APPENDIX D
SOUND ASSESSMENT

SOUND ASSESSMENT

05.07.2024

Clydesdale Ridge Wind Project

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1 Introduction

The Clydesdale Ridge Wind Project (the Project) is being developed by Clydesdale Holdings Ltd. (the Proponent). The Proponent represents a partnership between Natural Forces Developments Limited Partnership (Natural Forces) and Dalhousie Mountain Wind Energy Inc. The Proponent is further partnering with Mi'kmaq bands in Nova Scotia to ultimately develop, construct, own, and operate the Project.

The Project consists of up to 18 wind turbine generators (WTGs) and is situated adjacent to the operational Dalhousie Mountain Wind Farm, which is owned and operated by an affiliate of Dalhousie Mountain Wind Energy Inc. The Project is located near Mount Thom, Earltown, Loganville, and Berichan in both Colchester County and Pictou County. The proposed WTG locations and associated infrastructure are predominantly on privately-owned lands owned by multiple landowners, with a portion of the access road and collector lines traversing provincial Crown land. The private lands are secured under Lease, Option to Lease, and Easement. The Proponent has an active application for an Easement over the provincial Crown land.

On behalf of the Proponent, Natural Forces has undertaken a sound level impact assessment to determine the impact of sound emissions on the dwellings and local businesses in the surrounding area during both construction and operation stages of the Project.

This report outlines background information on sound levels, discusses relevant policy and guidelines, provides the prediction methodology and results, and proposes mitigation methods.

1.1 Policy and Guidelines

The *Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia* requires that wind farm design and siting does not cause sound levels to exceed 40 dBA at the exterior of receptors. Using this guidance document, a threshold of 40 dB(A) for operational sound levels at the exterior of a receptor for all wind speeds was selected. Additionally, any existing turbines within 3km were included in the model.

Additional to the Provincial threshold, the *Wind Turbine Development By-Law* of the Municipality of the County of Colchester outlines that all large wind turbines must not have an Ambient Degradation Noise Standard of greater than 36 dB(A) at existing dwellings. Notably, this regulation can be waived with written consent of landowners who share a common land boundary with the project. It should also be noted that the World Health Organization guidelines recommend less than 40 dB(A) of annual average night noise to prevent adverse health effects (WHO, 2010).

1.2 Source of Sound

This assessment is conducted using the Nordex N-163 turbine model, with a hub height of ~118m, a rotor diameter of 163m, and a total height of ~200m. Of the turbine models considered

for the Project, this model signifies the highest possible impact. This approach allows for the Sound Assessment to evaluate a scenario of maximum potential impact. This assessment also assumes that all 18 turbine locations will be constructed, further demonstrating the highest possible impact.

The geographical coordinates of the 18 proposed turbine locations are included in **Appendix B**, and a map is included in **Appendix A**.

There is one existing turbine within 3 km of the proposed WTG locations, which is also included in the sound assessment. Part of the Dalhousie Mountain Wind Farm the model of this turbine is the General Electric Energy GE 1.5 sl/sle, with a hub height of 80m and a rotor diameter of 77m.

1.3 Receptors

There are 26 receptors within the vicinity of the turbine locations. The receptors consist of year-long dwellings, seasonal dwellings, and local businesses. They have been identified based on online geographical data from the Nova Scotia Data Catalogue and cross referenced with aerial photography, as well as site visits. The geographical coordinates of these receptors are included in **Appendix B**. A map of the project area with the receptors is included in **Appendix A**. The following documents were reviewed in order to conduct the sound level impact assessment:

- Federal Guidance for Evaluating Human Health Impacts in Environmental Assessment: NOISE (2017).
- Highway Traffic Noise Analyses and Abatement: Policy and Guidance. U.S. Department of Transportation (US Department of Transportation, 1995)
- Biological Assessment Preparation for Transportation Projects – Advanced Training Manual (Washington State Department of Transportation, 2017)

There are no schools, care homes, or other sensitive receptors within 2 km of the turbines. The area is currently used primarily for forestry activities, and has extensive cleared areas and an existing network of forest service roads. The nearby trees to the South of the Project will aid in the absorption of sound from both construction and operation.

2 Sound Level Assessments

2.1 Construction Sound Assessment

2.1.1 Methods

The construction sound assessment was conducted using standard methodology. Construction noise is not always constant and can produce impulsive and variable sounds at different noise levels, which could create heightened annoyance levels in the surrounding community. The construction noise assessment will consider the maximum noise levels produced by various construction equipment to determine maximum sustained noise levels

when all equipment is running. The following documents were reviewed to conduct the construction sound level impact assessment:

- Highway Traffic Noise Analyses and Abatement: Policy and Guidance. U.S. Department of Transportation (US Department of Transportation, 1995), and
- Biological Assessment Preparation for Transportation Projects – Advanced Training Manual (Washington State Department of Transportation, 2017).

2.1.2 Results

General construction activities include those associated with vegetation clearing, road building, foundations, and turbine erection. These activities will likely involve the use of backhoes, concrete mixers and pumps, cranes, dump trucks, excavators and light-duty pickup trucks with the associated sound levels predicted in **Table 1.**

TABLE 1: SOUND POWER LEVELS ASSOCIATED WITH CONSTRUCTION EQUIPMENT (WSDOT 2017)

Equipment	Max Sound Power Level (dB{A})
Backhoe	78
Concrete Mixer	79
Concrete Pump	81
Crane	81
Dump Truck	76
Excavator	81
Pick-up Truck	75

In addition, occasional blasting may be associated with impact equipment use and that noise can reach 126 dBA (WSD0T 2017). If blasting is to be required as part of the Project, it will be limited in frequency and duration only to the extent possible to effectively construct turbine foundations.

It is not expected that all equipment would be running at the same time, but to determine maximum expected sound levels during construction, the WSDoT (2017) guidelines for decibel addition were used to conclude that 86 dB[A] is the highest expected sound level during combined construction activities. **Table 2** identifies the sound levels predicted to be observed at various distances from the construction site determined using WSDoT (2017) guidelines.

TABLE 2: WORST-CASE SOUND LEVELS IN THE SURROUNDING ENVIRONMENT CALCULATED USING WSDOT (2017) GUIDELINES*

Distance	Construction Sound Level (dB[A])

50 ft. (15.2 m)	86
100 ft. (30.5 m)	78.5
200 ft. (61 m)	71
400 ft. (122 m)	63.5
800 ft. (244 m)	56
1600 ft. (488 m)	48.5
3200 ft. (975 m)	41

* Assuming sound levels in soft environment attenuate at -7.5 db[a] per doubling of distance

Many sound level scales refer to 70 dB[A] as an arbitrary base of comparison where levels above 70 dB[A] can be considered annoying to some people (Purdue University 2017). As indicated in **Table 2**, at 61 m from the construction site, noise levels are approximately 70 dB[A], similar to that of a car travelling at 100 km/h and just at the threshold of possible annoyance (Purdue University 2000). Also indicated in **Table 2**, sound levels from the construction site reach only approximately 40 dB[A] at 1 km from the site. With the nearest dwelling located approximately 625 m from a proposed turbine, construction noise is not expected to significantly impact dwellings in the area.

The environment in which the Project construction will occur is considered a soft environment with normal unpacked earth. The normal unpacked earth and topography will facilitate attenuation of noise emissions at shorter distances.

Additionally, this site has been chosen due to its excellent wind resource. Wind generally increases ambient sound levels in an area and in combination with the vegetative cover will aid in making construction noise less noticeable at even shorter distances (WSDoT 2017).

2.2 Operational Sound Assessment

2.2.1 Methods

The sound assessment used site-specific information in calculating sound levels by utilizing existing wind direction data. This model assumes downwind propagation is occurring simultaneously in all directions of the wind turbines. Sound propagation in an upwind direction would result in a significant reduction of sound levels at any receptor located upwind from the turbine. This means that the resulting sound levels from the assessment are likely calculated as higher than they would be experienced.

No correction for special audible characteristics, such as clearly audible tones, impulses, or modulation of sound levels, was made as part of this assessment. These are not common characteristics of modern WTGs in a well-designed wind farm. It is common that WTG manufacturers guarantee the absence of tonal sound produced by the WTG. Furthermore, impulses and modulation of sound levels from the wind farm under normal conditions would not be of a level to necessitate the application of any penalty.

The operational sound pressure level was calculated at each point of reception using the Decibel module of WindPRO v.4.0, which uses the ISO 9613-2 method "Attenuation of sound during propagation outdoors, Part 2: A general method of calculation". The ISO 9613-2 method is a general standard used to fit the requirements of any wind farm. The demand type "*2: WTG plus ambient noise is compared to ambient noise plus margin*" is used in the model to add the ambient sound levels to the sound produced by WTGs, which is then compared to the 40 dB(A) threshold.

Low frequency sound is understood to be any frequency less than 125 Hz. Infrasound describes sounds with a frequency less than 20 Hz and can occur when large masses are in motion (Leventhall 2007). In some cases, the movement of wind turbine blades has generated infrasound in the local environment (Bolin et al. 2011). The low frequency noise assessment uses the Low Frequency Noise (ISO 9613-2) calculation model on WindPRO v.4.0.

2.2.2 Model Assumptions

Ground attenuation

A ground attenuation value of 0.5 was used in this model. Based on the vegetative and porous surfaces of the ground surrounding the Project, this factor is conservative and likely underestimates how much sound is absorbed by the ground.

Ambient Noise Assumptions

In order to assess the cumulative sound impacts of adding wind turbines to the existing landscape, Natural Forces considered local existing noise sources, and reviewed guidelines on ambient noise modelling in other jurisdictions. For site-specific context, the following anthropogenic noise sources exist near the Project and in surrounding communities. These sources include but are not limited to:

- Passenger vehicles, transport trucks, farming equipment, all-terrain vehicles, and snowmobiles operating on local roads and trails;
- Forestry and agricultural activities;
- Existing transmission lines;
- Recreational activities; and
- Local pits and quarries.

The temporal frequency, duration, and specific locations of the above-mentioned noise vary significantly throughout the day and across seasons. As detailed in the Alberta Utilities Commission Noise Control Guidelines (AUC, 2021), this variation poses challenges to assessment and in some situations assumptions about existing noise levels are appropriate. As such, an assumption for ambient noise was determined. 35 dB[A], the average nighttime ambient sound level in rural Alberta (AUC, 2021) was applied to the model. As this project is located in rural NS, 35 dB[A] was determined to be an appropriate estimate of nighttime ambient noise.

Low Frequency Sound Model Assumptions

A low frequency sound assessment was conducted Finland Low Frequency module of WindPRO v4.0. This calculation looks at frequencies between 20 and 300 Hz. There is no specific damping profile included in the Finnish code; however, WindPRO suggests the use of three publicly available profiles.

A list of more detailed assumptions is available as part of **Appendix B**.

2.2.3 Results

Sound Assessment

The Project, including existing turbines within 3 km, adheres to the identified threshold as the modeled sound levels do not exceed 40 dB(A) at any receptor. To demonstrate compliance with the threshold, turbine 2 has been derated to operating mode 9. Should a turbine be built at this location, it will be derated as modeled or it will be a different turbine design. Updated sound modelling will be submitted if any changes are made to the project layout or turbine models.

One receptor ("N") within the Municipality of the County of Colchester exceeds the limit defined in the Municipality's *Wind Turbine Development By-law* of 36 dB(A), by 0.2 dB(A). However, this By-law allows for a variance from this 36 dB(A) requirement (to a maximum of 40dB(A)) provided the proponent has written permission from landowners who share a common boundary with the project lands. Additionally, there are no adverse health effects anticipated below 40 dB(A).

The results of the sound prediction model for the receptors that are predicted to receive the highest sound levels (for wind speeds between 4.0 m/s and 12.0. m/s) are summarized in **Table 3**. These values combine the sound generated by the proposed WTGs with the existing ambient noise.

A map of the Project area and the sound assessment contours with the receptors is included as **Appendix A**. It should be noted that the map depicts only the noise generated by WTGs and does not account for the existing ambient noise. The full results from WindPRO are included as **Appendix B**.

The highest perceived sound (WTG + Ambient) at a receptor is anticipated to be 39.7 dB(A) according to the model.

TABLE 3: OPERATIONAL SOUND LEVEL OF THE 10 RECEPTORS PREDICTED TO RECEIVE THE HIGHEST ANTICIPATED SOUND LEVELS FOR WIND SPEEDS BETWEEN AND INCLUDING 4 TO 12 M/2*

Receptor ID	Max Sound Level from WTG [dB(A)]	Max Sound Level from WTG and Ambient [dB(A)]	Compliance with 40 dB(A) Threshold
O	37.9	39.7	Yes
I	35.2	38.1	Yes
P	34.5	37.8	Yes
Q	33.1	37.2	Yes
R	32.4	36.9	Yes
S	32.3	36.9	Yes
F	30.7	36.4	Yes
N	30.0	36.2	Yes
U	30.0	36.2	Yes
E	29.6	36.1	Yes

* Model assumes an ambient noise level of 35 dB[A]. The combined sound level from WTGs and ambient was calculated in WindPRO.

Low Frequency Sound Assessment

An additional assessment was completed using the Finland Low Frequency model in WindPRO v4.0. The results of this assessment show that the lowest frequency observed at any receptor is 50.0 Hz, which is 30 Hz higher than the threshold for infrasound (20Hz). Therefore, no infrasound noise is expected at any receptor.

A description of this model, its assumptions and methodologies are included in **Appendix C**.

2.3 Potential Interactions and Mitigations

Prior to carrying out a sound level assessment, careful siting of the turbines (as outlined in **Section 2.1.1**) reduced the majority of sound impacts to neighbouring residents**.**

The potential interactions of the Project with the ambient sound levels and the proposed mitigation measures are summarized in **Table 4**.

TABLE 4: POTENTIAL INTERACTIONS AND PROPOSED MITIGATION MEASURES FOR AMBIENT SOUND LEVELS

Potential Interactions with Ambient Sound Levels	Proposed Mitigation Measures
Disturbance to receptors within the surrounding area due to use of equipment and machinery during construction and decommissioning. Disturbance to receptors within the surrounding area due to sound levels generated during operations.	1) Turbines have been sited a minimum of 625 m away from residences. 2) A sound level impact assessment has been conducted showing that sound levels anticipated at nearby dwellings are below threshold of 40 dB(A). 3) The wind turbine model selected for the Project will incorporate noise reduction technologies to mitigate sound levels generated by the moving blades, if available. 4) Site preparation, construction, and decommissioning activities will be limited to daytime hours when it is safe to do so. 5) Clearing of flora on the Project site will be minimized to aid in attenuation of sound levels. 6) Events with particularly high sound levels, such as blasting, will be avoided or minimized and communicated to local residents adequately with ample time. 7) A complaint resolution plan will be developed to address sound level concerns.
Disturbance to receptors within the surrounding area due to infrasound from wind turbines during operations.	8) Infrasound from wind turbines is not anticipated to be a concern based on the project modeling and given the distance the wind turbines are located relative to dwellings.

3 Discussion and Conclusions

Natural Forces has completed an assessment to evaluate the sound impacts of the Clydesdale Ridge Wind Project at receptor locations within the vicinity of WTGs. Based on the parameters used in the WindPRO sound prediction model, it has been shown that in a conservative scenario, sound levels are compliant with the 40 dB(A) threshold at all receptors. Furthermore, it has been shown that receptors within the Municipality of the County of Colchester are compliant with the municipal threshold of 36 dB(A), with one exception exceeding by 0.2 dB(A). In this case, a written letter from landowners who share a common boundary with the project would warrant a variance of up to 40 dB(A).

While heightened sound levels during construction activities are unavoidable, the sound level assessment for the construction period shows that sounds levels at nearby residences are not expected to be significant. Various mitigation measures will be put in place during construction to limit the heightened sound levels.

The operational sound level modelling for the Project demonstrates that the sound levels expected to be experienced at receptors including ambient sound adhere to the identified Provincial threshold.

A complaint resolution plan will be developed for handling all concerns from surrounding communities. The Proponent will begin the review process for complaints after the concern or complaint has been received. The Proponent will then conduct an investigation into the complaint in collaboration with relevant parties.

4 References

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Appendix A: Project Map with Modeled Sound Levels

Clydesdale Ridge Wind Project

Sound Assessment Map

Legend

- Preliminary Turbine Layout
- Receptors

Sound Assessment Contours

- 35 dB(A)
- 40 dB(A)
- 45 dB(A)
- 50 dB(A)

Notes

1. Turbine markers are not to scale.
2. These lines depict only the turbine sound levels and do not take into account the existing ambient noise.

Sources

- Basedata provided by the Province of Nova Scotia
- Basemap: ESRI World Topo Map

N

0 500 1,000 1,500

Metres

Scale: 1:45,000

Spatial Reference: NAD 1983 CSRS UTM Zone 20N
Page Size: 11" x 17"

Production Date: Jul 5, 2024	Prepared By: Alex Torrealba

Natural Forces

Appendix B: WindPRO Sound Level Assessment Results and Assumptions

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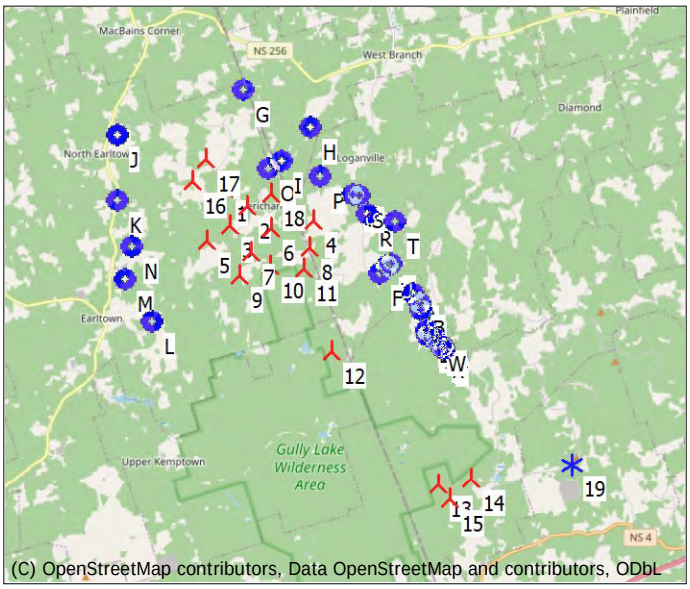
DECIBEL - Main Result

Calculation: CR 18Tc N163-7 GF:0.5 G&R:OM9, DM

Noise calculation model:
ISO 9613-2 General
Wind speed (at 10 m height):
4.0 m/s - 12.0 m/s, step 1.0 m/s
Ground attenuation:
General, Ground factor: 0.5
Meteorological coefficient, C0:
Selected option: Fixed value: 1.0 dB
Type of demand in calculation:
2: WTG plus ambient noise is compared to ambient noise plus margin (FR etc.)
Noise values in calculation:
All noise values are mean values (Lwa) (Normal)
Pure tones:
Fixed penalty added to source noise of WTGs with pure tones
Model: 5.0 dB(A)
Height above ground level, when no value in NSA object:
1.5 m; Don't allow override of model height with height from NSA object
Uncertainty margin:
0.0 dB; Uncertainty margin in NSA has priority
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
0.0 dB(A)
Noise reflections according to ISO 9613-2 included



Scale 1:200,000

New WTG | Existing WTG | Noise sensitive area

All coordinates are in
UTM (north)-NAD83 (US+CA) Zone: 20

WTGs

	Easting	Northing	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Noise data Creator	Name	First wind speed	LwaRef	Last wind speed	LwaRef	
			[m]					[kW]	[m]	[m]			[m/s]	[dB(A)]	[m/s]	[dB(A)]	
1	492,498	5,050,553	289.5	NORDEX N163/6.X 700...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	106.6	h
2	493,114	5,050,100	307.8	NORDEX N163/6.X 700...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	106.6	h
3	492,622	5,049,587	306.8	NORDEX N163/6.X 700...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	106.6	h
4	494,865	5,049,716	278.9	NORDEX N163/6.X 700...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	106.6	h
5	492,032	5,049,185	307.8	NORDEX N163/6.X 700...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	106.6	h
6	493,738	5,049,526	303.3	NORDEX N163/6.X 700...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	106.6	h
7	493,204	5,048,895	309.0	NORDEX N163/6.X 700...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	106.6	h
8	494,739	5,049,014	277.0	NORDEX N163/6.X 700...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	106.6	h
9	492,894	5,048,278	307.3	NORDEX N163/6.X 700...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	106.6	h
10	493,690	5,048,524	316.9	NORDEX N163/6.X 700...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	106.6	h
11	494,621	5,048,435	285.7	NORDEX N163/6.X 700...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	106.6	h
12	495,344	5,046,296	250.7	NORDEX N163/6.X 700...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	106.6	h
13	498,171	5,042,768	301.5	NORDEX N163/6.X 700...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	106.6	h
14	499,025	5,042,890	292.6	NORDEX N163/6.X 700...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	106.6	h
15	498,463	5,042,355	292.2	NORDEX N163/6.X 700...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	106.6	h
16	491,641	5,050,782	278.7	NORDEX N163/6.X 700...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	106.6	h
17	492,017	5,051,347	281.0	NORDEX N163/6.X 700...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	106.6	h
18	493,729	5,050,460	300.0	NORDEX N163/6.X 680...	No	NORDEX	N163/6.X-6,800	6,800	163.0	118.0	USER	Runtime input	4.0	96.6	12.0	101.0	h
19	501,723	5,043,297	300.3	Dalhousie Mountain Wi...	No	GE WIND ENERGY	GE 1.5sle-1,500	1,500	77.0	80.0	USER	Runtime input	4.0	96.0	12.0	104.0	h

h) Generic octave distribution used

Calculation Results

Sound level

Noise sensitive area No.	Name	Easting	Northing	Z	Immission height	Demands Max Additional exposure	Max Noise demand	Sound level Max From WTGs	Max Ambient+WTGs	Max Additional exposure	Distance to noise demand	Demands fulfilled ? Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[m]	
A	Noise sensitive point: Demands defined in calculation setup. (45)	497,492	5,047,816	145.7	1.5	0.0	40.0	27.4	35.7	0.7	2,147	Yes
B	Noise sensitive point: Demands defined in calculation setup. (46)	497,679	5,047,529	156.7	1.5	0.0	40.0	26.8	35.6	0.6	2,152	Yes
C	Noise sensitive point: Demands defined in calculation setup. (47)	497,710	5,047,387	156.2	1.5	0.0	40.0	26.7	35.6	0.6	2,119	Yes
D	Noise sensitive point: Demands defined in calculation setup. (48)	497,842	5,046,845	159.8	1.5	0.0	40.0	26.4	35.6	0.6	2,073	Yes
E	Noise sensitive point: Demands defined in calculation setup. (49)	496,911	5,048,580	123.7	1.5	0.0	40.0	29.6	36.1	1.1	1,542	Yes
F	Noise sensitive point: Demands defined in calculation setup. (50)	496,629	5,048,337	130.5	1.5	0.0	40.0	30.7	36.4	1.4	1,319	Yes
G	Noise sensitive point: Demands defined in calculation setup. (51)	493,018	5,053,158	159.6	1.5	0.0	40.0	28.9	35.9	0.9	1,524	Yes
H	Noise sensitive point: Demands defined in calculation setup. (52)	494,783	5,052,174	131.8	1.5	0.0	40.0	29.5	36.1	1.1	1,634	Yes
I	Noise sensitive point: Demands defined in calculation setup. (53)	494,025	5,051,304	196.8	1.5	0.0	40.0	35.2	38.1	3.1	516	Yes

To be continued on next page...

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Calculated:
04/07/2024 09:29/4.0.424

DECIBEL - Main Result

Calculation: CR 18Tc N163-7 GF:0.5 G&R:OM9, DM

...continued from previous page

Noise sensitive area No.	Name	Easting	Northing	Z	Immission height	Demands Max Additional exposure	Max Noise demand	Sound level Max From WTGs	Max Ambient+WTGs	Max Additional exposure	Distance to noise demand	Demands fulfilled ? Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[m]	
J	Noise sensitive point: User defined (54)	489,674	5,052,003	131.8	1.5	0.0	40.0	27.6	35.7	0.7	1,732	Yes
K	Noise sensitive point: User defined (55)	489,663	5,050,265	154.2	1.5	0.0	40.0	29.2	36.0	1.0	1,487	Yes
L	Noise sensitive point: User defined (56)	490,579	5,047,076	212.8	1.5	0.0	40.0	28.1	35.8	0.8	1,971	Yes
M	Noise sensitive point: User defined (57)	489,869	5,048,193	158.0	1.5	0.0	40.0	28.1	35.8	0.8	1,820	Yes
N	Noise sensitive point: User defined (58)	490,035	5,049,052	170.3	1.5	0.0	40.0	30.0	36.2	1.2	1,444	Yes
O	Noise sensitive point: Demands defined in calculation setup. (59)	493,652	5,051,082	235.5	1.5	0.0	40.0	37.9	39.7	4.7	219	Yes
P	Noise sensitive point: Demands defined in calculation setup. (60)	495,032	5,050,890	149.3	1.5	0.0	40.0	34.5	37.8	2.8	631	Yes
Q	Noise sensitive point: Demands defined in calculation setup. (61)	495,911	5,050,424	182.3	1.5	0.0	40.0	33.1	37.2	2.2	716	Yes
R	Noise sensitive point: Demands defined in calculation setup. (62)	496,278	5,049,910	142.8	1.5	0.0	40.0	32.4	36.9	1.9	866	Yes
S	Noise sensitive point: Demands defined in calculation setup. (63)	496,075	5,050,406	165.2	1.5	0.0	40.0	32.3	36.9	1.9	846	Yes
T	Noise sensitive point: Demands defined in calculation setup. (64)	497,034	5,049,689	99.3	1.5	0.0	40.0	28.9	35.9	0.9	1,597	Yes
U	Noise sensitive point: Demands defined in calculation setup. (65)	496,813	5,048,518	124.2	1.5	0.0	40.0	30.0	36.2	1.2	1,457	Yes
V	Noise sensitive point: Demands defined in calculation setup. (66)	497,889	5,046,691	159.3	1.5	0.0	40.0	26.3	35.6	0.6	2,093	Yes
W	Noise sensitive point: Demands defined in calculation setup. (67)	498,091	5,046,592	167.4	1.5	0.0	40.0	25.9	35.5	0.5	2,281	Yes
X	Noise sensitive point: Demands defined in calculation setup. (68)	498,238	5,046,413	167.0	1.5	0.0	40.0	25.7	35.5	0.5	2,413	Yes
Y	Noise sensitive point: Demands defined in calculation setup. (69)	498,309	5,046,338	168.0	1.5	0.0	40.0	25.6	35.5	0.5	2,481	Yes
Z	Noise sensitive point: Demands defined in calculation setup. (70)	498,280	5,046,392	166.5	1.5	0.0	40.0	25.6	35.5	0.5	2,454	Yes

Distances (m)

