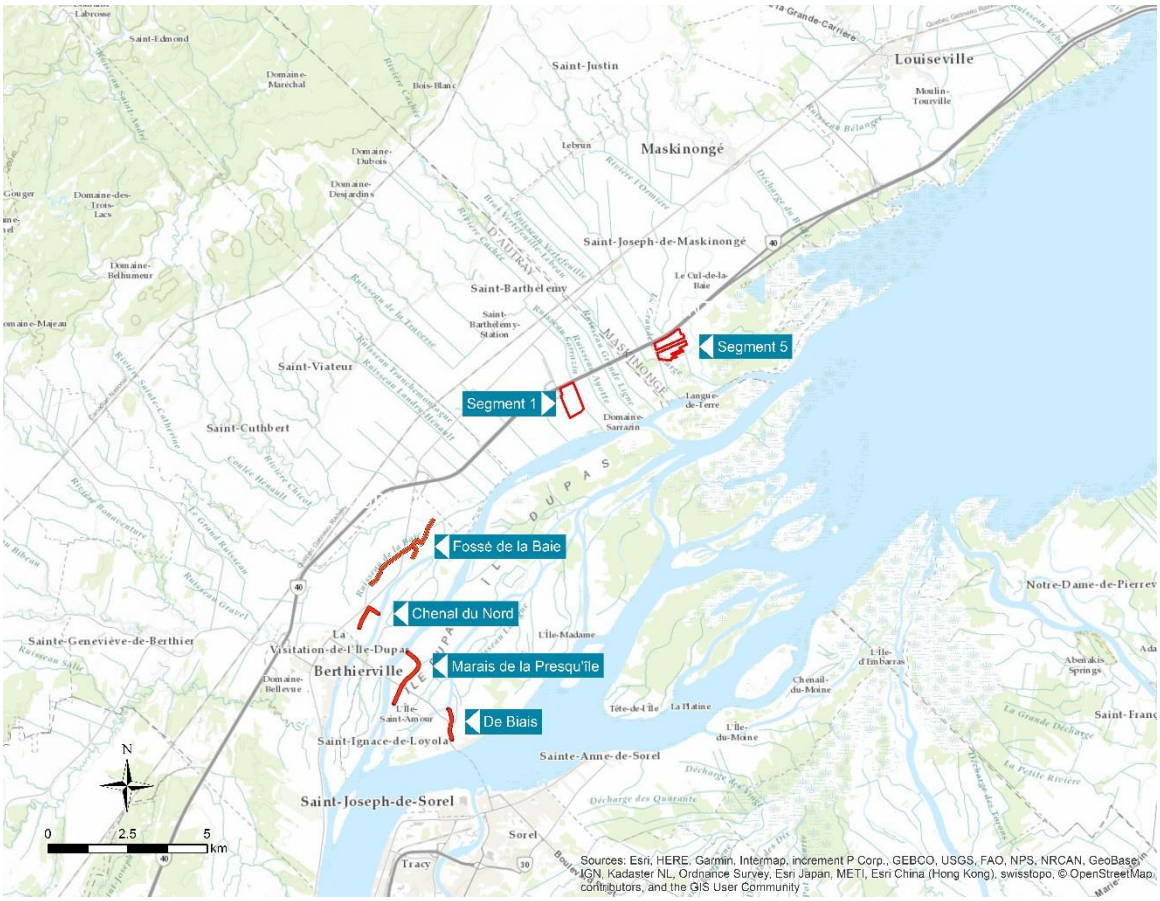

Figure 1. Locations of bird survey sites

2.1.1 Segment 1

Segment 1, a wildlife habitat management site located in the municipality of Saint-Barthélemy (in the D'Autray regional county municipality, RCM), belongs to Ducks Unlimited Canada (DUC) and is part of a large wetland complex known as the Saint-Barthélemy staging area, which covers a total area of 42 ha. Land use is entirely agricultural (**Figure 2**) and natural hedgerows remain between the plots in the northern part of the wildlife habitat management site. In 2017, DUC bought back the agricultural leases in the area, which halted farming activities. Restoration of the site is expected to begin in 2019.

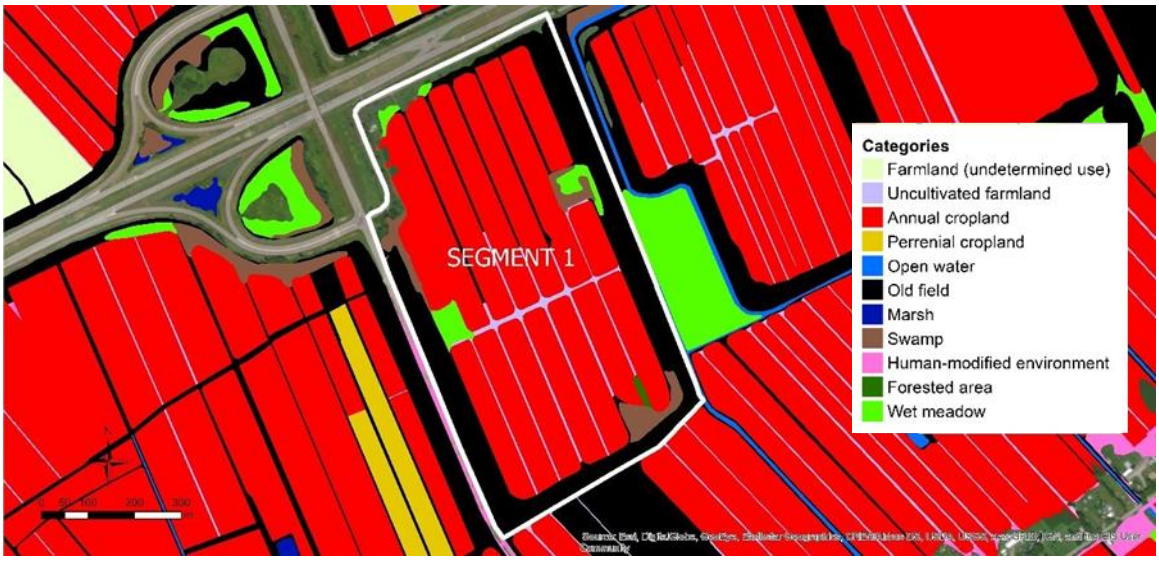

Figure 2. Land use (2014) in Segment 1
(Source: ECCC and MDDELCC, 2018)

2.1.2 Segment 5

Segment 5, a wildlife habitat management site located in the municipality of Maskinongé (Maskinongé RCM), belongs to Ducks Unlimited Canada (DUC) and is also part of a large wetland complex known as the Saint-Barthélemy staging area. A strip of privately owned land is located in the middle of Segment 5 (MERN, 2017). The land owned by DUC covers a total area of 49 ha. Although agricultural land dominates the landscape (**Figure 3**), there are also some natural habitats such as treed and shrubby swamps, wet meadows and the Rivière du Bois-Blanc, which runs along the western edge of the property. DUC also put a stop to farming activities in this wildlife habitat management site in 2017. Restoration work in Segment 5 began in the fall of 2017 and will continue in 2019.

Figure 3. Land use (2014) in Segment 5
(Source: ECCC and MDDELCC, 2018)

Willow cuttings planted during the restoration work in 2017 – photo taken on June 11, 2018 by Alexandre Nicole

It should be noted that, for the bird surveys, the strip of land in the middle of Segment 5 was considered an integral part of the segment. Since this piece of land covers a fairly small area and its plant composition is similar to that on nearby land, it was assumed that including it in the bird surveys would not affect the results in terms of the avifauna present in Segment 5.

2.1.3 Watercourses

The four watercourses selected for the bird surveys are located in a landscape dominated by farmland and other human-modified environments (**Figure 4**). Two of the watercourses are located in the Îles de Berthier area, and the other two, in the municipality of Sainte-Geneviève-de-Berthier. The restoration of these watercourses (except for Fossé de la Baie) was completed in October 2018.

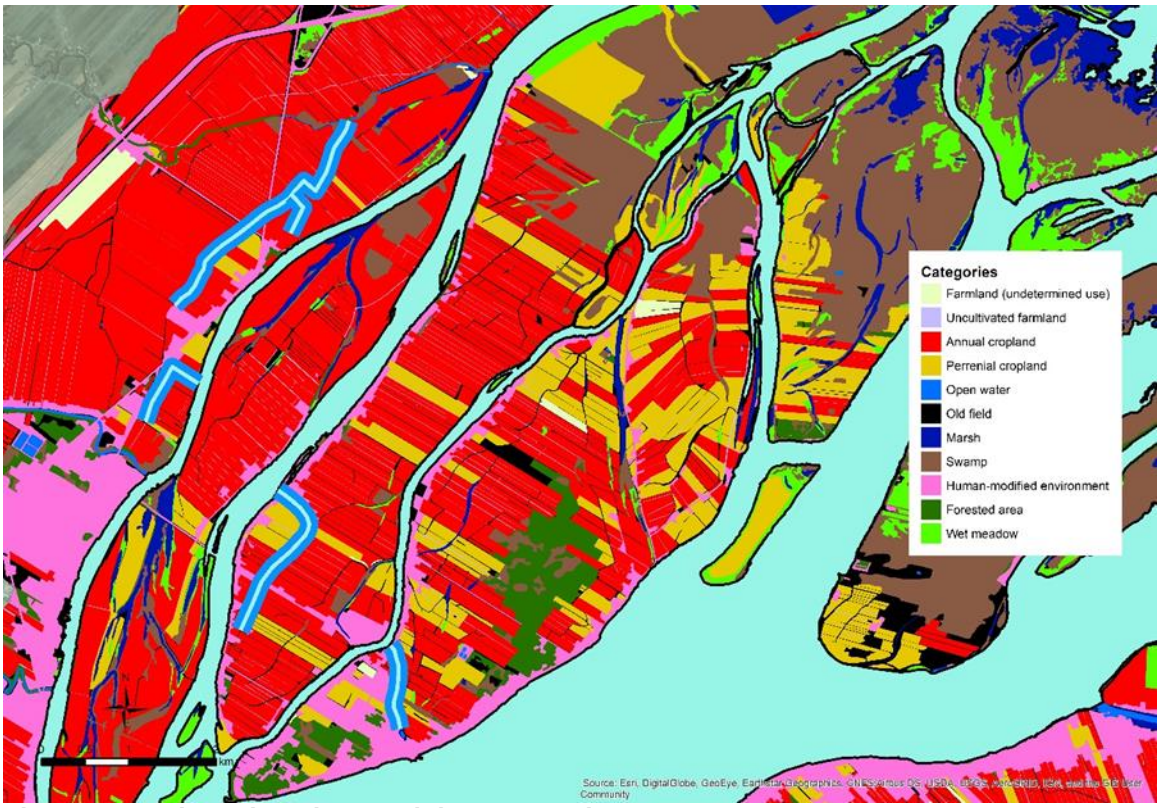

Figure 4. Land use (2014) around the surveyed watercourses
(Source: ECCC and MDDELCC, 2018)

De Biais Creek

This approximately 1-km-long creek is located in the municipality of Saint-Ignace-de-Loyola, in the D'Autray RCM (**Figure 5**). It originates in a marsh and drains several farm properties before emptying into Chenal des Épouffettes, a channel that runs between Île Saint-Ignace and Île Dupas. Its banks are bordered by annual and perennial crops and by the village of Saint-Ignace-de-Loyola. The vegetated strip along the watercourse is fairly narrow, but nonetheless has appreciable structural heterogeneity (trees, shrubs and herbaceous vegetation).

Marais de la Presqu'île

The 2-km-long Marais de la Presqu'île watercourse, which is located in the municipality of La Visitation-de-l'Île-Dupas, in the D'Autray RCM (**Figure 5**), drains the farmland in the southwestern part of Île Dupas (annual and perennial crops) and empties into Chenal aux Castors, a channel between Île Dupas and Île aux Castors. In the section northeast of Highway 158, the watercourse widens, offering a variety of habitats suitable for wildlife, such as marshes and treed swamps. No restoration work was planned for this section of the watercourse.

Figure 5. Locations of the watercourses surveyed in the Îles de Berthier area

Chenal du Nord

Chenal du Nord, 1.1-km long, is located in the municipality of Sainte-Geneviève-de-Berthier, in the D'Autray RCM (**Figure 6**). This watercourse drains farmland (annual and perennial crops) and empties into the channel (also called Chenal du Nord) between Île aux Castors and the north shore of the St. Lawrence River. A narrow riparian strip with sparse vegetation is present on either side of the watercourse, which has a 350-m stretch of marsh near the point where it empties into the Grand Chenal du Nord. A short section of the watercourse was not excavated and revegetated because the property owner was opposed to this work.

