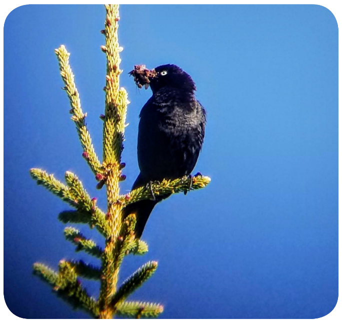
Keeyask Generation Project

Terrestrial Effects Monitoring Plan

Olive-sided Flycatcher and Rusty Blackbird Monitoring Report

TEMP-2020-15



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KEEYASK

Manitoba Conservation and Climate Client File 5550.00
Manitoba Environment Act Licence No. 3107

2019 - 2020

KEEYASK GENERATION PROJECT

TERRESTRIAL EFFECTS MONITORING PLAN

REPORT #TEMP-2020-15

OLIVE-SIDED FLYCATCHER AND RUSTY BLACKBIRD SENSORY DISTURBANCE MONITORING 2019

Prepared for

Manitoba Hydro

By

Wildlife Resource Consulting Services MB Inc.

June 2020

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SUMMARY

Background

Construction of the Keeyask Generation Project (the Project) at Gull Rapids began in July 2014. The Keeyask Hydropower Limited Partnership (KHLP) was required to prepare a plan to monitor the effects of construction and operation of the generating station on the terrestrial environment. Monitoring results will help the KHLP, government regulators, members of local First Nation communities, and the general public understand how construction and operation of the generating station will affect the environment, and whether more needs to be done to reduce harmful effects.

Olive-sided flycatcher and rusty blackbird are migratory songbirds that are found in the Keeyask region. Both species are considered species at risk in Canada and are protected under the federal *Species at Risk Act*. In Manitoba, the olive-sided flycatcher is also listed as Threatened under *The Endangered Species and Ecosystems Act*.

This report focuses on monitoring done for olive-sided flycatcher and rusty blackbird in 2019, the sixth summer of Project construction.

Why is the study being done?

Both the olive-sided flycatcher and rusty blackbird are near the edge of their breeding ranges in northern Manitoba and are found in relatively low numbers in the Keeyask region. Both are species at risk, have been experiencing widespread declines throughout their ranges, and may be vulnerable to Project effects. The goal of this study was to monitor the effect of Project-related disturbance on these species near the North Access Road and South Access Road, the areas where Project disturbance was expected to be greatest.

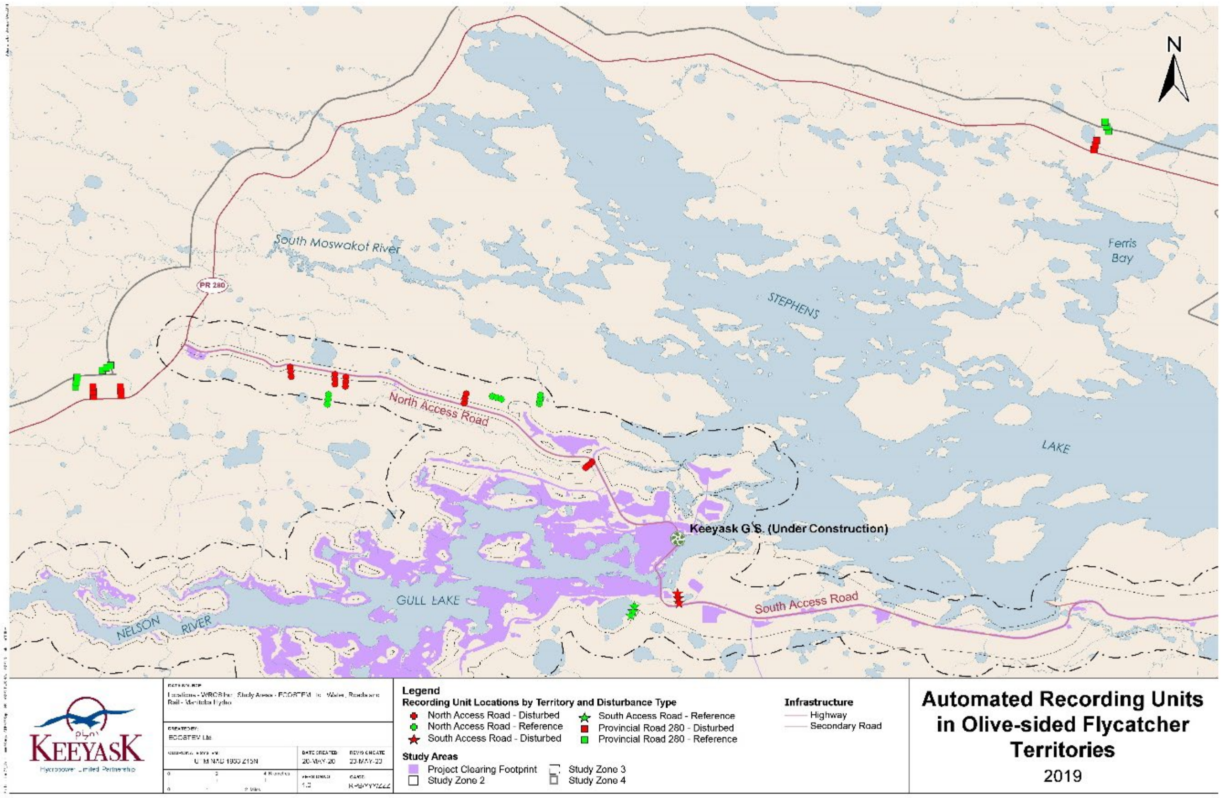
Rusty blackbird (left) and olive-sided flycatcher (right)

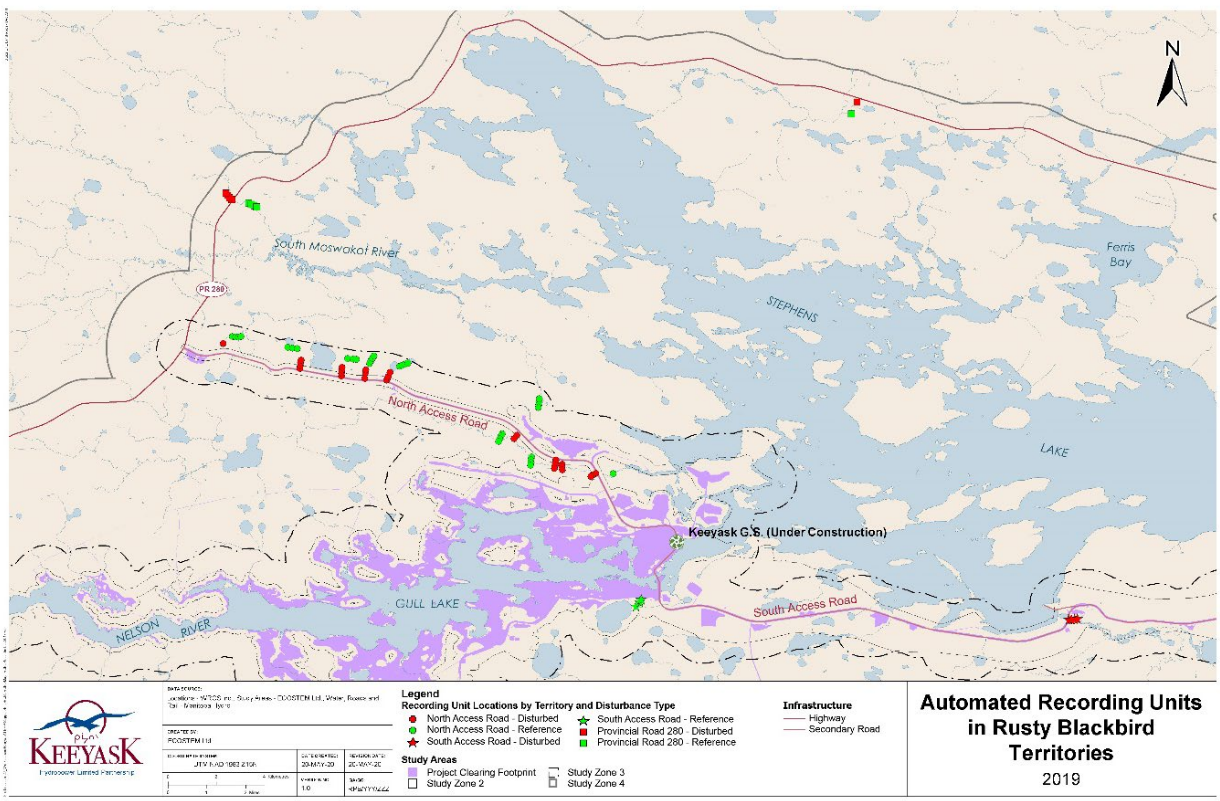
What was done?

Olive-sided flycatcher and rusty blackbird nesting territories were mapped near the North Access Road and South Access Road, which are Project-related sources of disturbance. Automated recording units, designed to record bird calls, were placed within the mapped territories. Territories near Provincial Road 280, an existing source of disturbance, were also included for comparison. For each territory surveyed at a disturbed site, a reference territory at a site with no disturbance was also surveyed.