	WTG																		
NSA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A	5694	4937	5182	3242	5629	4124	4421	3002	4621	3867	2936	2632	5093	5160	5547	6560	6514	4599	6191
B	5998	5239	5460	3564	5885	4418	4679	3293	4843	4112	3189	2641	4786	4831	5234	6858	6829	4918	5854
C	6098	5337	5544	3678	5957	4512	4752	3388	4898	4179	3262	2606	4641	4685	5088	6955	6935	5030	5729
D	6504	5740	5897	4136	6264	4902	5071	3786	5151	4479	3591	2559	4090	4129	4533	7345	7362	5476	5258
E	4834	4090	4406	2341	4916	3311	3720	2215	4028	3222	2294	2771	5947	6070	6416	5712	5622	3696	7146
F	4687	3932	4198	2240	4674	3126	3470	2007	3735	2945	2010	2412	5778	5951	6257	5555	5507	3594	7166
G	2657	3060	3593	3906	4094	3703	4267	4487	4882	4683	4988	7246	11598	11897	12098	2746	2070	2790	13154
H	2801	2662	3371	2459	4062	2847	3639	3159	4330	3810	3742	5905	9997	10207	10486	3436	2887	2012	11267
I	1702	1511	2218	1796	2910	1802	2546	2399	3231	2800	2931	5179	9489	9788	9989	2441	2009	895	11107
J	3175	3931	3811	5672	3674	4760	4703	5881	4924	5313	6100	8045	12549	13057	13051	2315	2433	4338	14865
K	2850	3455	3035	5230	2603	4141	3796	5228	3793	4386	5285	6930	11339	11918	11832	2045	2591	4070	13928
L	3971	3945	3237	5033	2561	3998	3193	4590	2608	3431	4265	4828	8729	9427	9189	3856	4506	4623	11767
M	3533	3764	3086	5223	2380	4092	3408	4939	3026	3835	4759	5794	9917	10581	10389	3138	3816	4477	12825
N	2884	3252	2641	4875	2001	3733	3172	4704	2962	3692	4628	5981	10280	10899	10764	2361	3033	3953	13028
O	1269	1120	1816	1827	2494	1559	2232	2336	2905	2558	2819	5077	9463	9797	9965	2033	1656	627	11214
P	2557	2075	2741	1186	3451	1881	2707	1899	3376	2721	2490	4605	8707	8942	9199	3393	3050	1373	10120
Q	3416	2816	3395	1264	4073	2352	3110	1833	3703	2923	2371	4167	7982	8152	8463	4285	4002	2183	9196
R	3834	3170	3671	1427	4308	2569	3238	1781	3757	2936	2219	3733	7388	7538	7865	4719	4497	2608	8566
S	3580	2977	3549	1394	4224	2497	3245	1929	3828	3039	2450	4175	7920	8074	8398	4450	4166	2347	9080
T	4618	3942	4414	2170	5028	3300	3912	2392	4374	3542	2720	3792	7014	7085	7472	5503	5284	3394	7927
U	4770	4023	4325	2287	4827	3235	3629	2132	3926	3123	2193	2665	5908	6048	6381	5646	5568	3644	7168
V	6632	5867	6011	4278	6366	5027	5178	3914	5241	4583	3704	2577	3933	3967	4374	7469	7494	5614	5120
W	6853	6089	6235	4491	6590	5249	5402	4135	5463	4807	3928	2763	3824	3818	4253	7692	7713	5830	4904
X	7077	6313	6451	4721	6797	5472	5613	4360	5660	5015	4143	2897	3645	3610	4064	7913	7940	6059	4675
Y	7178	6414	6550	4824	6893	5573	5710	4462	5752	5111	4242	2966	3573	3522	3986	8013	8042	6162	4572
Z	7124	6359	6498	4766	6844	5518	5660	4406	5707	5062	4190	2938	3625	3580	4041	7960	7986	6104	4629

Appendix C: WindPRO Low Frequency Sound Level Assessment Results and Assumptions

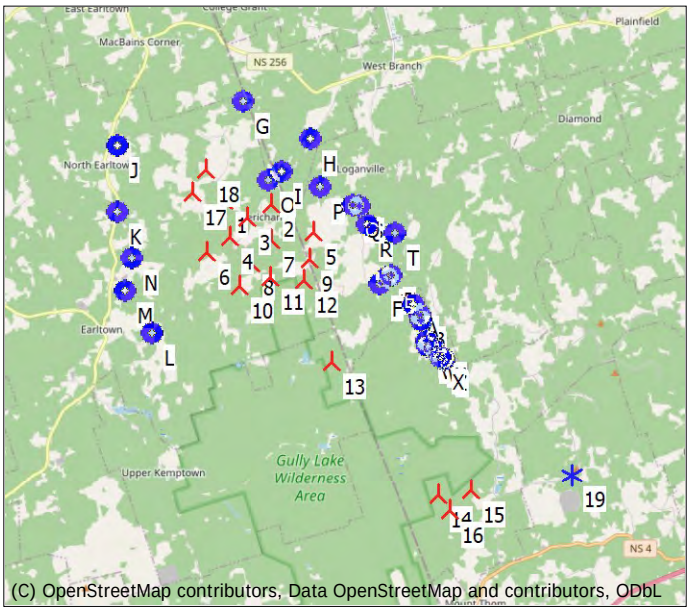
Licensed user:
Natural Forces Development Limited Partnership
1701 Hollis Street, Suite 1200
CA-HALIFAX, B3J 3M8, Nova Scotia
902 422 9663
Kellan / kduke@naturalforces.ca
Calculated:
04/07/2024 10:59/4.0.424

DECIBEL - Main Result

Calculation: 18Tc LF, DM

Noise calculation model:
Finland Low frequency
Wind speed (at 10 m height):
Highest noise value at receptor
Spectral distribution:
From 20.0 Hz to 200.0 Hz
Meteorological coefficient, C0:
Selected option: Fixed value: 0.0 dB
Type of demand in calculation:
1: WTG noise is compared to demand (DK, DE, SE, NL etc.)
Noise values in calculation:
All noise values are mean values (Lwa) (Normal)
Pure tones:
Pure tone penalty is subtracted from demand
Model: 5.0 dB(A)
Height above ground level, when no value in NSA object:
4.0 m; Don't allow override of model height with height from NSA object
Uncertainty margin:
0.0 dB; Uncertainty margin in NSA has priority
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
0.0 dB(A)

All coordinates are in
UTM (north)-NAD83 (US+CA) Zone: 20



Scale 1:200,000

New WTG | Existing WTG | Noise sensitive area

All coordinates are in
UTM (north)-NAD83 (US+CA) Zone: 20

WTGs

	Easting	Northing	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Noise data Creator	Name	First wind speed	LwaRef	Last wind speed	LwaRef
			[m]					[kW]	[m]	[m]			[m/s]	[dB(A)]	[m/s]	[dB(A)]
1	492,498	5,050,553	289.5	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
2	493,729	5,050,460	300.0	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
3	493,114	5,050,100	307.8	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
4	492,622	5,049,587	306.8	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
5	494,865	5,049,716	278.9	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
6	492,032	5,049,185	307.8	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
7	493,738	5,049,526	303.3	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
8	493,204	5,048,895	309.0	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
9	494,739	5,049,014	277.0	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
10	492,894	5,048,278	307.3	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
11	493,690	5,048,524	316.9	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
12	494,621	5,048,435	285.7	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
13	495,344	5,046,296	250.7	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
14	498,171	5,042,768	301.5	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
15	499,025	5,042,890	292.6	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
16	498,463	5,042,355	292.2	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
17	491,641	5,050,782	278.7	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
18	492,017	5,051,347	281.0	NORDEX N163/6.X 70...	Yes	NORDEX	N163/6.X-7,000	7,000	163.0	118.0	USER	Noise (-1)	10.0	100.8	10.0	100.8
19	501,723	5,043,297	300.3	Dalhousie Mountain W...	No	GE WIND ENERGY	GE 1.5sle-1,500	1,500	77.0	80.0	USER	Noise (-1)	10.0	99.2	10.0	99.2

Calculation Results

Sound level

Noise sensitive area No.	Name	Easting	Northing	Z	Immission height	Most critical demand Frequency	Noise	Predicted sound level WTG noise	Demands fulfilled ? Noise
				[m]	[m]	[Hz]	[dB]	[dB]	
A	Noise sensitive point: Demands defined in calculation setup. (45)	497,492	5,047,816	145.7	4.0	50.0	70.2	45.4	Yes
B	Noise sensitive point: Demands defined in calculation setup. (46)	497,679	5,047,529	156.7	4.0	50.0	70.2	45.0	Yes
C	Noise sensitive point: Demands defined in calculation setup. (47)	497,710	5,047,387	156.2	4.0	50.0	70.2	45.0	Yes
D	Noise sensitive point: Demands defined in calculation setup. (48)	497,842	5,046,845	159.8	4.0	50.0	70.2	44.7	Yes
E	Noise sensitive point: Demands defined in calculation setup. (49)	496,911	5,048,580	123.7	4.0	50.0	70.2	46.9	Yes
F	Noise sensitive point: Demands defined in calculation setup. (50)	496,629	5,048,337	130.5	4.0	50.0	70.2	47.6	Yes
G	Noise sensitive point: Demands defined in calculation setup. (51)	493,018	5,053,158	159.6	4.0	50.0	70.2	46.4	Yes

To be continued on next page...

Licensed user:
Natural Forces Development Limited Partnership
1701 Hollis Street, Suite 1200
CA-HALIFAX, B3J 3M8, Nova Scotia
902 422 9663
Kellan / kduke@naturalforces.ca
Calculated:
04/07/2024 10:59/4.0.424

DECIBEL - Main Result

Calculation: 18Tc LF, DM

...continued from previous page

Noise sensitive area						Most critical demand		Predicted sound level		Demands fulfilled ?
No.	Name	Easting	Northing	Z	Immission height	Frequency	Noise	WTG noise		Noise
				[m]	[m]	[Hz]	[dB]	[dB]		
H	Noise sensitive point: Demands defined in calculation setup. (52)	494,783	5,052,174	131.8	4.0	50.0	70.2	47.3		Yes
I	Noise sensitive point: Demands defined in calculation setup. (53)	494,025	5,051,304	196.8	4.0	50.0	70.2	51.5		Yes
J	Noise sensitive point: User defined (54)	489,674	5,052,003	131.8	4.0	50.0	70.2	45.3		Yes
K	Noise sensitive point: User defined (55)	489,663	5,050,265	154.2	4.0	50.0	70.2	46.5		Yes
L	Noise sensitive point: User defined (56)	490,579	5,047,076	212.8	4.0	50.0	70.2	45.9		Yes
M	Noise sensitive point: User defined (57)	489,869	5,048,193	158.0	4.0	50.0	70.2	45.9		Yes
N	Noise sensitive point: User defined (58)	490,035	5,049,052	170.3	4.0	50.0	70.2	47.1		Yes
O	Noise sensitive point: Demands defined in calculation setup. (59)	493,652	5,051,082	235.5	4.0	50.0	70.2	53.5		Yes
P	Noise sensitive point: Demands defined in calculation setup. (60)	495,032	5,050,890	149.3	4.0	50.0	70.2	50.4		Yes
Q	Noise sensitive point: Demands defined in calculation setup. (61)	495,911	5,050,424	182.3	4.0	50.0	70.2	49.1		Yes
R	Noise sensitive point: Demands defined in calculation setup. (62)	496,278	5,049,910	142.8	4.0	50.0	70.2	48.6		Yes
S	Noise sensitive point: Demands defined in calculation setup. (63)	496,075	5,050,406	165.2	4.0	50.0	70.2	48.6		Yes
T	Noise sensitive point: Demands defined in calculation setup. (64)	497,034	5,049,689	99.3	4.0	50.0	70.2	46.4		Yes
U	Noise sensitive point: Demands defined in calculation setup. (65)	496,813	5,048,518	124.2	4.0	50.0	70.2	47.2		Yes
V	Noise sensitive point: Demands defined in calculation setup. (66)	497,889	5,046,691	159.3	4.0	50.0	70.2	44.6		Yes
W	Noise sensitive point: Demands defined in calculation setup. (67)	498,091	5,046,592	167.4	4.0	50.0	70.2	44.3		Yes
X	Noise sensitive point: Demands defined in calculation setup. (68)	498,238	5,046,413	167.0	4.0	50.0	70.2	44.2		Yes
Y	Noise sensitive point: Demands defined in calculation setup. (69)	498,309	5,046,338	168.0	4.0	50.0	70.2	44.1		Yes
Z	Noise sensitive point: Demands defined in calculation setup. (70)	498,280	5,046,392	166.5	4.0	50.0	70.2	44.1		Yes

*)Spectral distribution, please see details in report "Detailed results"

Distances (m)

	WTG																		
NSA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A	5694	4599	4937	5182	3242	5629	4124	4421	3002	4621	3867	2936	2632	5093	5160	5547	6560	6514	6191
B	5998	4919	5239	5460	3564	5885	4418	4679	3293	4843	4112	3189	2641	4786	4831	5234	6858	6829	5854
C	6098	5030	5337	5544	3678	5957	4512	4752	3388	4898	4179	3262	2606	4641	4685	5088	6955	6935	5729
D	6504	5476	5740	5897	4136	6264	4902	5071	3786	5151	4479	3591	2559	4090	4129	4533	7345	7362	5258
E	4834	3696	4090	4406	2341	4916	3311	3720	2215	4028	3222	2294	2771	5947	6070	6416	5712	5622	7146
F	4687	3595	3932	4198	2240	4674	3126	3470	2007	3735	2945	2010	2412	5778	5951	6257	5555	5507	7166
G	2657	2790	3060	3593	3906	4094	3703	4267	4487	4882	4683	4988	7246	11598	11897	12098	2746	2070	13154
H	2801	2012	2662	3371	2459	4062	2847	3639	3159	4330	3810	3742	5905	9997	10207	10486	3436	2887	11267
I	1702	895	1511	2218	1796	2910	1802	2546	2399	3231	2800	2931	5179	9489	9788	9989	2441	2009	11107
J	3175	4338	3931	3811	5672	3674	4760	4703	5881	4924	5313	6100	8045	12549	13057	13051	2315	2433	14865
K	2850	4070	3455	3035	5230	2603	4141	3796	5228	3793	4386	5285	6930	11339	11918	11832	2045	2591	13928
L	3971	4623	3945	3237	5033	2561	3998	3193	4590	2608	3431	4265	4828	8729	9427	9189	3856	4506	11767
M	3533	4477	3764	3086	5223	2380	4092	3408	4939	3026	3835	4759	5794	9917	10581	10389	3138	3816	12825
N	2884	3953	3252	2641	4875	2001	3733	3172	4704	2962	3692	4628	5981	10280	10899	10764	2361	3033	13028
O	1269	626	1120	1816	1827	2494	1559	2232	2336	2905	2558	2819	5077	9463	9797	9965	2033	1656	11214
P	2557	1373	2075	2741	1186	3451	1881	2707	1899	3376	2721	2490	4605	8707	8942	9199	3393	3050	10120
Q	3416	2183	2816	3395	1264	4073	2352	3110	1833	3703	2923	2371	4167	7982	8152	8463	4285	4002	9196
R	3834	2609	3170	3671	1427	4308	2569	3238	1781	3757	2936	2219	3733	7388	7538	7865	4719	4497	8566
S	3580	2347	2977	3549	1394	4224	2497	3245	1929	3828	3039	2450	4175	7920	8074	8398	4450	4166	9080
T	4618	3394	3942	4414	2170	5028	3300	3912	2392	4374	3542	2720	3792	7014	7085	7472	5503	5284	7927
U	4770	3645	4023	4325	2287	4827	3235	3629	2132	3926	3123	2193	2665	5908	6048	6381	5646	5568	7168
V	6632	5614	5867	6011	4278	6366	5027	5178	3914	5241	4583	3704	2577	3933	3967	4374	7469	7494	5120
W	6853	5830	6089	6235	4491	6590	5249	5402	4135	5463	4807	3928	2763	3824	3818	4253	7692	7713	4904
X	7077	6059	6313	6451	4721	6797	5472	5613	4360	5660	5015	4143	2897	3645	3610	4064	7913	7940	4675
Y	7178	6162	6414	6550	4824	6893	5573	5710	4462	5752	5111	4242	2966	3573	3522	3986	8013	8042	4572
Z	7124	6105	6359	6498	4766	6844	5518	5660	4406	5707	5062	4190	2938	3625	3580	4041	7960	7986	4629

APPENDIX E
ACCDC REPORT

Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique

DATA REPORT 7800: Clysdale Ridge, NS

Prepared 14 August 2023
by C. Robicheau, Conservation Data Analyst

CONTENTS OF REPORT

Map 1. A 100 km buffer around the study area

1.0 PREFACE

The Atlantic Canada Conservation Data Centre (AC CDC; www.accdc.com) is part of a network of NatureServe data centres and heritage programs serving 50 states in the U.S.A, 10 provinces and 1 territory in Canada, plus several Central and South American countries. The NatureServe network is more than 30 years old and shares a common conservation data methodology. The AC CDC was founded in 1997, and maintains data for the jurisdictions of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. Although a non-governmental agency, the AC CDC is supported by 6 federal agencies and 4 provincial governments, as well as through outside grants and data processing fees.

Upon request and for a fee, the AC CDC queries its database and produces customized reports of the rare and endangered flora and fauna known to occur in or near a specified study area. As a supplement to that data, the AC CDC includes locations of managed areas with some level of protection, and known sites of ecological interest or sensitivity.

1.1 DATA LIST

Included datasets:

Filename	Contents
ClysdaleRidgNS_7800ob.xls	Rare or legally-protected Flora and Fauna in your study area
ClysdaleRidgNS_7800ob100km.xls	A list of Rare and legally protected Flora and Fauna within 100 km of your study area
ClysdaleRidgNS_7800msa.xls	Managed and Biologically Significant Areas in your study area
ClysdaleRidgNS_7800ff_py.xls	Rare Freshwater Fish in your study area (DFO database)

1.2 RESTRICTIONS

The AC CDC makes a strong effort to verify the accuracy of all the data that it manages, but it shall not be held responsible for any inaccuracies in data that it provides. By accepting AC CDC data, recipients assent to the following limits of use:

a) Data is restricted to use by trained personnel who are sensitive to landowner interests and to potential threats to rare and/or endangered flora and fauna posed by the information provided.
b) Data is restricted to use by the specified Data User; any third party requiring data must make its own data request.
c) The AC CDC requires Data Users to cease using and delete data 12 months after receipt, and to make a new request for updated data if necessary at that time.
d) AC CDC data responses are restricted to the data in our Data System at the time of the data request.
e) Each record has an estimate of locational uncertainty, which must be referenced in order to understand the record's relevance to a particular location. Please see attached Data Dictionary for details.
f) AC CDC data responses are not to be construed as exhaustive inventories of taxa in an area.
g) The absence of a taxon cannot be inferred by its absence in an AC CDC data response.

1.3 ADDITIONAL INFORMATION

The accompanying Data Dictionary provides metadata for the data provided.

Please direct any additional questions about AC CDC data to the following individuals:

Plants, Lichens, Ranking Methods, All other Inquiries
Sean Blaney
Senior Scientist / Executive Director
(506) 364-2658
sean.blaney@accdc.ca

Animals (Fauna)
John Klymko
Zoologist
(506) 364-2660
john.klymko@accdc.ca

Data Management, GIS
James Churchill
Conservation Data Analyst / Field Biologist
(902) 679-6146
james.churchill@accdc.ca

Billing
Jean Breau
Financial Manager / Executive Assistant
(506) 364-2657
jean.breau@accdc.ca

Questions on the biology of Federal Species at Risk can be directed to AC CDC: (506) 364-2658, with questions on Species at Risk regulations to: Samara Eaton, Canadian Wildlife Service (NB and PE): (506) 364-5060 or Julie McKnight, Canadian Wildlife Service (NS): (902) 426-4196.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in New Brunswick, please contact Hubert Askanas, Energy and Resource Development: (506) 453-5873.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in Nova Scotia, please contact Donna Hurlburt, NS DLF: (902) 679-6886. To determine if location-sensitive species (section 4.3) occur near your study site please contact a NS DLF Regional Biologist:

Western: Emma Vost
(902) 670-8187
Emma.Vost@novascotia.ca

Western: Sarah Spencer
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Eastern: Maureen Cameron-MacMillan
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Maureen.Cameron-MacMillan@novascotia.ca

Eastern: Elizabeth Walsh
(902) 563-3370
Elizabeth.Walsh@novascotia.ca

For provincial information about rare taxa and protected areas, or information about game animals, fish habitat etc., in Prince Edward Island, please contact Garry Gregory, PEI Dept. of Communities, Land and Environment: (902) 569-7595.

2.0 RARE AND ENDANGERED SPECIES

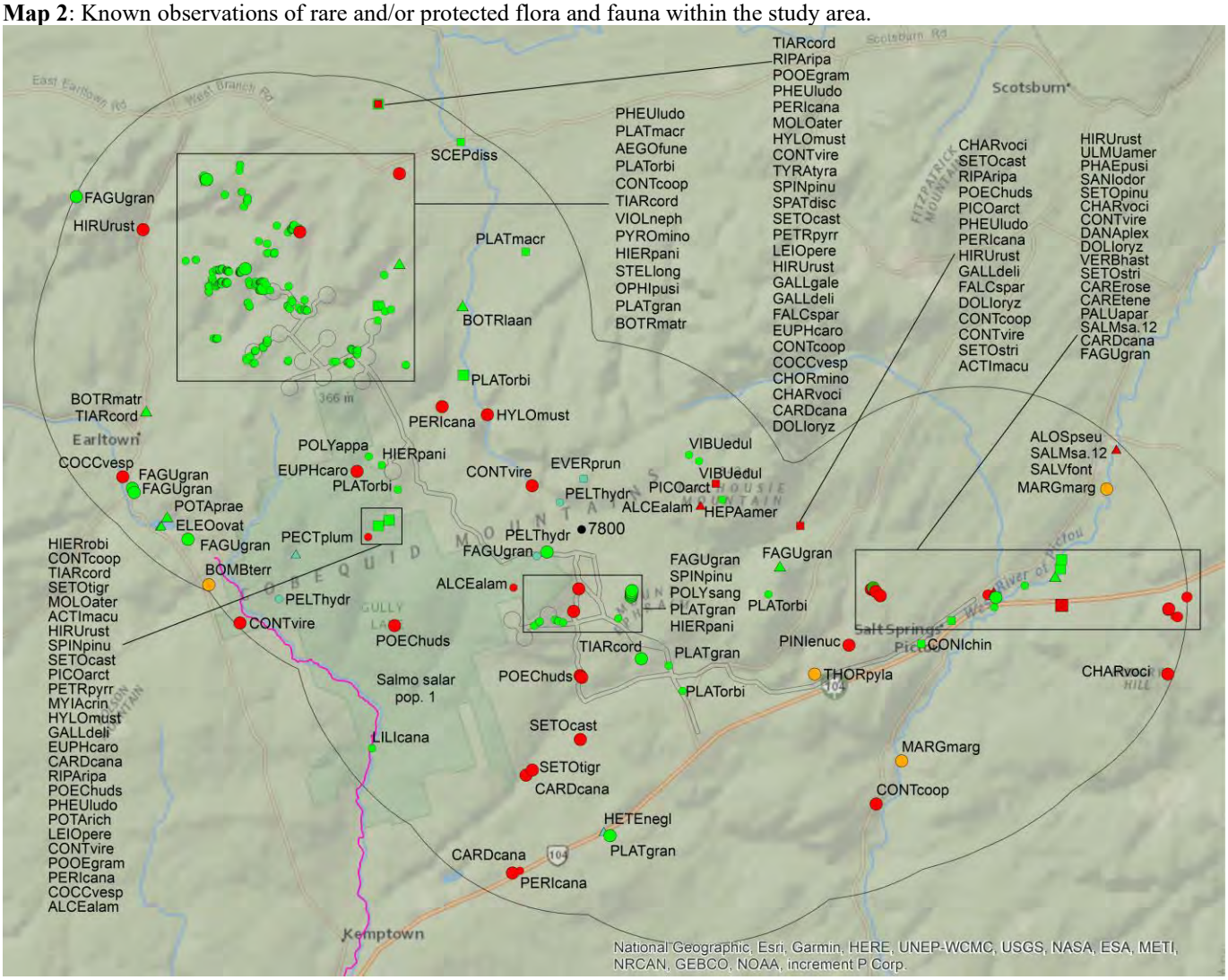
2.1 FLORA

The study area contains 310 records of 29 vascular and 8 records of 5 nonvascular flora (Map 2 and attached: *ob.xls), excluding 'location-sensitive' species.

2.2 FAUNA

The study area contains 157 records of 37 vertebrate and 7 records of 4 invertebrate fauna (Map 2 and attached data files - see 1.1 Data List), excluding 'location-sensitive species'. Please see section 4.3 to determine if 'location-sensitive'

Map 2: Known observations of rare and/or protected flora and fauna within the study area.



RESOLUTION

- 4.7 within 50s of kilometers
- 4.0 within 10s of kilometers
- 3.7 within 5s of kilometers
- 3.0 within kilometers
- 2.7 within 500s of meters
- 2.0 within 100s of meters
- 1.7 within 10s of meters

HIGHER TAXON

- vertebrate fauna
- invertebrate fauna
- vascular flora
- nonvascular flora

3.0 SPECIAL AREAS

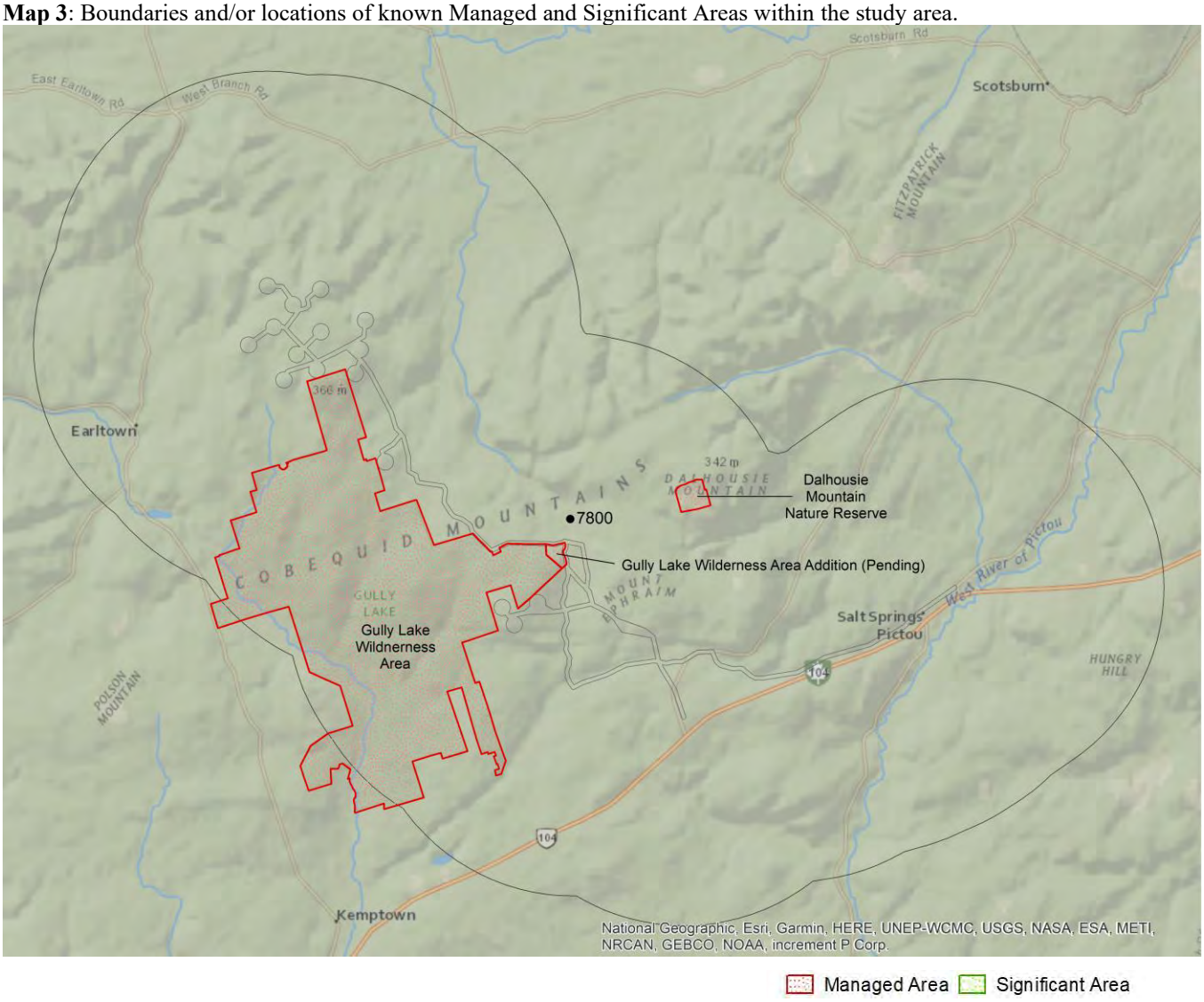
3.1 MANAGED AREAS

The GIS scan identified 3 managed areas in the vicinity of the study area (Map 3 and attached file: *ma*.xls).

