Wetland Bird Monitoring Protocol

Terrestrial Long-term Fixed Plot Monitoring Program

Regional Watershed Monitoring and Reporting

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Toronto and Region Conservation for The Living City®

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1.0 INTRODUCTION

Wetlands are recognized as being highly diverse, productive and dynamic ecosystems that serve a vital environmental role. Acting as a water filtration system, they prevent sedimentation, slow surface run-off and improve water quality. They also provide valuable breeding and spawning habitat for numerous bird, fish, mammal, and amphibian species. Throughout Ontario, there are five types of freshwater wetlands, namely, marshes, bogs, fens, swamps and shallow open water.

The wetland bird protocol used by Toronto and Region Conservation Authority (TRCA) has been adapted from the Marsh Monitoring Program (MMP). The MMP began in 1995 to document the decline of marsh birds and amphibians around the Great Lakes basin. Many of the marshes around the Great Lakes have been destroyed due to development, and with the loss of habitat, there is a loss of species biodiversity (Bird Studies Canada, 2009). Through the deployment of this standardized protocol, TRCA is collecting data to determine trends of marsh birds at a local jurisdictional level, but are also participating in a larger bi-national initiative through the MMP.

2.0 STUDY DESIGN

Ensuring a sample size that is appropriate to detect region wide trends is the primary objective of the monitoring program. However, with additional funds and resources in the future it will also be desirable to increase the sample size in order to have the ability to look at differences between three land-use zones (urban, urbanizing and rural).

Program Objective:

- To determine if wetland bird species richness and abundance is changing over time across the TRCA jurisdiction.

An *a priori* power analysis was conducted in 2008 (Zorn 2008) to determine the appropriate number of monitoring plots needed to achieve sufficient power. In 2015, a further power analysis (retrospective) was conducted to ensure the appropriate number of plots are monitored for assessing spatial and temporal trends in wetland-dependent bird species richness, wetland-dependent bird abundance, and the number of L1-L3 wetland bird species. The sample sizes used in this power analysis were based on sample sizes used in TRCA (2015a).

Power was sufficient (>80%) for all analyses comparing the rural and urban zones (10 rural, 10 urban). Power was low for analyzing temporal trends regionally. In order to improve power to an acceptable level (>80%) for wetland-dependent bird species richness, it is recommended to shift the baseline year from 2009 to 2011. This will allow the analysis to detect a 15% (or greater) decline over 5 years with 89% power. In order to improve power to an acceptable level (>97%) for wetland-dependent bird abundance and the number of L1-L3 wetland bird species, it is recommended to shift the baseline year from 2009 to 2011. Using a 2011 baseline will allow for the analysis to detect a 15% (or greater) decline over 5 years with >97% power.

Power was low for analyzing temporal trends in the rural zone alone. In order to improve power to an acceptable level (>78%) for wetland-dependent bird species richness, it is recommended to shift the baseline year from 2009 to 2011. In order to improve power to an acceptable level (>85%) for wetland-dependent bird abundance, it is recommended to increase the effect size from 20% over 5 years to 25% over 5 years and to shift the baseline year from 2009 to 2014. In order to improve power to an acceptable level (>83%) for the number of L1-L3 wetland bird species, it is recommended to increase the effect size from 20% over 5 years to 25% over 5 years, to shift the baseline year from 2009 to 2014 and to add 4 rural wetland bird monitoring plots in the rural zone.

Power was low for analyzing temporal trends in the urban zone alone; however, it was decided that it is more important to examine potential losses in the rural zone given the small number of sensitive wetland bird species currently in the urban zone. Full details of the 2015 power analysis can be found in TRCA (2015b).

3.0 EQUIPMENT & MATERIALS

Different materials and equipment are needed depending on whether the plot is being set-up for the very first time or if visited for seasonal monitoring (Table 1).

Table 1. List of required equipment and materials for plot set-up and seasonal monitoring activities.