Recordings were analyzed and olive-sided flycatcher and rusty blackbird calls were identified. In all, recordings from 30 territories were analyzed in 2019. Recordings made in 2016 and 2017 were also analyzed and the amount of olive-sided flycatcher and rusty blackbird activity at each territory was evaluated for the three survey years during Project construction.

Biologist setting up an automated recording unit to record bird calls


N
South Moswakot River
PR 280
Ferris Bay
STEPHENS
LAKE
North Access Road
Keeyask G.S. (Under Construction)
GULL LAKE
NELSON RIVER
South Access Road
Legend
Recording Unit Locations by Territory and Disturbance Type
North Access Road - Disturbed
North Access Road - Reference
South Access Road - Disturbed
South Access Road - Reference
Provincial Road 280 - Disturbed
Provincial Road 280 - Reference
Study Areas
Project Clearing Footprint
Study Zone 2
Study Zone 3
Study Zone 4
Infrastructure
Highway
Secondary Road
KEEYASK
Hydropower Limited Partnership
Automated Recording Units in Olive-sided Flycatcher Territories
2019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Study Zone 4
Infrastructure
Highway
Secondary Road
KEEYASK
Hydropower Limited Partnership
Automated Recording Units in Rusty Blackbird Territories
2019

What was found?

Olive-sided flycatcher was found at many sites in the Project area during construction, with their calls (an indication of activity in the area) recorded at nearly all of the 30 territories analyzed in 2016, at most of the 19 territories analyzed in 2017, and at all 16 territories analyzed in 2019. The amount of olive-sided flycatcher activity appeared to be similar in territories at disturbed and reference sites near the North Access Road, South Access Road, and Provincial Road 280. There was somewhat less activity in territories at disturbed sites than reference sites near the access roads, but the difference was small.

Rusty blackbird was also found at many sites in the Project area during construction, with their calls recorded at all 24 territories analyzed in 2016, at most of the 34 territories analyzed in 2017, and at all 24 territories analyzed in 2019. There was somewhat less rusty blackbird activity in territories at disturbed sites than reference sites near the North Access Road, South Access Road, and Provincial Road 280.

What does it mean?

Disturbance on the Project access roads may have had a minor effect on the amount of olive-sided flycatcher activity at nearby nesting territories; however, the differences in activity at disturbed and reference territories were small and may in part be due to factors other than the Project. In contrast, near Provincial Road 280 there tended to be more olive-sided flycatcher activity in territories at disturbed sites than reference sites, so there was not a clear link between disturbance along roads and olive-sided flycatcher activity.

Disturbance on the Project access roads may have affected the amount of rusty blackbird activity at nearby nesting territories. Activity levels were also lower in territories at disturbed sites near Provincial Road 280, suggesting that rusty blackbirds may be sensitive to disturbances on all types of roads.

Further analysis and mapping are continuing on the olive-sided flycatcher and rusty blackbird audio recordings.

What will be done next?

Data collected from audio recordings in 2016, 2017, and 2019 will be used to map and measure olive-sided flycatcher and rusty blackbird territories to further evaluate potential Project effects on habitat use and distribution.

STUDY TEAM

We would like to thank Sherrie Mason and Rachel Boone of Manitoba Hydro and Ron Bretecher of North/South Consultants Inc. for logistical assistance in the field. We would also like to thank James Ehnes of ECOSTEM Ltd. for GIS support and mapping. Biologists and other personnel who designed, participated in, and drafted the survey results included:

- Robert Berger, Wildlife Resource Consulting Services MB Inc. (WRCS) – Design and reporting
- James Ehnes, ECOSTEM Ltd. – Design

Alex McIlraith, Myrica Systems Inc. - Design and bird audio recording analysis

- Andrea Ambrose, WRCS – Data analysis and reporting
- Kevin McCrae, WRCS – Field lead, survey personnel
- Mark Baschuk, WRCS – Survey personnel
- Halle Fines, WRCS – Survey personnel
- Timothy Kroeker, WRCS – Survey personnel
- Aidan Novalkowski, WRCS – Survey personnel
- Erin Prokopanko, WRCS – Survey personnel
- Mercede Schindler, WRCS – Survey personnel
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- Cameron Neckoway, TCN – Survey personnel
- Keegan Neckoway, TCN – Survey personnel
- Kenneth Ouskun, TCN – Survey personnel
- Adam Spence, TCN – Survey personnel
- Courtney Spence, TCN – Survey personnel
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- Aaron Chornoby, WLFN – Survey personnel
- Harland Chornoby, WLFN – Survey personnel
- Cameron Flett, WLFN – Survey personnel
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- Jared Wastesicoot, YFFN – Survey personnel
- Brandon Anderson, Fox Lake Cree Nation (FLCN) – Survey personnel
- John Henderson, FLCN – Survey personnel
- Mark McGillvary, FLCN – Survey personnel
- Hunter Prieston, FLCN – Survey personnel

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1.0 INTRODUCTION

Construction of the Keeyask Generation Project (the Project), a 695-megawatt hydroelectric generating station (GS) and associated facilities, began in July 2014. The Project is located at Gull Rapids on the lower Nelson River in northern Manitoba where Gull Lake flows into Stephens Lake, 35 km upstream of the existing Kettle GS.

The *Keeyask Generation Project Response to EIS Guidelines* (the EIS), completed in June 2012, provides a summary of predicted effects and planned mitigation for the Project. Technical supporting information for the terrestrial environment, including a description of the environmental setting, effects and mitigation, and a summary of proposed monitoring and follow-up programs is provided in the *Keeyask Generation Project Environmental Impact Statement Terrestrial Supporting Volume* (TE SV). The *Keeyask Generation Project Terrestrial Effects Monitoring Plan* (TEMP) was developed as part of the licensing process for the Project. Monitoring activities for various components of the terrestrial environment were described, including the focus of this report, olive-sided flycatcher (*Contopis cooperi*) and rusty blackbird (*Euphagus carolinus*), during Project construction.

Olive-sided flycatcher and rusty blackbird are migratory songbirds protected under the federal *Species at Risk Act* (SARA). The olive-sided flycatcher is listed as Threatened under the SARA and is listed as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). In Manitoba, the olive-sided flycatcher is listed as Threatened under *The Endangered Species and Ecosystems Act*. Its breeding habitat consists mainly of mature coniferous forest with open patches created by natural disturbance (e.g., fire), wetlands, or forestry clear-cuts (Altman and Sallabanks 2012 in Environment Canada 2016). Snags (dead standing trees) and live trees left behind after logging are important for perching while foraging for flying insects in open areas (Altman and Sallabanks 2012 in Environment Canada 2016).

The rusty blackbird is listed as Special Concern under the SARA and has no designation under *The Endangered Species and Ecosystems Act* of Manitoba. Despite being a migratory bird, the rusty blackbird is not protected under the federal *Migratory Birds Convention Act 1994*. Rusty blackbirds inhabit the boreal forest during the breeding season, using wetland habitat such as sedge meadows, beaver ponds, muskegs, swamps, riparian scrub, and shrubby patches of willow and alder (COSEWIC 2017). Their diet consists mainly of aquatic invertebrates such as insect larvae and snails, and also grasshoppers, beetles, and spiders (COSEWIC 2017).

As part of the TEMP, pilot studies for olive-sided flycatcher and rusty blackbird were conducted in 2015, to identify and enumerate breeding pairs of birds in the Keeyask region. Sensory disturbance surveys were then conducted in 2016, 2017, and 2019, to determine if and how Project-related noise affects the distribution and abundance of each species. The north and south access roads were expected to be the main sources of sensory disturbance for olive-sided flycatcher and rusty blackbird.

2.0 METHODS

2.1 TERRITORY MAPPING AND AUDIO RECORDING

Olive-sided flycatcher and rusty blackbird nesting territories identified in previous survey years were re-visited in 2019. Additional sites were also surveyed to increase the sample size. A paired habitat sample design was employed to follow the TEMP (KHLP 2015). Survey sites represented either Project-disturbed or reference sites. Project-disturbed sites (disturbed sites) were within 500 m of the North Access Road (NAR) and South Access Road (SAR). Provincial Road 280 (PR 280) was included to compare an existing source of sensory disturbance with Project-related sensory disturbance. For each disturbed site, a reference site, located in similar habitat but beyond the expected range of sensory disturbance for olive-sided flycatchers and rusty blackbirds (500 m), was also surveyed (Map 1).

Surveys were conducted from June 5 to 22, 2019. Surveys began half an hour before sunrise and lasted no later than 10:00 am. At each survey site, observers watched and listened for olive-sided flycatchers and rusty blackbirds for a period of 10 minutes. If no bird was heard or observed, the observer repeated the process at the next site. When a bird was heard or observed at a site, observers marked its position using a GPS unit. The bird was observed until at least five perches were marked, defining its territory. Observers maintained a sufficient distance from the bird to avoid disturbance and record natural perch locations.

Two to four second-generation automated recording units (ARUs; Photo 1) were placed in the centre of territories at disturbed sites, at distances of 100 metres (m) (up to two recorders), 300 m, 500 m, and up to 700 m from the nearest road (Figure 1). Three or four ARUs were placed in each territory at reference sites, and 100 m, 300 m, 500 m, and 700 m from a non-habitat patch edge such that they were centrally located through the long side of the habitat patch. In all, 153 recorders were placed at 42 nesting territories from June 14 to 26, 2019. Fifty ARUs were placed at 16 olive-sided flycatcher nesting territories (Table 1) and 103 ARUs were placed at 26 rusty blackbird nesting territories (Table 2).