3.2 SIGNIFICANT AREAS

The GIS scan identified no biologically significant sites in the vicinity of the study area (Map 3 and attached file: *sa*.xls).

Map 3: Boundaries and/or locations of known Managed and Significant Areas within the study area.



4.0 RARE SPECIES LISTS

Rare and/or endangered taxa (excluding "location-sensitive" species, section 4.3) within the study area listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record). [P] = vascular plant, [N] = nonvascular plant, [A] = vertebrate animal, [I] = invertebrate animal, [C] = community. Note: records are from attached files *ob.xls/*ob.shp only.

4.1 FLORA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)
N	*Peltigera hydrothyria*	Eastern Waterfan	Threatened	Threatened	Threatened	S1	3	0.8 ± 0.0
N	*Pectenia plumbea*	Blue Felt Lichen	Special Concern	Special Concern	Vulnerable	S3	1	6.8 ± 0.0
N	*Phaeophyscia pusilloides*	Pompom-tipped Shadow Lichen				S3	2	9.9 ± 0.0
N	*Evernia prunastri*	Valley Oakmoss Lichen				S3S4	1	1.2 ± 5.0
N	*Heterodermia neglecta*	Fringe Lichen				S3S4	1	7.2 ± 0.0
P	*Sanicula odorata*	Clustered Sanicle				S1S2	1	11.4 ± 10.0
P	*Hepatica americana*	Round-lobed Hepatica				S2	1	3.4 ± 0.0
P	*Lilium canadense*	Canada Lily				S2	1	7.2 ± 0.0
P	*Platanthera macrophylla*	Large Round-Leaved Orchid				S2	8	12.2 ± 0.0
P	*Tiarella cordifolia*	Heart-leaved Foamflower				S2S3	207	10.1 ± 0.0
P	*Eleocharis ovata*	Ovate Spikerush				S2S3	2	10.0 ± 0.0
P	*Botrychium lanceolatum ssp. angustisegmentum*	Narrow Triangle Moonwort				S2S3	1	6.0 ± 1.0
P	*Ophioglossum pusillum*	Northern Adder's-tongue				S2S3	1	6.9 ± 0.0
P	*Conioselinum chinense*	Chinese Hemlock-parsley				S3	1	8.5 ± 5.0
P	*Hieracium robinsonii*	Robinson's Hawkweed				S3	1	4.6 ± 7.0
P	*Palustricodon aparinoides*	Marsh Bellflower				S3	2	10.0 ± 0.0
P	*Stellaria longifolia*	Long-leaved Starwort				S3	1	9.7 ± 0.0
P	*Viburnum edule*	Squashberry				S3	3	3.1 ± 0.0
P	*Polygala sanguinea*	Blood Milkwort				S3	1	2.3 ± 0.0
P	*Pyrola minor*	Lesser Pyrola				S3	1	7.6 ± 0.0
P	*Viola nephrophylla*	Northern Bog Violet				S3	1	7.6 ± 1.0
P	*Carex rosea*	Rosy Sedge				S3	1	11.4 ± 11.0
P	*Carex tenera*	Tender Sedge				S3	2	9.0 ± 1.0
P	*Platanthera grandiflora*	Large Purple Fringed Orchid				S3	37	2.2 ± 0.0
P	*Potamogeton praelongus*	White-stemmed Pondweed				S3	1	9.8 ± 1.0
P	*Potamogeton richardsonii*	Richardson's Pondweed				S3	1	4.8 ± 7.0
P	*Sceptridium dissectum*	Dissected Moonwort				S3	1	9.6 ± 5.0
P	*Polypodium appalachianum*	Appalachian Polypody				S3	1	5.3 ± 0.0
P	*Hieracium paniculatum*	Panicled Hawkweed				S3S4	6	2.2 ± 0.0
P	*Fagus grandifolia*	American Beech				S3S4	14	1.0 ± 0.0
P	*Ulmus americana*	White Elm				S3S4	1	11.3 ± 2.0
P	*Verbena hastata*	Blue Vervain				S3S4	1	10.0 ± 0.0
P	*Platanthera orbiculata*	Small Round-leaved Orchid				S3S4	9	12.2 ± 0.0
P	*Botrychium matricariifolium*	Daisy-leaved Moonwort				S3S4	2	10.7 ± 1.0

4.2 FAUNA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)
A	*Riparia riparia*	Bank Swallow	Threatened	Threatened	Endangered	S2B	5	11.2 ± 7.0
A	*Hylocichla mustelina*	Wood Thrush	Threatened	Threatened		SUB	4	11.2 ± 7.0
A	*Salmo salar pop. 12*	Atlantic Salmon - Gaspe - Southern Gulf of St. Lawrence population	Special Concern			S1	3	11.5 ± 50.0
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Endangered	S2B	3	11.2 ± 7.0
A	*Hirundo rustica*	Barn Swallow	Special Concern	Threatened	Endangered	S3B	12	11.2 ± 7.0
A	*Cardellina canadensis*	Canada Warbler	Special Concern	Threatened	Endangered	S3B	11	11.2 ± 7.0
A	*Chordeiles minor*	Common Nighthawk	Special Concern	Special Concern	Threatened	S3B	1	11.2 ± 7.0

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)
A	*Contopus cooperi*	Olive-sided Flycatcher	Special Concern	Special Concern	Threatened	S3B	8	11.2 ± 7.0
A	*Dolichonyx oryzivorus*	Bobolink	Special Concern	Threatened	Vulnerable	S3B	7	11.2 ± 7.0
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern	Special Concern	Vulnerable	S3B,S3N,S3M	6	10.9 ± 0.0
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern	Special Concern	Vulnerable	S3S4B	11	1.6 ± 0.0
A	*Aegolius funereus*	Boreal Owl	Not At Risk			S2?B,SUM	2	11.2 ± 7.0
A	*Alces alces americana*	Moose			Endangered	S1	4	2.1 ± 0.0
A	*Gallinula galeata*	Common Gallinule				S1B	1	11.2 ± 7.0
A	*Myiarchus crinitus*	Great Crested Flycatcher				S1B	1	4.8 ± 7.0
A	*Pooecetes gramineus*	Vesper Sparrow				S1S2B,SUM	4	11.2 ± 7.0
A	*Molothrus ater*	Brown-headed Cowbird				S2B	2	11.2 ± 7.0
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S2S3B	2	11.2 ± 7.0
A	*Setophaga pinus*	Pine Warbler				S2S3B,S4S5M	1	14.0 ± 0.0
A	*Perisoreus canadensis*	Canada Jay				S3	9	11.2 ± 7.0
A	*Poecile hudsonicus*	Boreal Chickadee				S3	9	3.5 ± 0.0
A	*Spinus pinus*	Pine Siskin				S3	5	1.4 ± 0.0
A	*Salvelinus fontinalis*	Brook Trout				S3	1	12.8 ± 0.0
A	*Spatula discors*	Blue-winged Teal				S3B	1	11.2 ± 7.0
A	*Charadrius vociferus*	Killdeer				S3B	6	11.2 ± 7.0
A	*Tyrannus tyrannus*	Eastern Kingbird				S3B	4	11.2 ± 7.0
A	*Pheucticus ludovicianus*	Rose-breasted Grosbeak				S3B	7	11.2 ± 7.0
A	*Alosa pseudoharengus*	Alewife				S3B	1	12.8 ± 0.0
A	*Falco sparverius*	American Kestrel				S3B,S4S5M	3	11.2 ± 7.0
A	*Gallinago delicata*	Wilson's Snipe				S3B,S5M	5	11.2 ± 7.0
A	*Setophaga striata*	Blackpoll Warbler				S3B,S5M	2	5.2 ± 7.0
A	*Pinicola enucleator*	Pine Grosbeak				S3B,S5N,S5M	1	6.9 ± 0.0
A	*Setophaga tigrina*	Cape May Warbler				S3B,SUM	2	4.8 ± 7.0
A	*Picoides arcticus*	Black-backed Woodpecker				S3S4	3	3.4 ± 7.0
A	*Setophaga castanea*	Bay-breasted Warbler				S3S4B,S4S5M	5	11.2 ± 7.0
A	*Actitis macularius*	Spotted Sandpiper				S3S4B,S5M	2	4.8 ± 7.0
A	*Leiothlypis peregrina*	Tennessee Warbler				S3S4B,S5M	3	11.2 ± 7.0
I	*Danaus plexippus*	Monarch	Endangered	Special Concern	Endangered	S2?B,S3M	3	7.0 ± 0.0
I	*Bombus terricola*	Yellow-banded Bumble Bee	Special Concern	Special Concern	Vulnerable	S3	1	8.9 ± 0.0
I	*Margaritifera margaritifera*	Eastern Pearlshell				S2	2	12.5 ± 0.0
I	*Cecropterus pylades*	Northern Cloudywing				S3S4	1	6.5 ± 0.0

4.3 LOCATION SENSITIVE SPECIES

The Department of Natural Resources in each Maritimes province considers a number of species “location sensitive”. Concern about exploitation of location-sensitive species precludes inclusion of precise coordinates in this report. Those intersecting your study area are indicated below with “YES”.

Nova Scotia

Scientific *Name*	Common Name	SARA	Prov Legal Prot	Known within the Study Site?
Fraxinus nigra	**Black Ash**		**Threatened**	**YES**
Emydoidea blandingii	*Blanding's Turtle - Nova Scotia pop.*	Endangered	Endangered	No
Glyptemys insculpta	Wood Turtle	Threatened	Threatened	No
Falco peregrinus pop. 1	Peregrine Falcon - anatum/tundrius pop.		Vulnerable	No
Bat hibernaculum or bat species occurrence		**[Endangered][1]**	**[Endangered][1]**	**YES**

1 *Myotis lucifugus* (Little Brown Myotis), *Myotis septentrionalis* (Long-eared Myotis), and *Perimyotis subflavus* (Tri-colored Bat or Eastern Pipistrelle) are all Endangered under the Federal Species at Risk Act and the NS Endangered Species Act.

4.4 SOURCE BIBLIOGRAPHY

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

# recs	CITATION
141	Bryson, I. 2013. Nova Scotia rare plant records. CBCL Ltd., 180 records.
117	LaPaix, R.W.; Crowell, M.J.; MacDonald, M. 2011. Stantec rare plant records, 2010-11. Stantec Consulting, 334 recs.
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9	Newell, R.E. 2000. E.C. Smith Herbarium Database. Acadia University, Wolfville NS, 7139 recs.
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4	Benjamin, L.K. (compiler). 2007. Significant Habitat & Species Database. Nova Scotia Dept Natural Resources, 8439 recs.
4	Blaney, C.S.; Mazerolle, D.M.; Belliveau, A.B. 2013. Atlantic Canada Conservation Data Centre Fieldwork 2013. Atlantic Canada Conservation Data Centre, 9000+ recs.
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3	Pronych, G. & Wilson, A. 1993. Atlas of Rare Vascular Plants in Nova Scotia. Nova Scotia Museum, Halifax NS, I:1-168, II:169-331. 1446 recs.
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2	Blaney, C.S & Spicer, C.D.; Popma, T.M.; Basquill, S.P. 2003. Vascular Plant Surveys of Northumberland Strait Rivers & Amherst Area Peatlands. Nova Scotia Museum Research Grant, 501 recs.
2	Blaney, C.S. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre. Sackville NB, 1042 recs.
2	Canadian Wildlife Service. 2019. Canadian Protected and Conserved Areas Database (CPCAD). December 2019. ECCC.https://www.canada.ca/en/environment-climate-change/services/national-wildlife-areas/protected-conserved-areas-database.html.
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2	Zinck, M. & Roland, A.E. 1998. Roland's Flora of Nova Scotia. Nova Scotia Museum, 3rd ed., rev. M. Zinck; 2 Vol., 1297 pp.
1	Amiro, P.G. 1998. Atlantic Salmon Inner Bay of Fundy SFA 22 & part of 23. DFO Sci. SSR D3-12.
1	Archibald, D.R. 2003. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 213 recs.
1	Benjamin, L.K. (compiler). 2001. Significant Habitat & Species Database. Nova Scotia Dept of Natural Resources, 15 spp, 224 recs.
1	Blaney, C.S. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre, 6719 recs.
1	Blaney, C.S. 2020. Sean Blaney 2020 field data. Atlantic Canada Conservation Data Centre, 4407 records.
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1	Nova Scotia Department of Lands and Forestry. 2020. NS Lands Proposed or Pending Protection. NSDLF, 231 features. Received via email.
1	O'Neil, S. 1998. Atlantic Salmon: Northumberland Strait Nova Scotia part of SFA 18. Dept of Fisheries & Oceans, Atlantic Region, Science. Stock Status Report D3-08. 9 recs.

5.0 RARE SPECIES WITHIN 100 KM

A 100 km buffer around the study area contains 57012 records of 149 vertebrate and 1420 records of 72 invertebrate fauna; 8714 records of 262 vascular and 2844 records of 147 nonvascular flora (attached: *ob100km.xls).

Taxa within 100 km of the study site that are rare and/or endangered in the province in which the study site occurs (including “location-sensitive” species). All ranks correspond to the province in which the study site falls, even for out-of-province records. Taxa are listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record).

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Myotis lucifugus*	Little Brown Myotis	Endangered	Endangered	Endangered	S1	104	8.1 ± 0.0	NS
A	*Myotis septentrionalis*	Northern Myotis	Endangered	Endangered	Endangered	S1	85	51.7 ± 0.0	NS
A	*Perimyotis subflavus*	Tricolored Bat	Endangered	Endangered	Endangered	S1	5	52.6 ± 5.0	NS
A	*Salmo salar pop. 1*	Atlantic Salmon - Inner Bay of Fundy population	Endangered	Endangered		S1	25	13.7 ± 0.0	NS
A	*Salmo salar pop. 6*	Atlantic Salmon - Nova Scotia Southern Upland population	Endangered			S1	30	38.8 ± 0.0	NS
A	*Charadrius melodus melodus*	Piping Plover melodus subspecies	Endangered	Endangered	Endangered	S1B	2260	24.0 ± 0.0	NS
A	*Sterna dougallii*	Roseate Tern	Endangered	Endangered	Endangered	S1B	19	87.8 ± 0.0	NS
A	*Dermochelys coriacea pop. 2*	Leatherback Sea Turtle - Atlantic population	Endangered	Endangered		S1S2N	1	99.4 ± 1.0	NB
A	*Morone saxatilis pop. 2*	Striped Bass - Bay of Fundy population	Endangered			S2S3B,S2S3N	2	70.4 ± 0.0	NS
A	*Lamna nasus*	Porbeagle Shark	Endangered			SNR	1	94.2 ± 1.0	NS
A	*Lasiurus cinereus*	Hoary Bat	Endangered			SUB, S1M	3	75.7 ± 1.0	PE
A	*Catharus bicknelli*	Bicknell's Thrush	Threatened	Threatened	Endangered	S1B	1	76.2 ± 7.0	NS
A	*Asio flammeus*	Short-eared Owl	Threatened	Special Concern		S1B	8	25.2 ± 7.0	NS
A	*Glyptemys insculpta*	Wood Turtle	Threatened	Threatened	Threatened	S2	8429	16.5 ± 1.0	NS
A	*Riparia riparia*	Bank Swallow	Threatened	Threatened	Endangered	S2B	2233	4.8 ± 7.0	NS
A	*Chaetura pelagica*	Chimney Swift	Threatened	Threatened	Endangered	S2S3B,S1M	679	11.0 ± 7.0	NS
A	*Limosa haemastica*	Hudsonian Godwit	Threatened			S2S3M	369	28.5 ± 0.0	NS
A	*Acipenser oxyrinchus*	Atlantic Sturgeon	Threatened			S2S3N	5	56.9 ± 0.0	NS
A	*Hydrobates leucorhous*	Leach's Storm-Petrel	Threatened			S3B	39	87.3 ± 7.0	NS
A	*Tringa flavipes*	Lesser Yellowlegs	Threatened			S3M	1502	23.5 ± 0.0	NS
A	*Anguilla rostrata*	American Eel	Threatened			S3N	92	27.1 ± 0.0	NS
A	*Ixobrychus exilis*	Least Bittern	Threatened	Threatened		SUB	3	97.8 ± 0.0	NS
A	*Hylocichla mustelina*	Wood Thrush	Threatened	Threatened		SUB	36	3.5 ± 0.0	NS
A	*Salmo salar pop. 12*	Atlantic Salmon - Gaspe - Southern Gulf of St. Lawrence population	Special Concern			S1	47	9.7 ± 50.0	NS
A	*Antrostomus vociferus*	Eastern Whip-Poor-Will	Special Concern	Threatened	Threatened	S1?B	9	61.7 ± 7.0	NS
A	*Passerculus sandwichensis princeps*	Ipswich Sparrow	Special Concern	Special Concern		S1B	2	90.7 ± 0.0	NS
A	*Bucephala islandica*	Barrow's Goldeneye	Special Concern	Special Concern		S1N,SUM	34	18.8 ± 0.0	NS
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Endangered	S2B	276	4.8 ± 7.0	NS
A	*Phalaropus lobatus*	Red-necked Phalarope	Special Concern	Special Concern		S2S3M	12	28.4 ± 0.0	NS
A	*Morone saxatilis pop. 1*	Striped Bass - Southern Gulf of St. Lawrence population	Special Concern			S2S3N	1	84.9 ± 1.0	NS
A	*Histrionicus histrionicus pop. 1*	Harlequin Duck - Eastern population	Special Concern	Special Concern	Endangered	S2S3N,SUM	27	31.8 ± 0.0	NS
A	*Chelydra serpentina*	Snapping Turtle	Special Concern	Special Concern	Vulnerable	S3	154	17.4 ± 0.0	NS
A	*Hirundo rustica*	Barn Swallow	Special Concern	Threatened	Endangered	S3B	2353	4.8 ± 7.0	NS
A	*Cardellina canadensis*	Canada Warbler	Special Concern	Threatened	Endangered	S3B	1135	4.8 ± 7.0	NS
A	*Chordeiles minor*	Common Nighthawk	Special Concern	Special Concern	Threatened	S3B	417	11.2 ± 7.0	NS
A	*Contopus cooperi*	Olive-sided Flycatcher	Special Concern	Special Concern	Threatened	S3B	1272	4.8 ± 7.0	NS
A	*Dolichonyx oryzivorus*	Bobolink	Special Concern	Threatened	Vulnerable	S3B	2341	5.2 ± 7.0	NS
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern	Special Concern	Vulnerable	S3B,S3N,S3M	851	4.8 ± 7.0	NS
A	*Podiceps auritus*	Horned Grebe	Special Concern	Special Concern		S3N,SUM	13	27.2 ± 0.0	NS
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern	Special Concern	Vulnerable	S3S4B	1320	1.6 ± 0.0	NS
A	*Phocoena phocoena*	Harbour Porpoise	Special Concern			S4	6	31.8 ± 0.0	NS
A	*Phocoena phocoena pop. 1*	Harbour Porpoise - Northwest Atlantic Population	Special Concern			S4	1	35.8 ± 1.0	NS
A	*Chrysemys picta*	Painted Turtle	Special Concern	Special Concern		S4	7	21.8 ± 0.0	NS
A	*Chrysemys picta picta*	Eastern Painted Turtle	Special Concern	Special Concern		S4	84	26.2 ± 1.0	NS
A	*Accipiter cooperii*	Cooper's Hawk	Not At Risk			S1?B,SUN,SUM	13	15.2 ± 7.0	NS

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A	*Fulica americana*	American Coot	Not At Risk			S1B	30	19.5 ± 7.0	NS
A	*Chlidonias niger*	Black Tern	Not At Risk			S1B	70	97.3 ± 0.0	NS
A	*Falco peregrinus pop. 1*	Peregrine Falcon - anatum/tundrius	Not At Risk		Vulnerable	S1B,SUM	44	27.8 ± 0.0	NS
A	*Sorex dispar*	Long-tailed Shrew	Not At Risk			S2	1	57.2 ± 0.0	NS
A	*Aegolius funereus*	Boreal Owl	Not At Risk			S2?B,SUM	14	9.5 ± 0.0	NS
A	*Globicephala melas*	Long-finned Pilot Whale	Not At Risk			S2S3	1	62.0 ± 100.0	NS
A	*Hemidactylium scutatum*	Four-toed Salamander	Not At Risk			S3	15	25.2 ± 0.0	NS
A	*Sterna hirundo*	Common Tern	Not At Risk			S3B	508	18.2 ± 7.0	NS
A	*Sialia sialis*	Eastern Bluebird	Not At Risk			S3B	67	11.2 ± 7.0	NS
A	*Buteo lagopus*	Rough-legged Hawk	Not At Risk			S3N	12	24.8 ± 0.0	NS
A	*Accipiter gentilis*	Northern Goshawk	Not At Risk			S3S4	155	15.2 ± 7.0	NS
A	*Glaucomys volans*	Southern Flying Squirrel	Not At Risk			S3S4	1	41.1 ± 0.0	NS
A	*Lagenorhynchus acutus*	Atlantic White-sided Dolphin	Not At Risk			S3S4	3	60.5 ± 0.0	NS
A	*Ammospiza nelsoni*	Nelson's Sparrow	Not At Risk			S3S4B	401	20.7 ± 7.0	NS
A	*Calidris canutus rufa*	Red Knot rufa subspecies	E,SC	Endangered	Endangered	S2M	491	24.0 ± 0.0	NS
A	*Calidris canutus*	Red Knot	E,SC	E,T		S2M	38	36.2 ± 0.0	NS
A	*Morone saxatilis*	Striped Bass	E,SC			S2S3B,S2S3N	16	31.7 ± 0.0	NS
A	*Gadus morhua*	Atlantic Cod	E,SC,DD			SNR	1	67.9 ± 0.0	NS
A	*Salmo salar*	Atlantic Salmon	E,T,SC			S1B,S1N	13	39.6 ± 0.0	NS
A	*Alces alces americana*	Moose			Endangered	S1	216	2.1 ± 0.0	NS
A	*Alces alces*	Moose				S1	11	38.9 ± 0.0	NS
A	*Picoides dorsalis*	American Three-toed Woodpecker				S1?	8	67.9 ± 7.0	NS
A	*Uria aalge*	Common Murre				S1?B	1	88.7 ± 0.0	NS
A	*Passerina cyanea*	Indigo Bunting				S1?B,SUM	19	34.3 ± 0.0	NS
A	*Nycticorax nycticorax*	Black-crowned Night-heron				S1B	1	87.5 ± 7.0	NS
A	*Oxyura jamaicensis*	Ruddy Duck				S1B	24	19.8 ± 0.0	NS
A	*Gallinula galeata*	Common Gallinule				S1B	28	11.2 ± 7.0	NS
A	*Myiarchus crinitus*	Great Crested Flycatcher				S1B	16	4.8 ± 7.0	NS
A	*Cistothorus palustris*	Marsh Wren				S1B	24	86.4 ± 3.0	NB
A	*Mimus polyglottos*	Northern Mockingbird				S1B	42	25.2 ± 7.0	NS
A	*Toxostoma rufum*	Brown Thrasher				S1B	10	25.2 ± 7.0	NS
A	*Charadrius semipalmatus*	Semipalmated Plover				S1B,S4M	1840	19.5 ± 7.0	NS
A	*Calidris minutilla*	Least Sandpiper				S1B,S4M	1159	23.3 ± 0.0	NS
A	*Anas acuta*	Northern Pintail				S1B,SUM	76	29.2 ± 0.0	NS
A	*Vireo gilvus*	Warbling Vireo				S1B,SUM	23	17.9 ± 7.0	NS
A	*Vespertilionidae sp.*	bat species				S1S2	81	7.0 ± 0.0	NS
A	*Pooecetes gramineus*	Vesper Sparrow				S1S2B,SUM	60	4.8 ± 7.0	NS
A	*Vireo philadelphicus*	Philadelphia Vireo				S2?B,SUM	87	17.2 ± 0.0	NS
A	*Alca torda*	Razorbill				S2B	3	51.9 ± 2.0	NS
A	*Fratercula arctica*	Atlantic Puffin				S2B	3	85.4 ± 0.0	NB
A	*Empidonax traillii*	Willow Flycatcher				S2B	29	17.9 ± 7.0	NS
A	*Molothrus ater*	Brown-headed Cowbird				S2B	201	4.8 ± 7.0	NS
A	*Spatula clypeata*	Northern Shoveler				S2B,SUM	67	23.4 ± 0.0	NS
A	*Mareca strepera*	Gadwall				S2B,SUM	108	26.8 ± 0.0	NS
A	*Piranga olivacea*	Scarlet Tanager				S2B,SUM	16	18.2 ± 7.0	NS
A	*Calidris alba*	Sanderling				S2N,S3M	1015	26.6 ± 0.0	NS
A	*Asio otus*	Long-eared Owl				S2S3	32	25.0 ± 7.0	NS
A	*Rallus limicola*	Virginia Rail				S2S3B	114	20.7 ± 7.0	NS
A	*Rissa tridactyla*	Black-legged Kittiwake				S2S3B	4	23.1 ± 0.0	NS
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S2S3B	358	4.8 ± 7.0	NS
A	*Phalacrocorax carbo*	Great Cormorant				S2S3B,S2S3N	176	24.5 ± 0.0	NS
A	*Cathartes aura*	Turkey Vulture				S2S3B,S4S5M	44	25.2 ± 0.0	NS
A	*Setophaga pinus*	Pine Warbler				S2S3B,S4S5M	28	14.0 ± 0.0	NS
A	*Bucephala clangula*	Common Goldeneye				S2S3B,S5N,S5M	185	22.0 ± 0.0	NS
A	*Icterus galbula*	Baltimore Oriole				S2S3B,SUM	80	18.2 ± 7.0	NS