Set-up Equipment	Seasonal Monitoring and Maintenance Equipment
• Compass • Aerial photo of general station area • Hand held GPS unit • ½ to ¾ m posts of iron rebar • Spray paint • Flagging tape • Pens and pencils • Clipboard • Small sledge hammer/mallet • Habitat description forms	• Compass • Map showing plot locations • Data forms • Thermometer • Watch/ stopwatch • Clipboard and pencils • Flagging tape • Binoculars • MP3 or IPOD with speakers (batteries) • Flashlight – for early morning sites(batteries) • Bug repellent • Digital camera (optional)

4.0 PLOT SET-UP METHODOLOGY

Wetland bird and amphibian stations were placed such that both could be monitored at the same location or were placed in close proximity to one another. Site access was also a consideration in order to reduce the amount of travel time between stations.

Monitoring stations are placed at the edge of wetlands that are generally large enough to accommodate at least one station (needing to be 100 m radius semi-circle in size). As larger wetlands are not evenly distributed across the jurisdiction, some monitoring sites are smaller than the 100 m radius semi-circle. By allowing smaller sized wetlands to be included, a more even distribution of stations is created across the jurisdiction and provides a gradient of wetland types and quality to be represented in the monitoring program.

The number of stations on a given monitoring route depends on the size of wetland. Smaller wetlands can accommodate fewer stations than a larger wetland. Stations must be at least 250 m apart to ensure that observers cannot hear the calling activity at a previously monitored station (prevent double counting). Regardless of the wetland size, a potential station site is only suitable if the 100 m radius semi-circle is dominated by at least 50% marsh habitat. Marsh habitat is dominated by non-woody vegetation such as cattails with shallow open water.

Stations are set-up and oriented to maximize the area of wetland being sampled by sight and ear. Choosing an elevated focal point is useful for this reason. Monitoring stations are marked by a ½ to ¾ m iron rebar post hammered down, enabling the top section to remain visible. The stakes are marked with flagging tape and spray painted to allow them to be relocated. The northing and easting is taken using the hand held GPS unit and recorded onto the data sheet. To help define the outer limits of the 100 m semi circle, interval distances of 25, 50, 75 m can be measured out to the front and to either side of the station and marked with flagging tape.

5.0 DATA COLLECTION METHODOLOGY

This protocol is based on the following:

Marsh Monitoring Program Participant's Handbook for Surveying Marsh Birds. 2009 Edition. 13 pages. Published by Bird Studies Canada in cooperation with Environment Canada and the U.S. Environmental Protection Agency. February 2009.

Once stations are set-up at appropriate locations a habitat description form is filled in to describe the marsh habitat (Appendix A – same form used for amphibians). This form is completed once annually around late May to mid-June (facilitates identification of vegetation*).* The date, assigned route number, assigned observer number and name, along with an indication of survey type (i.e. bird and or amphibian) and station letter (each station on a survey route is alphabetized i.e., the first station would have a station letter of "A" the second station would be "B" etc.) are filled in on the data form. There are an additional seven sections to the form. Part A asks for estimated percentages of the total sample area that is covered by emergent vegetation, open water (including floating plants), exposed mud/sand/rock, trees and shrubs (values should add up to

100%). In part B the density of floating plant cover in open water zones (none, slight, moderate, dense) is indicated. Part C is an indication of wetland permanency based on 3 categories of permanent (almost never dries up, water is usually quite deep), semi-permanent (dries up in some years of low precipitation; water fairly shallow) or seasonal (usually flooded in spring and early summer, but tends to dry up in late summer or in dry years). Part D is an indication of the overall marsh size based on the following categories of tiny (between 1.5 and 2.5 ha), small (between 2.5 and 5 ha), medium (between 5 and 25 ha), large (between 25 and 50 ha) and huge (greater than 50 ha). In part E the type of habitat behind the station (determines whether plot is located in marsh edge or interior) is indicated based on five categories; marsh, field, forest, urban, and other. In part F you are asked to indicate if there are human influences affecting the sample area (either positive or negative). The last section asks for the percentage coverage of dominant emergent vegetation (record of the four most dominantly occurring emergent vegetation species) (Note: These species do not need to add up to 100%). In addition, a sketch map of key habitat features showing the position of vegetation within the monitoring station is included. Also, an indication of the compass bearing for the marsh orientation of the survey is documented.