Fossé de la Baie

Fossé de la Baie, 3.7-km long (portion under study), is located in the municipality of Sainte-Geneviève-de-Berthier, in the D'Autray RCM (**Figure 6**). It drains farmland planted with annual and, to a lesser extent, perennial crops. The riparian strip along this watercourse has less tree cover than the other three watercourses; it is dominated by herbaceous plants and shrubs. The watercourse nonetheless has several wider sections bordered with marshes and it has a treed swamp at its northeastern tip. A 0.6-km section near the source of the watercourse was filled in at some point; surveys were not carried out along that stretch. The restoration work on this watercourse has been suspended, since the property owners are opposed to the establishment of a widened riparian strip, a measure planned during the excavation of any littoral zone in the RCM. For most of the length of the watercourse, the riparian strip does not meet the minimum regulated width.

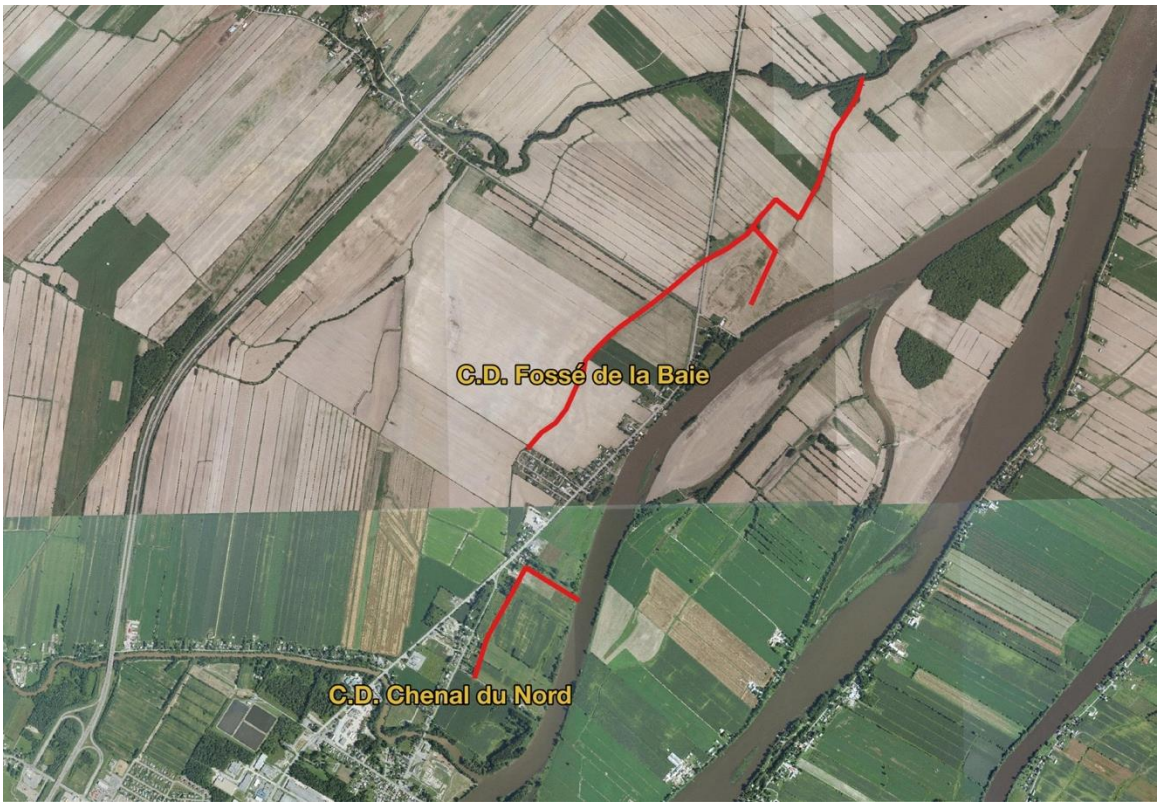

Figure 6. Locations of the watercourses surveyed in the Sainte-Geneviève-de-Berthier area

2.2 Bird survey methods

Although species at risk were observed on the sites in 2017, their presence had no impact on the 2018 surveys, which were carried out according to the same protocol as in 2017. In addition, the restoration work was carried out in October, i.e. after the bird breeding season.

The methods chosen for the bird surveys were designed to detect the majority of species present at the sites and also obtain relative abundance data for some of the species. When necessary (Segment 5), a random sampling technique was used.

2.2.1 Segment 1

The objective of the surveys conducted in Segment 1 was to take a complete count of Anatidae (ducks and geese) using the site during the spring migration period, i.e. between the last week of March and the third week of May.

During this period, a visit was made every three or four days (twice a week). For the Greater Snow Goose count, the observer arrived at the site at least 30 minutes before sunrise in order to begin the survey at dawn, since the geese sometimes leave their resting area very early to reach the recently dewatered fields where they feed. The survey of ducks and Canada Geese (species and number of individuals) was carried out after the survey of other geese. The counts were taken from higher ground, i.e. Montée St-Laurent for the southern portion and the Highway 40 service road for the northern portion. For the major groups of Anatidae, geese in particular, three successive counts were taken and

the average of these three counts was chosen as the final result. For each visit, the date, count start and end times and the weather conditions were recorded.

For the Greater Snow Goose, the results are expressed in two different ways: 1) the maximum number of geese observed, and 2) the number of goose-days. In order to calculate the number of goose-days, which represents the total number of geese present in the wildlife habitat management site each day of the survey period, values were assigned to the days during which there was no count. These values were obtained by calculating the average between the two nearest observed values. For example, if during visits on April 28 and 30, 5,000 and 10,000 (respectively) geese were observed, the number of geese estimated for April 29, is the average between these two values, i.e. 7,500. Hence, to obtain the number of goose-days, all the observed and estimated values are totalled for the survey period.

The counts were completed by only one observer between April 2, and May 18, 2018 under variable but generally good conditions: temperature between -7 and 11°C, clear to overcast skies, little or no rainfall, no wind to light wind.

2.2.2 Segment 5

The point count survey method was chosen for Segment 5 at Maskinongé. Although specifically designed for songbirds, this method can be used to detect and count many other species as well (by call or by sight), particularly in open habitat with few visual obstructions, such as Segment 5.

The point count survey method involves recording all birds seen or heard at given locations scattered across a specific area. Two techniques were combined for this purpose, specifically Unlimited Distance Point Counts (UDPC, also known as IPA) and fixed-radius counts. The UDPC technique involves counting all birds detected, regardless of their distance from the point count location. With the fixed-radius technique, only birds detected within a pre-determined radius (in this case, 75 m) are recorded. Combining these two methods makes it possible to obtain more information about the birds that use the habitat surveyed. The fixed-radius technique can be used to compare a given species' abundance in different types of habitat (i.e. distance of detection may differ) and to compare the abundance of different species (i.e. distance of detection of the different birds' calls/songs may differ). Such comparisons are possible because the fixed-radius technique standardizes the survey radius for all species and all habitats. UDPC data are generally used to compare differences in individual species' abundance among sites with similar habitats (i.e. distance of detection of each species is similar). They are used to complement the fixed-radius count results in order to present an overall picture of the bird species occurring during the breeding season in the habitats studied.

The fixed radius was set to 75 m (the distance at which the songs of most species can be heard) and the point count duration to 20 minutes. To increase the probability of detection, each point count location was to be visited twice, at least seven days apart, during the month of June 2018.

For each individual detected, the observer was required to record the bird's position in relation to the 75-m radius (whether located within or outside of the radius), its position relative to the management site (within or outside of it or on the privately owned land in the middle of the managed site), the bird's sex (if possible), type of detection (visual [individual, nest or family] or auditory [call, song]) and the habitat used. Only the behaviour

most indicative of breeding was recorded for a given individual. Therefore, when a bird uttered both a call and a song during the 20-minute point count period, only the song, a territorial behaviour, was recorded. If this same individual was observed on a nest or accompanied by young, this is the information that was recorded because it enabled confirmation of breeding. When two or more birds were heard or seen simultaneously, they were treated as different individuals. The same is true in cases where detections were so far apart they could not involve a single individual. When in doubt, the observer was to treat the detection as a single bird. The point count field sheet is presented in **Appendix A**.

During data compilation, the following convention was used: a bird seen or heard (male or female) = 0.5 pair; a singing male, a nest or a family = 1 pair. In the case of locations visited twice, the highest value for a given species was selected (better indicator of the carrying capacity of the environment). Individuals that merely flew over the habitat without using it (e.g. vultures or gulls high in the air) were excluded when the data were compiled. However, individuals feeding in flight (e.g. swallows) or flying within or over the habitat were counted. The data from the fixed-radius count and the UDPC were compiled separately for subsequent analyses.

A single observer performed the counts. The point counts, totalling 21, were carried out between sunrise and 10:00 a.m., the time of day when songbirds are most active. The first visit took place on June 10 and 11, 2018, and the second on June 21 and 22, 2018. The survey conditions, which were recorded on the field sheet for each point count, were excellent: clear skies, no rainfall and no wind to light wind.

Selection of point count locations

The point count locations were selected by computer using the ArcGIS program and shapefiles representing the boundaries of Segment 5 and land use in the area in 2014. A satellite image was used as a base map. A hexagonal grid with a 75-m radius was superimposed on the map to visualize the survey sample for the selection of count locations.

In all, 21 point count locations were selected (**Figure 7**) and distributed systematically in a staggered pattern (random sampling technique; Scherrer, 1984) to ensure adequate coverage of the survey area; the locations were thus distributed along six (6) lines in an east–west direction. For each of the two planned visits, two mornings were needed to cover the 21 point count locations. On one of these mornings, the observer was required to do the counts by skipping every second line of points in order to optimize coverage of the site.

Garmin's BaseCamp program was used to transfer the geographic coordinates of the locations to a GPS for the field visits. The coordinates are available in **Appendix B**.

Figure 7. The 21 point count locations surveyed within Segment 5

2.2.3 Watercourses

The transect method was chosen for the bird survey along the four watercourses at Saint-Ignace-de-Loyola, La Visitation-de-l'Île-Dupas and Sainte-Geneviève-de-Berthier. This involved counting all birds detected by walking slowly (2–3 km/h) along one side of the watercourse and recording all the birds seen or heard nearby as well as in adjacent habitats. All individuals detected on either bank were to be recorded (Deschênes et al., 1999; Jobin et al., 2001).

The observer was required to note the location of each bird detected in relation to the watercourse (open water, bank, vegetated riparian strip or adjacent habitat), its sex (if possible) and the type of detection (visual [individual, nest or family] or auditory [call, song]). Only the behaviour most indicative of breeding was recorded for a given individual, according to the same reasoning as described for Segment 5. When a bird was detected in the vegetated riparian strip, the observer was to note the plant composition, specifically whether it was dominated by trees, shrubs, herbaceous vegetation or a combination thereof. When a bird was recorded in the adjacent habitat, the observer was to specify the bird's position, that is, whether it was located within the first 25 m from the watercourse (immediately adjacent habitat) or farther than 25 m away (more distant habitat); the type of habitat being used at the time was also recorded (Deschênes et al., 2003). Birds feeding in flight (e.g. swallows) or flying within the habitat or over it were recorded and counted, whereas birds merely flying over the site without using it (e.g. vultures or gulls high in the air) were recorded but not included in the total count. The field sheet used for the transect survey is presented in **Appendix C**.

Maps of the sites to be surveyed were produced in advance and the geographic coordinates were added to the maps (**Appendix D**), allowing the observer to determine his/her position in the field with a GPS. A single observer performed the counts. The sites were visited twice, more than seven days apart, during the month of June 2018. The surveys were carried out between sunrise and 9:00 a.m. under ideal conditions (clear to partly cloudy skies, no rainfall, and no wind to light wind).

During data compilation, detections of individuals were converted to numbers of pairs in keeping with the convention described in the section on Segment 5. To simplify the presentation of results, the term “riparian zone” is used in the Results and Discussion section to designate the zone including the water, bank, vegetated riparian strip and immediately adjacent habitat.

3. Results and Discussion

3.1 Segment 1

Segment 1 was visited 13 times between April 2 and May 18, 2018. The counts were completed between 5:00 and 7:30 a.m.

The site was snow covered until April 17. The spring flood began between April 17 and 20, and the water reached maximum coverage from May 4 to 7, at which time 95% of the site was flooded.