The ARUs were programmed to record for five minutes at 10-minute intervals (i.e., six times per hour) for seven hours beginning half an hour before sunrise and for four hours beginning an hour before sunset. Audio recording units were typically left in place for 10 days; at two territories, ARUs were removed after nine days and some recorders remained in place for up to 20 days. Sixty-six recordings were made daily at each territory over the duration of the survey period.

Photo 1: Four-microphone Automated Recording Unit Housed in Protective Case

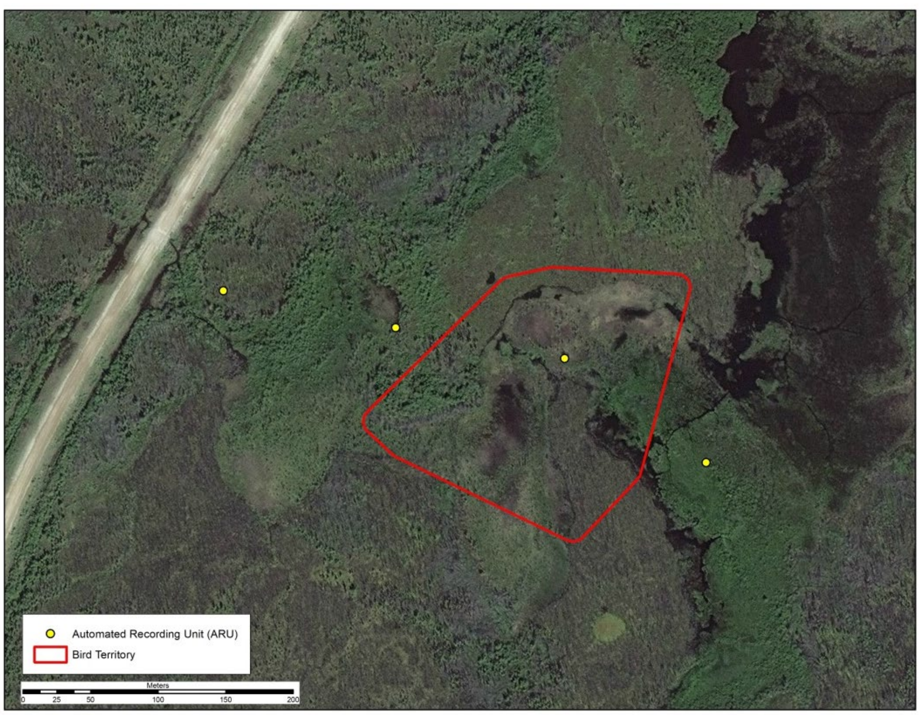


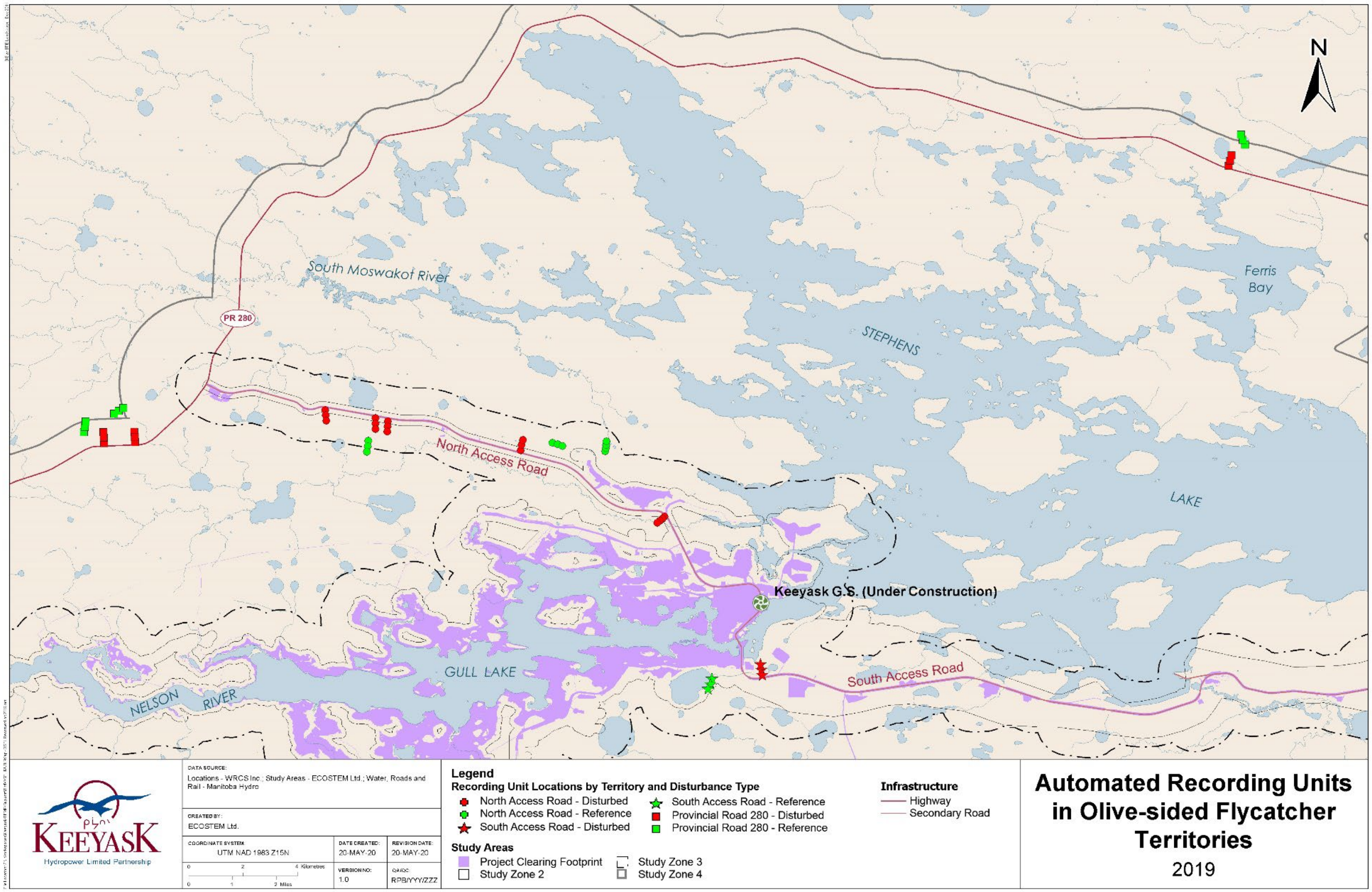
Figure 1: Example of ARU Placements Within a Bird Territory at a Disturbed Site

Table 1: Survey Effort for Olive-sided Flycatchers at Disturbed and Reference Sites, 2019

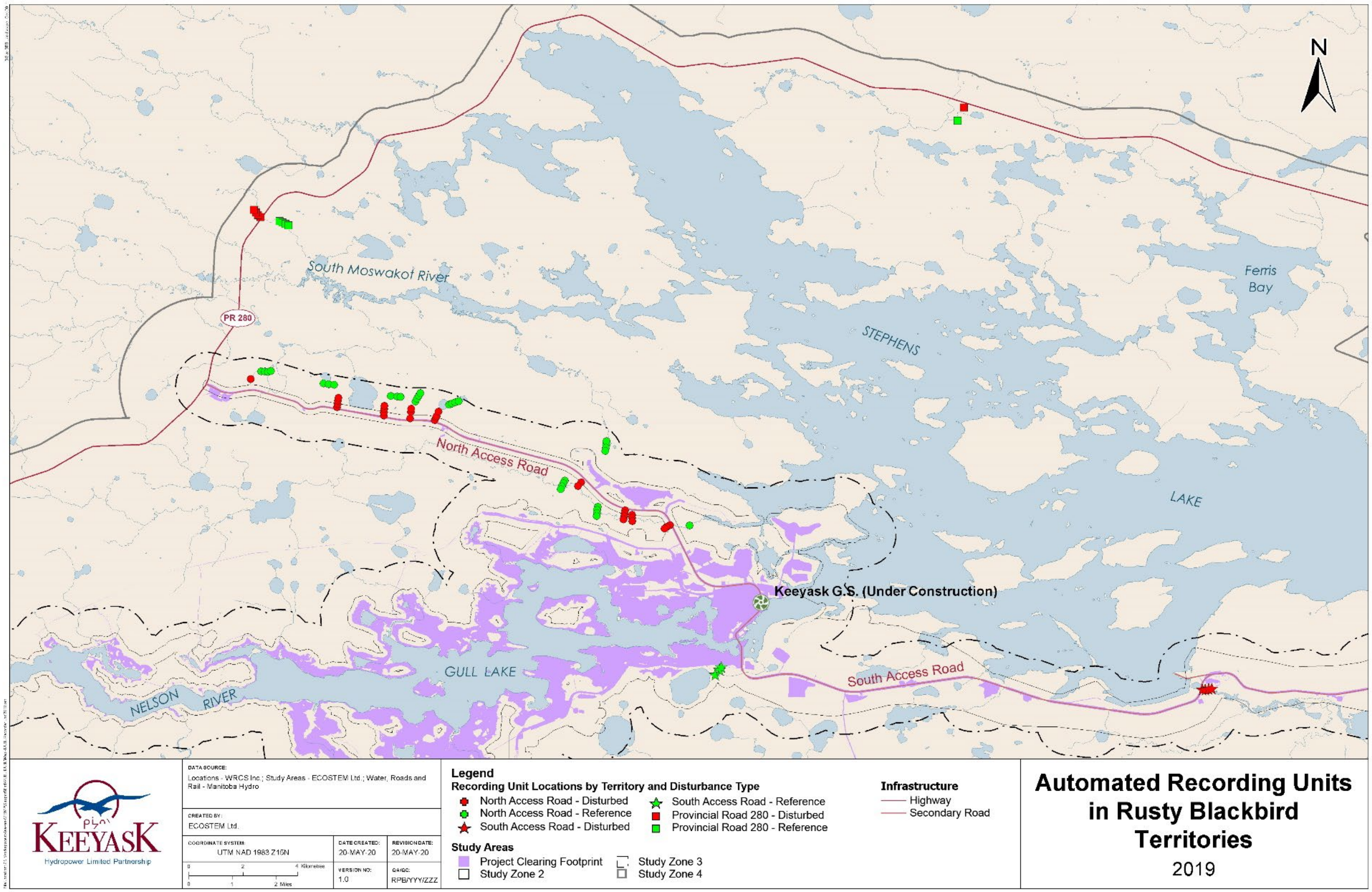
Disturbance Source	Disturbed		Reference		Total	
	Number of Territories	Number of Recorders	Number of Territories	Number of Recorders	Number of Territories	Number of Recorders
NAR	5	16	3	10	8	26
SAR	1	3	1	3	2	6
PR 280	3	9	3	9	6	18
Total	9	28	7	22	16	50