Birds are monitored twice during the field season between May 20th and July 5th each year in order to capture information on breeding birds and not birds migrating through an area. There are at least 10 days between the 2 monitoring visits in order to increase the breeding status for each record. Surveys are conducted in the morning a half hour before sunrise and end by 1000 hours. Surveys are conducted only when wind strength is less then four on the Beaufort Scale (Table 2), and when there is little or no rain. Two staff is required in order to undertake the survey: the biologist that will lead the survey along with the assistant. Having two staff members conducted the survey is mainly for safety purposes.

Table 2. Beaufort wind codes (taken from Marsh Monitoring Program Participant's Handbook for Surveying Marsh Birds, 2009)

Beaufort Scale	Wind Speed (km/h)	Description	Visual Cues
0	0 - 2	Calm	Smoke rises vertically
1	3 - 5	Light	Smoke drifts
2	6 - 11	Slight breeze	Leaves rustle
3	12 - 19	Gentle breeze	Lighter branches sway
4	20 - 30	Moderate breeze	Dust rises, branches move
5	31 - 39	Fresh breeze	Small trees sway

Upon arrival at the monitoring station the top portion of the data form (Appendix B) is filled in: route name, station number, observer name, assigned observer number, date, and visit number. Weather information also needs to be documented, wind speed, cloud cover and air temperature (°C). The background noise code for the recording period is also noted (Table 3).

Table 3. Background noise codes (taken from Marsh Monitoring Program Participant's Handbook for Surveying Marsh Birds, 2009)

Index	Description
0	No appreciable effect (e.g., owl calling)
1	Slightly affecting sampling (e.g., distant traffic, dog barking, car passing)
2	Moderately affecting sampling (e.g., distant traffic, 2-5 cars passing)
3	Seriously affecting sampling (e.g., continuous traffic nearby, 6-10 cars passing)
4	Profoundly affecting sampling (e.g., continuous traffic passing, construction noise)

The surveyor stands in the direction of the pre-determined compass bearing of the station and waits for a period of approximately one minute to allow any disturbance that his/her arrival has created to subside. This period also allows the surveyor to adjust to the surroundings. The assistant starts the timer, the broadcast commences, and the surveyor – unaided by the assistant – begins to map birds on the data form (using the semi-circle map).

The broadcast recording provided by the MMP is played at each monitoring station. The species on the broadcast are referred to as focal species and are generally secretive in nature. By playing the broadcast they are usually coaxed into responding. The following species are broadcast:

- Virginia rail
- sora
- least bittern
- common moorhen / American coot
- pied-billed grebe

In addition, to mapping any focal species an indication of when the call was heard is also documented.

After 5 minutes have passed (each passing minute indicated on the broadcast), the broadcast commences playing the full suite of calls, each species separated by a 30 second period of silence (for a total of 5 minutes). Once all species have been broadcast, the final 5 minute silent period is indicated, during this period any further observations can be mapped and documented.

During the survey period a sketch (per station) of the number and position and of each species calling from inside and from outside the 100 m station radius is created. The mapped position of each individual “secondary” species observed (and any observed change in position during count), together with timed occurrence is documented. An indication of the level of breeding evidence observed for each mapped record is noted based on a standard list of symbols (Appendix C). In addition, a tally of aerial foraging secondary species (together with timed occurrence) and a list of list of species recorded outside of the count area or as fly-throughs are noted.

Once the entire 15 minute period has ended the only information that can then be further recorded on the data form must be associated with observations made during that 15 minute period, i.e. if the surveyor omitted or did not have time enough during the 15 minute period to fill in the list of “outside/fly throughs” then this information can be recorded after the event, but care must be

taken not to record anything or any activity noted beyond the period. However, such non-survey observation can of course be recorded in the "comments" section of the data form.

Each bird seen or heard is to be assigned to one – and only one - of the three categories:

1. Mapped observations (using standard four letter codes – Appendix D): are all birds seen or heard actually residing within the boundaries of the 100 m sample semi-circle. Birds only seen in flight are to be excluded.

2. Aerial foragers: are birds seen actively foraging in the air over the sample area, no higher than 100 m and not otherwise using the sample area.

3. Outside/fly throughs: are additional marsh birds which are observed during the 10 minute period outside of the sample area or flying through without landing.

Note that during the survey:

- No pishing! The surveyor and assistant must remain silent for the entire 15 minute broadcast period.