Segment 1 (bordered by Highway 40 and Montée St-Laurent, in the upper half of the photo) – photo taken on May 9, 2018 by the Canadian Wildlife Service

In total, 13 species of Anatidae were observed in Segment 1 during the spring migration, namely Canada Goose, Greater Snow Goose and 11 species of ducks. **Table 1** indicates the maximum number of individuals observed for each species that was counted. The most abundant species, after the Greater Snow Goose, were the Northern Pintail, the Canada Goose and the Green-winged Teal (more than 400 individuals). The maximum numbers of each of the other nine species were all less than 26 individuals.

The maximum number of geese was reached on April 23, with 27,500 individuals observed (**Figure 8**). The number of goose-days, calculated over 21 days, is 106,185. The second most abundant species was the Northern Pintail; the peak of abundance for this species was reached on May 1, when 2,880 individuals were counted in the enhancement area (**Figure 8**).

Table 1. Species of Anatidae that used Segment 1 during the 2018 spring migration, maximum number surveyed and date on which this number was observed

Species	Maximum number	Date of the observation
Canada goose	1,170	April 17
Wood Duck	6	May 5
Gadwall	9	May 5
Mallard	14	April 20 and May 1
American Wigeon	26	May 4
American Black Duck	26	April 20
Northern Pintail	2,880	May 1
Northern Shoveler	4	April 27 and May 4
Ring-necked Duck	10	May 7
Redhead	1	May 7
Snow Goose	27,500	April 23
Blue-winged Teal	1	May 4
Green-winged Teal	460	May 7

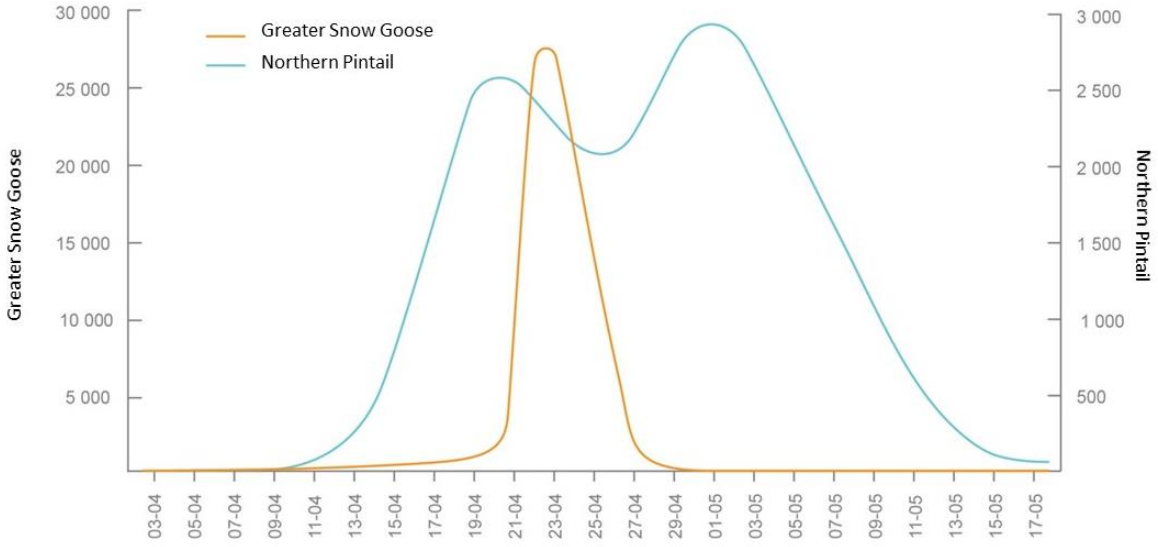

Figure 8. Total number of individuals of Greater Snow Geese (orange curve) and of Northern Pintails (blue curve) observed by date between April 2 and May 18, 2018

3.2 Segment 5

The two point count surveys (June 10-11 and 21-22) took place under excellent weather conditions. Contrary to the situation in 2017 on the same date, Segment 5 was largely dewatered, which made it possible to provide a more representative description of the species using the site during the breeding season before the restoration of the site. In 2017, the first visit was completed at a time when 50% of the wildlife habitat management site was covered with water, while the second visit was cancelled following an unexpected rise in the water level in late June (approximately 70% of the site was flooded).

Segment 5, June 1, 2018 (top) and June 11, 2017 (bottom) (Photos: Alexandre Nicole)

Based on the results of the fixed-radius and UDPC counts, 45 bird species were observed within the boundaries of Segment 5 (including the strip of privately owned land in the middle) during the surveys in 2018 (**Table 2**). Only two species were observed outside Segment 5: the Northern Cardinal and the Alder Flycatcher. Eight species flew over the site without using it: the Osprey (one individual carrying a fish), Canada Goose, American Bittern, Northern Shoveler, Double-crested Cormorant, Ring-billed Gull, Common Raven and Cliff Swallow (two individuals).

Table 2. Species that used Segment 5 during the 2017 and 2018 breeding seasons, as determined by the fixed-radius and point count survey methods

Code[1]	Species	Present 2018	Habitat[2]	Present 2017	Habitat[2]
X	Least Sandpiper	Yes	UF		
S	Wilson's Snipe			Yes	UF; FL; WM
H	Canada Goose*			Yes	OW; UF
AT	Song Sparrow	Yes	FH; OF; SW; HU; UF	Yes	FH; FO; SW; WM
T	Swamp Sparrow	Yes	FH; SW; HU; WM	Yes	WM
S	Savannah Sparrow	Yes	UF		
S	Chipping Sparrow	Yes	SW; HU		
P	Wood Duck			Yes	OW
P	Gadwall	Yes	OW; FL	Yes	OW; FL
P	Mallard*	Yes	OW; FL	Yes	OW; FL
P	American Black Duck	Yes	OW	Yes	OW; FL
P	Northern Shoveler			Yes	OW; FL
AT	Red-winged Blackbird	Yes	FH; SW; HU; WM	Yes	FH; SW; WM
T	American Goldfinch	Yes	OF; FO; SW; HU; UF	Yes	SW; (In flight)
T	Spotted Sandpiper	Yes	UF; WM	Yes	UF; FL; WM
T	American Crow	Yes	FO; SW	Yes	FO; SW
AT[3]	European Starling	Yes	FH; SW; UF	Yes	FH; UF
H	Merlin	Yes	(In flight)		
H	Blue Jay	Yes	FO; SW	Yes	SW
X	Ring-billed Gull*			Yes	UF; FL; WM
X	Great Blue Heron*	Yes	OW; UF; FL; WM	Yes	OW; UF; FL; WM
X	Great Egret*	Yes	OW; UF; FL; WM	Yes	UF; FL; WM
AT[3]	Black Tern*	Yes	(In flight)	Yes	(In flight)
NJ	Tree Swallow	Yes	SW; (In flight)	Yes	SW; (In flight)
H	Barn Swallow	Yes	(In flight)		
T	Cedar Waxwing	Yes	FH; FO; SW; (In flight)	Yes	(In flight)
X	Chimney Swift	Yes	(In flight)		
X	Belted Kingfisher	Yes	SW; (In flight)	Yes	(In flight)
I	American Robin	Yes	FH; FO; SW; HU; UF	Yes	FH; FO; HU; UF
T	Black-capped Chickadee	Yes	SW	Yes	SW
S	Gray Catbird			Yes	OF
T	Least Flycatcher	Yes	SW		
X	Greater Snow Goose	Yes	OW		
T	Baltimore Oriole	Yes	FO; SW	Yes	FO; SW
S	Black-throated Green Warbler	Yes	SW		
T	Yellow Warbler	Yes	FH; FO; SW; HU	Yes	FH; SW; HU; WM
T	Common Yellowthroat	Yes	FO; SW; HU	Yes	OF; FH; HU
S	Northern Flicker	Yes	SW		
T	Downy Woodpecker	Yes	FO; SW	Yes	SW
T	Eastern Wood Peewee	Yes	SW	Yes	SW
X	Black-bellied Plover	Yes	UF		
DD	Killdeer	Yes	UF	Yes	UF
H	Bald Eagle*	Yes	SW	Yes	UF; FL; (In flight)
AT[3]	Common Grackle	Yes	FH; FO; SW; UF	Yes	OF; SW; UF
H	Blue-winged Teal	Yes	(In flight)		
P	Green-winged Teal			Yes	OW; FL
S	White-breasted Nuthatch			Yes	FO
H	Mourning Dove			Yes	(In flight)
S	House Wren	Yes	FO; SW	Yes	FO; SW

T	Great Crested Flycatcher	Yes	SW	Yes	SW
H	Turkey Vulture	Yes	(In flight)	Yes	(In flight)
S	Brown-headed Cowbird	Yes	FH; SW	Yes	FH; SW
T	Red-eyed Vireo	Yes	SW		
T	Warbling Vireo	Yes	FH; FO; SW	Yes	FO; SW
Total		**45**		**41**	

[1] The highest level of breeding evidence obtained in Segment 5 (based on the nomenclature used in the *Québec Breeding Bird Atlas*). A description of the breeding evidence codes is provided in Appendix E. The codes were selected (for suitable breeding habitat) taking into account the fact that the farmland was not cultivated in 2017 and in 2018, the years of the surveys (and disregarding the flooding).

[2] Habitat codes: AC = annual cropland; PC = perennial cropland; OW = open water; OF = old field; FH = farm hedgerow; MA = marsh; SW = swamp; HU = human-modified environment; FO = forested area; UF = uncultivated farmland, FL = flooded land, WM = wet meadow.

[3] Species which were observed carrying food but which appeared not to be nesting within the boundaries of Segment 5.

* Species whose presence or abundance was favoured by the high water levels in 2017.

In the 2017 survey report, the hypothesis had been proposed that the high water levels that persisted until July 2017 had attracted to the site species that would otherwise not have been present in such large numbers (Nicole and Dauphin, 2018). These species are marked with an asterisk (*) in Table 2 (Canada Goose, Mallard, Ring-billed Gull, Great Blue Heron, Great Egret, Black Tern, Tree Swallow, Bald Eagle [species designated Vulnerable in Quebec] and Turkey Vulture). What these species have in common is that they used flooded or denuded areas in agricultural fields for feeding or resting, habitats which were completely dry in 2018.

In 2018, it was observed that the Canada Goose and the Ring-billed Gull were absent from the site, while the Mallard, the Great Blue Heron, the Great Egret, the Black Tern, the Tree Swallow, the Bald Eagle and the Turkey Vulture were present, but in lower numbers. For example, the largest group of Mallards observed in 2018 was composed of 19 individuals compared to 590 in 2017. The same is true for the Tree Swallow (10 in 2018 versus 36 in 2017) and the Black Tern (1 in 2018 versus 6 in 2017). These results clearly demonstrate the impact of the flooding on the presence and abundance of several species.

From **Table 2** we can also see that certain species used up to five different types of habitats (Song Sparrow, American Goldfinch and American Robin), while others used only one type of habitat (e.g. the Least Flycatcher, the Eastern Wood Peewee, the Great Crested Flycatcher as well as several shorebirds). Swamps are at the top of the list of the richest habitats, with 28 species surveyed (**Table 3**), i.e. 12 species more than in 2017. The few swampy woodlands present were used by the Black-capped Chickadee, the Yellow Warbler, the Downy Woodpecker, the Eastern Wood Peewee (species designated Special Concern in Canada), the Baltimore Oriole, the House Wren, the Great Crested Flycatcher, the Warbling Vireo and 20 other species (**Table 2**). New species noted in 2018 in the swamps included the Least Flycatcher, the Black-throated Green Warbler, the Northern Flicker and the Red-eyed Vireo. These species may have been put off by the extended presence of water in the swamps in 2017; the Least Flycatcher sometimes builds its nest 0.6 m above the ground, while the Black-throated Green Warbler generally builds its nest 1 to 3 m above the ground (Tarof and Briskie, 2008; Morse and Poole, 2005). The Northern Flicker, on the other hand, feeds mainly on ants and other insects that it catches, an activity more easily carried out on dry ground.