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A	*Pluvialis dominica*	American Golden-Plover				S2S3M	166	24.5 ± 0.0	NS
A	*Numenius phaeopus*	Whimbrel				S2S3M	8	29.3 ± 0.0	NS
A	*Numenius phaeopus hudsonicus*	Whimbrel				S2S3M	211	27.5 ± 0.0	NS
A	*Perisoreus canadensis*	Canada Jay				S3	616	4.4 ± 0.0	NS
A	*Poecile hudsonicus*	Boreal Chickadee				S3	961	3.5 ± 0.0	NS
A	*Spinus pinus*	Pine Siskin				S3	565	1.4 ± 0.0	NS
A	*Salvelinus fontinalis*	Brook Trout				S3	105	12.8 ± 0.0	NS
A	*Salvelinus namaycush*	Lake Trout				S3	2	47.6 ± 0.0	NS
A	*Pekania pennanti*	Fisher				S3	10	9.9 ± 0.0	NS
A	*Calcarius lapponicus*	Lapland Longspur				S3?N,SUM	11	33.2 ± 0.0	NS
A	*Spatula discors*	Blue-winged Teal				S3B	370	11.2 ± 7.0	NS
A	*Charadrius vociferus*	Killdeer				S3B	810	5.2 ± 7.0	NS
A	*Tringa semipalmata*	Willet				S3B	2173	18.2 ± 7.0	NS
A	*Sterna paradisaea*	Arctic Tern				S3B	43	80.6 ± 7.0	NS
A	*Coccyzus erythropthalmus*	Black-billed Cuckoo				S3B	134	15.2 ± 7.0	NS
A	*Tyrannus tyrannus*	Eastern Kingbird				S3B	415	11.2 ± 7.0	NS
A	*Pheucticus ludovicianus*	Rose-breasted Grosbeak				S3B	877	4.8 ± 7.0	NS
A	*Alosa pseudoharengus*	Alewife				S3B	30	12.8 ± 0.0	NS
A	*Somateria mollissima*	Common Eider				S3B,S3M,S3N	356	27.5 ± 9.0	NS
A	*Tringa melanoleuca*	Greater Yellowlegs				S3B,S4M	2482	22.4 ± 0.0	NS
A	*Falco sparverius*	American Kestrel				S3B,S4S5M	592	5.2 ± 7.0	NS
A	*Gallinago delicata*	Wilson's Snipe				S3B,S5M	1165	4.8 ± 7.0	NS
A	*Setophaga striata*	Blackpoll Warbler				S3B,S5M	106	5.2 ± 7.0	NS
A	*Cardellina pusilla*	Wilson's Warbler				S3B,S5M	110	20.7 ± 7.0	NS
A	*Pinicola enucleator*	Pine Grosbeak				S3B,S5N,S5M	133	6.9 ± 0.0	NS
A	*Setophaga tigrina*	Cape May Warbler				S3B,SUM	333	4.8 ± 7.0	NS
A	*Branta bernicla*	Brant				S3M	8	73.0 ± 0.0	NS
A	*Pluvialis squatarola*	Black-bellied Plover				S3M	2092	23.5 ± 0.0	NS
A	*Arenaria interpres*	Ruddy Turnstone				S3M	895	23.2 ± 0.0	NS
A	*Calidris pusilla*	Semipalmated Sandpiper				S3M	1790	23.3 ± 0.0	NS
A	*Calidris melanotos*	Pectoral Sandpiper				S3M	178	24.1 ± 0.0	NS
A	*Limnodromus griseus*	Short-billed Dowitcher				S3M	1089	23.4 ± 0.0	NS
A	*Chroicocephalus ridibundus*	Black-headed Gull				S3N	52	29.4 ± 0.0	NS
A	*Picoides arcticus*	Black-backed Woodpecker				S3S4	192	3.4 ± 7.0	NS
A	*Loxia curvirostra*	Red Crossbill				S3S4	175	11.3 ± 7.0	NS
A	*Sorex albibarbis*	Eastern Water Shrew				S3S4	6	68.9 ± 0.0	PE
A	*Botaurus lentiginosus*	American Bittern				S3S4B,S4S5M	649	11.3 ± 7.0	NS
A	*Setophaga castanea*	Bay-breasted Warbler				S3S4B,S4S5M	694	4.8 ± 7.0	NS
A	*Actitis macularius*	Spotted Sandpiper				S3S4B,S5M	943	4.8 ± 7.0	NS
A	*Leiothlypis peregrina*	Tennessee Warbler				S3S4B,S5M	706	4.8 ± 7.0	NS
A	*Passerella iliaca*	Fox Sparrow				S3S4B,S5M	74	24.8 ± 0.0	NS
A	*Mergus serrator*	Red-breasted Merganser				S3S4B,S5M,S5N	134	18.2 ± 7.0	NS
A	*Calidris maritima*	Purple Sandpiper				S3S4N	30	30.1 ± 0.0	NS
A	*Lanius borealis*	Northern Shrike				S3S4N	8	71.2 ± 1.0	PE
A	*Morus bassanus*	Northern Gannet				SHB	80	26.5 ± 4.0	NS
A	*Aythya americana*	Redhead				SHB	13	24.1 ± 0.0	NS
A	*Leucophaeus atricilla*	Laughing Gull				SHB	6	87.9 ± 0.0	NS
A	*Progne subis*	Purple Martin				SHB	13	67.9 ± 7.0	NS
A	*Eremophila alpestris*	Horned Lark				SHB,S4S5N,S5M	25	29.6 ± 0.0	NS
I	*Bombus bohemicus*	Ashton Cuckoo Bumble Bee	Endangered	Endangered	Endangered	S1	34	30.8 ± 5.0	NS
I	*Danaus plexippus*	Monarch	Endangered	Special Concern	Endangered	S2?B,S3M	247	7.0 ± 0.0	NS
I	*Barnea truncata*	Atlantic Mud-piddock	Threatened	Threatened		S1	4	63.5 ± 1.0	NS
I	*Bombus suckleyi*	Suckley's Cuckoo Bumble Bee	Threatened			SH	4	30.5 ± 5.0	NS
I	*Alasmidonta varicosa*	Brook Floater	Special Concern	Special Concern	Threatened	S3	16	39.4 ± 0.0	NS

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I	*Bombus terricola*	Yellow-banded Bumble Bee	Special Concern	Special Concern	Vulnerable	S3	156	8.9 ± 0.0	NS
I	*Coccinella transversoguttata richardsoni*	Transverse Lady Beetle	Special Concern		Endangered	SH	8	11.3 ± 2.0	NS
I	*Gomphurus ventricosus*	Skillet Clubtail	Special Concern	Endangered		SH	2	81.1 ± 0.0	NS
I	*Erora laeta*	Early Hairstreak				S1	1	77.0 ± 0.0	PE
I	*Atlanticoncha ochracea*	Tidewater Mucket				S1	9	89.9 ± 0.0	NS
I	*Polygonia satyrus*	Satyr Comma				S1?	23	26.3 ± 5.0	NS
I	*Euphyes bimacula*	Two-spotted Skipper				S1S2	2	42.4 ± 0.0	NS
I	*Boloria chariclea*	Arctic Fritillary				S1S2	1	26.2 ± 2.0	NS
I	*Somatochlora brevicincta*	Quebec Emerald				S1S2	1	95.6 ± 0.0	NS
I	*Tournotaris bimaculata*	Two-spotted Brachycerid Weevil				S2	1	89.7 ± 0.0	PE
I	*Tharsalea dospassosi*	Maritime Copper				S2	94	26.3 ± 0.0	NS
I	*Satyrium acadica*	Acadian Hairstreak				S2	16	24.6 ± 2.0	NS
I	*Neurocordulia michaeli*	Broad-tailed Shadowdragon				S2	26	44.5 ± 0.0	NS
I	*Coenagrion resolutum*	Taiga Bluet				S2	57	47.3 ± 0.0	NS
I	*Margaritifera margaritifera*	Eastern Pearlshell				S2	179	8.9 ± 0.0	NS
I	*Pantala hymenaea*	Spot-Winged Glider				S2?B	1	81.6 ± 1.0	NS
I	*Nymphalis l-album*	Compton Tortoiseshell				S2S3	12	26.3 ± 2.0	NS
I	*Aglais milberti*	Milbert's Tortoiseshell				S2S3	21	26.3 ± 2.0	NS
I	*Aglais milberti milberti*	Milbert's Tortoise Shell				S2S3	3	47.6 ± 0.0	NS
I	*Lanthus vernalis*	Southern Pygmy Clubtail				S2S3	8	57.3 ± 0.0	NS
I	*Somatochlora kennedyi*	Kennedy's Emerald				S2S3	3	85.5 ± 1.0	PE
I	*Somatochlora williamsoni*	Williamson's Emerald				S2S3	13	85.8 ± 0.0	PE
I	*Williamsonia fletcheri*	Ebony Boghaunter				S2S3	7	45.2 ± 0.0	NS
I	*Stylurus scudderi*	Zebra Clubtail				S2S3	4	71.7 ± 0.0	NS
I	*Alasmidonta undulata*	Triangle Floater				S2S3	19	35.0 ± 0.0	NS
I	*Astyleiopus variegatus*	Variegated Long-horned Beetle				S3	1	91.3 ± 0.0	NS
I	*Psephenus herricki*	Herrick's Water Penny Beetle				S3	1	35.5 ± 0.0	NS
I	*Hormorus undulatus*	Undulated Broad-nosed Weevil				S3	1	89.7 ± 0.0	PE
I	*Carabus serratus*	Serrated Ground Beetle				S3	1	41.9 ± 0.0	NS
I	*Chrysochus auratus*	Dogbane Leaf Beetle				S3	3	69.8 ± 3.0	NS
I	*Naemia seriata*	Seaside Lady Beetle				S3	1	78.7 ± 0.0	NS
I	*Chilocorus stigma*	Twice-stabbed Lady Beetle				S3	5	27.4 ± 0.0	NS
I	*Myzia pullata*	Streaked Lady Beetle				S3	3	86.9 ± 0.0	PE
I	*Iphthiminus opacus*	Cloudy Darkling Beetle				S3	1	60.8 ± 0.0	PE
I	*Monochamus marmorator*	Balsam Fir Sawyer				S3	2	45.8 ± 0.0	NS
I	*Astylopsis sexguttata*	Six-speckled Long-horned Beetle				S3	5	89.7 ± 0.0	PE
I	*Satyrium calanus*	Banded Hairstreak				S3	3	28.1 ± 2.0	NS
I	*Callophrys lanoraieensis*	Bog Elfin				S3	12	33.2 ± 0.0	NS
I	*Strymon melinus*	Gray Hairstreak				S3	1	92.3 ± 2.0	NS
I	*Phanogomphus descriptus*	Harpoon Clubtail				S3	4	52.4 ± 1.0	NS
I	*Ophiogomphus aspersus*	Brook Snaketail				S3	4	69.6 ± 0.0	NS
I	*Ophiogomphus mainensis*	Maine Snaketail				S3	14	40.8 ± 0.0	NS
I	*Ophiogomphus rupinsulensis*	Rusty Snaketail				S3	55	56.7 ± 0.0	NS
I	*Epitheca princeps*	Prince Baskettail				S3	17	45.2 ± 0.0	NS
I	*Somatochlora forcipata*	Forcipate Emerald				S3	3	78.8 ± 1.0	PE
I	*Enallagma vernale*	Vernal Bluet				S3	5	51.8 ± 1.0	NS
I	*Strophitus undulatus*	Creeper				S3	6	71.8 ± 1.0	NS
I	*Polygonia interrogationis*	Question Mark				S3B	65	18.1 ± 0.0	NS
I	*Cecropterus pylades*	Northern Cloudywing				S3S4	27	6.5 ± 0.0	NS
I	*Amblyscirtes hegon*	Pepper and Salt Skipper				S3S4	18	24.6 ± 2.0	NS
I	*Cupido comyntas*	Eastern Tailed Blue				S3S4	3	35.0 ± 0.0	NS
I	*Argynnis aphrodite*	Aphrodite Fritillary				S3S4	26	29.6 ± 2.0	NS

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I	*Polygonia faunus*	Green Comma				S3S4	22	26.3 ± 2.0	NS
I	*Oeneis jutta*	Jutta Arctic				S3S4	18	42.1 ± 0.0	NS
I	*Aeshna clepsydra*	Mottled Darner				S3S4	10	74.1 ± 1.0	NS
I	*Aeshna constricta*	Lance-Tipped Darner				S3S4	38	16.6 ± 0.0	NS
I	*Boyeria grafiana*	Ocellated Darner				S3S4	15	27.6 ± 0.0	NS
I	*Gomphaeschna furcillata*	Harlequin Darner				S3S4	9	25.2 ± 0.0	NS
I	*Somatochlora franklini*	Delicate Emerald				S3S4	7	53.6 ± 1.0	NS
I	*Erythrodiplax berenice*	Seaside Dragonlet				S3S4	4	49.9 ± 0.0	NS
I	*Nannothemis bella*	Elfin Skimmer				S3S4	21	20.8 ± 0.0	NS
I	*Sympetrum danae*	Black Meadowhawk				S3S4	7	75.3 ± 1.0	PE
I	*Enallagma vesperum*	Vesper Bluet				S3S4	1	88.8 ± 0.0	NS
I	*Amphiagrion saucium*	Eastern Red Damsel				S3S4	3	18.1 ± 0.0	NS
I	*Sphaerophoria pyrrhina*	Violaceous Globetail				SH	1	31.0 ± 5.0	NS
I	*Icaricia saepiolus*	Greenish Blue				SH	3	24.5 ± 2.0	NS
I	*Polygonia gracilis*	Hoary Comma				SH	2	26.3 ± 2.0	NS
N	*Erioderma mollissimum*	Graceful Felt Lichen	Endangered	Endangered	Endangered	S1	30	64.6 ± 0.0	NS
N	*Erioderma pedicellatum (Atlantic pop.)*	Boreal Felt Lichen - Atlantic pop.	Endangered	Endangered	Endangered	S1	518	57.8 ± 0.0	NS
N	*Peltigera hydrothyria*	Eastern Waterfan	Threatened	Threatened	Threatened	S1	82	0.8 ± 0.0	NS
N	*Pannaria lurida*	Wrinkled Shingle Lichen	Threatened	Threatened	Threatened	S2S3	28	62.5 ± 1.0	NS
N	*Anzia colpodes*	Black-foam Lichen	Threatened	Threatened	Threatened	S3	37	39.1 ± 0.0	NS
N	*Fuscopannaria leucosticta*	White-rimmed Shingle Lichen	Threatened			S3	7	58.1 ± 0.0	NS
N	*Heterodermia squamulosa*	Scaly Fringe Lichen	Threatened			S3	8	73.5 ± 0.0	NS
N	*Pectenia plumbea*	Blue Felt Lichen	Special Concern	Special Concern	Vulnerable	S3	179	6.8 ± 0.0	NS
N	*Sclerophora peronella (Atlantic pop.)*	Frosted Glass-whiskers (Atlantic population)	Special Concern	Special Concern		S3S4	24	63.2 ± 0.0	NS
N	*Pseudevernia cladonia*	Ghost Antler Lichen	Not At Risk			S2S3	8	61.8 ± 1.0	NS
N	*Fissidens exilis*	Pygmy Pocket Moss	Not At Risk			S3	10	40.4 ± 0.0	NS
N	*Chaenotheca servitii*	Flexuous Golden Stubble	Data Deficient			S1	1	53.2 ± 1.0	NS
N	*Aloina brevirostris*	Short-Beaked Rigid Screw Moss				S1	1	80.0 ± 0.0	NS
N	*Orthotrichum gymnostomum*	Aspen Bristle Moss				S1	1	45.7 ± 0.0	NS
N	*Sematophyllum demissum*	a Moss				S1	1	95.0 ± 2.0	NS
N	*Tetrodontium brownianum*	Little Georgia				S1	1	92.2 ± 0.0	NS
N	*Cyrto-hypnum minutulum*	Tiny Cedar Moss				S1	1	53.5 ± 0.0	NS
N	*Blennothallia crispa*	Crinkled Jelly Lichen				S1	1	90.2 ± 0.0	NS
N	*Cladonia brevis*	Short Peg Lichen				S1	1	98.1 ± 4.0	PE
N	*Scytinium schraderi*	Wrinkled Jellyskin Lichen				S1	1	53.9 ± 0.0	NS
N	*Lichina confinis*	Marine Seaweed Lichen				S1	2	88.9 ± 2.0	NS
N	*Polychidium muscicola*	Eyed Mossthorns Woollybear Lichen				S1	1	45.3 ± 0.0	NS
N	*Peltigera lepidophora*	Scaly Pelt Lichen				S1	3	53.6 ± 0.0	PE
N	*Hypogymnia hultenii*	Powdered Honeycomb Lichen				S1	12	90.0 ± 0.0	NS
N	*Calypogeia neogaea*	Common Pouchwort				S1?	1	81.5 ± 0.0	NS
N	*Jubula pennsylvanica*	a liverwort				S1?	1	81.7 ± 0.0	NS
N	*Aloina rigida*	Aloe-Like Rigid Screw Moss				S1?	2	43.5 ± 0.0	NS
N	*Brachythecium erythrorrhizon*	Taiga Ragged Moss				S1?	2	94.7 ± 0.0	PE
N	*Campylostelium saxicola*	a Moss				S1?	2	76.7 ± 0.0	PE
N	*Tortula obtusifolia*	a Moss				S1?	3	28.3 ± 2.0	NS
N	*Didymodon tophaceus*	Olive Beard Moss				S1?	2	90.1 ± 4.0	NS
N	*Paludella squarrosa*	Tufted Fen Moss				S1?	3	97.0 ± 0.0	NS
N	*Schistostega pennata*	Luminous Moss				S1?	2	89.8 ± 0.0	NS
N	*Enchylium limosum*	Lime-loving Tarpaper Lichen				S1?	3	79.6 ± 0.0	PE
N	*Scytinium intermedium*	Forty-five Jellyskin Lichen				S1?	2	85.6 ± 4.0	NS
N	*Arrhenopterum*	One-sided Groove Moss				S1S2	1	83.2 ± 1.0	NS

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	heterostichum								
N	*Plagiothecium latebricola*	Alder Silk Moss				S1S2	1	86.8 ± 3.0	NS
N	*Seligeria donniana*	Donian Beardless Moss				S1S2	1	93.2 ± 3.0	NS
N	*Sematophyllum marylandicum*	a Moss				S1S2	2	84.6 ± 6.0	NS
N	*Timmia megapolitana*	Metropolitan Timmia Moss				S1S2	3	42.4 ± 0.0	NS
N	*Pseudotaxiphyllum distichaceum*	a Moss				S1S2	2	88.4 ± 0.0	NS
N	*Haplocladium microphyllum*	Tiny-leaved Haplocladium Moss				S1S2	1	47.1 ± 5.0	NS
N	*Placidium squamulosum*	Limy Soil Stipplescale Lichen				S1S2	1	47.5 ± 6.0	NS
N	*Peltigera ponojensis*	Pale-bellied Pelt Lichen				S1S2	1	19.8 ± 0.0	NS
N	*Pilophorus cereolus*	Powdered Matchstick Lichen				S1S2	1	72.8 ± 3.0	NS
N	*Solorina spongiosa*	Blinking Owl Lichen				S1S2	7	73.4 ± 0.0	NS
N	*Parmeliella parvula*	Poor-man's Shingles Lichen				S1S2	13	70.8 ± 0.0	NS
N	*Heterodermia galactophylla*	Branching Fringe Lichen				S1S3	2	56.2 ± 0.0	NS
N	*Peltigera neckeri*	Black-saddle Pelt Lichen				S1S3	2	78.4 ± 0.0	NS
N	*Stereocaulon grande*	Grand Foam Lichen				S1S3	1	43.0 ± 0.0	NS
N	*Anacamptodon splachnoides*	a Moss				S2	1	86.8 ± 3.0	NS
N	*Sphagnum platyphyllum*	Flat-leaved Peat Moss				S2	2	90.8 ± 3.0	NS
N	*Sphagnum subnitens*	Lustrous Peat Moss				S2	1	90.0 ± 2.0	NS
N	*Scytinium imbricatum*	Scaly Jellyskin Lichen				S2	1	76.8 ± 4.0	NS
N	*Nephroma resupinatum*	a lichen				S2	3	90.7 ± 1.0	NS
N	*Placynthium flabellosum*	Scaly Ink Lichen				S2	1	72.5 ± 17.0	NS
N	*Anaptychia crinalis*	Hanging Fringed Lichen				S2	1	98.1 ± 4.0	PE
N	*Moerckia flotoviana*	Flotow's Ruffwort				S2?	2	88.0 ± 0.0	PE
N	*Riccardia multifida*	Delicate Germanderwort				S2?	2	67.2 ± 0.0	NS
N	*Anomodon viticulosus*	a Moss				S2?	1	44.1 ± 5.0	NS
N	*Atrichum angustatum*	Lesser Smoothcap Moss				S2?	3	22.4 ± 2.0	NS
N	*Drepanocladus polygamus*	Polygamous Hook Moss				S2?	5	83.8 ± 0.0	PE
N	*Ditrichum rhynchostegium*	a Moss				S2?	1	52.4 ± 0.0	PE
N	*Fontinalis hypnoides*	a moss				S2?	1	96.8 ± 0.0	PE
N	*Kiaeria starkei*	Starke's Fork Moss				S2?	1	86.8 ± 10.0	NS
N	*Philonotis marchica*	a Moss				S2?	3	21.8 ± 0.0	NS
N	*Platydictya jungermannioides*	False Willow Moss				S2?	3	64.0 ± 0.0	NS
N	*Saelania glaucescens*	Blue Dew Moss				S2?	1	21.3 ± 0.0	NS
N	*Cyrtomnium hymenophylloides*	Short-pointed Lantern Moss				S2?	1	21.3 ± 0.0	NS
N	*Platylomella lescurii*	a Moss				S2?	2	37.9 ± 0.0	NS
N	*Oxyrrhynchium hians*	Light Beaked Moss				S2S3	2	62.7 ± 25.0	NS
N	*Platydictya subtilis*	Bark Willow Moss				S2S3	3	76.7 ± 0.0	PE
N	*Scorpidium revolvens*	Limprichtia Moss				S2S3	2	83.8 ± 0.0	NS
N	*Moelleropsis nebulosa*	Blue-gray Moss Shingle Lichen				S2S3	56	48.8 ± 0.0	NS
N	*Moelleropsis nebulosa ssp. frullaniae*	Blue-gray Moss Shingle Lichen				S2S3	3	68.8 ± 0.0	NS
N	*Ramalina thrausta*	Angelhair Ramalina Lichen				S2S3	15	32.4 ± 0.0	NS
N	*Collema leptaleum*	Crumpled Bat's Wing Lichen				S2S3	97	45.5 ± 0.0	NS
N	*Usnea ceratina*	Warty Beard Lichen				S2S3	1	83.0 ± 0.0	NS
N	*Usnea rubicunda*	Red Beard Lichen				S2S3	2	30.7 ± 0.0	NS
N	*Ahtiana aurescens*	Eastern Candlewax Lichen				S2S3	7	43.1 ± 6.0	NS
N	*Cladonia incrassata*	Powder-foot British Soldiers Lichen				S2S3	1	74.7 ± 0.0	NS
N	*Cladonia parasitica*	Fence-rail Lichen				S2S3	1	55.9 ± 1.0	NS
N	*Scytinium tenuissimum*	Birdnest Jellyskin Lichen				S2S3	17	31.0 ± 0.0	NS
N	*Melanohalea septentrionalis*	Northern Camouflage Lichen				S2S3	2	96.7 ± 0.0	PE

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N	*Parmelia fertilis*	Fertile Shield Lichen				S2S3	10	22.7 ± 0.0	NS
N	*Hypotrachyna minarum*	Hairless-spined Shield Lichen				S2S3	1	81.3 ± 0.0	NS
N	*Parmeliopsis ambigua*	Green Starburst Lichen				S2S3	3	25.8 ± 1.0	NS
N	*Fuscopannaria sorediata*	a Lichen				S2S3	6	62.0 ± 0.0	NS
N	*Stereocaulon condensatum*	Granular Soil Foam Lichen				S2S3	11	11.0 ± 0.0	NS
N	*Physcia subtilis*	Slender Rosette Lichen				S2S3	1	73.6 ± 0.0	NS
N	*Cladonia coccifera*	Eastern Boreal Pixie-cup Lichen				S2S3	2	52.6 ± 1.0	NS
N	*Cladonia deformis*	Lesser Sulphur-cup Lichen				S2S3	2	80.0 ± 0.0	PE
N	*Ephemerum serratum*	a Moss				S3	2	25.1 ± 3.0	NS
N	*Fissidens taxifolius*	Yew-leaved Pocket Moss				S3	7	15.3 ± 0.0	NS
N	*Anomodon tristis*	a Moss				S3	3	79.7 ± 0.0	NS
N	*Sphagnum contortum*	Twisted Peat Moss				S3	4	81.8 ± 4.0	NS
N	*Tetraplodon angustatus*	Toothed-leaved Nitrogen Moss				S3	3	71.3 ± 0.0	NS
N	*Rostania occultata*	Crusted Tarpaper Lichen				S3	5	73.2 ± 0.0	PE
N	*Collema nigrescens*	Blistered Tarpaper Lichen				S3	21	47.0 ± 2.0	NS
N	*Solorina saccata*	Woodland Owl Lichen				S3	6	64.8 ± 2.0	NS
N	*Fuscopannaria ahlneri*	Corrugated Shingles Lichen				S3	88	8.4 ± 0.0	NS
N	*Scytinium lichenoides*	Tattered Jellyskin Lichen				S3	32	40.0 ± 0.0	NS
N	*Leptogium milligranum*	Stretched Jellyskin Lichen				S3	11	44.0 ± 0.0	NS
N	*Nephroma bellum*	Naked Kidney Lichen				S3	14	27.7 ± 0.0	NS
N	*Placynthium nigrum*	Common Ink Lichen				S3	4	47.6 ± 0.0	NS
N	*Platismatia norvegica*	Oldgrowth Rag Lichen				S3	1	93.8 ± 0.0	NS
N	*Punctelia appalachensis*	Appalachian Speckleback Lichen				S3	3	59.3 ± 0.0	NS
N	*Viridothelium virens*	a lichen				S3	2	78.1 ± 0.0	PE
N	*Ephebe lanata*	Waterside Rockshag Lichen				S3	2	45.3 ± 0.0	NS
N	*Phaeophyscia adiastola*	Powder-tipped Shadow Lichen				S3	4	59.6 ± 0.0	PE
N	*Phaeophyscia pusilloides*	Pompom-tipped Shadow Lichen				S3	11	9.9 ± 0.0	NS
N	*Peltigera collina*	Tree Pelt Lichen				S3	18	21.0 ± 0.0	NS
N	*Barbula convoluta*	Lesser Bird's-claw Beard Moss				S3?	1	53.2 ± 0.0	PE
N	*Calliergon giganteum*	Giant Spear Moss				S3?	1	84.6 ± 2.0	PE
N	*Elodium blandowii*	Blandow's Bog Moss				S3?	3	7.9 ± 3.0	NS
N	*Mnium stellare*	Star Leafy Moss				S3?	1	83.2 ± 1.0	NS
N	*Sphagnum lindbergii*	Lindberg's Peat Moss				S3?	1	90.4 ± 0.0	NS
N	*Sphagnum riparium*	Streamside Peat Moss				S3?	2	77.0 ± 0.0	NS
N	*Cladonia stygia*	Black-footed Reindeer Lichen				S3?	17	72.8 ± 0.0	NS
N	*Dichelyma capillaceum*	Hairlike Dichelyma Moss				S3S4	1	99.1 ± 3.0	NS
N	*Encalypta procera*	Slender Extinguisher Moss				S3S4	10	84.6 ± 0.0	NS
N	*Myurella julacea*	Small Mouse-tail Moss				S3S4	1	21.3 ± 0.0	NS
N	*Splachnum ampullaceum*	Cruet Dung Moss				S3S4	3	68.3 ± 0.0	NS
N	*Thamnobryum alleghaniense*	a Moss				S3S4	3	68.7 ± 0.0	NS
N	*Tomentypnum nitens*	Golden Fuzzy Fen Moss				S3S4	5	83.8 ± 0.0	NS
N	*Schistidium agassizii*	Elf Bloom Moss				S3S4	2	80.1 ± 0.0	NS
N	*Hylocomiastrum pyrenaicum*	a Feather Moss				S3S4	1	93.2 ± 3.0	NS
N	*Bryoria pseudofuscescens*	Mountain Horsehair Lichen				S3S4	24	59.3 ± 0.0	PE
N	*Enchylium tenax*	Soil Tarpaper Lichen				S3S4	10	40.0 ± 0.0	NS
N	*Sticta fuliginosa*	Peppered Moon Lichen				S3S4	53	17.5 ± 1.0	NS
N	*Arctoparmelia incurva*	Finger Ring Lichen				S3S4	13	88.3 ± 0.0	NS
N	*Scytinium teretiusculum*	Curly Jellyskin Lichen				S3S4	13	32.3 ± 0.0	NS
N	*Leptogium acadiense*	Acadian Jellyskin Lichen				S3S4	42	13.3 ± 0.0	NS
N	*Scytinium subtile*	Appressed Jellyskin Lichen				S3S4	35	52.7 ± 0.0	NS