- The assistant is not permitted to point out any birds or bird behaviour (or nests) to the surveyor. Again, it is important that observer ability/competence is standardized (consistent) so as to achieve meaningful observation of trends

- Young of the year are not to be counted, even if independent (e.g. ducks). Record adults only.
- Both sexes should be recorded for every species other than red-winged blackbird (*Agelaius phoeniceus*)(this species is polygamous).

7.0 DATA MANAGEMENT AND ANALYSIS

Data Management

At the end of each field season all data collected are sent to Bird Studies Canada to support this larger bi-national initiative. In addition, all data are entered into a corporate TRCA access database and all field collection forms are stored in a corporate filing system.

Data Analysis for the 2015 Terrestrial Long-term Monitoring Program Report (TRCA 2015a)

The TRCA Natural Heritage Monitoring database was queried and manually searched to ensure that two visits were conducted at each site over the season in each year. Bird data were retrieved using the 'Bird Yearly Analysis' link on the main page of the TRCA Natural Heritage Monitoring database. Using the Bird Yearly Analysis link ensures that the data do not include flyovers, species detected outside the 100 m radius and species that were likely migrating. Category and year were selected to retrieve relevant data. Data were then arranged into sheets in Excel by site.

Variables (species richness, # L1-L3 species, etc.) were calculated for each site in each year between 2008 and 2014. These data were arranged into Excel tables with the site name shown in each row and year running across the top as columns. If a site contained more than one point count station, an average value was used. For example, if a specific site had 2 stations surveyed in a specific year with station 1 having 3 individuals and station 2 having 4 individuals, the average abundance for that site would be 3.5. This calculation only applies to sites with >1 station.

For both temporal and spatial analysis, summary tables with site as row and year as column were used. For temporal trends, data analysis attempted to maximize the number of years with the same list of sites consistently surveyed each year. This often resulted in limiting the number of sites included because new sites were added in more recent years. Keeping the same group of sites studied in each year allows for valid comparisons among years. The list of sites and years included for the temporal analysis can be found in the appendix of TRCA (2015a). The current baseline year for the temporal data is 2009 but in future years a later baseline year may be used in order to increase the number of sites included in the analysis.

Temporal trends were statistically analyzed using Mann-Kendall tests in an established Microsoft Excel™ spreadsheet provided by the Ministry of Natural Resources and Forestry. The Mann-Kendall test is a non-parametric test for identifying monotonic trends in time series data. This test was chosen over traditional regression analyses because the data did not meet the assumption of independent samples required for regression analyses. When analyzing time-series data, data collected at the same site from one year to the next are not independent. This made the Mann-Kendall test the best option. The Mann-Kendall test uses the S statistic to determine an associated p-value. If the value of S is zero, there is no trend in the data. If a data value from a later time period is higher than a data value from an earlier time period, S is incremented by one. On the other hand, if a data value from a later time period is lower than a data value sampled earlier, S is decremented by one. The net result of all such increments and decrements yields the final value of S (TRCA 2011). For example, a very high positive value of S is an indicator of an increasing trend, and a very low negative value indicates a decreasing trend (TRCA 2011). A p-value of less than 0.05 denotes a significant trend (increasing or decreasing) and a p-value of greater than 0.05 indicates that there is no increase or decrease over time and that the variable of interest is stable.

For spatial analysis, data analysis attempted to maximize the number of sites. This often resulted in using more recent years of data because new sites were added in more recent years. Often the most recent 2-4 years of data were used because they contained a consistent set of sites in each year. An average value across the selected years was calculated for each site and this single value per site was used for analysis. The list of sites and years included for the spatial analysis can be found in the appendix of TRCA (2015a).

Spatial trend analysis was conducted using SAS JMP statistical software (SAS Institute Inc. 2008). Differences between urban and rural land use zones were analyzed using independent t-tests. An independent t-test is a parametric test that compares the mean value between two groups (e.g. urban and rural land use zones). This test is reported using the test statistic, t, and an associated p-value where a p-value of less than 0.05 indicates a difference between groups. A p-value of

greater than 0.05 indicates that there is no difference between groups. Before performing t-tests, all data were checked for normality and homoscedasticity because these are two assumptions of using parametric statistics. If these assumptions were not met, data transformations were attempted to improve normality or heteroscedasticity. If data transformations were not effective, a Wilcoxon test was conducted (Z-statistic). This is the non-parametric version of an independent t-test and is the appropriate test to proceed with if the data do not meet assumptions. For TRCA (2015a), an independent t-test was used but this may not be the appropriate test to use in the future if the data violate the assumptions of using parametric statistics listed previously.