Although agricultural land dominates the landscape in Segment 5, these parcels of land do not rank among the habitats with the greatest abundance of birds. In fact, 12 species were detected there (**Table 3**), a similar number to that observed in 2017 (11), despite the pronounced hydrological differences for this habitat between the two years. Fewer species attracted by water used the agricultural environments in 2018, but more terrestrial species used the bare ground to feed (e.g. the Song Sparrow, the Savannah Sparrow and the American Goldfinch). In addition to the Spotted Sandpiper and the Killdeer, two new species of shorebirds used this habitat: the Least Sandpiper (four individuals) and the Black-bellied Plover (four individuals). Since the nesting areas of the Least Sandpiper and the Black-bellied Plover are located, respectively, in the subarctic and arctic zones of North America, these individuals were late migrants. They foraged in the mud near the flooded areas.

Two categories of habitats are presented in Table 3 even if they are located mainly outside the site: forested areas and human-modified environments. Twelve species were found in forested areas and eight in human-modified environments, i.e. road shoulders, the right-of-way of Highway 40 and the residential lots adjoining the site.

In 2018, only six species used open water or flooded land, i.e., seven less than in 2017. These were all Anatidae and Ardeidae (Great Blue Heron and Great Egret). In addition to the Mallard, three other waterfowl species were surveyed on the site in 2018: the Gadwall, the American Black Duck and the Blue-winged Teal. In 2017, more species of Anatidae were detected, in addition to Wilson's Snipe and the Ring-billed Gull.

Ten species were observed in the natural farm hedgerows on the site. Five species used wet meadows, particularly the Swamp Sparrow and the Red-winged Blackbird. The Song Sparrow and the American Goldfinch were observed in old fields.

Table 3. Number of bird species observed in the habitats in Segment 5, 2017 and 2018

Habitat	Number of species observed	
	2018	2017
Swamp	28	16
Uncultivated farmland	12	11
Forested area*	12	7
Farm hedgerow	10	7
Human-modified environment*	8	3
Open water and/or flooded land	6	13
Wet meadow	5	9
Old field	2	3

* These habitats are located mainly outside the site.

In 2018, breeding by three species, the Tree Swallow (nest with young), the Killdeer (distraction display) and the House Wren (occupied nest), was confirmed at the site. The Red-winged Blackbird, the Black Tern and the Common Grackle were observed carrying food; however, the Black Tern nests in the Maskinongé marsh. Young of the Song Sparrow, the European Starling and the American Robin were also observed on the site.

Relative abundance

The fixed-radius survey results were used to compare the relative abundance of the different species found within Segment 5 (**Table 4**).

It should be noted that relative abundance values are used for comparison purposes only. They do not indicate the actual number of pairs present, on average, in the area surveyed (here, within a radius of 75 m). With a relative method like the fixed-radius count method, any individual detected within the area surveyed is counted as 0.5 pair or 1 pair, regardless of whether all or part of its territory is located there. The small area (1.8 ha) covered with the fixed-radius method reduces the precision of the results. In fact, the relative abundance values correspond to the number of individuals of the different species detected that were observed at the same locations under similar conditions (in this case, within a radius of 75 m, during a 20-minute count interval, two visits, etc.), based on the assumption that the most abundant species at the site will be detected in the greatest number and vice versa.

It should be noted that for some species, particularly non-territorial species or species that occupy very large territories (ducks, gulls, Bald Eagles, Turkey Vultures, etc.), the results of the fixed-radius counts cannot be used to adequately quantify abundance (**see Table 4**). Since this method is designed for counting territorial songbirds, caution should be exercised in making certain interpretations.

The results obtained indicate that the five most abundant species in Segment 5 in 2018 were also among the most abundant in 2017, namely the Song Sparrow, the Red-winged Blackbird, the Tree Swallow, the Common Grackle and the Yellow Warbler; these are species that are commonly found in open habitats or agricultural areas. The Song Sparrow overtook the Tree Swallow and holds first place in 2018, with an average pair density that increased from 0.71 in 2017 to 1.05 in 2018. The hypothesis proposed in 2017 that the flooding may have disadvantaged species that feed or nest on the ground appears to have been correct, since the densities of Song Sparrow and Killdeer recorded significant increases. In fact, among the songbirds, only the Tree Swallow appears to have been disadvantaged (density two-times lower than in 2017) by the hydrologic conditions in 2018, since almost all the other species recorded an increase in their density. Excluding the species whose abundance cannot be satisfactorily quantified based on the fixed-radius count results, the average total pair density per point count location increased from 4.70 in 2017 to 8.32 in 2018.

Frequency of occurrence

With the exception of the Yellow Warbler, the most abundant species are also, as a general rule, the species most often detected on point counts (**Table 5**). The Tree Swallow, detected on 76% of point counts, flew across the site regularly while foraging. The Red-winged Blackbird (76%), the Song Sparrow (67%), the Common Grackle (62%) and the American Goldfinch (57%), generalist species which used four or more types of habitats, complete the list of the five species most often detected in Segment 5.

Table 4. Mean relative abundance of the species counted by the fixed-radius method during point count surveys in Segment 5, 2017 and 2018

Species	2018		2017	
	Mean relative abundance (fixed-radius) in number of pairs	Rank	Mean relative abundance (fixed-radius) in number of pairs	Rank
Song Sparrow	1.05	1	0.71	2
Red-winged Blackbird	0.98	2	0.45	3
Tree Swallow	0.69	3	1,40	1
Common Grackle	0.64	4	0.33	5
Yellow Warbler	0.62	5	0.38	4
Killdeer	0.57	6	0.12	6
Cedar Waxwing	0.48	7	N/A	N/A
American Robin	0.48	7	0.10	7
American Goldfinch	0.43	8	0.07	8
Warbling Vireo	0.38	9	0.05	9
European Starling	0.36	10	0.33	5
Spotted Sandpiper	0.29	11	0.07	8
Swamp Sparrow	0.29	11	0.10	7
Common Yellowthroat	0.19	12	0.10	7
Brown-headed Cowbird	0.14	13	N/A	N/A
Barn Swallow	0.12	14	N/A	N/A
Baltimore Oriole	0.10	15	0.07	8
Eastern Wood Peewee	0.10	15	N/A	N/A
Savannah Sparrow	0.05	16	N/A	N/A
Black-capped Chickadee	0.05	16	0.05	9
Least Flycatcher	0.05	16	N/A	N/A
Black-throated Green Warbler	0.05	16	N/A	N/A
Downy Woodpecker	0.05	16	0.10	7
House Wren	0.05	16	0.05	9
Red-eyed Vireo	0.05	16	N/A	N/A
Least Sandpiper	0.02	17	N/A	N/A
Blue Jay	0.02	17	0.05	9
Blue-winged Teal	0.02	17	N/A	N/A
American Crow	N/A	N/A	0.07	8
Wilson's Snipe	N/A	N/A	0.05	9
Gray Catbird	N/A	N/A	0.05	9
Gadwall*	0.05	N/A	0.02	N/A
Mallard*	0.52	N/A	0.33	N/A
Northern Shoveler*	N/A	N/A	0.05	N/A
Ring-billed Gull*	N/A	N/A	0.67	N/A
Black Tern*	N/A	N/A	0.57	N/A
Belted Kingfisher*	N/A	N/A	0.02	N/A
Bald Eagle*	0.05	N/A	0.07	N/A
Turkey Vulture*	N/A	N/A	0.19	N/A

* Species whose abundance cannot be quantified from fixed-radius count results.

Table 5. Frequency of occurrence of the species counted by the fixed-radius method during point count surveys in Segment 5, 2017 and 2018

Species	2018			2017**		
	Frequency (number of point count locations)	Relative frequency (%)	Rank	Frequency (number of point count locations)	Relative frequency (%)	Rank
Tree Swallow	16	76	1	13	62	1
Red-winged Blackbird	16	76	1	10	48	3
Song Sparrow	14	67	2	11	52	2
Common Grackle	13	62	3	8	38	4
American Goldfinch	12	57	4	3	14	7
American Robin	11	52	5	3	14	7
Killdeer	10	48	6	3	14	7
European Starling	9	43	7	6	29	5
Cedar Waxwing	8	38	8	N/A	N/A	N/A
Yellow Warbler	7	33	9	5	24	6
Spotted Sandpiper	7	33	9	2	10	8
Warbling Vireo	6	29	10	1	5	9
Swamp Sparrow	5	24	11	2	10	8
Brown-headed Cowbird	5	24	11	N/A	N/A	N/A
Barn Swallow	4	19	12	N/A	N/A	N/A
Common Yellowthroat	4	19	12	2	10	8
Baltimore Oriole	2	10	13	2	10	8
Eastern Wood Peewee	2	10	13	N/A	N/A	N/A
Least Sandpiper	1	5	14	N/A	N/A	N/A
Savannah Sparrow	1	5	14	N/A	N/A	N/A
Blue Jay	1	5	14	1	5	9
Black-capped Chickadee	1	5	14	1	5	9
Least Flycatcher	1	5	14	N/A	N/A	N/A
Black-throated Green Warbler	1	5	14	N/A	N/A	N/A
Downy Woodpecker	1	5	14	2	10	8
Blue-winged Teal	1	5	14	N/A	N/A	N/A
House Wren	1	5	14	1	5	9
Red-eyed Vireo	1	5	14	N/A	N/A	N/A
American Crow	N/A	N/A	N/A	3	14	7
Wilson's Snipe	N/A	N/A	N/A	1	5	9
Gray Catbird	N/A	N/A	N/A	1	5	9
Gadwall*	1	5	N/A	3	14	N/A
Mallard*	2	10	N/A	10	48	N/A
Northern Shoveler*	N/A	N/A	N/A	1	5	N/A
Ring-billed Gull*	N/A	N/A	N/A	4	19	N/A
Black Tern*	N/A	N/A	N/A	12	57	N/A
Belted Kingfisher*	N/A	N/A	N/A	1	5	N/A
Bald Eagle*	2	10	N/A	3	14	N/A
Turkey Vulture*	N/A	N/A	N/A	2	10	N/A

* Species for which the fixed-radius count results are not applicable.
** The figures indicated differ from those presented in the 2017 survey report, which contained an error. The figures in this table have been corrected.

3.3 Watercourses

3.3.1 De Biais Creek

De Biais Creek was surveyed twice, on June 3 and 16, 2018. The surveys were carried out between sunrise and 9:00 a.m. under ideal weather conditions.

In all, 34 species were observed during the 2018 surveys, of which 27 were using the riparian zone (water + bank + vegetated riparian strip + immediately adjacent habitat [0 m–25 m]). The vegetated riparian strip (which included herbaceous plants, shrubs and trees) was the habitat used most by birds. More species were counted there than in the immediately adjacent habitat (which consisted primarily of annual cropland and other human-modified environments): 16 versus 11. Most significantly, on average there were twice as many pairs of birds per kilometre of shoreline (**Table 6**). The riparian zone contained on average 53.5 pairs per kilometre in 2018, compared to 56.5 pairs per kilometre in 2017.

The most observed species in the riparian zone in 2018 were, in decreasing order, the Red-winged Blackbird, the Song Sparrow, the Common Grackle, the American Robin and, tied for fifth place, the Yellow Warbler and the Warbling Vireo. Five of these six species were also among the most abundant in 2017. In 2018, these species represented 61% of the pairs observed. With the exception of the Song Sparrow, these species used the vegetated riparian strip as much or more than the immediately adjacent habitats (from 2 to 4.5 times as many pairs were counted per kilometre of shoreline). The Red-winged Blackbird was present only in the riparian strip. These results clearly illustrate the birds' attraction to vegetated riparian strips.

Eleven new species were surveyed in 2018: the Gadwall, the Northern Cardinal, the Blue Jay, the Ring-billed Gull, the Pileated Woodpecker, the Green Heron (2 individuals in the marsh sector), the Blackpoll Warbler (in migration), the Northern Flicker, the Blue-winged Teal (a male), the Great Crested Flycatcher and the Brown-headed Cowbird. Conversely, the following 12 species were seen only in 2017: Wilson's Snipe, the Swamp Sparrow, the Spotted Sandpiper, the Tree Swallow, the Cedar Waxwing, the Chimney Swift, the Alder Flycatcher, the American Redstart, the Common Yellowthroat, the Killdeer, the House Finch and the Eastern Kingbird.

In addition to the Gadwall, the Green Heron and the Blue-winged Teal, the Mallard and the Great Blue Heron are the other species associated with aquatic habitats that were observed near or in the creek.

The birds observed in more distant adjacent habitats (> 25 m) provide an indication of the species that frequent the landscape surrounding De Biais Creek. In all, 17 species were observed in these habitats consisting of annual and, to a lesser extent, perennial cropland. The Song Sparrow and the American Crow were seen in farm hedgerows, while the Savannah Sparrow and the Bobolink (species assessed as Threatened in Canada) were seen in perennial cropland. The Chipping Sparrow, the American Robin, the House Sparrow and the Mourning Dove were associated with the nearby human-modified environments (the village of Saint-Ignace-de-Loyola).