Table 2: Survey Effort for Rusty Blackbirds at Disturbed and Reference Sites, 2019

Disturbance Source	Disturbed		Reference		Total	
	Number of Territories	Number of Recorders	Number of Territories	Number of Recorders	Number of Territories	Number of Recorders
NAR	9	36	9	36	18	72
SAR	2	7	2	8	4	15
PR 280	2	8	2	8	4	16
Total	13	51	13	52	26	103



Map 1: Automated Recording Units in Olive-sided Flycatcher Territories, 2019



Map 2: Automated Recording Units in Rusty Blackbird Territories, 2019

2.2 AUDIO RECORDING SUPPORT AND ANALYSIS

To identify the presence or absence of olive-sided flycatcher or rusty blackbird calls, analyses of bird vocalizations were performed using the statistical package R (Hafner and Katz 2018). A stepwise process was used to remove most false positives, where other species were initially identified as the target species. Classification of audio clips involved setting a threshold for target and off-target calls and calculating a difference between the two (see Appendix 1 for detailed analysis methods). All calls identified as olive-sided flycatcher or rusty blackbird were isolated and reviewed for potential false positives not removed during the initial identification process.

Recordings from a total of 16 olive-sided flycatcher territories (Table 3) and 24 rusty blackbird territories (Table 4) were analyzed in 2019. Recordings made in 2016 and 2017 (Wildlife Resource Consulting Services MB Inc. 2018) were also analyzed. Because recorders were left in place for varying amounts of time over the three survey years (i.e., two to 20 days), territories with fewer than seven days of recordings were removed from the analysis (n = 1 in 2016 and n = 2 in 2017). For olive-sided flycatcher, recordings were analyzed from 30 territories in 2016 and from 19 territories in 2017 (Appendix 2, Table 2-1). For rusty blackbird, recordings were analyzed from 24 territories in 2016 and from 34 territories in 2017 (Appendix 2, Table 2-2). Calls from the first recorder were analyzed, or from the next recorder with calls if the first recorder could not be included, to avoid double-counting calls in the preliminary analysis presented in this report. Only calls from the first seven to 10 days of recordings were included in the analysis, to standardize the results.

Table 3: Number of Territories with Olive-sided Flycatcher Recordings, 2019

Disturbance Source	Disturbed Sites			Reference Sites		
	Number of Territories	Number of Recording Days	Number of Recordings	Number of Territories	Number of Recording Days	Number of Recordings
NAR	5	49	3,234	3	30	1,980
SAR	1	10	660	1	10	660
PR 280	3	30	1,980	3	30	1,980
Total	9	89	5,874	7	70	4,620

Table 4: Number of Territories with Rusty Blackbird Recordings, 2019

Disturbance Source	Disturbed Sites			Reference Sites		
	Number of Territories	Number of Recording Days	Number of Recordings	Number of Territories	Number of Recording Days	Number of Recordings
NAR	9	90	5,940	9	90	5,940
SAR	1	10	660	1	10	660
PR 280	2	20	1,320	2	19	1,254
Total	12	120	7,920	12	119	7,854

The amount of olive-sided flycatcher and rusty blackbird activity in territories at disturbed and reference sites at the NAR, the SAR, and PR 280 was evaluated with the percentage of days calls were recorded, the percentage of recordings on which calls were recorded, and the mean number of calls per territory over the seven- to 10-day analysis periods in all territories at each disturbance source. The percentage difference in each metric between territories at disturbed and reference sites at each disturbance source was calculated for comparison.

3.0 RESULTS

3.1 OLIVE-SIDED FLYCATCHER

Olive-sided flycatcher calls were recorded at 29 (97%) of the 30 territories analyzed in 2016, at 17 (89%) of the 19 territories analyzed in 2017, and at all 16 territories analyzed in 2019 over the standardized analysis period. Olive-sided flycatcher nesting territories were roughly delineated by identifying the locations of singing birds relative to the ARUs, examples of which are depicted in Appendix 3, Map 3-1.

There was no clear trend in the amount of olive-sided flycatcher activity in territories at the North and South access roads. At the NAR, there was a relatively small difference in the percentage of recording days and the percentage of recordings with calls at disturbed and reference sites in 2016 and 2017 (0 – 40%), with more activity in territories at reference sites in 2016 and more activity in territories at disturbed sites in 2017 (Table 5). In 2019, the percentage difference in recording days was small (17%), but the percentage of recordings with calls was 109% greater in territories at reference than disturbed sites. At the SAR, there was more olive-sided flycatcher activity in territories at disturbed than reference sites in 2016, and more activity in territories at reference than disturbed sites in 2019. However, few territories were found near the SAR (two in 2016 and 2019 and none in 2017) and results should be interpreted with caution.

There was more olive-sided flycatcher activity in territories at disturbed sites near PR 280 than in territories at reference sites in 2016 (Table 5). In 2017 and 2019, there was more activity in territories at reference sites than in territories at disturbed sites. The percentage difference in recording days with olive-sided flycatcher calls was relatively small (less than 100%) each year. However, the percentage difference in recordings with calls was relatively large in 2016 (140%) and 2019 (129%).

Table 5: Recording Days and Recordings with Olive-sided Flycatcher Calls, 2016, 2017, and 2019

Year	Disturbance Source	Percentage Recording Days			Percentage Recordings		
		Disturbed	Reference	% Difference	Disturbed	Reference	% Difference
2016	NAR	69	74	7	13	13	0
	SAR	90[1]	60	40	10[1]	2	133
	PR 280	84	33	87	17	3	140
2017	NAR	61	49	22	9	6	40
	SAR	-	-	-	-	-	-
	PR 280	63	85	30	6	16	91
2019	NAR	82	97	17	8	27	109
	SAR	10[1]	30[1]	100	<1[1]	11[1]	193
	PR 280	37	70	62	3	14	129

1. Results from one site.

When the mean number of olive-sided flycatcher calls per territory was considered for each disturbance source, there was relatively little difference between territories at disturbed and reference sites at the NAR (less than 100%) in all survey years (Table 6). At PR 280, there were more calls in territories at reference sites than at disturbed sites in 2017 and 2019 (154% and 161%, respectively). There were 49% more calls in territories at disturbed than reference sites in 2016.

Table 6: Mean Number of Olive-sided Flycatcher Calls per Territory, 2016, 2017, and 2019

Year	Disturbance Source	Disturbed Sites		Reference Sites		% Difference
		Mean	Range	Mean	Range	Mean
2016	NAR	985	0 – 2,152	977	17 – 2,916	1
	SAR	269[1]	-	15[1]	-	179
	PR 280	1,146	4 – 3,728	695	1 – 2,694	49
	KTP	592	2 – 1,182	858	4 – 1,711	37
2017	NAR	562	20 – 1,621	398	0 – 2,221	34
	SAR	-	-	-	-	-
	PR 280	223	0 – 483	1,696	187 – 3,204	154
	KTP	874	131 – 2,175	1,193	28 – 2,258	31
2019	NAR	916	87 – 2,721	2,014	1,108 – 3,526	75
	SAR	3[1]	-	959[1]	-	98
	PR 280	181	3 – 509	1,675	1 – 3,493	161
	KTP	1,935	135 – 3,831	959	0 – 3,074	67

1. Results from one territory.

When the survey years were combined, there was little difference in the percentage of recording days with olive-sided flycatcher calls in territories at the NAR (Figure 2). Calls were recorded at a smaller percentage of territories at disturbed sites than reference sites at the SAR. There was a small difference at PR 280, with calls recorded at a slightly greater percentage of territories at disturbed sites than reference sites.