8.0 REFERENCES

Marsh Monitoring Program Participant's Handbook for Surveying Marsh Birds. 2009 Edition. 13 pages. Published by Bird Studies Canada in cooperation with Environment Canada and the U.S. Environmental Protection Agency. February 2009

TRCA. 2011. Regional Watershed Monitoring Program: Surface Water Quality Summary 2006-2010. 49 pp + appendices.

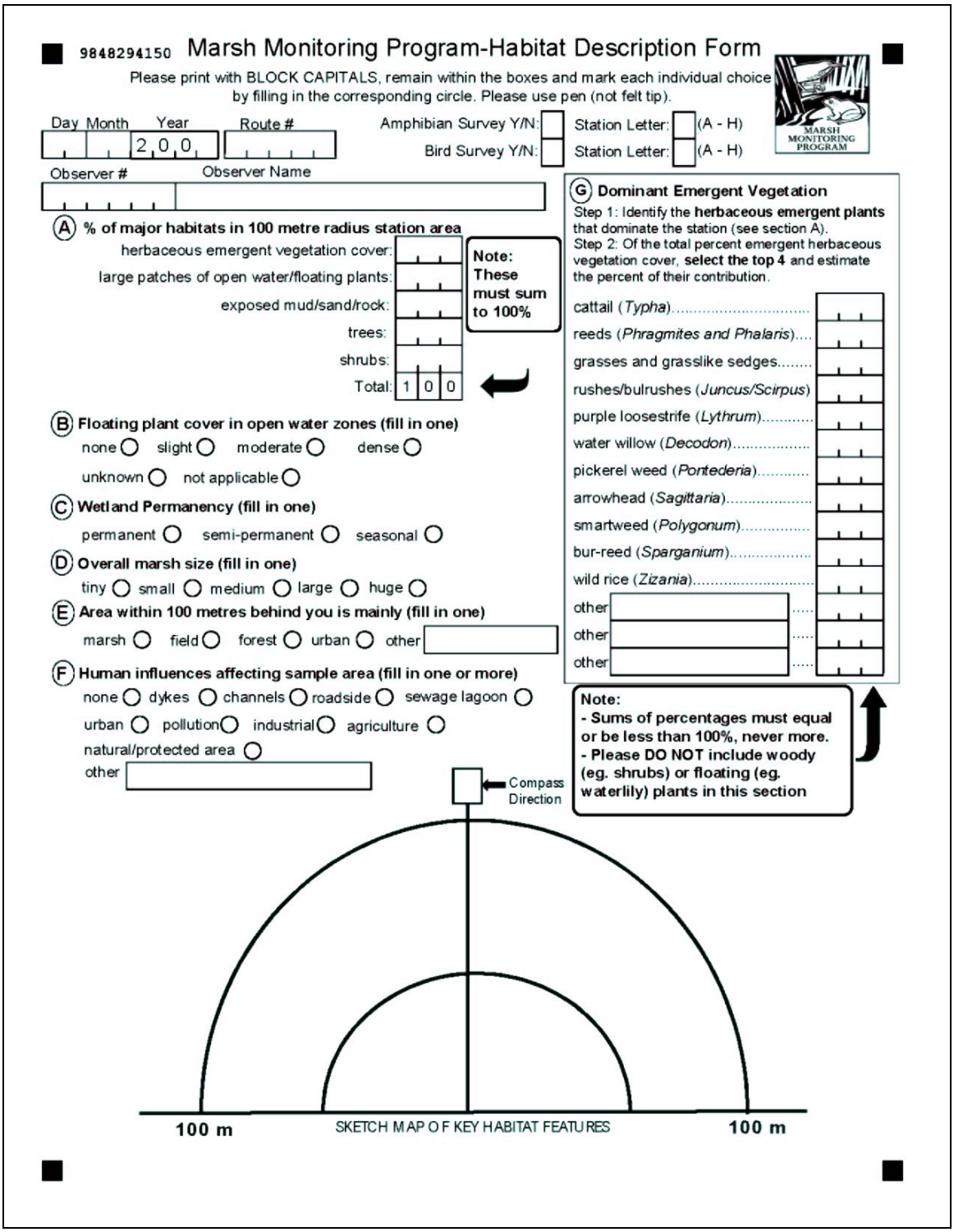
TRCA. 2015a. Terrestrial Long Term Monitoring: Spatial and Temporal Trends 2008-2014.