Table 6. Mean relative abundance per kilometre of shoreline and habitats used by birds: De Biais Creek and adjacent habitats, 2017 and 2018 surveys

		2018							2017						
		Watercourse and riparian strip [2]		Adjacent habitats		Total riparian zone [4]	Adjacent habitats		Watercourse and riparian strip [2]		Adjacent habitats		Total riparian zone [4]	Adjacent habitats	
				0-25 m			> 25 m				0-25 m			> 25 m	
Code [1]	Species	Mean abundance (pairs/km)	Habitat [3]	Mean abundance (pairs/km)	Habitat [5]	Mean abundance (pairs/km)	Mean abundance (pairs/km)	Habitat [5]	Mean abundance (pairs/km)	Habitat [3]	Mean abundance (pairs/km)	Habitat [5]	Mean abundance (pairs/km)	Mean abundance (pairs/km)	Habitat [5]
DD	Wilson's Snipe								2	H			2		
JE	Song Sparrow	3	T; S+T	4	OF; FH; SW; HU	7	3	FH	3,5	H; T; S+T; H+S; H+S+T			3,5	4	FH; HU
S	Swamp Sparrow													1	MA
S	Savannah Sparrow						1	PC						1	PC; AC
AT	Chipping Sparrow						1	HU			1	HU	1	2	HU
S	American Bittern						1	PC	1	H			1		
P	Gadwall	1	W			1									
P	Mallard	2	W			2			1,5	W			1,5		
S	Northern Cardinal			1	HU	1									
P	Red-winged Blackbird	7,5	H; H+T; S+T; H+S+T			7,5	2	PC; FH	9,5	H; T; H+T; H+S+T	1	FH	10,5	2	FH
P	American Goldfinch	1	T	1	PC; OF	2			0,5	In flight			0,5		
S	Spotted Sandpiper								0,5	H			0,5		
H	American Crow	0,5	H			0,5	1	FH; FO						0,5	FO
NO	European Starling						4	AC; PC; HU	0,5	T			0,5	1	FO
H	Blue Jay	0,5	In flight			0,5	0,5	HU							
X	Ring-billed Gull	0,5	In flight			0,5									
T	Bobolink						2	PC						1	PC
H	Great Blue Heron	0,5	W			0,5			0,5	W			0,5		
S	Pileated Woodpecker			1	FO	1									
A	Green Heron	1	W; T			1									
H	Tree Swallow								0,5	In flight			0,5		
T	Cedar Waxwing								1	T			1		
H	Chimney Swift								1	In flight			1		
AT	American Robin	3	In flight; B; T; S+T	1,5	PC; HU	4,5	1	HU	4	H; T	1	AC; HU	5	2	HU
T	Black-capped Chickadee			1,5	OF; FH	1,5	0,5	HU						1	HU
NO	House Sparrow	2	S+T			2	2	HU			2	HU	2		
S	Gray Catbird	1	S+T			1								1	FH
T	Alder Flycatcher													1	FH
S	Baltimore Oriole	1	T			1					1	FO	1		
S	American Redstart										1	SW	1		
T	Yellow Warbler	2	T; S+T	2	SW	4	2	FH; FO	5	T; S+T	1	SW	6	2	FH
T	Common Yellowthroat								1	H+S+T	1	FH	2	1	FH
X	Blackpoll Warbler			1	FO	1									
S	Northern Flicker	1	T			1									
S	Downy Woodpecker	1	T			1			2	T			2		
S	Killdeer										1	AC	1		
JE	Common Grackle	4,5	B; T; S+T	1	PC; HU	5,5	1	HU	3,5	H; T	1	AC	4,5		
S	House Finch													1	HU
H	Blue-winged Teal	0,5	In flight, W			0,5									
H	White-breasted Nuthatch	0,5	T			0,5									
T	Mourning Dove						2	HU	1	T	1	HU	2		
T	Great Crested Flycatcher			1	SW	1									
S	Eastern Kingbird								1	S			1		
H	Brown Cowbird	0,5	T			0,5									
S	Red-eyed Vireo						1	FO	4	T	1	FH	5	2	FO; HU
T	Warbling Vireo	3	T; S+T	1	HU	4	1	FO; SW						1	HU
			Vegetated riparian strip only							Vegetated riparian strip only					
	Total	37,5	32,5	16		53,5	26		43,5	39,5	13		56,5	24,5	
	Number of species	22	16	11		27	17		20	15	12		25	17	

[1] Breeding evidence codes (based on the nomenclature used in the *Québec Breeding Bird Atlas*). A description of the codes is provided in Appendix E.

[2] Water + bank + vegetated riparian strip if present.

[3] **W** = water; **B** = bank; **H** = herbaceous cover; **S** = shrub cover; **T** = tree cover.

[4] Water + bank + riparian strip + adjacent habitat (0 m–25 m).

[5] Habitat codes: **AC** = annual cropland; **PC** = perennial cropland; **OW** = open water; **OF** = old field; **FH** = farm hedgerow; **MA** = marsh; **SW** = swamp; **HU** = human-modified environment; **FO** = forested area; **UF** = uncultivated farmland; **WM** = wet meadow.

Two species flew over the site without stopping: the Cedar Waxwing (nine individuals) and the Common Tern (two individuals).

Blue-winged Teal (on the left) and Mallard (on the right) in a Broad-leaved Arrowhead (*Sagittaria latifolia*) marsh – photo taken on June 16, 2018 by Alexandre Nicole

3.3.2 Marais de la Presqu'île

Marais de la Presqu'île was surveyed twice, on June 3 and 16, 2018. The surveys were carried out between sunrise and 9:00 a.m. under ideal weather conditions.

In all, 30 species were observed during the surveys of Marais de la Presqu'île, 23 of them in the riparian zone (water + bank + vegetated riparian strip + immediately adjacent habitat [0 to 25 m]). The vegetated riparian strip (composed of herbaceous plants, shrubs and trees) was the habitat used most frequently by birds. More species were counted there than in the immediately adjacent habitat (which consisted mainly of annual cropland, with some perennial crops): 16 versus 7 species, respectively. Most notably, there were four times as many pairs per kilometre of shoreline, on average, in the vegetated riparian strip (**Table 7**). The riparian zone contained on average 40.8 pairs per kilometre in 2018, compared to 52.5 pairs per kilometre in 2017.

In addition to the Song Sparrow, which was the most abundant bird, the species observed most frequently in the riparian zone (in descending order) were the Common Grackle, the Red-winged Blackbird, the Mallard and the Yellow Warbler; together, they represented 56% of the pairs observed. These species were also all among the most abundant species in 2017. With the exception of the Mallard, these species were observed both in the immediately adjacent habitat and in the vegetated riparian strip where they were more

abundant (from 1.5 to 12 times more pairs, on average, per kilometre of shoreline). These results once again demonstrate the birds' attraction to vegetated riparian strips.

The Song Sparrow used various habitats: riparian strips (with a marked preference for woody species), annual cropland, farm hedgerows, forested areas and swamps. The Common Grackle used treed swamps, annual cropland and human-modified environments. The presence of the Red-winged Blackbird was, with rare exceptions, limited to the vegetated riparian strip. Finally, the Yellow Warbler used riparian strips with shrub and/or tree vegetation.

Five new species were observed in 2018 (the Northern Cardinal, the Spotted Sandpiper, the Cedar Waxwing, the Willow Flycatcher and the Blackpoll Warbler), while 12 species surveyed in 2017 were not seen in 2018, including the Gadwall, the Wood Duck and the Eastern Wood Peewee.

Among the species observed in the riparian zone, only the Mallard and the Great Blue Heron used the watercourse, while the Spotted Sandpiper and the Common Grackle fed on the banks.

In the swamps formed by widenings of the watercourse between Highway 158 and its mouth in the Chenal aux Castors, the most observed species were the Baltimore Oriole, the Common Grackle and the Warbling Vireo.

Nesting of the European Starling in the riparian zone was confirmed by the discovery of a nest with young in a snag. Although a few families of Common Grackles were observed in the riparian zone, it cannot be determined with certainty if this species nested in the riparian zone or in more distant adjacent habitats.

The results obtained in the more distant adjacent habitats (> 25 m) provide an indication of the species that frequent the landscape surrounding Marais de la Presqu'île. In all, 18 species were counted in these habitats, which are made up largely of annual cropland with a smaller amount of perennial cropland and pasture. The Bobolink (species assessed as Threatened in Canada), the Savannah Sparrow and the European Starling were seen or heard in the pastures and on the adjacent perennial cropland. The Willow Flycatcher, the Yellow Warbler and the Common Yellowthroat were among the species that used farm hedgerows. The Northern Cardinal, the American Robin, the Black-capped Chickadee and seven other species were associated with human-modified environments (the village core of La Visitation-de-l'Île-Dupas and other residences).

Three species flew over the site but did not land: the Canada Goose (eight individuals), the Double-crested Cormorant (one individual) and the Ring-billed Gull (five individuals).

Table 7. Mean relative abundance per kilometre of shoreline and habitats used by birds: Marais de la Presqu'île and adjacent habitats, 2017 and 2018 surveys

		2018							2017						
		Watercourse and riparian strip[2]		Adjacent habitats		Total riparian zone[4]	Adjacent habitats		Watercourse and riparian strip[2]		Adjacent habitats		Total riparian zone[4]	Adjacent habitats	
				0-25 m			> 25 m				0-25 m			> 25 m	
Code[1]	Species	Mean abundance (pairs/km)	Habitat[3]	Mean abundance (pairs/km)	Habitat[5]	Mean abundance (pairs/km)	Mean abundance (pairs/km)	Habitat[5]	Mean abundance (pairs/km)	Habitat[3]	Mean abundance (pairs/km)	Habitat[5]	Mean abundance (pairs/km)	Mean abundance (pairs/km)	Habitat[5]
AT	Song Sparrow	5	H; T; H+S; H+T; H+S+T	3,25	AC; FH; FO; HU	8,25	2,5	FH; HU	7	S; T; H+T; H+S+T	0,75	FH; HU	7,75	4	FH; HU
S	Swamp Sparrow	0,5	H+S			0,5								0,5	FH
T	Savannah Sparrow			0,5	PC	0,5	0,5	PC						0,5	PC
T	Chipping Sparrow										0,5	HU	0,5	1,5	HU
S	American Bittern								0,25	H			0,25		
H	Wood Duck								0,75	W			0,75		
P	Gadwall								0,5	W	0,5	AC	1		
JE	Mallard	3	In flight; W			3			1,75	W			1,75		
P	Northern Cardinal						0,5	HU							
P	Red-winged Blackbird	3	In flight; S; T; H+T; H+S+T	0,25	PC	3,25	1,25	FH	3,25	H; T; H+S; H+T	2	PC	5,25	0,5	FH
P	American Goldfinch	1,75	In flight; S; T			1,75	0,25	FH	1	H; T	0,5	FO	1,5	0,75	FH; HU
H	Spotted Sandpiper	0,5	B			0,5									
JE	American Crow	1	T			1			1	T			1		
NJ	European Starling	1,75	T; S+T			1,75	0,5	PC	2	H; T	0,5	HU	2,5	2,25	PC; HU
T	Blue Jay	0,25	In flight			0,25			0,25	T	0,5	FO	0,75	0,25	HU
X	Ring-billed Gull													0,5	
T	Bobolink						1	PC						2	PC
H	Great Blue Heron	0,5	B; W			0,5			0,5	H			0,5		
H	Tree Swallow	0,5	In flight			0,5			1	In flight			1		
H	Barn Swallow	0,25	In flight			0,25								0,25	PC
H	Cedar Waxwing	2	T			2									
JE	American Robin	1	T; S+T	0,75	PC	1,75	1	HU	2	H; T; H+T	0,5	PC	2,5	2,25	HU
T	Black-capped Chickadee						1	HU	0,5	T			0,5	1	HU
H	House Sparrow						0,5	HU						1	HU
S	Brown Thrasher													0,5	HU
S	Willow Flycatcher						0,5	FH							
P	Baltimore Oriole	2	T			2	0,5	HU	1	T; H+T	0,5	FO	1,5	0,5	FO
T	Yellow Warbler	2	T; S; H+T; H+S+T	0,5	FH	2,5	0,5	FH	2	T; H+S; H+T; H+S+T			2		
P	Common Yellowthroat	1	S+T; H+S+T	0,5	FH	1,5	1	FH	0,5	T	0,5	OF; FH	1	0,5	OF; FH
X	Blackpoll Warbler	0,5	T			0,5									
S	Northern Flicker								0,5	T			0,5		
NJ	Downy Woodpecker	0,5	T			0,5			1	T			1	0,5	FO
S	Eastern Wood Peewee								0,5	T			0,5		
S	Killdeer													0,25	AC
AT	Common Grackle	5	In flight; B; T; H+T	0,75	AC; HU	5,75	0,5	HU	3,75	H; T			3,75	0,5	HU
T	White-breasted Nuthatch								0,5	T			0,5		
T	Mourning Dove						0,5	HU	0,25	T	0,5	HU	0,75	0,5	AC
S	House Wren													0,5	HU
S	Eastern Kingbird								0,5	H+T			0,5		
S	Brown Cowbird	0,25	T			0,25					0,5	FO	0,5		
S	Red-eyed Vireo						0,5	HU	2	T			2	0,5	FO
T	Warbling Vireo	2	T			2	2	FO; HU	0,5	T			0,5	0,5	FO
			Vegetated riparian strip only							Vegetated riparian strip only					
	Total	34,25	29,25	6,5		40,75	15		44,75	30,75	7,75		52,5	22	
	Number of species	22	16	7		23	18		26	22	12		28	24	

[1] Breeding evidence codes (based on the nomenclature used in the *Québec Breeding Bird Atlas*). A description of the codes is provided in Appendix E.