When the percentage of recordings with olive-sided flycatcher calls was considered over the combined survey period, there was very little difference between disturbed and reference sites at the NAR, SAR, and PR 280 (Figure 3). There was marginally less activity in territories at disturbed sites than reference sites at the access roads.

The mean number of olive-sided flycatcher calls was similar in territories at disturbed and reference sites at the NAR over the combined survey period (Figure 4). The mean number of calls was consistently greater at reference sites.

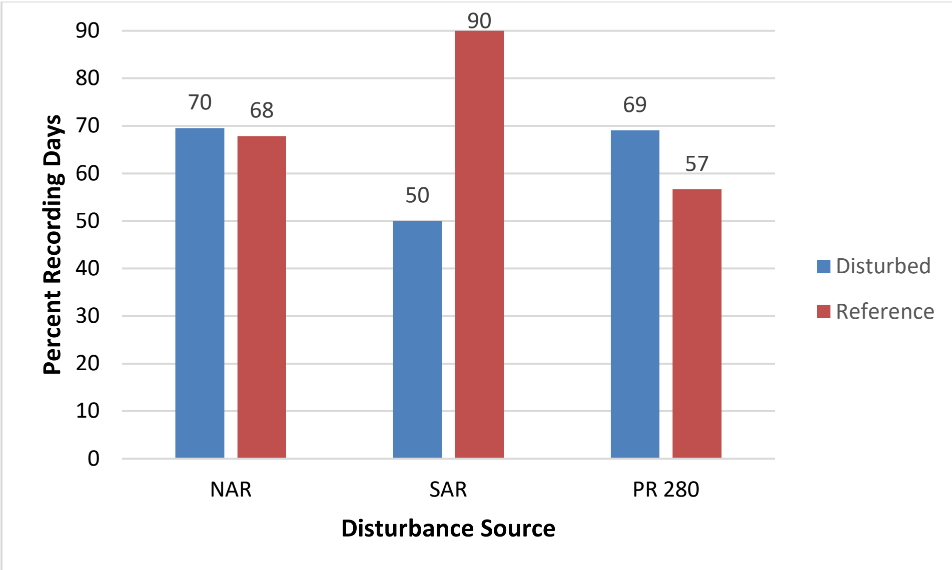


Figure 2: Percentage of Recording Days with Olive-sided Flycatcher Calls Over the Combined Survey Period, 2016, 2017, and 2019

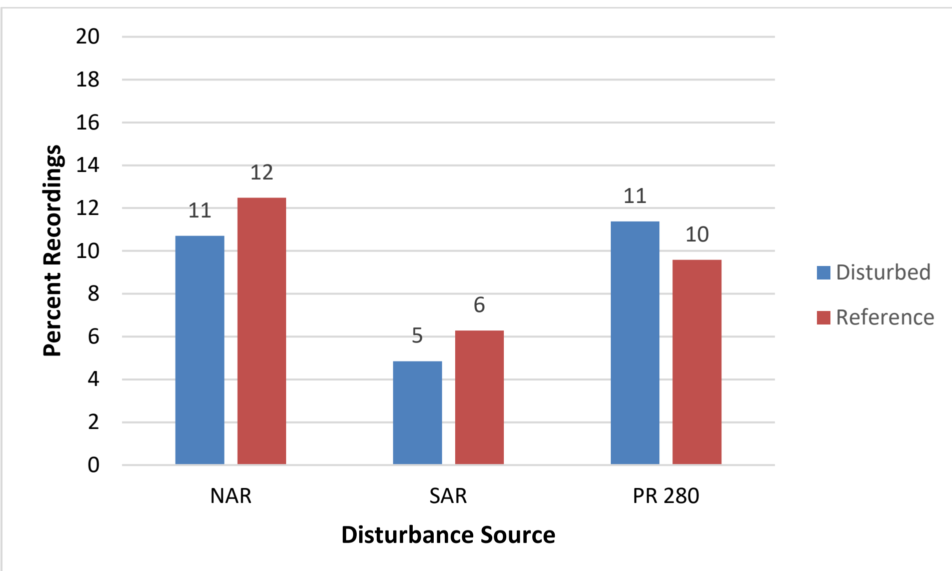


Figure 3: Percentage of Recordings with Olive-sided Flycatcher Calls Over the Combined Survey Period, 2016, 2017, and 2019

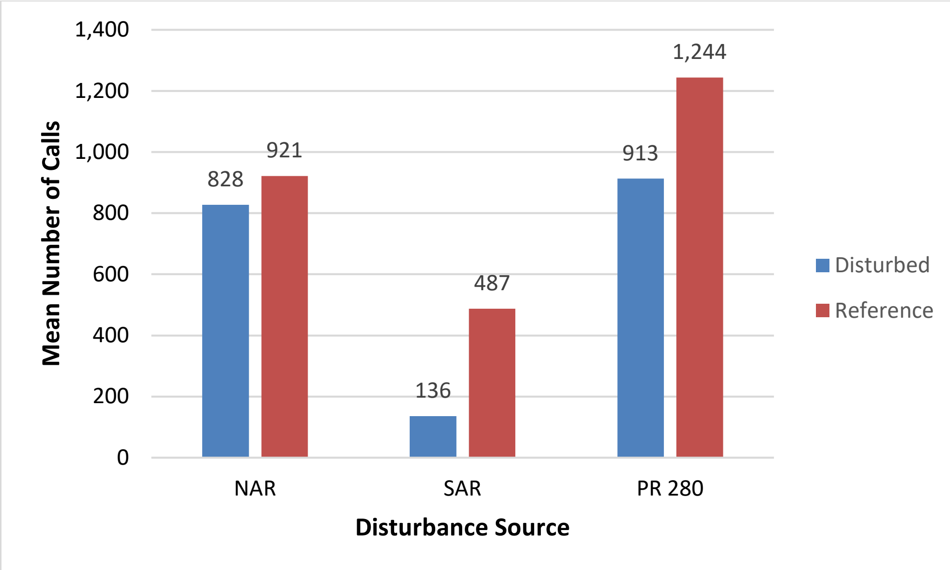


Figure 4: Mean Number of Olive-sided Flycatcher Calls per Territory Over the Combined Survey Period, 2016, 2017, and 2019

3.2 RUSTY BLACKBIRD

Rusty blackbird calls were recorded at all 24 territories analyzed in 2016, at 33 (97%) of the 34 territories analyzed in 2017, and at all 24 territories analyzed in 2019 over the standardized analysis period. Rusty blackbird territories were roughly delineated by identifying the locations of singing birds relative to the ARUs, examples of which are depicted in Appendix 3, Map 3-2.

Rusty blackbirds were consistently recorded on a greater percentage of recording days in territories at reference sites than disturbed sites at the NAR, but the difference was relatively small (45 – 67%; Table 7). The percentage of recordings with rusty blackbird calls also tended to be greater in territories at reference sites, except for 2016 when there was no difference. There was no clear trend in rusty blackbird activity at the SAR; there was more activity at in territories at disturbed sites in 2016 and more activity in territories at reference sites in 2017 and 2019.

There was generally more rusty blackbird activity at territories at reference sites than disturbed sites during all survey years at PR 280, particularly as measured by the percentage of recording days with calls (Table 7). However, the percentage difference in recording days was relatively small (21 – 50%).

Table 7: Recording Days and Recordings with Rusty Blackbird Calls, 2016, 2017, and 2019

Year	Disturbance Source	Percentage Recording Days			Percentage Recordings		
		Disturbed	Reference	% Difference	Disturbed	Reference	% Difference
2016	NAR	30	60	67	3	3	0
	SAR	70[1]	40	56	3[1]	1	100
	PR 280	24	40	50	1	6	143
2017	NAR	41	65	45	3	5	50
	SAR	70	83	17	4	11	93
	PR 280	36	60	50	3	2	40
2019	NAR	44	74	51	2	4	67
	SAR	30[1]	100[1]	108	1[1]	23[1]	183
	PR 280	30	37	21	1	1	0

1. Results from one territory.

The mean number of rusty blackbird calls per territory was similar in territories at disturbed and reference sites at the NAR, with the greatest difference (50%) in 2016 (Table 8). At the SAR, mean calls per territory was greatest at in territories at reference sites in 2017 and 2019. A single territory at a disturbed site was surveyed in 2019. In 2016, mean calls per territory was greatest at disturbed sites, where only one territory was surveyed in disturbed and reference areas.

There was a relatively large difference in the mean number of rusty blackbird calls per territory at disturbed and reference sites at PR 280 in 2016 (176%), where there were more calls at reference sites (Table 8). There were somewhat more calls in territories at disturbed than reference sites in 2017 and 2019, with smaller percentage differences between the two than in 2016.