TRCA. 2015b. A Retrospective Power Analysis for the Terrestrial Long Term Monitoring Program.

Zorn, Paul. 2008. A *Priori* Power Analysis for Toronto and Region Conservation Authority's Regional Watershed Monitoring Program. Report prepared for TRCA. Ottawa, ON

APPENDICES

Appendix A: Sample habitat description form



9848294150 Marsh Monitoring Program-Habitat Description Form

Please print with BLOCK CAPITALS, remain within the boxes and mark each individual choice by filling in the corresponding circle. Please use pen (not felt tip).

MARSH MONITORING PROGRAM

Day Month Year 2 0 0 Route #

Amphibian Survey Y/N: Station Letter: (A - H)

Bird Survey Y/N: Station Letter: (A - H)

Observer # Observer Name

(A) % of major habitats in 100 metre radius station area

herbaceous emergent vegetation cover:
large patches of open water/floating plants:
exposed mud/sand/rock:
trees:
shrubs:
Total: 1 0 0

Note: These must sum to 100%

(B) Floating plant cover in open water zones (fill in one)

none ○ slight ○ moderate ○ dense ○
unknown ○ not applicable ○

(C) Wetland Permanency (fill in one)

permanent ○ semi-permanent ○ seasonal ○

(D) Overall marsh size (fill in one)

tiny ○ small ○ medium ○ large ○ huge ○

(E) Area within 100 metres behind you is mainly (fill in one)

marsh ○ field ○ forest ○ urban ○ other

(F) Human influences affecting sample area (fill in one or more)

none ○ dykes ○ channels ○ roadside ○ sewage lagoon ○
urban ○ pollution ○ industrial ○ agriculture ○
natural/protected area ○
other

(G) Dominant Emergent Vegetation

Step 1: Identify the **herbaceous emergent plants** that dominate the station (see section A).
Step 2: Of the total percent emergent herbaceous vegetation cover, **select the top 4** and estimate the percent of their contribution.

cattail (*Typha*).....
reeds (*Phragmites and Phalaris*).....
grasses and grasslike sedges.....
rushes/bulrushes (*Juncus/Scirpus*)
purple loosestrife (*Lythrum*).....
water willow (*Decodon*).....
pickerel weed (*Pontederia*).....
arrowhead (*Sagittaria*).....
smartweed (*Polygonum*).....
bur-reed (*Sparganium*).....
wild rice (*Zizania*).....
other ..... other ..... other .....

Note:
- Sums of percentages must equal or be less than 100%, never more.
- Please DO NOT include woody (eg. shrubs) or floating (eg. waterlily) plants in this section

Compass Direction

100 m SKETCH MAP OF KEY HABITAT FEATURES 100 m

Appendix B: Sample bird survey form

1772450679

Marsh Monitoring Program - Bird Survey Form

Route # [ ] Station (A-H) [ ] Observer # [ ] Observer Name [ ]

MARSH MONITORING PROGRAM

*Please print with BLOCK CAPITALS and mark each individual choice by filling in the corresponding circle.

Has the habitat on your route changed from previous years? ○ Yes ○ No ○ N/A

○ Visit1 ○ Visit2 **Day** [ ] **Month** [ ] **Year** [2 0 0] **Station Start Time (24hr)** [ ]

Cloud Cover (10ths) [ ] **Temperature** [ ] ○ °C ○ °F **Beaufort Wind Scale (0-6)** [ ]

Precipitation ○ None/Dry ○ Damp/Haze/Fog ○ Drizzle ○ Rain **Background Noise Code (0-4)** [ ]

FOCAL SPECIES American Bittern (AMBI), American Coot (AMCO), Black Rail (BLRA), Common Moorhen (COMO), King Rail (KIRA), Least Bittern (LEBI), Pied-billed Grebe (PBGR), Sora (SORA), Virginia Rail (VIRA), Yellow Rail (YERA)