[2] Water + bank + vegetated riparian strip if present.

[3] **W** = water; **B** = bank; **H** = herbaceous cover; **S** = shrub cover; **T** = tree cover.

[4] Water + bank + riparian strip + adjacent habitat (0 m–25 m).

[5] Habitat codes: **AC** = annual cropland; **PC** = perennial cropland; **OW** = open water; **OF** = old field; **FH** = farm hedgerow; **MA** = marsh; **SW** = swamp; **HU** = human-modified environment; **FO** = forested area; **UF** = uncultivated farmland; **WM** = wet meadow.

3.3.3 Chenal du Nord

Chenal du Nord was surveyed twice, on June 6 and 17, 2018. The surveys were carried out between sunrise and 9:00 a.m. under ideal weather conditions.

In all, 28 species were observed during the Chenal du Nord surveys. Of those species, 16 used the riparian zone (water + bank + vegetated riparian strip + immediately adjacent habitat [0 m–25 m]) (**Table 8**). The immediately adjacent habitat was higher in species richness and pair density than the vegetated riparian strip (whose vegetation is limited in several locations, i.e. bare ground, herbaceous or occasionally shrub vegetation). This can be explained at least in part by the diversity of the immediately adjacent habitat, which, although dominated by annual cropland, also includes perennial cropland, a small wooded area and swamps. The riparian zone contained on average 32.7 pairs per kilometre in 2018, compared to 35 pairs per kilometre in 2017.

The species encountered most frequently in the riparian zone were (in decreasing order) the Song Sparrow, the Red-winged Blackbird, the Yellow Warbler, the Common Grackle and the Spotted Sandpiper; together, they represented 74% of the pairs observed. With the exception of the Spotted Sandpiper, these species were all among the most abundant species in 2017. The extended flooding of 2017 was probably unfavourable to this species, which builds its nest on the ground. In 2018, the Song Sparrow, the Spotted Sandpiper and the Common Grackle were 1.4 to 3 times more abundant in the vegetated riparian strip (or on the banks) than in the adjacent habitat. The Red-winged Blackbird was twice as abundant in the immediately adjacent habitat (mainly perennial cropland) than in the riparian strip. The Yellow Warbler was only present in the immediately adjacent habitat, where it was associated with old fields, forested areas and swamps.

Seven new species were observed in 2018 (the Blue Jay, the Cedar Waxwing, the House Sparrow, the Magnolia Warbler, the Downy Woodpecker, the Great Crested Flycatcher and the Brown-headed Cowbird), while ten species observed in 2017 were not seen again on the site in 2018, including the Gadwall and the Mallard. The aquatic habitats created by the extended flooding of 2017 probably favoured the presence of these two species of Anatidae. The Blue Jay, the Cedar Waxwing, the House Sparrow and the Magnolia Warbler were present on residential lots, the Downy Woodpecker and the Great Crested Flycatcher in the swamps, and the Brown-headed Cowbird in both of these habitats.

The young woodland of Eastern Cottonwoods which was frequented by at least eight species in 2017 was occupied only by the Song Sparrow, the American Robin and the Black-capped Chickadee in 2018. The Red-breasted Nuthatch was seen again, but in a conifer on a residential lot. The Eastern Wood Peewee (species assessed as Special Concern in Canada) and the Barn Swallow (species assessed as Threatened in Canada) were not detected near the watercourse in 2018.

No duck species were seen on the watercourse. However, the Spotted Sandpiper was more abundant than in 2017 in the riparian zone, and its nesting was confirmed in the immediately adjacent habitat composed of perennial cropland (nest with four eggs). A Red-winged Blackbird nest containing two eggs was also discovered nearby. Two young American Robins were also observed in the immediately adjacent habitat.

Table 8. Mean relative abundance per kilometre of shoreline and habitats used by birds: Chenal du Nord and adjacent habitats, 2017 and 2018 surveys

		2018							2017						
		Watercourse and riparian strip[2]		Adjacent habitats		Total riparian zone[4]	Adjacent habitats		Watercourse and riparian strip[2]		Adjacent habitats		Total riparian zone[4]	Adjacent habitats	
				0-25 m			> 25 m				0-25 m			> 25 m	
Code[1]	Species	Mean abundance (pairs/km)	Habitat[3]	Mean abundance (pairs/km)	Habitat[5]	Mean abundance (pairs/km)	Mean abundance (pairs/km)	Habitat[5]	Mean abundance (pairs/km)	Habitat[3]	Mean abundance (pairs/km)	Habitat[5]	Mean abundance (pairs/km)	Mean abundance (pairs/km)	Habitat[5]
T	Song Sparrow	4,55	B; H; T; H+S; H+T; H+S+T	3,18	PC; FO; SW	7,73	6,36	FH; FO; SW; HU	4,55	T; H+T; H+S+T	2,73	FO	7,27	4,55	OF; FH, HU; WM
S	Chipping Sparrow						0,91	HU						0,91	HU
H	Gadwall													0,45	MA
P	Mallard								0,91	W			0,91		
S	Northern Cardinal						0,45	HU						0,91	HU
NF	Red-winged Blackbird	1,82	T; H+S+T	3,64	PC	5,46	1,82	FH; HU	4,09	T; H+S; H+T; H+S+T			4,09	0,91	HU
S	American Goldfinch	0,45	In flight			0,45	0,91	HU	0,45	H+S+T			0,45		
NF	Spotted Sandpiper	1,82	B; H; T; H+S; H+T; H+S+T	0,91	PC	2,73					0,45	PC	0,45	1,36	HU; WM
H	American Crow			0,45	FO	0,45			0,45	In flight			0,45	0,45	UF
JE	European Starling						0,91	HU	0,91	In flight			0,91	1,36	HU
H	Blue Jay						0,91	HU							
X	Ring-billed Gull						6,36	HU						21,82	UF
H	Tree Swallow	0,45	In flight			0,45			0,45	In flight			0,45		
H	Barn Swallow								0,45	In flight			0,45		
H	Cedar Waxwing						0,91	HU							
JE	American Robin	0,45	H+S+T	0,91	FO; HU	1,36	0,91	FO; HU	0,91	H; T			0,91	1,82	HU
T	Black-capped Chickadee			0,91	FO	0,91	1,36	SW; HU			0,91	SW	0,91		
H	House Sparrow						0,45	HU							
T	Eastern Phoebe													0,91	HU
T	Baltimore Oriole			0,91	FH; SW	0,91			0,91	T			0,91	0,91	SW
X	Magnolia Warbler						0,91	HU							
S	American Redstart										0,91	FO	0,91	0,91	SW
P	Yellow Warbler			4,55	OF; FO; SW	4,55	1,82	FO; SW	0,45	H+T	4,55	FO; SW	5,00	1,82	OF; FO; SW
T	Common Yellowthroat			0,91	OF	0,91					0,91	FO	0,91	1,82	OF; HU
P	Northern Flicker						0,45	HU	0,91	H+S+T			0,91		
H	Downy Woodpecker			0,45	FO; SW	0,45									
S	Eastern Wood Pewee										0,91	SW	0,91		
JE	Killdeer										1,82	AC; UF	1,82		
H	Bald Eagle													0,45	SW
JE	Common Grackle	2,73	In flight; T; H+S+T	0,91	FO	3,64	1,82	HU	1,82	T; H+T; H+S+T	0,45	PC	2,27		
S	House Finch													0,91	HU
S	Red-breasted Nuthatch						0,91	HU			0,45	FO	0,45		
S	Mourning Dove						0,91	HU						0,91	HU
T	Great Crested Flycatcher			0,91	SW	0,91	0,91	HU							
S	Eastern Kingbird								0,91	T			0,91		
T	Brown Cowbird						1,36	SW; HU							
S	Red-eyed Vireo			0,91	SW	0,91								0,91	SW
T	Warbling Vireo			0,91	SW	0,91	1,82	FO; SW			2,73	FO; SW	2,73	0,91	FO; SW
			Vegetated riparian strip only							Vegetated riparian strip only					
	Total	12,27	11,37	20,46		32,73	33,17		18,18	15,01	16,82		35,00	45,00	
	Number of species	7	5	14		16	21		14	9	11		22	20	

[1] Breeding evidence codes (based on the nomenclature used in the *Québec Breeding Bird Atlas*). A description of the codes is provided in Appendix E.

[2] Water + bank + vegetated riparian strip if present.

[3] **W** = water; **B** = bank; **H** = herbaceous cover; **S** = shrub cover; **T** = tree cover.

[4] Water + bank + riparian strip + adjacent habitat (0 m–25 m).

[5] Habitat codes: **AC** = annual cropland; **PC** = perennial cropland; **OW** = open water; **OF** = old field; **FH** = farm hedgerow; **MA** = marsh; **SW** = swamp; **HU** = human-modified environment; **FO** = forested area; **UF** = uncultivated farmland; **WM** = wet meadow.

Red-winged Blackbird nest (on the left) and Spotted Sandpiper nest (on the right) in perennial cropland adjoining the Chenal du Nord – photos taken on June 6, 2018 by Alexandre Nicole

The birds observed in the more distant adjacent habitats (> 25 m) provide an indication of the species that frequent the landscape surrounding the Chenal du Nord. In all, 21 species were observed in these habitats, which consisted mostly of annual and perennial cropland, but also included swamps and human-modified environments. Of these 21 species, 19 used human-modified environments. A few species were also found in farm hedgerows, swamps and forested areas. No species were observed in the annual or perennial cropland of the more distant adjacent habitats.

Three species flew over the site without stopping: the Canada Goose (18 individuals), the Mallard (150 individuals) and the Barn Swallow.

3.3.4 Fossé de la Baie

Fossé de la Baie was surveyed twice, on June 6 and 17, 2018. The surveys were carried out between sunrise and 9:00 a.m. under ideal weather conditions.

In all, 32 species were observed during the surveys of Fossé de la Baie, including 25 that were using the riparian zone (water + bank + vegetated riparian strip + immediately adjacent habitat) (**Table 9**). Compared to the immediately adjacent habitat, the vegetated riparian strip contained fewer species (12 versus 20), but a higher density of pairs per kilometre of shoreline (8.4 versus 6.1, Ring-billed Gulls excluded).

With the exception of the Ring-billed Gull, which represented 21% of the pairs observed in the riparian zone (group which was feeding in a field), the other species observed most frequently in the riparian zone were (in descending order) the Song Sparrow, the Red-winged Blackbird, the Yellow Warbler, the Savannah Sparrow and, tied for fifth place, the American Robin and the European Starling. The species occupying the first three positions were the same as in 2017 (excluding the Mallard and the Canada Goose), although the Red-winged Blackbird was the most abundant species that year. The six species, which accounted for 65% of the pairs observed (excluding the Ring-billed Gull), were 1.5 to 6 times more abundant in the riparian strip than in the immediately adjacent habitat (with the

exception of the Savannah Sparrow). The Savannah Sparrow was equally abundant in the croplands where it nests as in the vegetated riparian strip that it uses for foraging and singing (when perches are present). The Song Sparrow was always observed in proximity to woody species, while the Red-winged Blackbird was observed in the herbaceous riparian strips with or without woody species. The vegetated riparian strip was frequented by six times more Yellow Warblers than the immediately adjacent habitats (swamps), while this species was 2.5 times more numerous in the adjacent habitat in 2017. Finally, the American Robin and the European Starling were observed in the trees and shrubs of the riparian strip as well as in annual cropland and human-modified environments. The American Robin was also seen feeding on the bare banks.