Table 8: Mean Number of Rusty Blackbird Calls per Territory, 2016, 2017, and 2019

Year	Disturbance Source	Disturbed Sites		Reference Sites		% Difference Mean
		Mean	Range	Mean	Range	
2016	NAR	125	1 – 744	75	48 – 129	50
	SAR	69[1]	-	32	8 – 55	73
	PR 280	21	1 – 61	322	11 – 842	176
2017	NAR	111	1 – 1,091	136	3 – 886	20
	SAR	53	1 – 127	296	70 – 670	139
	PR 280	44	0 – 116	36	21 – 50	20
2019	NAR	49	1 – 140	59	7 – 256	19
	SAR	21[1]	-	2,415[1]	-	197
	PR 280	48	11 – 85	28	5 – 51	53

1. Results from one territory.

When the survey periods were combined, rusty blackbird calls were recorded on a greater percentage of recording days and recordings in territories reference sites at each of the three disturbance sources (Figure 5, Figure 6). The differences, however, were relatively small. At the NAR, there was no difference in the mean number of calls per territory at disturbed and reference sites (Figure 7). The mean number of calls per territory was considerably greater in territories at reference sites than disturbed sites at the SAR. There were somewhat more calls in territories at reference sites than disturbed sites at PR 280.

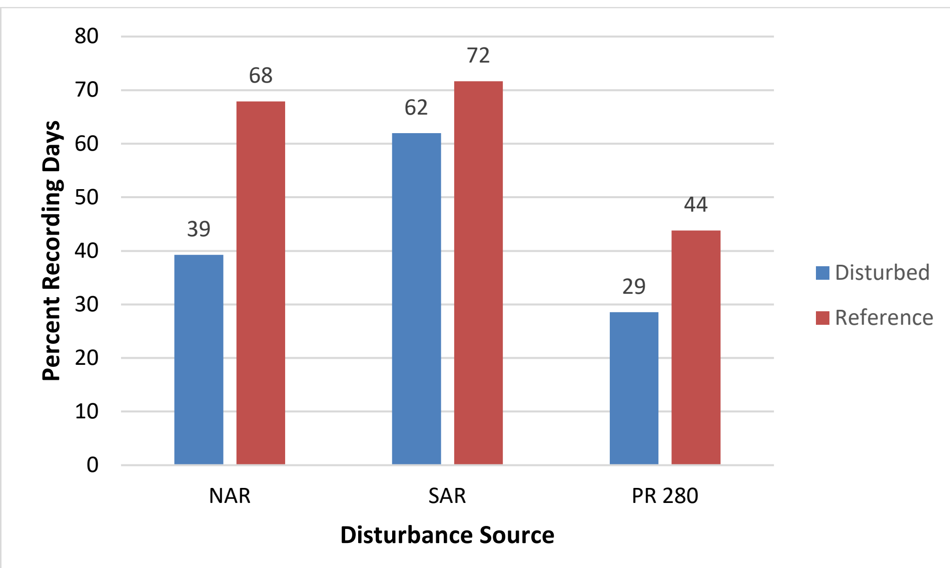


Figure 5: Percentage of Recording Days with Rusty Blackbird Calls Over the Combined Survey Period, 2016, 2017, and 2019

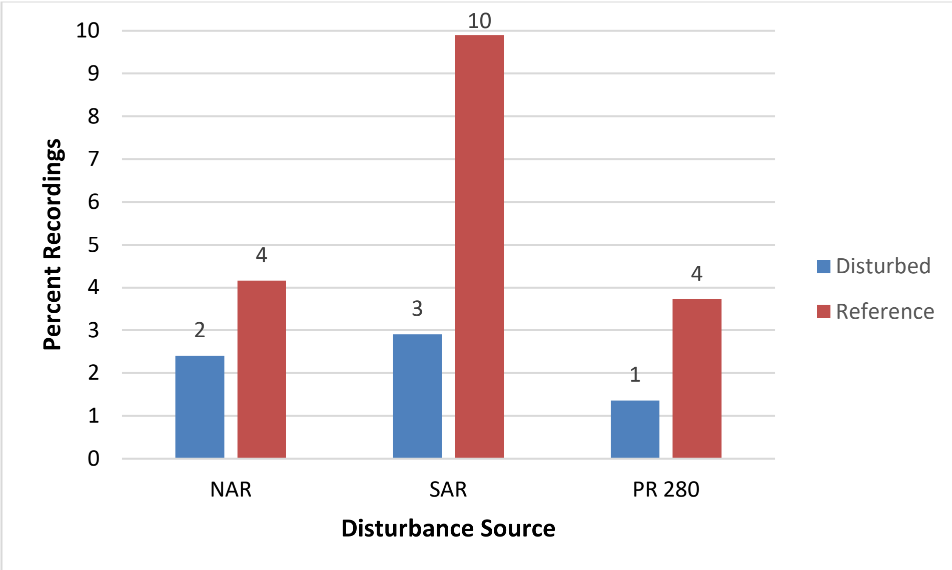


Figure 6: **Percentage of Recordings with Rusty Blackbird Calls Over the Combined Survey Period, 2016, 2017, and 2019**

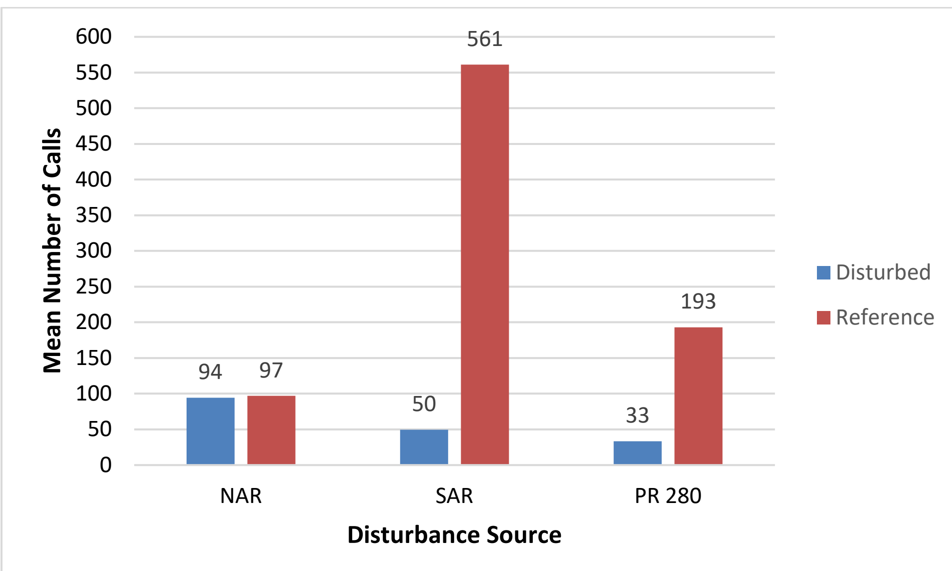


Figure 7: **Mean Number of Rusty Blackbird Calls per Territory Over the Combined Survey Period, 2016, 2017, and 2019**

4.0 DISCUSSION

Olive-sided flycatcher and rusty blackbird are species at risk and vulnerable to potential Project effects. Olive-sided flycatchers selected territories near the NAR and PR 280 during all three study years. There were fewer territories near the SAR; one disturbed territory was found in 2016 and 2019 and none were found in 2017. Rusty blackbirds selected territories near all three sources of disturbance; however, three or fewer territories were found near the SAR each study year.

Olive-sided flycatcher activity appeared to be similar at disturbed and reference territories near the NAR, SAR, and PR 280. When measured as the percentage of recording days with olive-sided flycatcher calls over the combined survey period, the amount of activity was the same in territories at disturbed and reference sites at the NAR. The percentage of recordings with olive-sided flycatcher calls and the mean number of calls per territory were somewhat greater in territories at reference than disturbed sites at the NAR and SAR. Disturbance on the NAR and SAR may or may not have had a minor effect on the amount of olive-sided flycatcher activity at disturbed territories, given the small differences in activity observed. In the EIS, no effect on territorial use by olive-sided flycatchers during construction was predicted. The potential effect appeared to be somewhat more pronounced on the SAR, where greater differences in activity were observed between territories at disturbed and reference sites than at the NAR. However, few territories were surveyed near the SAR, which could have influenced the results. In contrast, there tended to be more olive-sided flycatcher activity in territories at disturbed sites than reference sites near PR 280 in terms of the percentage of recording days and of recordings with calls.

There appeared to be somewhat less rusty blackbird activity in territories at disturbed than reference sites near all three sources of disturbance, as measured by the percentage of recording days with calls, the percentage of recordings with calls, and by the mean number of calls per territory. Small differences in the percentage of recording days and recordings with calls were observed. At the SAR and PR 280, larger differences in the mean number of calls per territory were observed, particularly at the SAR. Disturbance on the NAR and SAR may have affected the amount of rusty blackbird activity near these features. However, rusty blackbirds appeared to be somewhat sensitive to disturbance on all roads, suggested by the lower activity levels at disturbed territories at all three disturbance sources. The main effect of roads on rusty blackbirds is habitat loss, which is negligible because there are few roads in in northern wetland breeding areas (COSEWIC 2017); the species does not appear to be highly influenced by sensory disturbance.

To further study the potential effects of the NAR and SAR on olive-sided flycatchers and rusty blackbirds, bird response to sensory disturbance will be estimated by mapping call density as a function of distance from the roads, while controlling for differences in habitat. Potential Project effects on habitat use and distribution will be evaluated.

5.0 SUMMARY AND CONCLUSIONS

Overall, there were minor to no Project effects observed on olive-sided flycatcher and rusty blackbird activity during monitoring from 2016 to 2019 along the SAR and NAR. Olive-sided flycatcher activity appeared to be similar at disturbed and reference territories near the NAR, SAR, and PR 280, while there appeared to be somewhat less rusty blackbird activity at disturbed territories than reference territories near all three sources of disturbance. Additional analyses such as resource selection function analysis will be used to further evaluate potential Project effects on these species and will be included in the construction synthesis report.