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N	*Vahliella leucophaea*	Shelter Shingle Lichen				S3S4	11	59.5 ± 0.0	NS
N	*Heterodermia speciosa*	Powdered Fringe Lichen				S3S4	34	21.1 ± 0.0	NS
N	*Leptogium corticola*	Blistered Jellyskin Lichen				S3S4	45	52.6 ± 0.0	NS
N	*Melanohalea olivacea*	Spotted Camouflage Lichen				S3S4	6	25.0 ± 3.0	NS
N	*Parmeliopsis hyperopta*	Gray Starburst Lichen				S3S4	5	8.6 ± 1.0	NS
N	*Parmotrema perlatum*	Powdered Ruffle Lichen				S3S4	1	87.0 ± 0.0	NS
N	*Peltigera hymenina*	Cloudy Pelt Lichen				S3S4	1	81.3 ± 1.0	NS
N	*Sphaerophorus fragilis*	Fragile Coral Lichen				S3S4	3	92.9 ± 0.0	NS
N	*Coccocarpia palmicola*	Salted Shell Lichen				S3S4	731	39.1 ± 0.0	NS
N	*Physcia tenella*	Fringed Rosette Lichen				S3S4	6	56.8 ± 0.0	PE
N	*Anaptychia palmulata*	Shaggy Fringed Lichen				S3S4	70	19.2 ± 0.0	NS
N	*Evernia prunastri*	Valley Oakmoss Lichen				S3S4	85	1.2 ± 5.0	NS
N	*Heterodermia neglecta*	Fringe Lichen				S3S4	62	7.2 ± 0.0	NS
P	*Clethra alnifolia*	Coast Pepper-Bush	Endangered	Threatened	Vulnerable	S2	1	93.4 ± 0.0	PE
P	*Fraxinus nigra*	Black Ash	Threatened		Threatened	S1S2	1394	3.8 ± 0.0	NS
P	*Lilaeopsis chinensis*	Eastern Lilaeopsis	Special Concern	Special Concern	Vulnerable	S3	20	65.3 ± 0.0	NS
P	*Isoetes prototypus*	Prototype Quillwort	Special Concern	Special Concern	Vulnerable	S3	13	52.8 ± 0.0	NS
P	*Floerkea proserpinacoides*	False Mermaidweed	Not At Risk			S2S3	3	24.8 ± 7.0	NS
P	*Acer saccharinum*	Silver Maple				S1	5	74.7 ± 0.0	PE
P	*Nabalus racemosus*	Glaucous Rattlesnakeroot				S1	1	99.1 ± 20.0	PE
P	*Cochlearia tridactylites*	Limestone Scurvy-grass				S1	1	96.6 ± 0.0	NS
P	*Lobelia spicata*	Pale-Spiked Lobelia				S1	6	46.0 ± 7.0	NS
P	*Stellaria crassifolia*	Fleshy Stitchwort				S1	1	97.7 ± 5.0	PE
P	*Hudsonia tomentosa*	Woolly Beach-heath				S1	40	36.6 ± 7.0	NS
P	*Callitriche hermaphroditica*	Northern Water-starwort				S1	6	95.3 ± 0.0	PE
P	*Elatine americana*	American Waterwort				S1	1	73.6 ± 0.0	NS
P	*Ribes americanum*	Wild Black Currant				S1	2	30.3 ± 5.0	NS
P	*Utricularia ochroleuca*	Yellowish-white Bladderwort				S1	31	98.1 ± 0.0	NS
P	*Fraxinus pennsylvanica*	Red Ash				S1	13	55.2 ± 0.0	NS
P	*Persicaria careyi*	Carey's Smartweed				S1	1	45.5 ± 3.0	NS
P	*Ranunculus pensylvanicus*	Pennsylvania Buttercup				S1	31	47.2 ± 0.0	NS
P	*Salix myrtillifolia*	Blueberry Willow				S1	1	63.3 ± 0.0	NS
P	*Salix serissima*	Autumn Willow				S1	2	63.3 ± 0.0	NS
P	*Carex alopecoidea*	Foxtail Sedge				S1	3	95.3 ± 0.0	NS
P	*Carex garberi*	Garber's Sedge				S1	4	15.9 ± 0.0	NS
P	*Carex granularis*	Limestone Meadow Sedge				S1	2	97.5 ± 0.0	NS
P	*Carex ormostachya*	Necklace Spike Sedge				S1	1	92.1 ± 1.0	NB
P	*Carex plantaginea*	Plantain-Leaved Sedge				S1	4	24.1 ± 0.0	NS
P	*Carex prairea*	Prairie Sedge				S1	1	85.6 ± 0.0	PE
P	*Carex tenuiflora*	Sparse-Flowered Sedge				S1	2	97.6 ± 0.0	NS
P	*Carex tincta*	Tinged Sedge				S1	6	92.1 ± 5.0	PE
P	*Carex viridula var. saxilittoralis*	Greenish Sedge				S1	4	90.5 ± 0.0	NS
P	*Carex grisea*	Inflated Narrow-leaved Sedge				S1	6	84.9 ± 0.0	NS
P	*Cyperus lupulinus ssp. macilentus*	Hop Flatsedge				S1	18	30.1 ± 0.0	NS
P	*Scirpus atrovirens*	Dark-green Bulrush				S1	2	57.6 ± 0.0	NS
P	*Blysmopsis rufa*	Red Bulrush				S1	1	96.5 ± 5.0	PE
P	*Elodea nuttallii*	Nuttall's Waterweed				S1	2	91.6 ± 1.0	PE
P	*Iris prismatica*	Slender Blue Flag				S1	2	78.8 ± 1.0	NS
P	*Juncus vaseyi*	Vasey Rush				S1	4	19.8 ± 0.0	NS
P	*Trillium grandiflorum*	White Trillium				S1	1	75.5 ± 1.0	PE
P	*Malaxis monophyllos var. brachypoda*	North American White Adder's-mouth				S1	3	82.4 ± 1.0	NS
P	*Elymus hystrix*	Spreading Wild Rye				S1	10	35.5 ± 1.0	NS
P	*Adiantum pedatum*	Northern Maidenhair Fern				S1	7	29.0 ± 0.0	NS
P	*Solidago hispida*	Hairy Goldenrod				S1?	1	53.2 ± 7.0	NS

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P	*Suaeda rolandii*	Roland's Sea-Blite				S1?	1	73.7 ± 2.0	NS
P	*Carex pensylvanica*	Pennsylvania Sedge				S1?	3	47.2 ± 3.0	NS
P	*Bolboschoenus robustus*	Sturdy Bulrush				S1?	2	46.0 ± 7.0	NS
P	*Allium schoenoprasum*	Wild Chives				S1?	1	69.9 ± 0.0	PE
P	*Allium schoenoprasum var. sibiricum*	Wild Chives				S1?	1	31.8 ± 7.0	NS
P	*Cypripedium arietinum*	Ram's-Head Lady's-Slipper			Endangered	S1S2	33	45.1 ± 0.0	NS
P	*Sanicula odorata*	Clustered Sanicle				S1S2	6	11.4 ± 10.0	NS
P	*Ageratina altissima*	White Snakeroot				S1S2	2	85.8 ± 7.0	NS
P	*Proserpinaca intermedia*	Intermediate Mermaidweed				S1S2	1	66.4 ± 0.0	NS
P	*Anemone virginiana var. alba*	Virginia Anemone				S1S2	5	22.4 ± 5.0	NS
P	*Parnassia parviflora*	Small-flowered Grass-of-Parnassus				S1S2	1	68.9 ± 1.0	NS
P	*Carex haydenii*	Hayden's Sedge				S1S2	4	30.2 ± 1.0	NS
P	*Platanthera huronensis*	Fragrant Green Orchid				S1S2	2	65.2 ± 10.0	NS
P	*Calamagrostis stricta ssp. stricta*	Slim-stemmed Reed Grass				S1S2	25	78.6 ± 0.0	PE
P	*Carex vacillans*	Estuarine Sedge				S1S3	5	89.6 ± 0.0	NS
P	*Zizia aurea*	Golden Alexanders				S2	51	15.3 ± 1.0	NS
P	*Antennaria parlinii ssp. fallax*	Parlin's Pussytoes				S2	4	12.0 ± 0.0	NS
P	*Rudbeckia laciniata*	Cut-Leaved Coneflower				S2	26	10.8 ± 0.0	NS
P	*Arabis pycnocarpa*	Cream-flowered Rockcress				S2	1	86.9 ± 0.0	NS
P	*Hudsonia ericoides*	Pinebarren Golden Heather				S2	2	96.5 ± 5.0	PE
P	*Desmodium canadense*	Canada Tick-trefoil				S2	20	20.4 ± 0.0	NS
P	*Hylodesmum glutinosum*	Large Tick-trefoil				S2	6	93.7 ± 0.0	NS
P	*Anemonastrum canadense*	Canada Anemone				S2	1	29.0 ± 0.0	NS
P	*Hepatica americana*	Round-lobed Hepatica				S2	32	3.4 ± 0.0	NS
P	*Galium boreale*	Northern Bedstraw				S2	6	53.4 ± 5.0	NS
P	*Comandra umbellata*	Bastard's Toadflax				S2	49	91.6 ± 5.0	NS
P	*Gratiola neglecta*	Clammy Hedge-Hyssop				S2	21	38.6 ± 0.0	NS
P	*Dirca palustris*	Eastern Leatherwood				S2	19	60.9 ± 7.0	NS
P	*Carex chordorrhiza*	Creeping Sedge				S2	35	91.6 ± 1.0	PE
P	*Carex gynocrates*	Northern Bog Sedge				S2	2	63.3 ± 0.0	NS
P	*Carex pellita*	Woolly Sedge				S2	12	20.2 ± 0.0	NS
P	*Carex livida*	Livid Sedge				S2	27	48.0 ± 0.0	NS
P	*Juncus greenei*	Greene's Rush				S2	7	54.2 ± 1.0	NS
P	*Juncus alpinoarticulatus ssp. americanus*	Northern Green Rush				S2	6	89.9 ± 0.0	PE
P	*Luzula spicata*	Spiked Woodrush				S2	1	84.9 ± 0.0	NS
P	*Allium tricoccum*	Wild Leek				S2	10	10.6 ± 0.0	NS
P	*Lilium canadense*	Canada Lily				S2	151	7.2 ± 0.0	NS
P	*Cypripedium parviflorum var. pubescens*	Yellow Lady's-slipper				S2	38	25.2 ± 7.0	NS
P	*Cypripedium reginae*	Showy Lady's-Slipper				S2	100	20.2 ± 0.0	NS
P	*Platanthera flava var. herbiola*	Pale Green Orchid				S2	8	11.0 ± 7.0	NS
P	*Platanthera macrophylla*	Large Round-Leaved Orchid				S2	16	6.7 ± 5.0	NS
P	*Bromus latiglumis*	Broad-Glumed Brome				S2	33	32.4 ± 0.0	NS
P	*Cinna arundinacea*	Sweet Wood Reed Grass				S2	19	36.5 ± 0.0	NS
P	*Elymus wiegandii*	Wiegand's Wild Rye				S2	20	16.0 ± 0.0	NS
P	*Festuca subverticillata*	Nodding Fescue				S2	6	60.1 ± 1.0	NS
P	*Cryptogramma stelleri*	Steller's Rockbrake				S2	1	72.4 ± 0.0	NS
P	*Cuscuta cephalanthi*	Buttonbush Dodder				S2?	9	22.4 ± 1.0	NS
P	*Rumex persicarioides*	Peach-leaved Dock				S2?	4	71.6 ± 5.0	PE
P	*Crataegus submollis*	Quebec Hawthorn				S2?	6	32.0 ± 5.0	NS
P	*Carex peckii*	White-Tinged Sedge				S2?	3	25.9 ± 0.0	NS
P	*Thuja occidentalis*	Eastern White Cedar			Vulnerable	S2S3	956	54.1 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Osmorhiza longistylis*	Smooth Sweet Cicely				S2S3	23	12.3 ± 0.0	NS
P	*Bidens hyperborea*	Estuary Beggarticks				S2S3	3	66.3 ± 0.0	NS
P	*Erigeron philadelphicus*	Philadelphia Fleabane				S2S3	6	45.1 ± 5.0	NS
P	*Lactuca hirsuta*	Hairy Lettuce				S2S3	3	74.7 ± 5.0	PE
P	*Impatiens pallida*	Pale Jewelweed				S2S3	3	40.8 ± 0.0	NS
P	*Caulophyllum thalictroides*	Blue Cohosh				S2S3	104	10.5 ± 0.0	NS
P	*Boechera stricta*	Drummond's Rockcress				S2S3	8	20.4 ± 0.0	NS
P	*Stellaria humifusa*	Saltmarsh Starwort				S2S3	9	72.2 ± 1.0	PE
P	*Oxybasis rubra*	Red Goosefoot				S2S3	8	26.7 ± 0.0	NS
P	*Hypericum majus*	Large St John's-wort				S2S3	21	47.2 ± 0.0	NS
P	*Hypericum x dissimulatum*	Disguised St. John's-wort				S2S3	6	54.1 ± 1.0	NS
P	*Empetrum atropurpureum*	Purple Crowberry				S2S3	2	94.9 ± 5.0	PE
P	*Euphorbia polygonifolia*	Seaside Spurge				S2S3	14	48.7 ± 1.0	PE
P	*Myriophyllum farwellii*	Farwell's Water Milfoil				S2S3	10	37.2 ± 0.0	NS
P	*Hedeoma pulegioides*	American False Pennyroyal				S2S3	7	28.1 ± 5.0	NS
P	*Oenothera fruticosa ssp. tetragona*	Narrow-leaved Evening Primrose				S2S3	3	11.0 ± 7.0	NS
P	*Polygonum aviculare ssp. buxiforme*	Box Knotweed				S2S3	5	28.7 ± 0.0	NS
P	*Polygonum oxyspermum ssp. raii*	Ray's Knotweed				S2S3	4	93.7 ± 5.0	PE
P	*Rumex triangulivalvis*	Triangular-valve Dock				S2S3	4	49.0 ± 0.0	NS
P	*Primula mistassinica*	Mistassini Primrose				S2S3	17	21.6 ± 0.0	NS
P	*Anemone quinquefolia*	Wood Anemone				S2S3	21	34.1 ± 0.0	NS
P	*Caltha palustris*	Yellow Marsh Marigold				S2S3	107	43.7 ± 0.0	NS
P	*Amelanchier fernaldii*	Fernald's Serviceberry				S2S3	1	80.2 ± 5.0	NS
P	*Potentilla canadensis*	Canada Cinquefoil				S2S3	1	50.1 ± 5.0	NS
P	*Galium obtusum*	Blunt-leaved Bedstraw				S2S3	1	92.1 ± 1.0	NB
P	*Salix pellita*	Satiny Willow				S2S3	5	38.4 ± 0.0	NS
P	*Tiarella cordifolia*	Heart-leaved Foamflower				S2S3	223	3.4 ± 0.0	NS
P	*Agalinis purpurea var. parviflora*	Small-flowered Purple False Foxglove				S2S3	33	19.6 ± 0.0	NS
P	*Boehmeria cylindrica*	Small-spike False-nettle				S2S3	3	71.4 ± 0.0	NS
P	*Carex adusta*	Lesser Brown Sedge				S2S3	6	30.9 ± 0.0	NS
P	*Carex capillaris*	Hairlike Sedge				S2S3	2	88.0 ± 0.0	NS
P	*Carex comosa*	Bearded Sedge				S2S3	17	36.2 ± 7.0	NS
P	*Carex houghtoniana*	Houghton's Sedge				S2S3	5	47.1 ± 1.0	NS
P	*Carex hystericina*	Porcupine Sedge				S2S3	7	20.2 ± 0.0	NS
P	*Eleocharis ovata*	Ovate Spikerush				S2S3	8	10.0 ± 0.0	NS
P	*Scirpus pedicellatus*	Stalked Bulrush				S2S3	8	37.5 ± 0.0	NS
P	*Vallisneria americana*	Wild Celery				S2S3	8	45.0 ± 1.0	NS
P	*Najas gracillima*	Thread-Like Naiad				S2S3	2	100.0 ± 0.0	NS
P	*Goodyera pubescens*	Downy Rattlesnake-Plantain				S2S3	6	53.9 ± 0.0	NS
P	*Spiranthes casei*	Case's Ladies'-Tresses				S2S3	1	92.6 ± 1.0	NS
P	*Spiranthes casei var. novaescotiae*	Case's Ladies'-Tresses				S2S3	7	52.1 ± 0.0	NS
P	*Spiranthes lucida*	Shining Ladies'-Tresses				S2S3	25	16.8 ± 5.0	NS
P	*Calamagrostis stricta*	Slim-stemmed Reed Grass				S2S3	12	78.6 ± 0.0	PE
P	*Potamogeton friesii*	Fries' Pondweed				S2S3	17	28.0 ± 5.0	NS
P	*Woodsia glabella*	Smooth Cliff Fern				S2S3	1	48.4 ± 1.0	NS
P	*Botrychium lanceolatum ssp. angustisegmentum*	Narrow Triangle Moonwort				S2S3	12	6.0 ± 1.0	NS
P	*Botrychium simplex*	Least Moonwort				S2S3	4	35.7 ± 0.0	NS
P	*Ophioglossum pusillum*	Northern Adder's-tongue				S2S3	9	6.9 ± 0.0	NS
P	*Potamogeton pulcher*	Spotted Pondweed			Vulnerable	S3	3	47.8 ± 2.0	NS
P	*Angelica atropurpurea*	Purple-stemmed Angelica				S3	13	37.7 ± 0.0	NS
P	*Conioselinum chinense*	Chinese Hemlock-parsley				S3	3	8.5 ± 5.0	NS
P	*Hieracium robinsonii*	Robinson's Hawkweed				S3	3	4.6 ± 7.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Senecio pseudoarnica*	Seabeach Ragwort				S3	17	31.8 ± 7.0	NS
P	*Symphyotrichum boreale*	Boreal Aster				S3	82	31.8 ± 7.0	NS
P	*Symphyotrichum ciliolatum*	Fringed Blue Aster				S3	21	25.7 ± 0.0	NS
P	*Betula michauxii*	Michaux's Dwarf Birch				S3	34	54.2 ± 0.0	NS
P	*Betula pumila*	Bog Birch				S3	71	63.7 ± 0.0	NS
P	*Cardamine parviflora*	Small-flowered Bittercress				S3	4	91.4 ± 0.0	NS
P	*Palustricodon aparinoides*	Marsh Bellflower				S3	39	10.0 ± 0.0	NS
P	*Mononeuria groenlandica*	Greenland Stitchwort				S3	2	76.7 ± 0.0	NS
P	*Sagina nodosa*	Knotted Pearlwort				S3	9	90.1 ± 0.0	NS
P	*Sagina nodosa ssp. borealis*	Knotted Pearlwort				S3	10	89.1 ± 0.0	NS
P	*Stellaria longifolia*	Long-leaved Starwort				S3	21	9.7 ± 0.0	NS
P	*Ceratophyllum echinatum*	Prickly Hornwort				S3	19	36.5 ± 0.0	NS
P	*Triosteum aurantiacum*	Orange-fruited Tinker's Weed				S3	140	10.7 ± 0.0	NS
P	*Viburnum edule*	Squashberry				S3	3	3.1 ± 0.0	NS
P	*Crassula aquatica*	Water Pygmyweed				S3	2	90.5 ± 5.0	PE
P	*Empetrum eamesii*	Pink Crowberry				S3	8	70.0 ± 5.0	PE
P	*Halenia deflexa*	Spurred Gentian				S3	1	90.9 ± 1.0	NS
P	*Geranium bicknellii*	Bicknell's Crane's-bill				S3	5	45.5 ± 2.0	NS
P	*Myriophyllum verticillatum*	Whorled Water Milfoil				S3	6	37.4 ± 0.0	NS
P	*Epilobium strictum*	Downy Willowherb				S3	74	29.9 ± 5.0	NS
P	*Polygala sanguinea*	Blood Milkwort				S3	38	2.3 ± 0.0	NS
P	*Persicaria arifolia*	Halberd-leaved Tearthumb				S3	68	12.9 ± 0.0	NS
P	*Plantago rugelii*	Rugel's Plantain				S3	7	20.4 ± 0.0	NS
P	*Samolus parviflorus*	Seaside Brookweed				S3	31	50.2 ± 0.0	NS
P	*Pyrola minor*	Lesser Pyrola				S3	3	7.6 ± 0.0	NS
P	*Anemone virginiana*	Virginia Anemone				S3	38	22.4 ± 0.0	NS
P	*Galium labradoricum*	Labrador Bedstraw				S3	113	36.1 ± 0.0	NS
P	*Salix pedicellaris*	Bog Willow				S3	62	32.2 ± 7.0	NS
P	*Salix sericea*	Silky Willow				S3	1	83.0 ± 1.0	NS
P	*Lindernia dubia*	Yellow-seeded False Pimperel				S3	47	15.6 ± 0.0	NS
P	*Laportea canadensis*	Canada Wood Nettle				S3	54	10.1 ± 10.0	NS
P	*Pilea pumila*	Dwarf Clearweed				S3	35	36.8 ± 0.0	NS
P	*Viola nephrophylla*	Northern Bog Violet				S3	9	7.6 ± 1.0	NS
P	*Carex bebbii*	Bebb's Sedge				S3	18	20.4 ± 0.0	NS
P	*Carex castanea*	Chestnut Sedge				S3	39	57.3 ± 0.0	NS
P	*Carex cryptolepis*	Hidden-scaled Sedge				S3	13	36.8 ± 0.0	NS
P	*Carex eburnea*	Bristle-leaved Sedge				S3	34	39.9 ± 0.0	NS
P	*Carex hirtifolia*	Pubescent Sedge				S3	59	10.4 ± 1.0	NS
P	*Carex lupulina*	Hop Sedge				S3	60	14.9 ± 0.0	NS
P	*Carex rosea*	Rosy Sedge				S3	35	11.4 ± 11.0	NS
P	*Carex tenera*	Tender Sedge				S3	10	9.0 ± 1.0	NS
P	*Carex tribuloides*	Blunt Broom Sedge				S3	12	20.5 ± 2.0	NS
P	*Carex tuckermanii*	Tuckerman's Sedge				S3	41	15.1 ± 0.0	NS
P	*Carex atratiformis*	Scabrous Black Sedge				S3	3	98.7 ± 1.0	NS
P	*Eleocharis nitida*	Quill Spikerush				S3	6	75.5 ± 7.0	NS
P	*Eleocharis flavescens var. olivacea*	Bright-green Spikerush				S3	7	36.2 ± 0.0	NS
P	*Eriophorum gracile*	Slender Cottongrass				S3	33	30.1 ± 10.0	NS
P	*Schoenoplectus americanus*	Olney's Bulrush				S3	1	84.9 ± 0.0	NS
P	*Juncus stygius ssp. americanus*	Moor Rush				S3	37	97.3 ± 0.0	NS
P	*Coeloglossum viride*	Long-bracted Frog Orchid				S3	1	56.6 ± 0.0	NS
P	*Cypripedium parviflorum*	Yellow Lady's-slipper				S3	54	20.1 ± 0.0	NS
P	*Neottia bifolia*	Southern Twayblade				S3	25	20.8 ± 0.0	NS
P	*Platanthera grandiflora*	Large Purple Fringed Orchid				S3	177	2.2 ± 0.0	NS
P	*Platanthera hookeri*	Hooker's Orchid				S3	27	45.1 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Dichanthelium linearifolium*	Narrow-leaved Panic Grass				S3	4	20.3 ± 0.0	NS
P	*Piptatheropsis canadensis*	Canada Ricegrass				S3	9	37.0 ± 1.0	NS
P	*Poa glauca*	Glaucous Blue Grass				S3	2	88.0 ± 0.0	NS
P	*Stuckenia filiformis*	Thread-leaved Pondweed				S3	6	86.7 ± 0.0	PE
P	*Potamogeton praelongus*	White-stemmed Pondweed				S3	50	9.8 ± 1.0	NS
P	*Potamogeton richardsonii*	Richardson's Pondweed				S3	7	4.8 ± 7.0	NS
P	*Potamogeton zosteriformis*	Flat-stemmed Pondweed				S3	19	38.1 ± 0.0	NS
P	*Asplenium viride*	Green Spleenwort				S3	10	54.8 ± 7.0	NS
P	*Dryopteris fragrans*	Fragrant Wood Fern				S3	11	17.8 ± 7.0	NS
P	*Sceptridium dissectum*	Dissected Moonwort				S3	6	9.6 ± 5.0	NS
P	*Polypodium appalachianum*	Appalachian Polypody				S3	13	5.3 ± 0.0	NS
P	*Persicaria amphibia var. emersa*	Long-root Smartweed				S3?	4	70.5 ± 0.0	NS
P	*Spiranthes ochroleuca*	Yellow Ladies'-tresses				S3?	55	17.3 ± 0.0	NS
P	*Diphasiastrum x sabinifolium*	Savin-leaved Ground-cedar				S3?	10	12.0 ± 0.0	NS
P	*Bidens vulgata*	Tall Beggarticks				S3S4	5	30.2 ± 0.0	NS
P	*Erigeron hyssopifolius*	Hyssop-leaved Fleabane				S3S4	41	48.2 ± 0.0	NS
P	*Hieracium paniculatum*	Panicled Hawkweed				S3S4	7	2.2 ± 0.0	NS
P	*Bidens beckii*	Water Beggarticks				S3S4	14	30.2 ± 0.0	NS
P	*Packera paupercula*	Balsam Groundsel				S3S4	81	19.5 ± 0.0	NS
P	*Atriplex glabriuscula var. franktonii*	Frankton's Saltbush				S3S4	4	27.4 ± 2.0	NS
P	*Vaccinium boreale*	Northern Blueberry				S3S4	7	86.4 ± 0.0	NS
P	*Vaccinium cespitosum*	Dwarf Bilberry				S3S4	55	19.3 ± 0.0	NS
P	*Fagus grandifolia*	American Beech				S3S4	547	1.0 ± 0.0	NS
P	*Bartonia virginica*	Yellow Bartonia				S3S4	1	83.0 ± 7.0	NS
P	*Proserpinaca pectinata*	Comb-leaved Mermaidweed				S3S4	2	40.0 ± 1.0	NS
P	*Decodon verticillatus*	Swamp Loosestrife				S3S4	1	93.4 ± 0.0	PE
P	*Nuphar microphylla*	Small Yellow Pond-lily				S3S4	4	19.5 ± 2.0	NS
P	*Persicaria pensylvanica*	Pennsylvania Smartweed				S3S4	23	19.7 ± 0.0	NS
P	*Fallopia scandens*	Climbing False Buckwheat				S3S4	46	19.4 ± 0.0	NS
P	*Rumex pallidus*	Seabeach Dock				S3S4	2	84.6 ± 0.0	NS
P	*Pyrola asarifolia*	Pink Pyrola				S3S4	15	16.1 ± 0.0	NS
P	*Endotropis alnifolia*	alder-leaved buckthorn				S3S4	476	36.2 ± 0.0	NS
P	*Amelanchier spicata*	Running Serviceberry				S3S4	14	17.8 ± 2.0	NS
P	*Crataegus succulenta*	Fleshy Hawthorn				S3S4	5	82.9 ± 5.0	PE
P	*Fragaria vesca ssp. americana*	Woodland Strawberry				S3S4	67	16.3 ± 1.0	NS
P	*Fragaria vesca*	Woodland Strawberry				S3S4	3	57.6 ± 0.0	NS
P	*Galium aparine*	Common Bedstraw				S3S4	20	32.0 ± 0.0	NS
P	*Geocaulon lividum*	Northern Comandra				S3S4	16	28.6 ± 0.0	NS
P	*Limosella australis*	Southern Mudwort				S3S4	39	51.1 ± 0.0	NS
P	*Ulmus americana*	White Elm				S3S4	119	11.3 ± 1.0	NS
P	*Verbena hastata*	Blue Vervain				S3S4	257	10.0 ± 0.0	NS
P	*Viola sagittata var. ovata*	Arrow-Leaved Violet				S3S4	5	72.5 ± 1.0	PE
P	*Viola selkirkii*	Great-Spurred Violet				S3S4	5	56.6 ± 0.0	NS
P	*Symplocarpus foetidus*	Eastern Skunk Cabbage				S3S4	136	67.6 ± 0.0	NS
P	*Carex argyrantha*	Silvery-flowered Sedge				S3S4	1	64.1 ± 5.0	PE
P	*Triglochin gaspensis*	Gasp ├⌐ Arrowgrass				S3S4	23	88.8 ± 0.0	NS
P	*Juncus acuminatus*	Sharp-Fruit Rush				S3S4	3	70.2 ± 2.0	NS
P	*Juncus subcaudatus*	Woods-Rush				S3S4	19	27.7 ± 5.0	NS
P	*Luzula parviflora ssp. melanocarpa*	Black-fruited Woodrush				S3S4	5	61.5 ± 0.0	NS
P	*Goodyera repens*	Lesser Rattlesnake-plantain				S3S4	11	49.0 ± 1.0	PE
P	*Liparis loeselii*	Loesel's Twayblade				S3S4	27	42.4 ± 1.0	NS
P	*Platanthera obtusata*	Blunt-leaved Orchid				S3S4	6	57.3 ± 1.0	NS
P	*Platanthera orbiculata*	Small Round-leaved Orchid				S3S4	38	4.5 ± 0.0	NS
P	*Alopecurus aequalis*	Short-awned Foxtail				S3S4	26	25.2 ± 1.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Dichanthelium clandestinum*	Deer-tongue Panic Grass				S3S4	181	61.3 ± 5.0	NS
P	*Panicum philadelphicum*	Philadelphia Panicgrass				S3S4	13	46.7 ± 0.0	NS
P	*Koeleria spicata*	Narrow False Oats				S3S4	10	19.4 ± 0.0	NS
P	*Equisetum pratense*	Meadow Horsetail				S3S4	12	22.0 ± 0.0	NS
P	*Diphasiastrum complanatum*	Northern Ground-cedar				S3S4	17	25.6 ± 0.0	NS
P	*Diphasiastrum sitchense*	Sitka Ground-cedar				S3S4	4	23.4 ± 5.0	NS
P	*Huperzia appressa*	Mountain Firmoss				S3S4	9	22.2 ± 5.0	NS
P	*Sceptridium multifidum*	Leathery Moonwort				S3S4	16	26.1 ± 0.0	NS
P	*Botrychium matricariifolium*	Daisy-leaved Moonwort				S3S4	12	7.2 ± 10.0	NS
P	*Viola canadensis*	Canada Violet				SH	1	24.8 ± 7.0	NS