Six new species were observed in 2018 (the Horned Lark, the Ring-billed Gull, the Brown Creeper, the Cedar Waxwing, the Hairy Woodpecker and the Brown-headed Cowbird), while seven species observed in 2017 were not seen again on the site in 2018, including Wilson's Snipe, the Gadwall, the American Black Duck and the Snow Goose. We note once again that the aquatic species were less numerous in 2018 than in 2017. In fact, like the Marais de la Presqu'île, the only species using open water in 2018 were the Mallard and the Great Blue Heron.

The swamps at the northeastern end of Fossé de la Baie contributed significantly to the list of species observed. The species associated only with this area are the Brown Creeper, the Least Flycatcher, the American Redstart, the Downy Woodpecker, the House Wren, the Brown-headed Cowbird, the Red-eyed Vireo and the Warbling Vireo.

The birds observed in the more distant adjacent habitats (> 25 m) provide an indication of the species that frequent the landscape surrounding Fossé de la Baie. In all, 20 species, nine more than in 2017, were observed in those habitats, which consisted mainly of annual cropland, with some perennial crops and swamps. Despite their small area in comparison with the other habitats, the swamps were frequented by more species (11) than annual cropland (6), perennial cropland (2), farm hedgerows (2) and wet meadows (2). Two species at risk were also detected there: the Eastern Wood Peewee (species assessed as Special Concern in Canada) and the Bald Eagle (species designated Vulnerable in Quebec).

Two species, the American Crow (3 individuals) and the Common Raven (2 individuals), flew over the site but did not land.

Table 9. Mean relative abundance per kilometre of shoreline and habitats used by birds: Fossé de la Baie and adjacent habitats, 2017 and 2018 surveys

		2018							2017						
		Watercourse and riparian strip[2]		Adjacent habitats		Total riparian zone[4]	Adjacent habitats		Watercourse and riparian strip[2]		Adjacent habitats		Total riparian zone[4]	Adjacent habitats	
				0-25 m			> 25 m				0-25 m			> 25 m	
Code[1]	Species	Mean abundance (pairs/km)	Habitat[3]	Mean abundance (pairs/km)	Habitat[5]	Mean abundance (pairs/km)	Mean abundance (pairs/km)	Habitat[5]	Mean abundance (pairs/km)	Habitat[3]	Mean abundance (pairs/km)	Habitat[5]	Mean abundance (pairs/km)	Mean abundance (pairs/km)	Habitat[5]
T	Horned Lark						0,54	AC							
S	Wilson's Snipe													0,27	
H	Canada Goose						2,7	AC	1,22	W	11,35	AC; UF	12,57		
JE	Song Sparrow	2,16	S; H+S; H+T	1,08	AC; OF; FH; SW	3,24	1,62	FH; SW; WM	1,35	S; T; H+S; H+S+T	0,54	AC; SW	1,89	1,62	FH; FO; UF
T	Savannah Sparrow	0,54	B; H	0,54	AC; PC	1,08	1,89	AC; PC	0,81	H; H+S			0,81	1,08	AC; PC
H	Red-tailed Hawk										0,14	FH	0,14		
H	American Bittern						0,27	MA	0,27	H			0,27		
H	Gadwall								0,14	W			0,14		
P	Mallard	0,27	W			0,27			26,89	W			26,89		
P	American Black Duck								0,27	W			0,27		
P	Red-winged Blackbird	1,49	H; S; S+T; H+S+T	0,81	AC; OF; HU; WM	2,3	0,68	FH; UF; WM	2,57	H; S; H+S; H+S+T	0,54	AC; FH	3,11		
T	American Goldfinch	0,27	In flight; S+T	0,27	SW	0,54			0,54	T; H+S+T			0,54		
T	Spotted Sandpiper	0,41	B; H	0,14	AC	0,55			0,95	H	0,14	AC; UF	1,08		
H	American Crow								0,14	In flight			0,14		
H	European Starling	0,41	In flight; S+T	0,27	AC	0,68			0,14	H+S			0,14	5,00	AC
X	Ring-billed Gull			4,05	AC	4,05	18,24	AC							
T	Bobolink						1,08	PC			0,81	PC	0,81	0,54	PC
H	Great Blue Heron	0,14	W			0,14			0,27	W	0,14	AC	0,41		
S	Brown Creeper			0,27	SW	0,27									
H	Tree Swallow	0,14	In flight			0,14			0,41	In flight			0,41		
H	Barn Swallow								0,27	In flight			0,27		
H	Cedar Waxwing	0,27	S+T			0,27									
A	American Robin	0,54	B; H+S	0,14	AC; SW	0,68	0,27	SW	0,27	T			0,27	0,14	FO
T	Willow Flycatcher	0,27	S			0,27			0,27	S			0,27		
T	Least Flycatcher			0,27	SW	0,27	0,27	SW			0,27	SW	0,27	0,27	SW
X	Snow Goose								0,14	W			0,14		
S	American Redstart			0,27	SW	0,27	0,27	SW	0,27	T			0,27		
T	Yellow Warbler	1,62	T; S+T	0,27	SW	1,89	1,62	SW	0,54	S; H+S+T	1,35	SW	1,89	0,27	FO
P	Hairy Woodpecker	0,14	T	0,27	SW	0,41									
S	Downy Woodpecker			0,14	SW	0,14					0,54	SW	0,54		
T	Eastern Wood Peewee						0,54	SW						0,54	SW
JE	Killdeer			0,14	HU	0,14	0,68	AC			1,35	AC; UF	1,35		
H	Bald Eagle						0,14	SW	0,14	In flight			0,14		
JE	Common Grackle	0,14	In flight	0,14	AC	0,28	0,14	AC	0,27	H	0,54	FH	0,81		
T	House Wren			0,27	SW	0,27	0,27	SW			0,27	SW	0,27		
S	Great Crested Flycatcher						0,27	SW						0,27	SW
C	Brown Cowbird			0,27	SW	0,27									
T	Red-eyed Vireo			0,27	SW	0,27	0,27	SW	0,27	T			0,27	0,00	
T	Warbling Vireo	0,27	T	0,27	SW	0,54	0,27	SW			0,54	SW	0,54	0,27	FO
			Vegetated riparian strip only							Vegetated riparian strip only					
	Total	9,08	8,39	10,15		19,23	32,03		38,38	8,51	18,51		56,89	10,27	
	Number of species	16	12	20		25	20		23	13	14		30	11	

[1] Breeding evidence codes (based on the nomenclature used in the *Québec Breeding Bird Atlas*). A description of the codes is provided in Appendix E.

[2] Water + bank + vegetated riparian strip if present.

[3] **W** = water; **B** = bank; **H** = herbaceous cover; **S** = shrub cover; **T** = tree cover.

[4] Water + bank + riparian strip + adjacent habitat (0 m–25 m).

[5] Habitat codes: **AC** = annual cropland; **PC** = perennial cropland; **OW** = open water; **OF** = old field; **FH** = farm hedgerow; **MA** = marsh; **SW** = swamp; **HU** = human-modified environment; **FO** = forested area; **UF** = uncultivated farmland; **WM** = wet meadow.

Several locations along Fossé de la Baie do not meet the minimum regulated riparian strip width, which limits its wildlife potential – photo taken on June 6, 2018 by Alexandre Nicole

Conclusion

Segment 1
The waterfowl survey of Segment 1 was carried out under good weather conditions during the months of April and May 2018. The maximum number of Greater Snow Geese counted in a visit was 27,500 individuals, while the maximum number of Northern Pintails was 2,880. No species at risk were observed in Segment 1. It will be interesting to see how the restoration of the site will promote the maintenance of a high-quality resting and feeding area for waterfowl during the migratory period.

Segment 5
The survey of Segment 5 was carried out under ideal weather conditions while the flood waters had almost entirely receded.

Of the 45 species found in 2018, 13 had not been observed in 2017. The new species were identified in flight or in the swamps. Several aquatic species or species attracted by water surveyed in 2017 were absent (Wilson's Snipe, Canada Goose, Wood Duck, Northern Shoveler, Ring-billed Gull and Green-winged Teal) or were present, but in lower numbers (Mallard, Great Blue Heron, Great Egret, Black Tern, Tree Swallow, Bald Eagle and Turkey Vulture) in 2018.

In general, the relative abundance of songbirds (number of pairs per point count location) was higher in 2018. The Song Sparrow, the Red-winged Blackbird, the Tree Swallow, the Common Grackle and the Yellow Warbler were the most abundant species. With the exception of the Tree Swallow, these are generalist species that adapt well to the habitats found in Segment 5 (Maisonneuve et al., 1996; Gagnon-Lupien, 2013).

The species at risk observed during the surveys of Segment 5 in 2018 were the Barn Swallow (species assessed as Threatened in Canada), the Chimney Swift (species assessed as Threatened in Canada), the Eastern Wood Peewee (species assessed as Special Concern in Canada) and the Bald Eagle (species designated Vulnerable in Quebec).

In short, the revegetation of the areas in Segment 5 where agriculture has been abandoned should offer great potential for birds, which will undoubtedly see their abundance increase significantly. However, from year to year, the flood dynamics in this sector will have an impact on the abundance and even the presence of several species, in particular the species attracted by water and the species that nest on or near the ground.

Watercourses
The watercourse surveys were carried out under ideal weather conditions. The Song Sparrow, the Red-winged Blackbird and the Yellow Warbler were among the most abundant species along the four watercourses in 2018, as in 2017. In the Îles de Berthier area, the largest numbers of species and of pairs per kilometre of shoreline were recorded in the vegetated riparian strips, while the reverse was true in the Sainte-Geneviève-de-Berthier sector, where the riparian strips were often denuded of vegetation, or even under cultivation.

The Chenal du Nord, located in an intensive agricultural area, was the watercourse whose riparian zone had the lowest number of species (16), while the relative abundance was

lowest in the riparian zone of Fossé de la Baie (15.18 pairs per kilometre) (**Table 10**). The riparian zones of the De Biais Creek and Marais de la Presqu'île, whose riparian strips were well vegetated, had densities of 40.75 and 53.50 pairs per kilometre. The watercourses with larger numbers of species and higher pair densities were generally those characterized by denser vegetation and greater structural diversity of habitats.

Table 10. Number of species and mean relative abundance per kilometre of shoreline of the birds observed in the riparian zone (water + bank + vegetated riparian strip + immediately adjacent habitat) of the watercourses, 2017 and 2018 surveys

Watercourse	2018		2017	
	Number of species	Relative abundance Pairs/km	Number of species	Relative abundance Pairs/km
De Biais Creek	27	53.50	25	56.50
Marais de la Presqu'île	23	40.75	28	52.50
Chenal du Nord	16	32.73	22	35.00
Fossé de la Baie	25	15.18 [1]	22	17.53 [2]

[1] Group of Ring-billed Gulls excluded

[2] Canada Geese and Mallards excluded

Generally, a lower abundance of pairs per kilometre was measured in 2018 compared to 2017. This is explained by the presence of fewer species of Anatidae as well as fewer individuals of those species. For example, only the Mallard was observed in 2018 in the Marais de la Presqu'île, the Chenal du Nord and the Fossé de la Baie, while the Canada Goose, the Wood Duck, the Gadwall and the American Black Duck were present in one or more of these three watercourses in 2017.

One species at risk was observed in De Biais Creek: the Bobolink (species assessed as Threatened in Canada); two in the Marais de la Presqu'île: the Bobolink and the Barn Swallow (species assessed as Threatened in Canada); none in the Chenal du Nord; and three in the Fossé de la Baie: the Bobolink, the Eastern Wood Peewee (species assessed as Special Concern in Canada) and the Bald Eagle (species designated Vulnerable in Quebec).

Now that three of the four watercourses have been restored, the composition and density of the bird communities that are associated with them should change over time. It will be interesting to measure the magnitude of these changes in the coming years.