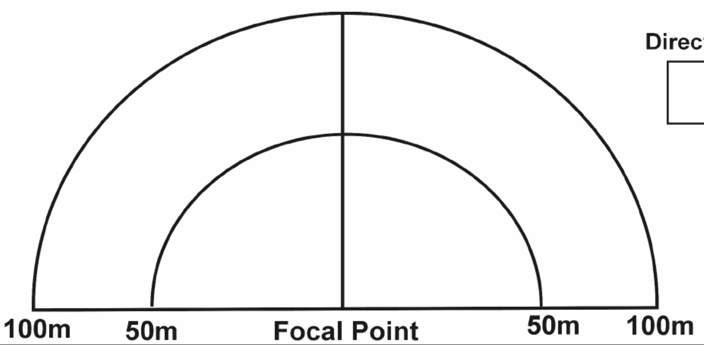
Species code	Responded During: (please fill choice circle) Before/After Survey Period	Pass. min. 0-1	Pass. min. 1-2	Pass. min. 2-3	Pass. min. 3-4	Pass. min. 4-5	LEBI min. 5-6	SORA min. 6-7	VIRA min. 7-8	MOOT min. 8-9	PBGR min. 9-10	Pass. min. 10-15	Direction	Within 100 m	Detected at Previous Point	Comments
	○	○	○	○	○	○	○	○	○	○	○	○		○	○	
	○	○	○	○	○	○	○	○	○	○	○	○		○	○	
	○	○	○	○	○	○	○	○	○	○	○	○		○	○	
	○	○	○	○	○	○	○	○	○	○	○	○		○	○	
	○	○	○	○	○	○	○	○	○	○	○	○		○	○	
	○	○	○	○	○	○	○	○	○	○	○	○		○	○	
	○	○	○	○	○	○	○	○	○	○	○	○		○	○	
	○	○	○	○	○	○	○	○	○	○	○	○		○	○	
	○	○	○	○	○	○	○	○	○	○	○	○		○	○	
	○	○	○	○	○	○	○	○	○	○	○	○		○	○	

SECONDARY SPECIES

Aerial Foragers Tally

Species	min0-5	min5-10	min10-15

Outside/Fly-Throughs List



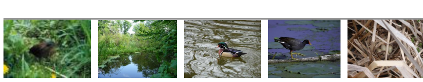
Direction [ ]

Secondary Species Summary

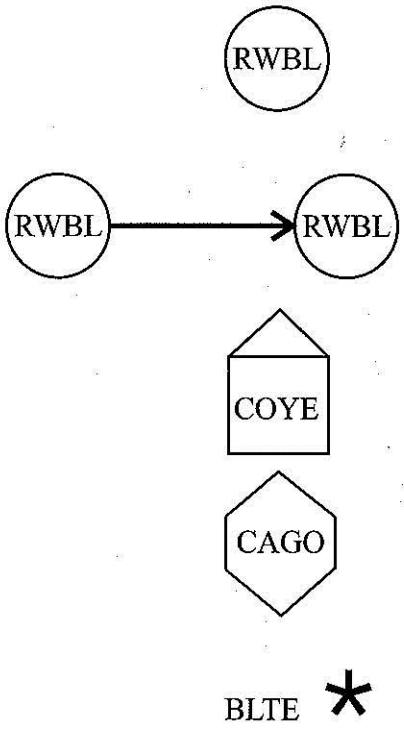
Species Code	# Observed* min0-5	min5-10	min10-15	O/F**	Species Code	# Observed* min0-5	min5-10	min10-15	O/F**	Species Code	# Observed* min0-5	min5-10	min10-15	O/F**
				○					○					○
				○					○					○
				○					○					○
				○					○					○
				○					○					○
				○					○					○

* #Observed = The number of individuals mapped and/or actively foraging within the sample area.
**O/F = Outside/flythroughs (Species recorded outside the sample area or flying through the sample area without landing.)

Appendix C: Marsh bird mapping symbols



Marsh Bird Mapping Symbols



Bird: seen or heard.

Known change in position.

Pair together (assumed mated).

Family group seen. Include number of observed accompanying adults only beside the symbol. Do not record number of young.

Nest location.