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The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

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445	Paquet, Julie. 2019. Atlantic Canada Shorebird Survey ACSS database for 2019. Environment Canada, Canadian Wildlife Service.
427	Wildlife Division. 2021. Fraxinus nigra records assembled to define and model habitat. Nova Scotia Department of Natural Resources and Renewables.
401	SwiftWatch. 2022. Total Chimney Swift counts from roost watches for the duration of the SwiftWatch program (2011-2021). Birds Canada.
372	Blaney, C.S.; Mazerolle, D.M.; Belliveau, A.B. 2015. Atlantic Canada Conservation Data Centre Fieldwork 2015. Atlantic Canada Conservation Data Centre, # recs.
372	Parks Canada. 2021. PEI National Park Bank swallow nest records from 2010-2019. Parks Canada, 1535 records.
370	Benjamin, L.K. (compiler). 2007. Significant Habitat & Species Database. Nova Scotia Dept Natural Resources, 8439 recs.
337	Benjamin, L.K. (compiler). 2012. Significant Habitat & Species Database. Nova Scotia Dept Natural Resources, 4965 recs.
333	Blaney, C.S.; Mazerolle, D.M. 2010. Fieldwork 2010. Atlantic Canada Conservation Data Centre. Sackville NB, 15508 recs.
332	McRae, Daniel. 2023. Black Ash and other flora records on Prince Edward Island. MacPhail Woods Ecological Forestry Project, 443 records.
329	Wilhelm, S.I. et al. 2011. Colonial Waterbird Database. Canadian Wildlife Service, Sackville, 2698 sites, 9718 recs (8192 obs).
317	Blaney, C.S.; Mazerolle, D.M. 2012. Fieldwork 2012. Atlantic Canada Conservation Data Centre, 13,278 recs.
301	Neily, T.H. & Pepper, C.; Toms, B. 2013. Nova Scotia lichen location database. Mersey Tobeatic Research Institute, 1301 records.
268	Blaney, C.S; Korol, J.B.; Crowell, I. 2023. 2022 AC CDC Botany program field data. Atlantic Canada Conservation Data Centre, 5293 records.
253	Hicks, Andrew. 2009. Coastal Waterfowl Surveys Database, 2000-08. Canadian Wildlife Service, Sackville, 46488 recs (11149 non-zero).
244	Blaney, C.S & Spicer, C.D.; Popma, T.M.; Basquill, S.P. 2003. Vascular Plant Surveys of Northumberland Strait Rivers & Amherst Area Peatlands. Nova Scotia Museum Research Grant, 501 recs.
244	eBird. 2014. eBird Basic Dataset. Version: EBD_relNov-2014. Ithaca, New York. Nov 2014. Cornell Lab of Ornithology, 25036 recs.
227	Newell, R.E. 2000. E.C. Smith Herbarium Database. Acadia University, Wolfville NS, 7139 recs.
226	Neily, T.H. 2017. Nova Scotia lichen records. Mersey Tobeatic Research Institute.
198	Scott, F.W. 2002. Nova Scotia Herpetofauna Atlas Database. Acadia University, Wolfville NS, 8856 recs.
195	Brunelle, P.-M. (compiler). 2009. ADIP/MDDS Odonata Database: data to 2006 inclusive. Atlantic Dragonfly Inventory Program (ADIP), 24200 recs.

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187	Chapman-Lam, C.J. 2022. Atlantic Canada Conservation Data Centre 2021 botanical fieldwork. Atlantic Canada Conservation Data Centre, 15099 recs.
185	Newell, R.E. 2005. E.C. Smith Digital Herbarium. E.C. Smith Herbarium, Irving Biodiversity Collection, Acadia University, Web site: http://luxor.acadiau.ca/library/Herbarium/project/. 582 recs.
174	Island Nature Trust. 2016. Farmland birds project. Mader, Shannon (ed.) .
170	Bryson, I. 2013. Nova Scotia rare plant records. CBCL Ltd., 180 records.
168	Bryson, I.C. 2020. Nova Scotia flora and lichen observations 2020. Nova Scotia Environment, 139 recs.
166	Blaney, C.S.; Mazerolle, D.M.; Hill, N.M. 2011. Nova Scotia Crown Share Land Legacy Trust Fieldwork. Atlantic Canada Conservation Data Centre, 5022 recs.
165	Klymko, J. 2018. Maritimes Butterfly Atlas database. Atlantic Canada Conservation Data Centre.
159	MacDonald, E.C. 2018. Piping Plover nest records from 2010-2017. Canadian Wildlife Service.
156	Blaney, C.S. & Mazerolle, D.M. 2011. Field data from NCC properties at Musquash Harbour NB & Goose Lake NS. Atlantic Canada Conservation Data Centre, 1739 recs.
156	Chapman, C.J. 2018. Atlantic Canada Conservation Data Centre botanical fieldwork 2018. Atlantic Canada Conservation Data Centre, 11171 recs.
156	Gallop, John. 2023. Species at Risk and Species of Conservation Interest records. McCallum Environmental.
151	Pronych, G. & Wilson, A. 1993. Atlas of Rare Vascular Plants in Nova Scotia. Nova Scotia Museum, Halifax NS, I:1-168, II:169-331. 1446 recs.
144	Churchill, J.L. 2022. Atlantic Canada Conservation Data Centre Fieldwork 2022. Atlantic Canada Conservation Data Centre.
144	Mazerolle, D.M. 2018. Atlantic Canada Conservation Data Centre botanical fieldwork 2018. Atlantic Canada Conservation Data Centre, 13515 recs.
137	Burke, Lindsey. 2022. Species data recorded during the 2021 season at Prince Edward Island National Park. Parks Canada.
136	MacDonald, E.C. 2018. CWS Piping Plover Census, 2010-2017. Canadian Wildlife Service, 672 recs.
133	Pepper, C. 2013. 2013 rare bird and plant observations in Nova Scotia. , 181 records.
127	MacDonald, Haley. 2022. Updates to Fraxinus nigra observations on NCC Docherty's Brook property. Nature Conservancy of Canada.
124	Catling, P.M., Erskine, D.S. & MacLaren, R.B. 1985. The Plants of Prince Edward Island with new records, nomenclatural changes & corrections & deletions, 1st Ed. Research Branch, Agriculture Canada, Ottawa, Publication 1798. 22pp.
121	LaPaix, R.W.; Crowell, M.J.; MacDonald, M. 2011. Stantec rare plant records, 2010-11. Stantec Consulting, 334 recs.
116	Pepper, C. 2021. Rare bird, plant and mammal observations in Nova Scotia, 2017-2021.
116	Tranquilla, L. 2015. Maritimes Marsh Monitoring Project 2015 data. Bird Studies Canada, Sackville NB, 5062 recs.
114	Richardson, Leif. 2018. Maritimes Bombus records from various sources. Richardson, Leif.
113	Amirault, D.L. & McKnight, J. 2003. Piping Plover Database 1991-2003. Canadian Wildlife Service, Sackville, unpublished data. 7 recs.
110	Blaney, C.S. 2000. Fieldwork 2000. Atlantic Canada Conservation Data Centre. Sackville NB, 1265 recs.
109	Hagerman, Christianne. 2022. Wisqoq and Eastern White Cedar field work. E.C. Smith Herbarium, Acadia University.
106	Toms, B. 2018. Bat Species data from www.batconservation.ca for Nova Scotia. Mersey Tobeatic Research Institute, 547 Records.
105	Klymko, J.J.D. 2012. Insect fieldwork & submissions, 2011. Atlantic Canada Conservation Data Centre. Sackville NB, 760 recs.
102	Belliveau, A.G. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
97	Cameron, R.P. 2009. Cyanolichen database. Nova Scotia Environment & Labour, 1724 recs.
95	Neily, T.H. & Pepper, C. 2020. Nova Scotia SMP lichen surveys 2020. Mersey Tobeatic Research Institute.
88	Chapman-Lam, C.J. 2021. Atlantic Canada Conservation Data Centre 2020 botanical fieldwork. Atlantic Canada Conservation Data Centre, 17309 recs.
87	Blaney, C.S. 2020. Sean Blaney 2020 field data. Atlantic Canada Conservation Data Centre, 4407 records.
87	McNeil, J.A. 2018. Wood Turtle records, 2018. Mersey Tobeatic Research Institute, 68 recs.
85	Burns, L. 2013. Personal communication concerning bat occurrence on PEI. Winter 2013. Pers. comm.
83	Blaney, C.S.; Mazerolle, D.M.; Belliveau, A.B. 2013. Atlantic Canada Conservation Data Centre Fieldwork 2013. Atlantic Canada Conservation Data Centre, 9000+ recs.
80	Nature Conservancy of Canada. 2022. NCC Field data for Nova Scotia. Nature Conservancy of Canada.
79	Canadian Wildlife Service, Dartmouth. 2010. Piping Plover censuses 2007-09, 304 recs.
77	Cameron, R.P. 2011. Lichen observations, 2011. Nova Scotia Environment & Labour, 731 recs.
71	Munro, Marian K. Nova Scotia Provincial Museum of Natural History Herbarium Database. Nova Scotia Provincial Museum of Natural History, Halifax, Nova Scotia. 2013.
71	Neily, T.H. & Pepper, C.; Toms, B. 2020. Nova Scotia lichen database [as of 2020-03-18]. Mersey Tobeatic Research Institute.
69	Staicer, C. & Bliss, S.; Achenbach, L. 2017. Occurrences of tracked breeding birds in forested wetlands. , 303 records.
66	Blaney, C.S.; Mazerolle, D.M.; Oberndorfer, E. 2007. Fieldwork 2007. Atlantic Canada Conservation Data Centre. Sackville NB, 13770 recs.
64	Blaney, C.S.; Mazerolle, D.M. 2008. Fieldwork 2008. Atlantic Canada Conservation Data Centre. Sackville NB, 13343 recs.
62	Manthorne, A. 2014. MaritimesSwiftwatch Project database 2013-2014. Bird Studies Canada, Sackville NB, 326 recs.
61	Cameron, R.P. 2009. Erioderma pedicellatum database, 1979-2008. Dept Environment & Labour, 103 recs.
60	Mazerolle, D.M. 2017. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
59	Roland, A.E. & Smith, E.C. 1969. The Flora of Nova Scotia, 1st Ed. Nova Scotia Museum, Halifax, 743pp.
58	Blaney, C.S. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre, 6719 recs.
58	Munro, Marian K. Tracked lichen specimens, Nova Scotia Provincial Museum of Natural History Herbarium. Atlantic Canada Conservation Data Centre. 2019.
57	Blaney, C.S.; Spicer, C.D. 2001. Fieldwork 2001. Atlantic Canada Conservation Data Centre. Sackville NB, 981 recs.
57	Glen, W. 1991. 1991 Prince Edward Island Forest Biomass Inventory Data. PEI Dept of Energy and Forestry, 10059 recs.
57	Toms, Brad & Pepper, Chris; Neily, Tom. 2022. Nova Scotia lichen database [as of 2022-04]. Mersey Tobeatic Research Institute.
56	Patrick, Allison. 2021. Animal and plant records from NCC properties from 2019 and 2020. Nature Conservancy Canada.
55	Zinck, M. & Roland, A.E. 1998. Roland's Flora of Nova Scotia. Nova Scotia Museum, 3rd ed., rev. M. Zinck; 2 Vol., 1297 pp.
54	iNaturalist. 2018. iNaturalist Data Export 2018. iNaturalist.org and iNaturalist.ca, Web site: 11700 recs.
53	Blaney, C.S.; Spicer, C.D.; Popma, T.M.; Hanel, C. 2002. Fieldwork 2002. Atlantic Canada Conservation Data Centre. Sackville NB, 2252 recs.
52	Klymko, John. 2022. Atlantic Canada Conservation Data Centre zoological fieldwork 2021. Atlantic Canada Conservation Data Centre.

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49	Nussey, Pat & NCC staff. 2019. AEI tracked species records, 2016-2019. Chapman, C.J. (ed.) Atlantic Canada Conservation Data Centre, 333.
48	Belliveau, A.G. 2020. E.C. Smith Herbarium and Atlantic Canada Conservation Data Centre Fieldwork 2019, 2020. E.C. Smith Herbarium.
48	LaPaix, R.W.; Crowell, M.J.; MacDonald, M.; Neily, T.D.; Quinn, G. 2017. Stantec Nova Scotia rare plant records, 2012-2016. Stantec Consulting.
47	Churchill, J.L. 2020. Atlantic Canada Conservation Data Centre Fieldwork 2020. Atlantic Canada Conservation Data Centre, 1083 recs.
43	Benjamin, L.K. 2012. NSDNR fieldwork & consultant reports 2008-2012. Nova Scotia Dept Natural Resources, 196 recs.
43	Neily, T.H. & Pepper, C.; Toms, B. 2015. Nova Scotia lichen location database [as of 2015-02-15]. Mersey Tobeatic Research Institute, 1691 records.
43	Staicer, C. 2021. Additional compiled Nova Scotia Species at Risk bird records, 2005-2020. Dalhousie University.
43	Staicer, Cindy. 2023. 2022 SAR Bird field occurrences from the Landbirds at Risk Project, NS. Dalhousie University, 446 records.
42	Hall, R.A. 2003. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 189 recs.
41	Blaney, C.S.; Mazerolle, D.M.; Klymko, J; Spicer, C.D. 2006. Fieldwork 2006. Atlantic Canada Conservation Data Centre. Sackville NB, 8399 recs.
41	eBird. 2021. eBird Basic Dataset. Version: EBD_relOct-2020. Ithaca, New York. Oct 2020, Prince Edward Island Bird SAR subset. Cornell Lab of Ornithology.
41	Erskine, D. 1960. The plants of Prince Edward Island, 1st Ed. Research Branch, Agriculture Canada, Ottawa., Publication 1088. 1238 recs.
41	Hall, R.A. 2001. S.. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 178 recs.
41	Nova Scotia Nature Trust. 2013. Nova Scotia Nature Trust 2013 Species records. Nova Scotia Nature Trust, 95 recs.
39	Curley, F.R. 2005. PEF&W Collection 2003-04. PEI Fish & Wildlife Div., 716 recs.
39	Staicer, Cindy. 2022. 2021 Landbird Species at Risk observations. Dalhousie University.
38	iNaturalist. 2020. iNaturalist butterfly records selected for the Maritimes Butterfly Atlas. iNaturalist.
38	Porter, C.J.M. 2014. Field work data 2007-2014. Nova Scotia Nature Trust, 96 recs.
37	Belland, R.J. Maritimes moss records from various herbarium databases. 2014.
37	Blaney, C.S. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre. Sackville NB, 1042 recs.
37	Layberry, R.A. & Hall, P.W., LaFontaine, J.D. 1998. The Butterflies of Canada. University of Toronto Press. 280 pp+plates.
37	Pulsifer, M.D. 2002. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 369 recs.
36	Rock, J. 2020. Atlantic Canada Piping Plover field surveys: Nesting pairs by beach, 2018-2020. Environment and Climate Change Canada - Canadian Wildlife Service, 216 records.
35	Arsenault, M. 2019. Cormorant colony nest counts. PE Department of Communities, Land, and Environment.
35	Benjamin, L.K. (compiler). 2001. Significant Habitat & Species Database. Nova Scotia Dept of Natural Resources, 15 spp, 224 recs.
34	Chapman, C.J. 2019. Atlantic Canada Conservation Data Centre 2019 botanical fieldwork. Atlantic Canada Conservation Data Centre, 11729 recs.
33	Blaney, C.S. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2018. Atlantic Canada Conservation Data Centre.
33	Porter, Caitlin et al. 2022. 2021 wildlife observaitions from the Caemmerer NCC site. Atlantic Canada Conservation Data Centre.
32	Belliveau, A.G. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre, 10695 recs.
31	PEI National Park. 2019. SAR and Bombus records from PEI NP from the 2019 field season. Moody, Allison (ed.) PEI National Park, 158 recs.
31	Tims, J. & Craig, N. 1995. Environmentally Significant Areas in New Brunswick (NBESA). NB Dept of Environment & Nature Trust of New Brunswick Inc, 6042 recs. https://doi.org/10.1037/arc0000014.
30	Ayles, P. 2006. Prince Edward Island National Park Digital Database. Parks Canada, 179 recs.
30	Belliveau, A.G. 2021. E.C. Smith Herbarium and Atlantic Canada Conservation Data Centre Fieldwork 2021. E.C. Smith Herbarium.
29	Parks Canada. 2021. PEI National Park 2020 Species at Risk records. Parks Canada, 40 records.
29	Sollows, M.C,. 2008. NBM Science Collections databases: mammals. New Brunswick Museum, Saint John NB, download Jan. 2008, 4983 recs.
28	Neily, T.H. 2010. Erioderma Pedicellatum records 2005-09. Mersey Tobiatic Research Institute, 67 recs.
27	Sharkie, R., MacQuarrie, K., Fraser, M. 2003. A Floral Inventory of the Western Section of Prince Edward Island National Park and adjacent Crown lands. Parks Canada Agency, v + 106 pp.
26	Popma, T.M. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre. Sackville NB, 113 recs.
25	Blaney, C.S.; Spicer, C.D.; Mazerolle, D.M. 2005. Fieldwork 2005. Atlantic Canada Conservation Data Centre. Sackville NB, 2333 recs.
25	e-Butterfly. 2016. Export of Maritimes records and photos. Maxim Larrivee, Sambo Zhang (ed.) e-butterfly.org.
25	Pepper, Chris. 2012. Observations of breeding Canada Warbler's along the Eastern Shore, NS. Pers. comm. to S. Blaney, Jan. 20, 28 recs.
24	Hirtle, Sarah. 2023. 2022 Bank Swallow occurrence data. Island Nature Trust.
24	Neily, T.H. 2019. Tom Neily NS Bryophyte records (2009-2013). T.H. Neily, Atlantic Canada Conservation Data Centre, 1029 specimen records.
23	Blaney, C.S.; Spicer, C.D.; Rothfels, C. 2004. Fieldwork 2004. Atlantic Canada Conservation Data Centre. Sackville NB, 1343 recs.
22	Anderson, Frances; Neily, Tom. 2010. A Reconnaissance Level Survey of Calciphilous Lichens in Selected Karst Topography in Nova Scotia with Notes on Incidental Bryophytes. Mersey Tobeatic Research Institute.
22	Archibald, D.R. 2003. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 213 recs.
22	Birds Canada. 2022. Maritimes Swiftwatch project data for 2022. Pers. comm., 155 records.
22	Cameron, R.P. 2018. Degelia plumbea records. Nova Scotia Environment.
22	Powell, B.C. 1967. Female sexual cycles of Chrysemy spicta & Clemmys insculpta in Nova Scotia. Can. Field-Nat., 81:134-139. 26 recs.
22	Staicer, Cindy. 2023. 2022 SAR Bird ARU occurrences. Dalhousie University, 379 records.
21	Chapman, C.N. (Cody). 2020. Nova Scotia Black Ash (Fraxinus nigra) field observations by Confederacy of Mainland Mi'kmaq. Forestry Program, Confederacy of Mainland Mi'kmaq.
21	Churchill, J.L., Klymko, J.D.D. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre.
21	Grandtner, M.M. 1971. Ecological Study of the Interior Dunes of West Brackley Beach, Prince Edward Island National Park. Parks Canada, 1: 70. 41 recs.
20	LaPaix, Rich. 2022. Rare species observations, 2018-2022. Nova Scotia Nature Trust.
20	Munro, Marian K. Nova Scotia Provincial Museum of Natural History Herbarium Database. Nova Scotia Provincial Museum of Natural History, Halifax, Nova Scotia. 2014.
20	Ogden, J. NS DNR Butterfly Collection Dataset. Nova Scotia Department of Natural Resources. 2014.
19	Brazner, J. 2016. Nova Scotia Forested Wetland Bird Surveys. Nova Scotia Department of Lands and Forestry.
19	Cameron, R.P. 2013. 2013 rare species field data. Nova Scotia Department of Environment, 71 recs.
19	Haughian, Sean. 2021. Update to lichen data from 2017-2021. Nova Scotia Museum.

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19	Klymko, J.J.D.; Robinson, S.L. 2012. 2012 field data. Atlantic Canada Conservation Data Centre, 447 recs.
19	NS DNR. 2017. Black Ash records from NS DNR Permanent Sample Plots (PSPs), 1965-2016. NS Dept of Natural Resources.
19	Westwood, A., Staicer, C. 2016. Nova Scotia landbird Species at Risk observations. Dalhousie University.
18	Cameron, R.P. 2014. 2013-14 rare species field data. Nova Scotia Department of Environment, 35 recs.
18	Neily, T.H. 2012. 2012 Erioderma pedicellatum records in Nova Scotia.
17	Belliveau, A. 2013. Rare species records from Nova Scotia. Mersey Tobeatic Research Institute, 296 records. 296 recs.
17	Gilhen, J. 1984. Amphibians & Reptiles of Nova Scotia, 1st Ed. Nova Scotia Museum, 164pp.
17	Klymko, J. 2021. Atlantic Canada Conservation Data Centre zoological fieldwork 2020. Atlantic Canada Conservation Data Centre.
17	McMullin, R.T. 2022. Maritimes lichen records. Canadian Museum of Nature.
17	NatureServe Canada. 2019. iNaturalist Maritimes Butterfly Records. iNaturalist.org and iNaturalist.ca.
16	Adams, J. & Herman, T.B. 1998. Thesis, Unpublished map of C. insculpta sightings. Acadia University, Wolfville NS, 88 recs.
16	Belliveau, A.G. 2014. Plant Records from Southern and Central Nova Scotia. Atlantic Canada Conservation Data Centre, 919 recs.
16	Ferguson, D.C. 1954. The Lepidoptera of Nova Scotia. Part I, macrolepidoptera. Proceedings of the Nova Scotian Institute of Science, 23(3), 161-375.
16	McNeil, J.A. 2016. Blandings Turtle (Emydoidea blandingii), Eastern Ribbonsnake (Thamnophis sauritus), Wood Turtle (Glyptemys insculpta), and Snapping Turtle (Chelydra serpentina) sightings, 2016. Mersey Tobeatic Research Institute, 774 records.
15	Chaput, G. 2002. Atlantic Salmon: Maritime Provinces Overview for 2001. Dept of Fisheries & Oceans, Atlantic Region, Science Stock Status Report D3-14. 39 recs.
15	McMullin, R.T. 2015. Prince Edward Island's lichen biodiversity and proposed conservation status in a report prepared for the province of PEI. Biodiversity Institute of Ontario Herbarium, University of Guelph, 776 records.
15	McNeil, Jeffie. 2023. 2022 Turtle Records. Mersey Tobeatic Research Institute.
15	Richardson, D., Anderson, F., Cameron, R, McMullin, T., Clayden, S. 2014. Field Work Report on Black Foam Lichen (Anzia colpodes). COSEWIC.
15	Spicer, C.D. & Harries, H. 2001. Mount Allison Herbarium Specimens. Mount Allison University, 128 recs.
14	Belliveau, A.G. 2018. E.C. Smith Herbarium and Atlantic Canada Conservation Data Centre Fieldwork 2018. E.C. Smith Herbarium, 6226 recs.
14	Benjamin, L.K. 2011. NSDNR fieldwork & consultant reports 1997, 2009-10. Nova Scotia Dept Natural Resources, 85 recs.
14	Churchill, J.L. 2019. Atlantic Canada Conservation Data Centre Fieldwork 2019. Atlantic Canada Conservation Data Centre.
14	Phinney, Lori; Toms, Brad; et. al. 2016. Bank Swallows (Riparia riparia) in Nova Scotia: inventory and assessment of colonies. Merset Tobeiatc Research Institute, 25 recs.
14	Taylor, B.R., and Tam, J.C. 2012. Local distribution of the rare plant Triosteum aurantiacum in northeastern Nova Scotia, Canada. Rhodora, 114(960): 366-382.
14	Toms, Brad. 2022. Non-Lichen Observations from Lichen SMP and NCC Property Searches. Mersey Tobeatic Research Institute.
13	Basquill, S.P. 2012. 2012 rare vascular plant field data. Nova Scotia Department of Natural Resources, 37 recs.
13	Klymko, John. 2023. Atlantic Canada Conservation Data Centre zoological fieldwork 2022. Atlantic Canada Conservation Data Centre.
13	McRae, Daniel. 2023. PEI EcoGiftsSite Records for 2022. Pers. comm., 990 records.
13	Robinson, S.L. 2015. 2014 field data.
13	Stewart, J.I. 2010. Peregrine Falcon Surveys in New Brunswick, 2002-09. Canadian Wildlife Service, Sackville, 58 recs.
13	Wilhelm, S.I. et al. 2019. Colonial Waterbird Database. Canadian Wildlife Service.
12	Bryson, I. 2020. Nova Scotia and Newfoundland rare species observations, 2018-2020. Nova Scotia Environment.
12	Doucet, D.A. 2009. Census of Globally Rare, Endemic Butterflies of Nova Scotia Gulf of St Lawrence Salt Marshes. Nova Scotia Dept of Natural Resources, Species at Risk, 155 recs.
12	Spicer, C.D. 2002. Fieldwork 2002. Atlantic Canada Conservation Data Centre. Sackville NB, 211 recs.
11	Bateman, M.C. 2001. Coastal Waterfowl Surveys Database, 1965-2001. Canadian Wildlife Service, Sackville, 667 recs.
11	Downes, C. 1998-2000. Breeding Bird Survey Data. Canadian Wildlife Service, Ottawa, 111 recs.
11	Neily, T. H. 2018. Lichen and Bryophyte records, AEI 2017-2018. Tom Neily; Atlantic Canada Conservation Data Centre.
11	Oldham, M.J. 2000. Oldham database records from Maritime provinces. Oldham, M.J; ONHIC, 487 recs.
11	Plissner, J.H. & Haig, S.M. 1997. 1996 International piping plover census. US Geological Survey, Corvallis OR, 231 pp.
11	White, S. 2018. Notable species sightings, 2016-2017. East Coast Aquatics.
10	Canadian Wildlife Service, Atlantic Region. 2010. Piping Plover censuses 2006-09. , 35 recs.
10	Churchill, J.L.; Walker, J. 2017. Species at Risk Surveys at Correctional Services Canada Properties in Nova Scotia and New Brunswick. Atlantic Canada Conservation Data Centre.
10	Goltz, J.P. & Bishop, G. 2005. Confidential supplement to Status Report on Prototype Quillwort (Isoetes prototypus). Committee on the Status of Endangered Wildlife in Canada, 111 recs.
10	Klymko, J.J.D. 2016. 2015 field data. Atlantic Canada Conservation Data Centre.
10	Mersey Tobetic Research Institute. 2021. 2020 Monarch records from the MTRI monitoring program. Mersey Tobetic Research Institute, 72 records.
10	Zahavich, J. 2018. Canada Warbler and Olive-sided Flycatcher records 2018. Island Nature Trust, 14 recs.
10	Zahavich, J.L. 2020. Canada Warbler, Olive-sided Flycatcher and Eastern Wood-Pewee observations, Prince Edward Island, 2017-2019. Island Nature Trust.
9	Blacquiere, Hailey. 2022. Black Ash locations in August 2022. PEI Forests Fish and Wildlife Division. Pers. comm., 9 records.
9	Blaney, C.S. 2019. Sean Blaney 2019 field data. Atlantic Canada Conservation Data Centre, 4407 records.
9	Blaney, C.S.; Mazerolle, D.M. 2011. Fieldwork 2011. Atlantic Canada Conservation Data Centre. Sackville NB.
9	Cameron, R.P. 2005. Erioderma pedicellatum unpublished data. NS Dept of Environment, 9 recs.
9	Cameron, R.P. 2006. Erioderma pedicellatum 2006 field data. NS Dept of Environment, 9 recs.
9	Cameron, R.P. 2017. 2017 rare species field data. Nova Scotia Environment, 64 recs.
9	Churchill, J.L.; Klymko, J.D. 2015. Chignecto and Tintamarre National Wildlife Area Bird Surveys 2015. Atlantic Canada Conservation Data Centre, 2238 recs.
9	Klymko, J. Dataset of butterfly records at the New Brunswick Museum not yet accessioned by the museum. Atlantic Canada Conservation Data Centre. 2016.
9	Klymko, J.J.D.; Robinson, S.L. 2014. 2013 field data. Atlantic Canada Conservation Data Centre.
9	O'Neil, S. 1998. Atlantic Salmon: Northumberland Strait Nova Scotia part of SFA 18. Dept of Fisheries & Oceans, Atlantic Region, Science. Stock Status Report D3-08. 9 recs.