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APPENDIX 1: AUDIO RECORDING ANALYSIS METHODS

Automated Recording Units (ARUs)

Although there is extensive precedent for using automated recording units (ARUs) for avian studies (Shonfield and Bayne 2017)[1], we had difficulty finding an ARU to meet our needs. In some of the species at risk studies proposed for the *Terrestrial Effects Monitoring Plan* (TEMP), for example, it was necessary to estimate distance and direction to the vocalizing birds. This required more than two channels of audio recording. Study design also demanded a large number of recorders to meet sample size requirements. After surveying the available technology, no recorders were found that could record four channels at a reasonable cost. Wildlife Resource Consulting Services MB Inc. commissioned Myrica Systems Inc. to design custom ARUs and a local contract assembler was hired to build them.

There were a number of criteria to be met in the ARU design:

- **Time accuracy**: ARUs contained a temperature-compensated quartz clock with an accuracy of +/- 2 minutes per year over a range of -40°C to 85°C.
- **Flexible time scheduling**: Timing parameters included start times, recording duration, interval, and number repetitions. Recordings can be corrected for sunrise and sunset over the season; units were loaded with daily sunrise and sunset times determined from National Oceanic and Atmospheric Administration (NOAA) calculations given the year, latitude, and longitude.
- **Lengthy unattended run time**: The design was optimized for minimal power consumption. ARUs could be powered from AA, D and 6V lantern batteries as required to meet recording time requirements.
- **Audio sensitivity**: Microphones were mounted in a separate case containing low-noise pre-amplifiers. Gain was set to match the sensitivity of human observers trained to identify bird calls.
- **Noise insensitivity**: Filtering was designed to remove frequencies above and below the range of interest for the bird species being recorded. This reduces, for example, wind noise. Microphones were also fitted with open-cell foam “windsocks”.
- **Environmental tolerance**: ARUs were designed and components chosen to operate in the full range of temperatures expected in the field. Microphone cables were sheathed in metal braid to resist chewing by rodents. Electronics were protected in weather proof cases.
- **Directionality**: Each of four microphones was mounted in a recessed hole on each face of a square enclosure. This provided a degree of audio isolation of each from its neighbours. The ‘north’ microphone was labelled on enclosures to permit alignment in the field.
- **Data storage**: ARUs were fitted with secure digital (SD) cards (8 gigabyte [GB] or 32GB) as appropriate for each study. The audio sampling rate was also varied to match study, storage,

[1] Shonfield, J. and Bayne. E.M. 2017. Autonomous recording units in avian ecological research: current use and future applications. Avian Conservation and Ecology 12(1):14. https://doi.org/10.5751/ACE-00974-120114.

and analysis requirements (16.0 kilohertz [kHz] or 44.1 kHz). Files were compressed in Ogg Vorbis format (OGG) using a patent-and-royalty-free algorithm,, which provided no noticeable signal degradation. Each field recording consisted of two stereo recordings on the SD card (A and B). An audible time marker (click) was used to verify synchronization of the two stereo recordings.

- **Data identification**: Each ARU had a serial number label and was programmed with the same number in software. Recording file names contained the day of the year (DOY), hour (HH) and minute (MM) that the recording started. For example two stereo recordings would be labelled 1832110A.ogg and 1832110B.ogg. As a back-up, data were embedded within the audio file that included time, date, and serial number.

Pre-processing Data

For each survey year, field recordings from each recorder were copied from SD cards into a directory structure on a hard drive matching the respective year, study, and site. Each recording for olive-sided flycatcher and rusty blackbird was 300 seconds in length. Data from each year comprised several terabytes despite data being in compressed format. Data were kept in separate working and backup repositories.

Analysis of bird vocalizations was performed using the statistical package R[2]. In order for data to be analyzed in R, OGG files had to be converted to wave (WAV) format using either SOX[3] or LameXP[4]. It was determined that an audio bandwidth of 5.5 kHz was sufficient to recognize the species of interest in recordings. For this reason, OGG files were converted to WAV format with a sampling rate of 11.025 kHz; this reduced the storage volume of uncompressed data and speeded file reading during analysis.

[2]R (www.r-project.org), a free statistical analysis software environment. The Package ‘monitoR’ (https://CRAN.R-project.org/package=monitoR) was used. monitoR is described briefly in “A short introduction to acoustic template matching with monitoR.” Sasha D. Hafner and Jonathan Katz. February 14, 2018 (available from www.r-project.org) and in more detail in: “monitoR: Automation Tools For Landscape-scale Acoustic Monitoring - PhD Dissertation. Jonathan Katz. The University of Vermont. May, 2015.

[3]SOX (http://sox.sourceforge.net) is a free command line application for converting formats of and processing data in audio files.

[4] LameXP (http://lamexp.sourceforge.net) is a free audio file format converter with a windows front end.

Species Detection

Templates were created from exemplars of species vocalizations (calls) of interest. MonitoR uses a method called template matching to identify species by their sounds. The method can be thought of as taking a low-resolution spectrogram and measuring its correlation against the spectrogram of a whole recording. In fact, templates can be plotted as spectrograms.

It was necessary to use multiple exemplars for a given species to cover the range in variation of calls. It was also necessary to measure correlation against other non-target sounds (calls and environmental sound) that also had a high correlation with the same species.

Due to the very large collection of recordings for analysis, a balance needed to be struck between the detail of templates used and the speed of analysis; recording analysis with detailed templates would take much longer. Attention was also paid to the duration and frequency bandwidth chosen for each template. To reduce analysis time to a practical order of magnitude, a two-step process of analysis was required.

In the first step, a limited number of low-resolution templates were used to discover candidate calls of the target species, recognizing that there would be many false positives. These candidate calls were extracted as two-second sound clips with each clip starting one second prior to the centre of the call detection and running to one second after the centre of the call. Datasets were also created at this step that included clip file name and statistics about the candidate clip. A clip spectrogram was created for each clip that was useful for validation. By the second step, the volume of data had been greatly reduced and only clips were processed. These could then be analyzed at high resolution to remove most false positives.

Classification of clips involved setting a threshold for target and off-target calls and calculating a difference between the two. A viewing system for validation was developed to allow experts to view each call (clip) as a spectrogram along with its classification and to listen to it by simply clicking on the spectrogram. Summary statistics were created for all detections to aid in validation.

Distance and Direction Estimation

Sound pressure level in decibels (SPL), which humans perceive as 'sound volume', has been shown to provide a good estimate of distance to a calling bird (Yip et al. 2017)[5]. Direction can be estimated using the equivalent of Interaural Level Difference (ILD); from a human perspective this would be equivalent to using sound volume as a cue about direction (Nelson and Suthers 2004)[6]. Although many automated direction estimation algorithms use Interaural Time Difference (ITD), humans do not use this for frequencies high frequencies (Roman et al. 2003)[7]. There were several

[5] Yip, D.A., Leston, L., Bayne, E.M., Sólymos, P., and Grover, A. 2017. Experimentally derived detection distances from audio recordings and human observers enable integrated analysis of point count data. Avian Conservation and Ecology 12(1):11. https://doi.org/10.5751/ACE-00997-120111.

[6] Nelson, B.S. and Suthers, R.A. 2004. Sound localization in a small passerine bird: discrimination of azimuth as a function of head orientation and sound frequency. The Journal of Experimental Biology 207: 4121–4133.

[7] Roman, N., Wang, D., and Brown, G. 2003. Speech segregation based on sound localization. The Journal of the Acoustical Society of America 114: 2236–2252. https://doi.org /10.1121/1.1610463.

reasons why we were concerned that ITD might be unreliable in our studies. Some include: low signal to noise ratios (SNR), reverberation, environmental noise like wind, etc. In addition, our recording hardware was expected to have small differences that would be more pronounced at the high frequencies of bird calls. Microphones and circuits were identical by design, but tolerances in components were not and phase errors were expected. Exact synchronization of the two stereo recordings was problematic, even with the synchronization click that was used. We concluded that ILD was the best choice.

In order to calculate distance and direction to a singing bird recorded by the four-channel recorders, it was necessary to calibrate the system using bird songs recorded at varying distances. When a singing olive-sided flycatcher or rusty blackbird was observed, the observer would record the calls using a handheld recorder (Tascam DR100-MKII). The distance of the bird from the observer was estimated using a rangefinder or waypoints taken at the observer's location and the bird's perch after it moved. Recordings were taken at approximately 20 m increasing increments until the bird could no longer be heard. Several dozen examples were collected using these techniques.

An algorithm was devised to find the peak root mean square (RMS) amplitude within each clip and convert it to a decibel value with an accurate time stamp. The four peak values were then used to triangulate the direction of the call; it was assumed that the calling bird was in the horizontal plane of the microphone array.

In the final data set, distance of the calling bird was estimated using decibel-distance curves created with field calibration recordings. Using the sound clips, distances were estimated by choosing the largest decibel value measured by the four microphones.