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Appendix A

Point count field sheets

(available in French only)

INVENTAIRE DES OISEAUX CHANTEURS DANS LE SEGMENT 5 À SAINT-BARTHÉLEMY- ÉTÉ 2018

No STATION :	OBSERVATEUR :	TEMPÉRATURE :
No VISITE (1 ou 2) :	Nbre PAGES POUR CETTE STATION :	VENT :
DATE :		PRÉCIPITATIONS :
HEURE (DÉBUT- FIN) :		ENNUAGEMENT :

ESPÈCES	

- **VENT** :
  - **0** : PAS DE VENT
  - **1** : VENT FAIBLE (LES FEUILLES BOUGENT)
  - **2** : VENT MOYEN (LES BRANCHES BOUGENT)
  - **3** : VENT FORT (LES BRANCHES PLIENT)
  - **4** : VENT VIOLENT (LES BRANCHES CASSENT)
- **PRÉCIPITATIONS** :
  - **0** : PAS DE PRÉCIPITATIONS
  - **1** : BRUINE
  - **2** : PLUIE LÉGÈRE
  - **3** : PLUIE FORTE
  - **4** : ORAGE
- **ENNUAGEMENT** :
  - **0** : CLAIR, DÉGAGÉ
  - **1** : PARTIELLEMENT COUVERT
  - **2** : COUVERT

REMARQUES :

- **TYPE DE CONTACT :**
  - **T** : COMPORTEMENT **T**ERRITORIAL (CHANT)
  - **C** : **C**RI
  - **H** : OBSERVATION VISUELLE DANS L'**H**ABITAT
  - **V** : **V**OL
  - **S** : **S**URVOL AU DESSUS DE L'HABITAT (HAUT DANS LES AIRS)
  - **N** : **N**ID
  - **F** : **F**AMILLE
- **SEXE :** ♂ : MÂLE ; ♀ : FEMELLE
- **DISTANCE ENTRE L'OISEAU ET LE POINT D'ÉCOUTE:**
  - **I** : À L'**I**NTÉRIEUR DU RAYON DE 75 M
  - **E** : À L'**E**XTÉRIEUR DU RAYON DE 75 M
- **POSITION DE L'OISEAU :**
  - **A** : À L'INTÉRIEUR DES LIMITES DE L'**A**MÉNAGEMENT
  - **H** : **H**ORS LIMITES DE L'AMÉNAGEMENT
  - **P**: DANS LA BANDE DE TENURE **P**RIVÉE
- **HABITAT UTILISÉ :**
  - **CA** : **C**ULTURE **A**NNUELLE
  - **CP** : **C**ULURE **P**ÉRENNE
  - **NC** : AGRICOLE **N**ON **C**ULTIVÉ
  - **HA** : **HA**IE **A**GRICOLE
  - **EL** : **E**AU **L**IBRE
  - **FR** : **FR**ICHE
  - **MA** : **MA**RAIS
  - **MG** : **M**ARÉCA**G**E
  - **MQ** : **M**ILIEU ANTHROPI**Q**UE
  - **MF** : **M**ILIEU **F**ORESTIER
  - **UM** : PRAIRIE H**UM**IDE

Appendix B

Segment 5 point count coordinates

Point	Latitude	Longitude
SEG5-01	46.17438177	-73.04370087
SEG5-02	46.17553885	-73.04077718
SEG5-03	46.17669586	-73.03785336
SEG5-04	46.17785280	-73.03492942
SEG5-05	46.17321301	-73.04371054
SEG5-06	46.17437010	-73.04078690
SEG5-07	46.17552711	-73.03786315
SEG5-08	46.17668405	-73.03493927
SEG5-09	46.17262281	-73.04225843
SEG5-10	46.17377986	-73.03933480
SEG5-11	46.17493683	-73.03641105
SEG5-12	46.17609373	-73.03348717
SEG5-13	46.17145405	-73.04226813
SEG5-14	46.17261110	-73.03934456
SEG5-15	46.17376808	-73.03642087
SEG5-16	46.17492498	-73.03349706
SEG5-17	46.17086383	-73.04081609
SEG5-18	46.17202085	-73.03789252
SEG5-19	46.17317779	-73.03496883
SEG5-20	46.17085209	-73.03790231
SEG5-21	46.17200903	-73.03497868

Appendix C

Watercourse transect field sheet

(available in French only)

INVENTAIRE DES OISEAUX CHANTEURS DES COURS D'EAU - ÉTÉ 2018

NOM DU COURS D'EAU :	OBSERVATEUR : AN		TEMPÉRATURE :
No VISITE (1 ou 2) :	Nbre PAGES POUR CE COURS D'EAU :		VENT :
DATE : JUIN 2018			PRÉCIPITATIONS :
HEURE (DÉBUT- FIN) :			ENNUAGEMENT :

ESPÈCE	Nbre INDIVIDUS	TYPE DE RECENSEMENT	SEXE	LOCALISATION (E, R, B ou M)	SI BANDE RIVERAINE - HABITAT (H, U, O)	MILIEU ADJACENT - I ou E vs 1er 25 m	MILIEU ADJACENT - HABITAT	REMARQUES

- VENT :
0 : PAS DE VENT
1 : VENT FAIBLE (LES FEUILLES BOUGENT)
2 : VENT MOYEN (LES BRANCHES BOUGENT)
3 : VENT FORT (LES BRANCHES PLIENT)
4 : VENT VIOLENT (LES BRANCHES CASSENT)

- PRÉCIPITATIONS :
0 : PAS DE PRÉCIPITATIONS
1 : BRUINE
2 : PLUIE LÉGÈRE
3 : PLUIE FORTE
4 : ORAGE

- ENNUAGEMENT :
0 : CLAIR, DÉGAGÉ
1 : PARTIELLEMENT COUVERT
2 : COUVERT

REMARQUES :

- TYPE DE RECENSEMENT :
T : COMPORTEMENT **T**ERRITORIAL (CHANT)
C : **C**RI
H : OBSERVATION VISUELLE DANS L'**H**ABITAT
V : **V**OL
S : **S**URVOL AU DESSUS DE L'HABITAT (HAUT DANS LES AIRS)
N : **N**ID
F : **F**AMILLE

- SEXE : ♂ : MÂLE ♀ : FEMELLE

- LOCALISATION DE L'OISEAU :
E : **E**AU LIBRE
R : **R**IVE
B : **B**ANDE DE VÉGÉTATION RIVERAINE
M : **M**ILIEU ADJACENT

- BANDE DE VÉGÉTATION RIVERAINE - HABITAT UTILISÉ :
H : **H**ERBACÉES
U : ARB**U**STES
O: ARBRES (ARB**O**RÉ)

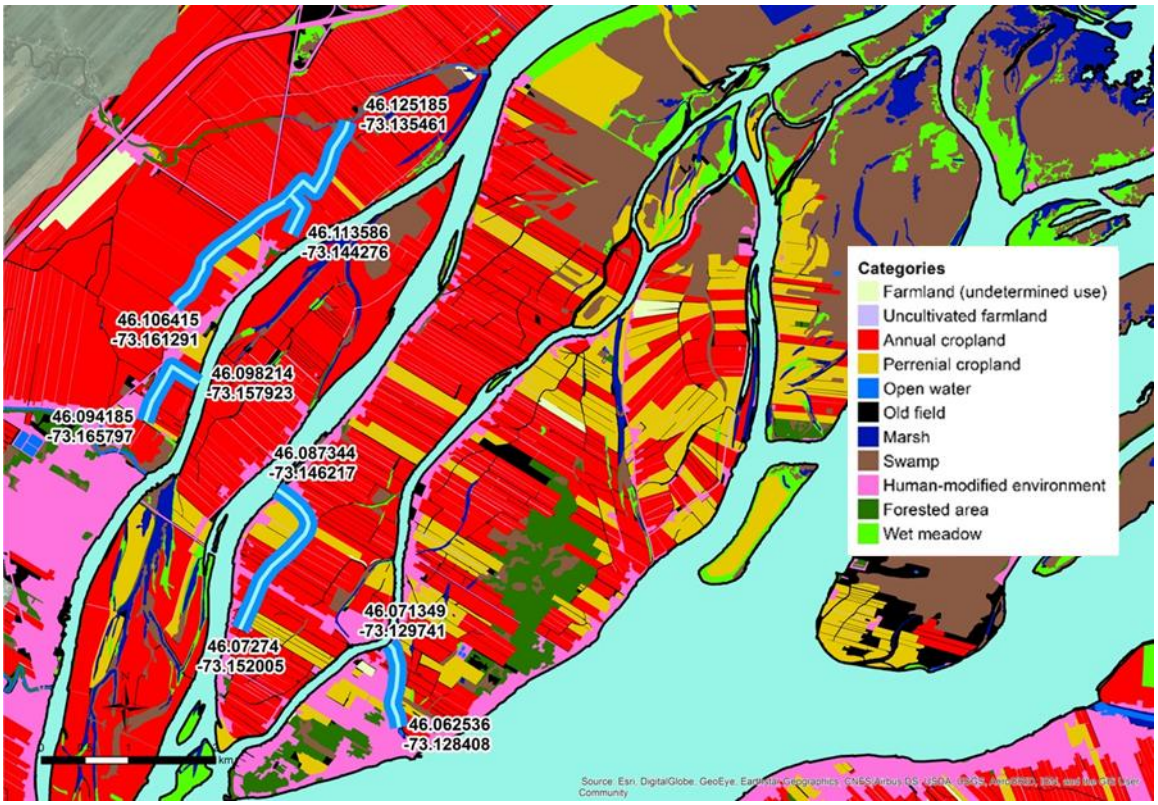
- MILIEU ADJACENT - POSITION DE L'OISEAU VS LE 1ER 25 MÈTRES :
I : À L'**I**NTÉRIEUR **E** : À L'**E**XTÉRIEUR

- MILIEU ADJACENT - HABITAT UTILISÉ PAR L'OISEAU :
CA : **C**ULTURE **A**NNUELLE
CP : **C**ULURE **P**ÉRENNE
NC : AGRICOLE **N**ON **C**ULTIVÉ
HA : **HA**IE **A**GRICOLE
EL : **E**AU **L**IBRE
FR : **FR**ICHE
MA : **MA**RAIS
MG : **M**ARÉCA**G**E
MQ : **M**ILIEU ANTHROPI**Q**UE
MF : **M**ILIEU **F**ORESTIER
UM : PRAIRIE H**UM**IDE

Appendix D

Watercourse transect coordinates

(Source: ECCC and MDDELCC, 2018)



Appendix E

Breeding evidence codes from the *Québec Breeding Bird Atlas* (AONQ, 2017)

OBSERVED SPECIES

X	Species observed during its breeding season, but not in suitable nesting habitat (no breeding evidence found).

POSSIBLE BREEDING

H	Species observed in suitable nesting habitat during its breeding season.
S	Individual singing or producing sounds associated with breeding (e.g. calls, drumming) heard in suitable nesting habitat during the species' breeding season.

PROBABLE BREEDING

M	At least 7 individuals singing or producing sounds associated with breeding (e.g. calls, drumming), heard during the same visit to a single square and in suitable nesting habitat during the species' breeding season.
P	Pair observed in suitable nesting habitat during the species' breeding season.
T	Presumed territory based on the presence of an adult bird, whether producing sounds associated with breeding (e.g., song, other calls or drumming) or not, at the same place, in suitable nesting habitat, on at least two visits, one week or more apart, during the species' breeding season.
C	Breeding behaviour involving a male and female (e.g. display, courtship feeding and copulation) or antagonistic behaviour between two or more individuals (e.g. territorial disputes or chases), in suitable nesting habitat during the species' breeding season.
V	Bird visiting a probable nest site in suitable nesting habitat during the species' breeding season.
A	Agitated behaviour or alarm calls of an adult in suitable nesting habitat during the species' breeding season.
B	Brood patch or cloacal protuberance on an adult individual caught in suitable nesting habitat during the species' breeding season.
N	Nest building by wrens or nest hole excavation by woodpeckers.

CONFIRMED BREEDING

CN	Nest building, including the carrying of nesting material, by all species except wrens and woodpeckers.
DD	Individual attempting to draw attention away from a nest or young by feigning injury or by using any other distraction display.
NU	Empty nest used during the atlas survey period, or the shells of eggs laid during the same period.
JE	Recently fledged (nidicolous species) or downy (nidifugous species) young incapable of sustained flight.
NO	Adult occupying, leaving or entering a probable nest site (visible or not) whose behaviour suggests the presence of an occupied nest.
FE	Adult carrying a fecal sac.
AT	Adult carrying food for young.
NF	Nest containing one or more eggs.
NJ	Nest with one or more young (seen or heard).

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