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9	Webster, R.P. Atlantic Forestry Centre Insect Collection, Maritimes butterfly records. Natural Resources Canada. 2014.
8	Cameron-MacMillan, Maureen. 2020. Northern Goshawk Nests in Eastern Nova Scotia, as of November, 2020. Nova Scotia Department of Lands and Forestry.
8	Cameron, R.P. 2012. Rob Cameron 2012 vascular plant data. NS Department of Environment, 30 recs.
8	Curley, F.R. 2007. PEF&W Collection. PEI Fish & Wildlife Div., 199 recs.
8	e-Butterfly. 2019. Export of Maritimes records and photos. McFarland, K. (ed.) e-butterfly.org.
8	Hubley, Nicole. 2022. Monarch (Danaus plexippus) records submitted to MTRI from the 2021 field season. Mersey Tobeatic Research Institute.
8	Hughes, Cory. 2020. Atlantic Forestry Centre Coccinella transversoguttata collections. Canadian Forest Service, Atlantic Forestry Centre.
8	Manthorne, A. 2019. Incidental aerial insectivore observations. Birds Canada.
8	Nature Conservancy Canada, Prince Edward Island. 2022. NCC PEI 2022 occurrence data. NCC PEI. Pers. comm., 214 records.
8	Porter, Caitlin. 2021. Field data for 2020 in various locations across the Maritimes. Atlantic Canada Conservation Data Centre, 3977 records.
7	Basquill, S.P. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre, Sackville NB, 69 recs.
7	Belland, R.J. 2012. PEI moss records from Devonian Botanical Garden. DBG Cryptogam Database, Web site: https://secure.devonian.ualberta.ca/bryo_search.php 748 recs.
7	Benjamin, L.K. 2009. Boreal Felt Lichen, Mountain Avens, Orchid and other recent records. Nova Scotia Dept Natural Resources, 105 recs.
7	Blaney, C.S.; Mazerolle, D.M. 2009. Fieldwork 2009. Atlantic Canada Conservation Data Centre. Sackville NB, 13395 recs.
7	Cameron, B. 2006. Hepatica americana Survey at Scotia Mine Site in Gays River, and Discovery of Three Yellow-listed Species. Conestoga-Rovers and Associates, (a consulting firm), october 25. 7 recs.
7	Harding, R.W. 2008. Harding Personal Insect Collection 1999-2007. R.W. Harding, 309 recs.
7	Hill, N.M. 1994. Status report on the Long's bulrush Scirpus longii in Canada. Committee on the Status of Endangered Wildlife in Canada, 7 recs.
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APPENDIX F
PRIORITY SPECIES LIST

Scientific Name	Common Name	SRank	COSEWIC	*SARA*	*ESA*	Habitat Description
VASCULAR PLANTS						
Acer saccharinum	Silver Maple	S1				Generally found near flowing water and in wetlands. In Nova Scotia, it has been found along the Cornwallis River, Kings Co. (Munro, Newell & Hill, 2014).
Agalinis maritima var. maritima	Saltmarsh Agalinis	S2				High salt marshes often within stands of Spartina alterniflora and Spartina patens. Generally, occurring where the Spartina spp. are thin, and some soils are exposed. Flowers spring - summer (New York Flora Atlas, 2021)
Agalinis purpurea	Purple False-Foxglove	S2S3				Bogs, calcareous and mafic fens, open floodplain swamps, depression ponds, interdune swales, tidal freshwater marshes and swamps; more numerous in a variety of wet to mesic, open, disturbed habitats, including old fields, clearings, and roadsides. Flowers in late summer to early fall (Digital Atlas of Virginia Forest, nd).
Agalinis purpurea var. parviflora	Small-flowered Purple False Foxglove	S2S3				Sandy soils of stream and lake margins, bogs, and barren (NatureServe, 2021)
Agalinis tenuifolia	Slender Agalinis	S1				Anthropogenic (man-made or disturbed habitats), brackish or salt marshes and flats, fresh tidal marshes or flats, meadows and fields, woodlands https://gobotany.nativeplanttrust.org/species/agalinis/tenuifolia/; Exotic to Nova Scotia, http://www.accdc.com/webranks/NSall.htm.
Ageratina altissima	White Snakeroot	S1S2				Grows in moist soils at the edge of fields and forests. Flowers in late summer, August and September. Known from Mill Brook, McGahey Brook and a brook near Refugee Cove, all in Cape Chignecto Provincial Park; older collection from Antigonish County. (Munro, Newell and Hill, 2014)
Ageratina altissima var. altissima	White Snakeroot	S1S2				Grows in moist soils at the edge of fields and forests. Flowers in late summer, August and September. Known from Mill Brook, McGahey Brook and a brook near Refugee Cove, all in Cape Chignecto Provincial Park; older collection from Antigonish County. (Munro, Newell and Hill, 2014)
Allium schoenoprasum	Wild Chives	S1?				Wet meadows, rocky or gravelly stream banks and lake shores. Flowering June to August (Flora North America).
Allium schoenoprasum var. sibiricum	Wild Chives	S1?				Wet meadows, rocky or gravelly stream banks and lake shores. Flowering June to August (Flora North America).
Amelanchier fernaldii	Fernald's Serviceberry	S2S3				Thickets, open barrens, shores, and ravines. Occurs mostly in calcareous areas. Grows in riparian and shrub wetlands (Nature Serve Explorer, nd). Flowers June - August (Munro, Newell & Hill, 2014).
Amelanchier spicata	Running Serviceberry	S3S4				Man-made or disturbed habitats, cliffs, balds, ledges, forest edges, grassland, meadows and fields, woodlands (GoBotany, nd). Flowers in the spring (NC State Extension, nd)
Angelica atropurpurea	Purple-stemmed Angelica	S3				Grows in swamps, meadows, in ditches and along streams. Flowers from late May until September. Very abundant in northern Cape Breton (Munro, Newell & Hill, 2014)
Atriplex glabriuscula var. franktonii	Frankton's Saltbush	S3S4				confined to indigenous salt marsh and beach habitats. t is very common in northern areas, such as the Northumberland Strait region and along Cape Breton's northern coasts. Occasionally seen elsewhere as near Truro and Halifax.
Barbarea orthoceras	American Yellow Rocket	S1				It inhabits ice-scoured river shores on high-pH bedrock or till, and on wet talus in the subalpine zone.
Bartonia virginica	Yellow Bartonia	S3S4				Flowers July to September. Dry barrens, sandy or peaty soils, bogs, lakeshores. Common in the southwestern counties becoming scarcer east to Annapolis and Halifax; St. Peter's area of Cape Breton.
Betula minor	Dwarf White Birch	S1				Favors alpine or subalpine zones, mountain summits and plateaus. Flowers in June to July (GoBotany, nd).
Bidens beckii	Water Beggarticks	S3S4				Found in shallows of sluggish streams and ponds. Flowers during August and September. Scattered throughout but more abundant from Pictou northward. (Munro, Newell and Hill, 2014).

Scientific Name	Common Name	SRank	COSEWIC	*SARA*	*ESA*	Habitat Description
Bidens hyperborea	Estuary Beggarticks	S2S3				Its habitat is limited to estuarine conditions. Flowers in August. Reported from River Philip and known from Antigonish and Inverness counties (Munro, Newell and Hill, 2014).
Bolboschoenus robustus	Sturdy Bulrush	S1?				An estuarine species. Collected on the northern side from Annapolis and Cumberland counties to Cape Breton. Flowering and fruiting July - October (Munro, Newell & Hill 2014)
Botrychium lanceolatum	Triangle Moonwort	S2S3				Kentville Ravine (Kings County); Colchester, Cumberland and a few sites in western Cape Breton. Rare when found and of limited distribution in the Northern counties. Found where there are fertile soils on wooded hillsides. Bogs, fens, forests, meadows, fields, swamps and edges of wetlands. This species releases its spores later than most moonworts (July to August) (Minnesota Environment and Natural Resources Trust Fund, Go Botany and Munro et al., 2014).
Botrychium lanceolatum ssp. angustisegmentum	Narrow Triangle Moonwort	S2S3				Kentville Ravine (Kings County); Colchester, Cumberland and a few sites in western Cape Breton. Rare where found and of limited distribution in the Northern counties. Found where there are fertile soils on wooded hillsides. Bogs, fens, forests, meadows, fields, swamps and edges of wetlands. This species releases its spores later than most moonworts (July to August) (Minnesota Environment and Natural Resources Trust Fund, Go Botany and Munro et al., 2014).
Botrychium lunaria	Common Moonwort	S1				Known from Conrad's Beach, Halifax County and from New Campbellton and Indian Brook in northern Cape Breton. Found on open slopes, sand or gravel; shores and meadows. Basic soils. Anthropogenic habitats (man-made or disturbed habitats), fields and edges of wetlands. Spores are produced throughout the summer (Go Botany and Munro et al., 2014).
Botrychium lunaria var. lunaria	Moonwort Grapefern	S1				Known from Conrad's Beach, Halifax County and from New Campbellton and Indian Brook in northern Cape Breton. Found on open slopes, sand or gravel, shores and meadows. Basic soils. Anthropogenic habitats (man-made or disturbed habitats), fields and edges of wetlands. Spores are produced throughout the summer (Go Botany and Munro et al., 2014).
Botrychium simplex	Least Moonwort	S2S3				Scattered locations from Yarmouth County to Cape Breton: Cedar Lake (Digby- Yarmouth border), West Berlin (Queens County), Petpeswick and in Antigonish, Victoria and Inverness Counties. Reported from various habitats, usually involving damp or mossy streambanks or lakeshores. Also, anthropogenic habitats (man-made or disturbed habitats), meadows and fields. Subspecies: occurs primarily in open sites, including prairies, wetlands, and abandoned mine sites. Spores produced in late May and June (Minnesota DNR, Go Botany and Munro et al., 2014).
Botrychium simplex var. simplex	Least Moonwort	S2S3				Scattered locations from Yarmouth County to Cape Breton: Cedar Lake (Digby- Yarmouth border), West Berlin (Queens County), Petpeswick and in Antigonish, Victoria and Inverness Counties. Reported from various habitats, usually involving damp or mossy streambanks or lakeshores. Also, anthropogenic habitats (man-made or disturbed habitats), meadows and fields. Subspecies: occurs primarily in open sites, including prairies, wetlands, and abandoned mine sites. Spores produced in late May and June (Minnesota DNR, Go Botany and Munro et al., 2014).
Bromus latiglumis	Broad-Glumed Brome	S2				Floodplain (River or stream floodplains), forest, shores of rivers or lakes (Go Botany)
Cardamine dentata	Toothed Bittercress	S1				Rare species of calcareous swamps and fens
Carex grisea	Inflated Narrow-leaved Sedge	S1				Floodplain forest and deciduous woods (Munro, Newell & Hill, 2014)
Carex normalis	a Sedge	S1				Open, often wet, woods, thickets, meadows and roadsides. Fruiting early summer (Flora of North America, nd)
Carex vacillans	Estuarine Sedge	S1S3				Saline, brackish shores, swales, salt and intertidal marshes. Fruiting in June to August (Flora of North America).
Carex viridula ssp. brachyrrhyncha	Greenish Sedge	S1				Found along river and lake shores (Go Botany).
Carex viridula var. elatior	Greenish Sedge	S1				Moist to wet fens and runnels, on lime-rich soils. Fruiting in July-August (Flora North America).
Carex viridula var. saxilittoralis	Greenish Sedge	S1				Moist to wet, exposed shores and limestone barrens. Fruiting July-August (Flora North America).

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Caulophyllum thalictroides	Blue Cohosh	S2S3				Shade-tolerant, restricted to river floodplain deciduous forests. Appears in April, until beginning of June. A wide and patchy distribution over the northern portion of the province from Annapolis River to River Denys in Cape Breton (Munro, Newell & Hill, 2014).
Ceratophyllum echinatum	Prickly Hornwort	S3				Marshes. A plant more typical of the shallows of acidic water bodies than its congener.
Coleataenia longifolia	Long-leaved Panicgrass	S3S4				Marshes, meadows and fields, shores of rivers or lakes (GO Botany).
Coleataenia longifolia ssp. longifolia	Coastal Plain Panicgrass	S3S4				Marshes, meadows and fields, shores of rivers or lakes (GO Botany).
Conioselinum chinense	Chinese Hemlock-parsley	S3				Found in treed swamps, mossy coniferous forest, seepy coastal slopes. Flowers from August to October. Common on Saint Paul Island and infrequent elsewhere (Munro, Newell & Hill, 2014).
Crataegus submollis	Quebec Hawthorn	S2?				Anthropogenic (man-made or disturbed habitats), forest edges, meadows and fields, shrublands or thickets. Flowers in June (GoBotany, nd).
Crataegus succulenta	Fleshy Hawthorn	S3S4				Forest edges, forests, meadows and fields. Also found in abandoned farmland, along streams and in forest openings. Flowers in late spring (Natural Resources Canada, nd).
Crataegus succulenta var. succulenta	Fleshy Hawthorn	S3S4				Forest edges, forests, meadows and fields. Also found in abandoned farmland, along streams and in forest openings. Flowers in late spring (Natural Resources Canada, nd).
Cuscuta cephalanthi	Buttonbush Dodder	S2?				Flowers during August and September. Low-lying coastal areas, often seen parsitizing Symphyotrichum novi- belgii. Anthropogenic (man-made or disturbed habitats), meadows and fields, shores of rivers or lakes, swamps
Cyperus lupulinus ssp. macilentus	Hop Flatsedge	S1				Various well-drained, open places. Fruiting summer (Flora North America).
Cypripedium parviflorum var. makasin	Small Yellow Lady's-Slipper	S2				Mesic to wet fens, prairies, meadows, thickets, open coniferous, and mixed forest. Flowering in May to August (Flora of North America).
Elatine americana	American Waterwort	S1				Brackish or salt marshes and flats, lacustrine (in lakes or ponds), riverine (in rivers or streams), shores of rivers or lakes
Eleocharis erythropoda	Red-stemmed Spikerush	S1				Non-calcareous or calcareous fresh or brackish shores. Fruiting occurs in the summer (Flora North America).
Eleocharis flavescens	Pale Spikerush	S3				Bogs, brackish or salt marshes and flats, floodplain (river or stream floodplains), marshes, shores of rivers or lakes, wetland margins (edges of wetlands) (Go Botany).
Eleocharis flavescens var. olivacea	Bright green Spikerush	S3				Bogs, cold springs, dry stream banks, lake and pond margins, maritime mud flats, marshes, moist meadows, swamps. Fruiting summer-winter (June-November) (Flora North America).
Epilobium lactiflorum	White-flowered Willowherb	S1?				Alpine or subalpine zones, cliffs, balds or ledges, shores of rivers or lakes (GoBotany, nd).
Epilobium strictum	Downy Willowherb	S3				Scattered through throughout Cape Breton Island, infrequently elsewhere - Found in bogs and other peatlands - Flowers July to September (Munro, Newell & Hill, 2014)
Equisetum pratense	Meadow Horsetail	S3S4				Known to be in several streams in Hants, Colchester and Cumberland counties, in addition to Victoria and Inverness Counties. Uncommon and limited to alluvial thickets, pastures and treed stream sides, including gravelly bars. Flowers mid to late spring (Minnesota Environment and Natural Resources Trust Fund and Munro et al., 2014).
Fallopia scandens	Climbing False Buckwheat	S3S4				Uncommon and local, from Digby to Richmond counties on the northern side of the province - Grows on low ground in riparian zones - Flowers mid-August to October (Munro, Newell & Hill, 2014)
Festuca prolifera var. prolifera	Proliferous Fescue	S1S2				Proliferous fescue is a rare alpine species found only in Maine and New Hampshire, where it forms mats on cliffs, seeps and in ravines https://gobotany.nativeplanttrust.org/species/festuca/prolifera/.
Fimbristylis autumnalis	Slender Fimbry	S1				Moist to wet sands, peats, slits, or clays primarily of disturbed, sunny ground such as seeps, ditches, savanna, stream banks, reservoir drawdowns, and pond shores (Flora of North America)

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Fraxinus nigra	Black Ash	S1S2	Threatened	No Status	Threatened	Black ash is typically found in poorly drained areas that are often seasonally flooded. It is most common on peat and muck soils, but also grows on fine sands over sands and loams. Although this species can tolerate still semi-stagnant conditions, there is a preference for swampy woodland streams and riverbanks with moving water. It is often associated with species such as Red maple, Speckled alder, Balsam poplar, and Black spruce. The species is shade intolerant, and seedlings, saplings and sprouts tend to regenerate only in partially opened forest canopies.
Fraxinus pennsylvanica	Red Ash	S1				Flowers May - June. Found in riparian and upland forest and shelter belts (Minnesota Wildflowers, nd)
Gentianella amarella ssp. acuta	Northern Gentian	S1				Open and forested riverbanks, subalpine gullies and brook sides, occurring in regions of high-pH bedrock and/or till.
Goodyera repens	Lesser Rattlesnake-plantain	S3S4				Shady, moist, coniferous or mixed woods, on mossy or humus-covered ground. Sometimes it is found in bogs or cedar swamps. Flowering early July-early September (Flora North America).
Humulus lupulus var. lupuloides	Common Hop	S1?				Anthropogenic (man-made or disturbed habitats), floodplain (river or stream floodplains), forests, shrublands or thickets
Huperzia selago	Northern Firmoss	S1?				Limited to the northern half of the province, as far west as Brier Island, Digby County. Many localities clustered about the Bay of Fundy, inland to the south-facing slopes of the Cobequids and along the slopes of northern Cape Breton. Grows in rock crevices along streams and moist ravines. Anthropogenic habitats (man-made or disturbed habitats), cliffs, balds, or ledges, forests, meadows and fields, shores of rivers or lakes. Flowers from summer to early fall (Minnesota Environment and Natural Resources Trust Fund, Go Botany and Munro et al., 2014).
Hylodesmum glutinosum	Large Tick-trefoil	S2				Anthropogenic (man-made or disturbed habitats), cliffs, balds, or ledges, forest edges, forests, ridges or ledges, talus and rocky slopes. Flowers June to August
Hypericum x dissimulatum	Disguised St. John's-wort	S2S3				Wet mucky soils in lacustrine habitats. Historically collected from Digby to Halifax Co. with a single specimen from each of Pictou and Guysborough counties (Munro, Newell & Hill, 2014).
Juncus alpinoarticulatus	Northern Green Rush	S2				Fen, fresh tidal marshes or flats, marshes, meadows and fields, shores of rivers or lakes. Fruiting mid-summer to fall (Go Botany).
Juncus anthelatus	Greater Poverty Rush	S1?				Exposed or partially shaded sites in moist or seasonally wet sandy or clay soils. Flowering and fruiting in spring (Flora North America).
Juncus caesariensis	New Jersey Rush	S3	Special Concern	Special Concern	Vulnerable	New Jersey Rush is reported from 16 bogs and fens on the coastal plain of southeastern Cape Breton Island, Nova Scotia. These sites ranged from the Gracieville/Point Michaud area in the south, northeastwards along the coast to Fourchu Bay, approximately 50 km. Populations also occurred as much as 20 km inland (vicinity of Loch Lomond). The frequent association of this species with animals and lightly used all-terrain-vehicle trails on the edges of bogs and fens suggests a possible dependence on some level of disturbance for the maintenance of open habitat. These disturbances would reduce competition from other species. Seasonal flooding of New Jersey Rush habitats would also prevent the establishment of many species including shrubs.
Juncus stygius ssp. americanus	Moor Rush	S3				Wet moss, bogs and bog-pools. Flowering and fruiting in mid to late summer.
Liparis loeselii	Loesel's Twayblade	S3S4				Cool, moist ravines, bogs, or fens, wet peaty or sandy meadows, and exposed sand along edges of lakes, often colonizing previously open and disturbed habitats during early and middle stages of reforestation. Flowering May-August (Go Botany).
Lorinseria areolata	Netted Chain Fern	S3S4				Bogs, meadows and fields, swamps, wetland margins (edges of wetlands) (Go Botany).
Luzula parviflora ssp. melanocarpa	Black-fruited Woodrush	S3S4				uncommon in damp coniferous or mixed woods, cool ravines and banks (Hinds, 2000)
Malaxis monophyllos	White Adder's-mouth	S1				Found in Fens, ridges or ledges, swamps with northern white-cedar. Flowering in summer (GoBotany).
Malaxis monophyllos var. brachypoda	North American White Adder's-mouth	S1				Found in swamps and bogs. Flower in summer (Flora of North America).

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Nabalus racemosus	Glaucous Rattlesnakeroot	S1				Favors calcareous riverbanks, shores and damp prairies (Maine Department of Agriculture, Conservation & Forestry, nd).
Neottia bifolia	Southern Twayblade	S3				Bogs and swamps (Go Botany)
Nuphar microphylla	Small Yellow Pond-lily	S3S4				Ponds, lakes, sluggish streams, sloughs, ditches and occasionally tidal waters. Flowers summer - early fall (Flora of North America, nd)
Ophioglossum pusillum	Northern Adder's-tongue	S2S3				Known from Yarmouth and Digby Counties; scattered east to Halifax and Amherst; a single Cape Breton record from George River. Found in sterile soils, swamps and sandy or cobbly lakeshores. Anthropogenic habitats (man-made or disturbed habitats), marshes, meadows, fields and edges of wetland margins. Spores produced May to August (Go Botany and Munro et al., 2014).
Osmorhiza longistylis	Smooth Sweet Cicely	S2S3				Intervale soils where fertility is high, deciduous forests. Flowers Late June to July. Scattered along the North Mountain in Annapolis and Kings counties to Cumberland Cobequids, infrequent in Cape Breton (Munro, Newell and Hill, 2014)
Oxybasis rubra	Red Goosefoot	S2S3				Moist, disturbed soils such pond and lake shores, river and creek banks, and mud flats. Flowers July to September
Oxybasis rubra var. rubra	Red Goosefoot	S2S3				In New York, Red Pigweed has been found along the coast in wet interdunal swales, stony beaches, and the shores of coastal ponds, as well as amongst ship ballast and waste places (New York Natural Heritage Program 2010). Salt marshes (Clemants 1992). Salt marshes and brackish soil (Gleason and Cronquist 1991). Waste ground, shores, and riverbanks (Voss 1985).
Packera paupercula	Balsam Groundsel	S3S4				Confined to calcareous or gypsum soils, on cliffs, talus and outcrops. Flowers in July. Abundant where found but local to Hants Co. north to northern Inverness Co. (Munro, Newell & Hill, 2014).
Packera paupercula var. paupercula	Balsam Groundsel	S3S4				Confined to calcareous or gypsum soils, on cliffs, talus and outcrops. Flowers in July. Abundant where found but local to Hants Co. north to northern Inverness Co. (Munro, Newell & Hill, 2014).
Panicum dichotomiflorum ssp. puritanorum	Spreading Panicgrass	S1?				Flowering and fruiting from June through October
Parnassia parviflora	Small-flowered Grass-of-Parnassus	S1S2				Rocky seeps. Flowers August to September (Jepson Herbarium, 2021)
Persicaria amphibia var. emersa	Long-root Smartweed	S3?				Bloom on moist soil and are terrestrial adapted. Flower June - September (Flora of North America)
Persicaria arifolia	Halberd-leaved Tearthumb	S3				Found inf shaded swamps, ponds, tidal marshes along rivers, wet ravines in forests. Flowers July - October (Flora of North America, nd)
Persicaria careyi	Carey's Smartweed	S1				Low thickets, swamps, bogs, moist shorelines, clearings, recent burns, cultivated ground. Flowering July - October (Flora of North America, nd)
Persicaria pensylvanica	Pennsylvania Smartweed	S3S4				Moist, disturbed places, ditches, riverbanks, cultivated fields, shorelines of ponds and reservoirs. Flowers May - December (Flora of North America, nd)
Pilea pumila	Dwarf Clearweed	S3				Usually grows in cool shady habitats as found on forested slopes of maple-beech, in the centre of the Province. Flowers from July - October. So far only known from West Branch, Pictou Co.; Little River, near Brookfield, Halifax Co.; and along the Herbert River, Hants Co. at Woodville.
Platanthera flava var. herbiola	Pale Green Orchid	S2				Known from a variety of habitats: sandy, gravelly or peaty shorelines of lakes or streams; bogs, swamps and meadows. Found along the Tusket River, Yarmouth Co., Medway River, Queens County and north to Kings and Colchester Co. (Kemptown) (Munro, Newell & Hill, 2014).
Platanthera huronensis	Fragrant Green Orchid	S1S2				No good record found. Habitat are known from streamsides, in wetlands, even forests. Flowers throughout the summer (Munro, et al., 2014).
Platanthera obtusata	Blunt-leaved Orchid	S3S4				Fens, Forests, Meadows field and swamps