APPENDIX 2: AUTOMATED RECORDER UNITS 2016 AND 2017

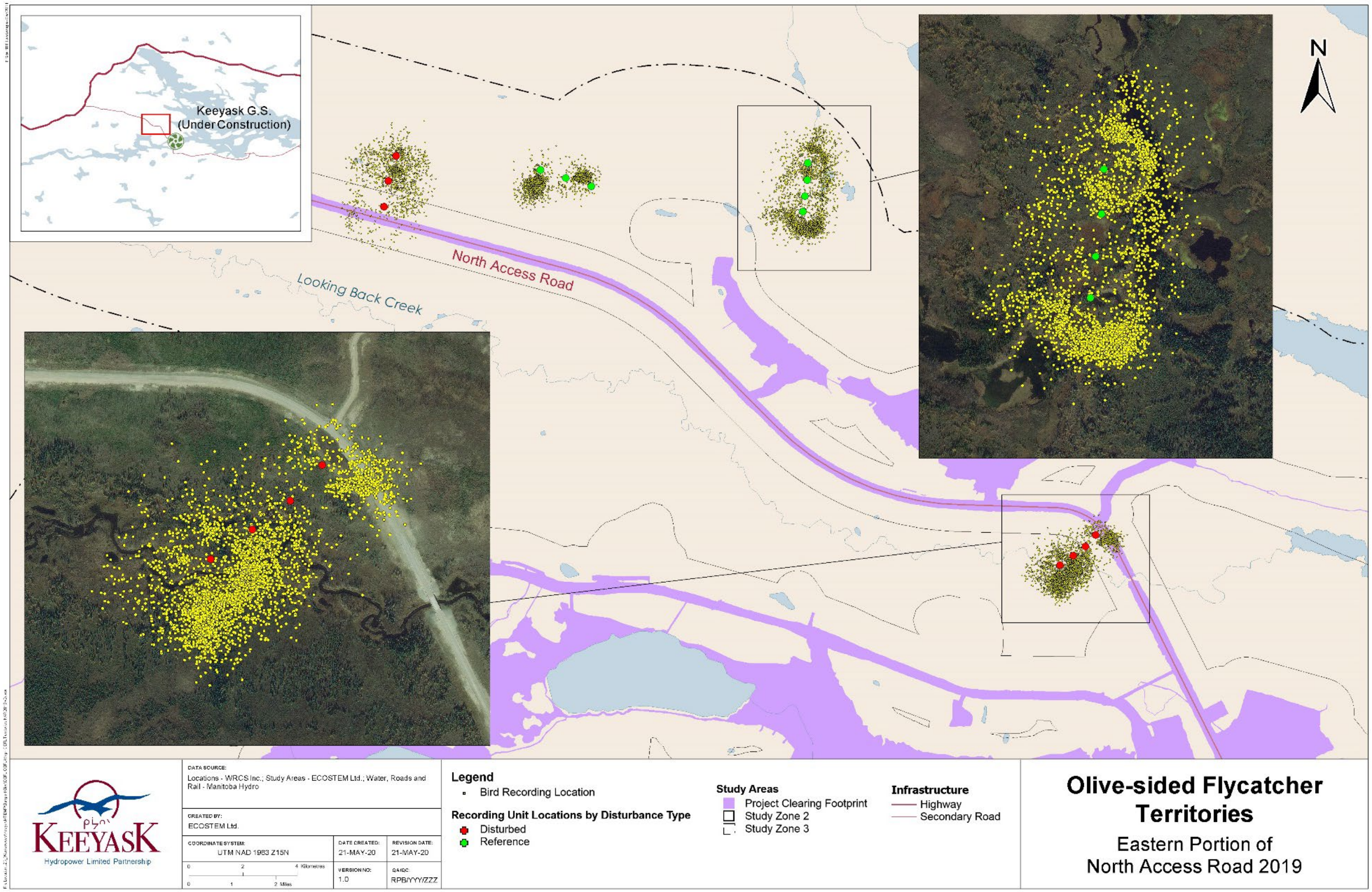
Table 2-1: Number of Territories with Olive-sided Flycatcher Recordings, 2016 and 2017

Year	Disturbance Source	Disturbed Sites			Reference Sites		
		Number of Territories	Number of Recording Days	Number of Recordings	Number of Territories	Number of Recording Days	Number of Recordings
2016	NAR	9	88	5,808	7	68	4,488
	SAR	1	10	660	1	10	660
	PR 280	8	79	5,214	4	40	2,640
	Total	18	177	11,682	12	118	7,788
2017	NAR	7	70	4,620	7	67	4,422
	SAR	0	0	0	0	0	0
	PR 280	3	30	1,980	2	20	1,320
	Total	10	100	6,600	9	87	5,742

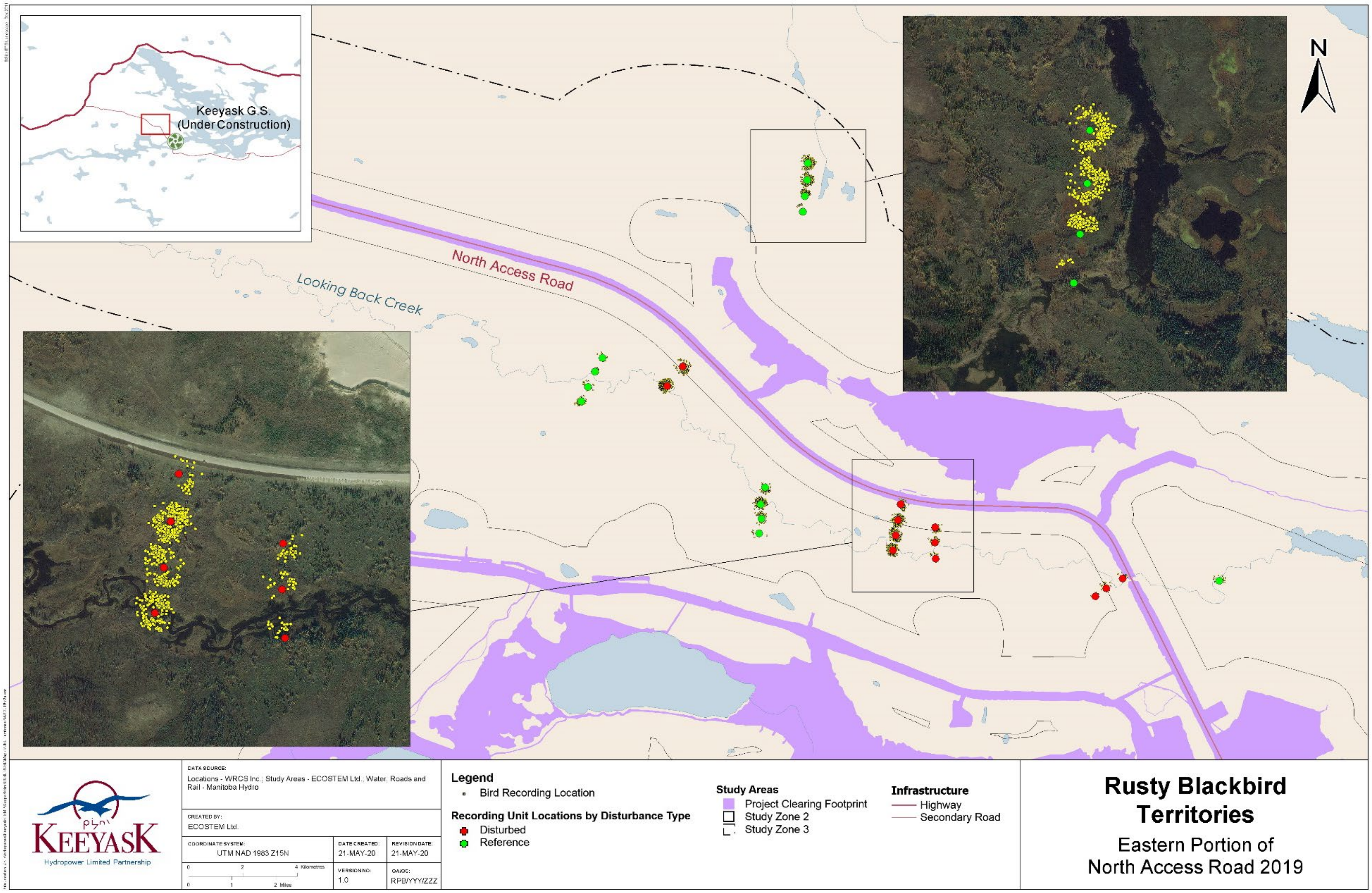
Table 2-2: Number of Territories with Rusty Blackbird Recordings, 2016 and 2017

Year	Disturbance Source	Disturbed Sites			Reference Sites		
		Number of Territories	Number of Recording Days	Number of Recordings	Number of Territories	Number of Recording Days	Number of Recordings
2016	NAR	7	70	4,620	4	40	2,640
	SAR	1	10	660	2	20	1,320
	PR 280	5	50	3,300	5	50	3,300
	Total	13	130	8,580	11	110	7,260
2017	NAR	12	120	7,920	11	110	7,260
	SAR	3	30	1,980	3	30	1,980
	PR 280	3	28	1,848	2	20	1,320
	Total	18	178	11,748	16	160	10,560

APPENDIX 3:
OLIVE-SIDED FLYCATCHER AND RUSTY BLACKBIRD TERRITORIES 2019



Map 3-1: Olive-sided Flycatcher Territories at the North Access Road, 2019



Map 3-2: Rusty Blackbird Territories at the North Access Road, 2019