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Podostemum ceratophyllum	Horn-leaved Riverweed	S1				Medium to fast flowing river bottoms with ledge, cobble or sand substrate (GoBotany, nd)
Polygonum achoreum	Leathery Knotweed	S1				Reported from Annapolis Royal and Annapolis River area but no extant collections - Typical plant of halophytic communities: salt marshes and beaches - Flowers from July to September (Munro, Newell & Hill, 2014)
Polygonum aviculare ssp. buxiforme	Box Knotweed	S2S3				Roadsides, vacant lots, sidewalks, packed and non-drifting sands, borders of marshes and dunes. Flowering July - December (Flora of North America, nd)
Polygonum aviculare ssp. neglectum	Narrow-leaved Knotweed	S3?				Found in disturbed areas. Flowers June - November (Flora of North America, nd)
Polygonum oxyspermum	Sharp-fruit Knotweed	S2S3				Collected from Shelburne and Queens counties, east to Strait of Canso; Bras d'Or Lakes to northern Cape Breton - Found in damp sands and gravels on the coast - Terminally deciduous ocreae with prominent persistent veins; smooth achenes without tubercles (Munro, Newell & Hill, 2014)
Polygonum oxyspermum ssp. raii	Ray's Knotweed	S2S3				Collected from Shelburne and Queens counties, east to Strait of Canso; Bras d'Or Lakes to northern Cape Breton - Found in damp sands and gravels on the coast - Ocreae are scarcely veined and nearly all deciduous; the achenes are roughened and sometimes tubercled (Munro, Newell & Hill, 2014)
Potamogeton polygonifolius	oblong-leaved pondweed	S1				Occurs in almost any wet or semi-wet oligotrophic and/or acidic habitat so long as flow is not too rapid. It may be found in lakes, slow-flowing rivers, ponds, ditches, seeps and among bog mosses (Wikipedia).
Ranunculus pensylvanicus	Pennsylvania Buttercup	S1				Found in wet fields, ditches, marshes, along shores. Flowers June - August (Minnesota Wildflowers, nd)
Ranunculus sceleratus	Cursed Buttercup	S2				Anthropogenic (man-made or disturbed habitats), fresh tidal marshes or flats, marshes, swamps (GoBotany, n.d.). Flowers May - September (Minnesota Wildflowers, nd)
Ranunculus sceleratus var. sceleratus	Cursed Buttercup	S1S2				Ponds, riverbanks. Flowers from April - June, October (Jepson Herbarium, 2021)
Rhinanthus minor ssp. groenlandicus	Little Yellow Rattle	S1				Grows on disturbed, compacted soils as on roadsides, abandoned fields and the like. Flowers from mid-June through July (Munro, Newell & Hill, 2014)
Rudbeckia laciniata	Cut-Leaved Coneflower	S2				Grows in wet fertile soils along the edge of swamps, swales or streams. Often colonial. Flowers in August. Common in Kings Co., isolated colonies from Annapolis and Cumberland counties to Guysborough (Munro, Newell & Hill, 2014).
Rumex persicarioides	Peach-leaved Dock	S2?				Infrequently found around the coast from Amherst and Advocate to Queens county, Abundant on Sable Island; scattered in western Cape Breton Island - Found in open, organic coastal microsites, particularly of saltmarshes and barrachois - Flowers from July to October (Munro, Newell & Hill, 2014)
Rumex triangulivalvis	Triangular-valve Dock	S2S3				Grows in moist areas and disturbed habitats, meadows and fields (GoBotany, nd)
Sagina nodosa	Knotted Pearlwort	S3				Flowers from July to September. Coastal cliffs, sand flats and dune slopes. Cliffs, balds, or ledges, coastal beaches (sea beaches), meadows and fields, ridges or ledges Scattered from Annapolis to Guysborough counties. Nova Scotia Plants by Munro, Newell & Hill (2014).
Salix myrtillifolia	Blueberry Willow	S1				Reed bogs, fens, stream banks, subalpine spruce thickets, Pinus contorta woods, sand dunes, coal spoils. Flowers early May - late July (Flora of North America, nd)
Salix pedicellaris	Bog Willow	S3				Grows in acidic substrate as in bogs; nutrient-rich marshes and in sphagnous lacustrine habitats. Flowers from May - July. Queens County, occasionally seen along Sharpe Brook in Kings County. Collections from South Branch, Stewiacke River, Colchester Co., Black River fen, Inverness Co. and several Queens Co. localities are recent. (Munro, Newell & Hill, 2014)
Salix serissima	Autumn Willow	S1				Fens, meadows and fields, swamps (GoBotany, nd). Also found in brackish marshy strands, marly lakeshores, treed bogs, gravelly stream banks, lakeshores. Flowers from early June to early July (Flora of North America, nd).
Samolus parviflorus	Seaside Brookweed	S3				Prefers wet places, shallow water, often on tidal shores. It can also be found in brackish or salt marshes and flats, fresh tidal marshes or flats, riverine (in rivers or streams), swamps (GoBotany, nd; Newell, L. 1977)

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Sceptridium dissectum	Dissected Moonwort	S3				Frequently in the southwestern counties and scattered eastward to Cape Breton. Not abundant but often seen. Generally, in sandy, gravelly, grassy or open soils. Spores from September to November (Munro et al., 2014).
Senecio pseudoarnica	Seabeach Ragwort	S3				Found only on gravelly seashores. Flowers from late July to August. Scattered along the entire Atlantic coast (Munro, Newell & Hill, 2014).
Solidago rugosa var. sphagnophila	Cedar-swamp Goldenrod	S1S3				Frequently waste soils, forests and fallow fields. Flowers bloom late in August through September. Common throughout the province (Munro, Newell & Hill, 2014).
Sparganium androcladum	Branching Bur-Reed	S1				Found in lakes, ponds, rivers or streams or the shore of rivers or lakes (Go Botany).
Symphyotrichum boreale	Boreal Aster	S3				Favors lacustrine gravels, streamsides and edges of peatlands. Flowers during August and September. Scattered from Yarmouth to Cape Breton uncommon (Munro, Newell & Hill, 2014).
Thalictrum confine	Northern Meadow-rue	S1				Alluvial or shingly calcareous shores and talus. Flowers June - July (Flora of North America, nd)
Thuja occidentalis	Eastern White Cedar	S2S3				Found in riparian areas along streams, in swamps, along lakeshores, in woodland forests and in old pastures. It is shade- tolerant and typically occurs in cool, moist habitats that are nutrient rich. It does best in moderate drainage conditions that are neither too wet nor dry. Eastern White Cedar is typically observed in cool, moist shaded areas.
Toxicodendron vernix	Poison Sumac	S1				Usually found in swamps or marshes. Flowers from May to July. Only known in Telfer Lake and Apple Tree Lake in Queens county (Munro, Newell & Hill, 2014)
Triglochin gaspensis	Gaspé Arrowgrass	S3S4				Tidal saltwater marshes usually submerged daily. Flowering summer (July-August) (Flora North America).
Triosteum aurantiacum var. aurantiacum	Orange-fruited Tinker's Weed	S3				Dry-mesic to mesic forests, woodlands, and forest borders
Utricularia ochroleuca	Yellowish-white Bladderwort	S1				Shallow (generally <30cm) acidic waters. Flowers June - September (Jepson Herbarium, 2021)
Verbena hastata	Blue Vervain	S3S4				Limited to mucky fertile soils, as along floodplains. Flowers during August - September (Munro, Newell & Hill, 2014)
Veronica catenata	Pink Water-Speedwell	S1				Shores of rivers or lakes, wetland margins (edges of wetlands) (GoBotany, nd). Flowers May - September (Minnesota Wildflowers, nd)
Viola nephrophylla	Northern Bog Violet	S3				Cool, mossy sites: bogs, streamsides and wet woods. Flowers May - July (Munro, Newell & Hill, 2014)
Zizia aurea	Golden Alexanders	S2				Found in meadows, shores, thickets and wooded swamps. Flowers May and June. Occasionally reported in: Pomquet and South River, Antigonish County, Upper Musquodoboit, Halifax County (Munro, Newell and Hill, 2014).
LICHENS						
Anzia colpodes	Black-foam Lichen	S3	Threatened	Threatened	Threatened	Anzia colpodes require mature deciduous tree habitats with high humidity and high light levels. The required humidity is supplied by wetlands, nearby brooks, lakes or by the host's position on upland slopes above a water body. Host tree trunks are usually free of dense undergrowth and the lichen usually occurs at or above the height of the undergrowth (in swamps and fens). A few of the Anzia collections from are reported to be from the canopy of Red Maple trees. Recent searches have found that A. colpodes occurs from 20 cm above the ground to 2 m up the tree trunks.
Erioderma pedicellatum	Boreal Felt Lichen	S1	Endangered	Endangered	Endangered	The existing boreal felt lichen occurs within 25 km of the seacoast at an elevation of up to 300 m above sea level and they are found in forested habitats with low open crown closure. Boreal Felt Lichens are typically found in balsam fir stands on north- facing trunks of mature and overmature trees. Habitat preference for boreal felt lichen is cool and moist and remains relatively constant throughout the year. They are often located on or at the base of slopes with northern or northeastern exposure.

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Pectenia plumbea	Blue Felt Lichen	S3	Special Concern	Special Concern	Vulnerable	The Blue Felt Lichen is usually found on the trunks of old broad-leaved trees growing in moist habitats or close to streams and lake margins. This lichen occurs in coastal suboceanic areas but also some distance inland in damp valleys. It prefers cool, humid woodlands that may be mixed coniferous/hardwood or dominated by deciduous trees. The Blue Felt Lichen seems to prefer mature deciduous trees, particularly maple, ash and yellow birch. At its northerly limit of distribution in Nova Scotia, the Blue Felt Lichen has once been found on moss-covered rocks.
Peltigera hydrothyria	Eastern Waterfan	S1	Threatened	Threatened	Threatened	Eastern Waterfan grows attached to rocks at or below water level in clear, cool, partially shaded streams. Small waterfalls, exposed boulders and sinuous stream configurations create quiet or protected backwaters where the lichen grows outside the main current. In summer, this lichen is often partially or completely exposed during low water flow periods. Partial shade may be needed to help keep humidity high and temperatures low during summer months.
Sclerophora peronella (Atlantic pop.)	Frosted Glass-whiskers (Atlantic population)	S3S4	Special Concern	Special Concern		Collections from Nova Scotia were on exposed heartwood of living red maple trees growing in old-growth hardwood stands. Frosted Glass-whiskers grow on old deciduous trees, usually on the exposed heartwood of living trunks and more rarely on bark, in humid and rather shaded situations. This arboreal lichen is often associated with old-growth forests in coastal regions, but it is also found in open forests, in clearings, and on the margins of old deciduous forests (COSEWIC Assessment and Status Report).
MAMMALS						
Alces alces	Moose	S1			Endangered	Moose are herbivores who live in boreal and mixed-wood forests. They are often found where there is an abundance of food (twigs, stems, and foliage of young deciduous trees and shrubs). In spring, islands and peninsulas are often used by cows when giving birth. In summer, access to wetlands (and aquatic vegetation) is important.
Lasionycteris noctivagans	Silver-haired Bat	S1M, SUB				Most are found in boreal or coniferous and deciduous forests near bodies of water. Summer day roosts are typically under loose bark in trees such as willows, maple, ash and dead trees. Maternity colonies can be found in cavities in these trees. Uncommonly, they use human structures (garages, sheds, etc). During the winter, these bats have been found in caves and other rocky areas that provide shelter, in tree cavities, and in buildings.
Lasiurus borealis	Eastern Red Bat	S1M, SUB				Lives in forests, forest edges, and hedgerows. It roosts among foliage, usually in deciduous trees, but sometimes roosts in coniferous trees. Rare in heavily urbanized areas.
Lasiurus cinereus	Hoary Bat	S1M, SUB				They prefer deciduous and coniferous trees at the edge of clearings, but have been found in trees in heavy forests, open wooded glades, and shade trees along urban streets and in city parks.
Myotis septentrionalis	Northern Myotis	S1	Endangered	Endangered	Endangered	Northern Myotis may hibernate in cooler sections of a cave. Northern Myotis will generally return to the same hibernaculum, but not always in consecutive years. Northern Myotis roost singly or in small groups and favour tree roosts (under raised bark and in tree cavities and crevices), but they can also be found in anthropogenic structures (e.g., under shingles). Northern Myotis' maternity roosts are strongly associated with forest cover, streams, and tree characteristics (e.g., species, height, diameter, age, and decay). Females prefer to roost in tall, large diameter trees in early- to mid-stages of decay. Maternity colonies in Nova Scotia were generally in larger-than-average trees. Males generally roost alone under raised bark or within cavities of trees in mid-stages of decay.
Pekania pennanti	Fisher	S3				They are often found in deciduous and mixedwood forest stands in the forested region. They can also be found in wetland vegetation types including shrubby swamps, shrubby bogs, and marshes. There is a higher likelihood to find them in harvested stands compared to naturally regenerating stands of similar age.
Perimyotis subflavus	Tricolored Bat	S1	Endangered	Endangered	Endangered	Tri-colored Bat often select the deepest part of caves or mines where temperature is the least variable, have strong humidity level preferences, and use warmer walls than other species. They have been recorded within any one hibernaculum, possibly because they tend to hibernate solitarily (i.e., not in clusters) in the deepest sections of the caves/mines. Tri-colored Bats exhibit high fidelity to hibernacula. Roosts provide thermal regulation, shelter from weather and predation, and can be sites for social interaction. Individuals may switch roosts regularly and therefore, may use a network of roosts in a roosting area. The tendency to switch roosts may depend on species, sex, age, reproductive status, and roost type.
Sorex maritimensis	Maritime Shrew	S3				Often found in marshes and wet meadows The most favoured habitat is the edges of freshwater swamps and marshes which have become overgrown with tangled grass and rushes.

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Sorex palustris	American Water Shrew	S3S4				Mostly aquatic, the water shrew lives beneath the overhanging banks and in rock crevices along the edges of swiftly flowing mountain streams. Rhododendron and yellow birch are usually the dominant vegetation in these areas.
Synaptomys cooperi	Southern Bog Lemming	S3				They are often found in sphagnum bogs and low moist places, but they are also found in grasslands, mixed deciduous/coniferous forests, spruce-fir forests, freshwater wetlands, marshes, and meadows. They prefer areas with a thick mat of herbaceous and shrubby vegetation.
AVIFAUNA						
Accipiter cooperii	Cooper's Hawk	S1?B,SUN,SUM				Not common in Nova Scotia but does breed in the province. Found in mature forest, open woodlands, wood edges and river groves. Nests in coniferous, deciduous and mixed woods, typically those with tall trees and with openings or edge habitat nearby. Also found among trees along rivers through open country, and increasingly in suburbs and cities where tall trees exist for nesting (e.g. parks, open fields and even backyards with feeders). Breeds between April and July (Audubon and The Cornell Lab)
Accipiter gentilis	Northern Goshawk	S3S4				Found in coniferous and mixed forests. Generally restricted to wooded areas (along riparian corridors) but may be in relatively open woods or along edges. Often more common as a breeding bird in mixed woods (e.g. mature and old-growth forests with more than 60% closed canopy). In the East, goshawks seek out nest sites in mixed-hardwood forests where beeches, birch, hemlock and maples dominate. Goshawks often build nests near breaks in the canopy, such as a forest trail, road or opening created by a downed tree and prefer sites with a creek, pond or lake nearby. Breeds between April and July. May mate for life (Audubon and The Cornell Lab).
Actitis macularius	Spotted Sandpiper	S3S4B,S5M				Common near fresh and saltwater. Habitat includes pebbly lake shores, ponds and streamsides (and seashores in the winter). Spotted Sandpipers spend the winter along the coasts of North America. During migration and winter, this species is found along the coast on mudflats, beaches and breakwaters (also found in inland habitats such as sewage ponds and irrigation ditches). Breeds near the edge of fresh water in a wide variety of settings, including lakes, ponds, rivers and streams (in either open or wooded country). Breeding territories generally need to have a shoreline, a semi-open area for the nest and patches of dense vegetation to conceal the chicks. Breeds between April and July (Audubon and The Cornell Lab).
Aegolius funereus	Boreal Owl	S2?B,SUM				Year-round resident, mainly in Cape Breton (MBBA, as of July 2021). Does not migrate regularly but is nomadic and moves outside of range when prey is scarce. Boreal Owls occur in stands of spruce, aspen, poplar, birch and fir in the boreal forest (muskeg, mixed-wood and conifer forests). They also occur in high elevation mountains with subalpine forests in Canada. In the winter, they forage in spruce-fir forests where encrusted snow under the trees facilitates access to prey. In spring, they often forage in clearcuts and agricultural fields where small mammals are easier to locate. Beginning in late winter or early spring, male sings at night to defend territory and attract a female (Audubon and The Cornell Lab).
Ammospiza nelsoni	Nelson's Sparrow	S3S4B				They spend most of their time on or near the ground in dense marsh vegetation. Nelson's Sparrow breed mainly in fresh and saltwater marshes in the northern Great Plains and along the northern Atlantic Coast. Breeds between April and July (Audubon and The Cornell Lab)
Anas acuta	Northern Pintail	S1B,SUM				Found in marshes, prairies, fresh ponds, lakes and salt bays. Summers in wide variety of open habitats, including prairies, farmland, northern tundra and near bodies of water. Breeds in seasonal wetlands, open areas with short vegetation, wet meadows, grasslands and crop fields. During the nonbreeding season they use flooded and dry agricultural fields, lakes, reservoirs, estuaries, salt marshes, freshwater and brackish wetlands and bays. Pintails also use different habitats depending on time of day (e.g. tend to forage in wetlands during the day). Breeds between April and July (Audubon and The Cornell Lab)
Antrostomus vociferus	Eastern Whip-Poor-Will	S1?B	Threatened	Threatened	Threatened	Roughly 50% of home ranges consisted of open habitats, used primarily for foraging. Common habitat choices include rock or sand barrens with scattered trees, savannahs, old burns or other disturbed sites in a state of early to mid-forest succession, or open conifer plantations. Accordingly, pine (barrens and plantations), oak (barrens and savannahs), and aspen and birch (early to mid-succession) are common tree species associations. Individuals will often feed in nearby shrubby pastures or wetlands where perches, and powerline and roadway corridors are also occupied. Other necessary habitat elements are thought to involve ground-level vegetation and woodland size. Areas with little ground cover are preferred.

Scientific Name	Common Name	SRank	COSEWIC	*SARA*	*ESA*	Habitat Description
Asio flammeus	Short-eared Owl	S1B	Threatened	Special Concern		Short-eared Owls breed primarily in well-drained grasslands near coastal wetlands. In areas with extensive coastlines, some caution is warranted in summarizing breeding habitat as inland marshes and bogs are less frequently monitored and thus may be under-represented in assessments of breeding habitat (COSEWIC Assessment and Status Report).
Asio otus	Long-eared Owl	S2S3				Known to breed throughout Nova Scotia. They occur at elevations ranging from near sea level to above 6,500 feet. May be nomadic at times, moving about in response to changing food supplies. Favored habitat includes dense trees for nesting and roosting and open country (e.g. grasslands and shrublands) for hunting. Inhabits a wide variety of such settings, including forest with extensive meadows to groves of conifers or deciduous trees. Generally, avoids unbroken forest. Known to be an early breeder. Breeds between April and July (Audubon and The Cornell Lab).
Botaurus lentiginosus	American Bittern	S3S4B,S4S5M				Found in marshes and reedy lakes. Breeds in freshwater marshes, mainly large, shallow wetlands with a large amount of tall marsh vegetation (cattails, grasses and sedges) and areas of open shallow water. Sometimes feeds in dry grassy fields. They are rarely seen out in the open, prefers vegetation cover. Breeds between April and July (Audubon and The Cornell Lab)
Bucephala clangula	Common Goldeneye	S2S3B,S5N,S5M				Winters in Nova Scotia along the coast. Generally, migrates late in fall and early in spring. Males tend to winter farther north than females. Found in shallow coastal bays, estuaries that offer good foraging sites: sand, gravel, rock and boulder substrates supporting mollusks and crustaceans. In the interior, wintering flocks gather on large lakes and rivers as far north as open water occurs. Breeds between April and July (Audubon and The Cornell Lab)
Buteo lagopus	Rough-legged Hawk	S3N				Common across Nova Scotia during nonbreeding (winter). Spends the winter in open country, including grasslands, coastal prairies, marshes, farmland and dunes. In tree-covered areas they hunt over open bogs and other clearings. Breeds mostly on tundra, in areas having cliffs for nest sites; some breed along northern edge of coniferous forest zone. Rough-legged Hawks breed in the open country of the arctic, both in North America and Eurasia. Breeds between April and July. May mate for life (Audubon and The Cornell Lab).
Accipiter cooperii	Cooper's Hawk	S1?B,SUN,SUM				Not common in Nova Scotia but does breed in the province. Found in mature forest, open woodlands, wood edges and river groves. Nests in coniferous, deciduous and mixed woods, typically those with tall trees and with openings or edge habitat nearby. Also found among trees along rivers through open country, and increasingly in suburbs and cities where tall trees exist for nesting (e.g. parks, open fields and even backyards with feeders). Breeds between April and July (Audubon and The Cornell Lab)
Calidris melanotos	Pectoral Sandpiper	S3M				Common migrant in Nova Scotia. Compared to other shorebirds, migration is relatively early in spring and late in fall (adults before juveniles). During migration, they prefer wet, grassy environments such as prairie pools, muddy shores, fresh and tidal marshes. They prefer tundra in the summer. Migrants favor grassy places rather than open mudflats. Often seen along grassy edges of shores, at edges of tidal marshes, in flooded fields or wet meadows. Sometimes on dry prairie or even plowed fields. On breeding grounds, wet grassy areas of tundra dominated by grasses and sedges. Breeds between April and July (Audubon and The Cornell Lab).
Calidris pusilla	Semipalmated Sandpiper	S3M				Common migrant in Nova Scotia. Migrates in flocks (adults before juveniles). May make very long nonstop flights between major feeding areas on migration. Semipalmated Sandpipers nest in low tundra, usually not far from marshes or ponds (both dry upland habitats with sufficient vegetation cover). In preparation for migration, they gather into flocks in shallow-water mudflats or lakeshores. Migrating birds stop over at sewage ponds, ephemeral wetlands (rain pools), beaches, inlets, estuaries, tidal mudflat, sandbars and freshwater impoundments with shallow margins (edges of lakes and marshes). Breeds between April and July (Audubon and The Cornell Lab).
Cardellina canadensis	Canada Warbler	S3B	Special Concern	Threatened	Endangered	Forest undergrowth, shady thickets. Breeds in mature mixed hardwoods of extensive forests and streamside thickets. Prefers to nest in moist habitat: in luxuriant undergrowth, near swamps, on stream banks, in rhododendron thickets, in deep, rocky ravines and in moist deciduous second growth.
Cardellina pusilla	Wilson's Warbler	S3B,S5M				Found in thickets along wooded streams, moist tangles, low shrubs, willows, alders. Breeds in thickets, second-growth, bogs, or in alder and willow groves near streams and ponds. In migration and winter, occurs from hot lowland thickets up to cool mountain woods; always in scrubby overgrown clearings and thin woods, not in the interior of dense forest. Breeds between April and July (Cornell Lab, Audubon).

Scientific Name	Common Name	SRank	COSEWIC	*SARA*	*ESA*	Habitat Description
Cathartes aura	Turkey Vulture	S2S3B,S4S5M				In past was not surveyed/very rare to see Turkey Vultures in Nova Scotia, but as the climate warms, they are now sighted across the province (MBBA and Nova Scotia Bird Society). Look for Turkey Vultures as they soar high over open areas. They are particularly noticeable along roadsides and at landfills. At night, they roost in trees, on rocks and other highly secluded spots. Most common over open or semi-open country (including mixed farmland, forest, rangeland and even small offshore islands), especially within a few miles of rocky or wooded areas providing secure nesting sites. Generally, avoids densely forested regions. Breeds between April and July (Audubon and The Cornell Lab)
Chordeiles minor	Common Nighthawk	S3B	Special Concern	Special Concern	Threatened	Common Nighthawk breeds in a range of open and partially open habitats, including forest openings and post-fire habitats, prairies, bogs, and rocky or sandy natural habitats, as well as disturbed areas. It is also found in settled areas that meet its habitat needs, those with open areas for foraging and bare or short-cropped surfaces for nesting. The species use of a wide range of habitats makes it difficult to estimate trends in habitat availability, except in urban habitats, where their main nesting sites – flat graveled roofs – are disappearing.
Chroicocephalus ridibundus	Black-headed Gull	S3N				Most of this species in Nova Scotia likely comes from Iceland (followed by a sudden growth of the Icelandic nesting population in the 1930s). In winter, found primarily along seacoasts, estuaries and protected bays (generally rare on fresh waters well inland). Breeds along lakes, rivers, bogs, moors, grasslands, swamps and coastal marshes. Usually nests in colonies, sometimes in isolated pairs. Breeds in scattered colonies between April and July (Audubon and The Cornell Lab).
Coccothraustes vespertinus	Evening Grosbeak	S3B,S3N,S3M	Special Concern	Special Concern	Vulnerable	Evening Grosbeak breeding habitat generally includes open, mature mixedwood forests, where fir species and/or White Spruce are dominant, and Spruce Budworm is abundant. Outside the breeding season, the species seems to depend largely on seed crops from various trees such as firs and spruces in the boreal forest but is also attracted to ornamental trees that produce seeds or fruit, and bird feeders stocked with sunflower seeds.
Coccyzus erythropthalmus	Black-billed Cuckoo	S3B				Black-billed Cuckoos are birds of woodlands and thickets, including aspen, poplar, birch, sugar maple, hickory, hawthorn and willow. They tend to occur more frequently in larger and denser woodlands than the Yellow-billed Cuckoo. On their wintering grounds, they live in forest, woodlands and scrub. A long-distance migrant, going to South America for the winter. Migrates at night; sometimes heard calling in flight overhead at night during the spring. During migration, they seek any kind of dense vegetation cover (e.g. young trees or tall shrubs). Common breeder in Nova Scotia. Breeds mostly in deciduous thickets and shrubby places, often on the edges of woodland or around marshes. Also, in second growth of mixed deciduous- coniferous woods, or along their brushy edges. Breeds between April and July (Audubon and The Cornell Lab).
Contopus cooperi	Olive-sided Flycatcher	S3B	Special Concern	Special Concern	Threatened	Olive-sided Flycatcher has been widely observed in open coniferous or mixed coniferous forests, often located near water or wetlands with the presence of tall snags or trees from which the species sallies for prey and advertises its territory. Mature conifer stands within patchy landscapes influenced by natural disturbance (e.g., recent burns) support the highest densities of Olive-sided Flycatcher. Nests are generally placed toward the tip of coniferous branches (although other tree types have been used).
Contopus virens	Eastern Wood-Pewee	S3S4B	Special Concern	Special Concern	Vulnerable	The Eastern Wood-pewee is mostly associated with the mid-canopy layer of forest clearings and edges of deciduous and mixed forests. It is most abundant in forest stands of intermediate age and in mature stands with little understory vegetation. During migration, a variety of habitats are used, including forest edges, early and successional clearings.
Coturnicops noveboracensis	Yellow Rail	SUB	Special Concern	Special Concern		Yellow rail is distributed along northern Nova Scotia. Nesting Yellow Rails are typically found in marshes dominated by sedges, true grasses, and rushes, where there is little or no standing water (generally 0-12 cm water dept), and where the substrate remains saturated throughout the summer. They can be found in damp fields and meadows, on the floodplains of rivers and streams, in the herbaceous vegetation of bogs, and at the upper levels (drier margins) of estuarine and salt marshes. Nesting habitats usually have a dry mat of dead vegetation from previous growing seasons. A greater diversity of habitat types is used during migration and winter than during the breeding season. In winter, the rails are known to use coastal wetlands and rice fields. (COSEWIC Assessment and Status Report).

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Empidonax traillii	Willow Flycatcher	S2B				Uncommon breeder throughout mainland Nova Scotia, not Cape Breton (MBBA, as of July 2021). In winter, they use shrubby clearings, pastures and woodland edges often near water. Migrates relatively late in spring and early in fall. Breeds in thickets of deciduous trees and shrubs, especially willows, or along woodland edges. Often near streams or marshes and may be found in drier habitats than the Alder Flycatcher. Breeds between April and July (Audubon and The Cornell Lab).
Euphagus carolinus	Rusty Blackbird	S2B	Special Concern	Special Concern	Endangered	Breeding habitat is characterized by coniferous-dominated forests adjacent to wetlands, such as slow-moving streams, peat bogs, sedge meadows, marshes, swamps and beaver ponds. On migration, the Rusty Blackbird is primarily associated with wooded wetlands. In winter, it occurs primarily in lowland forested wetlands, cultivated fields and pecan groves. Suitable habitat for the species appears to be decreasing on its breeding range and wintering grounds, due mainly to the loss and degradation of wetlands by human activities.
Gallinago delicata	Wilson's Snipe	S3B,S5M				Common across Nova Scotia during breeding and also known as a permanet resident in the southern areas of the province. Wilson's Snipes can be found in all types of wet, marshy settings, including wet fields, bogs, fens, swamps, wet meadows and along muddy edges of rivers and ponds. They avoid areas with tall, dense vegetation, but need patches of cover to hide in and to provide a safe lookout for predators. During the breeding season they are mainly found around fresh marshes and bogs, shrubby streamsides and northern tundra. Breeds between April and July (Audubon and The Cornell Lab).
Gallinula galeata	Common Gallinule	S1B				Common Gallinules use freshwater and brackish marshes, ponds and lakes that have a mix of submerged, floating and emergent aquatic vegetation and are open water year-round. They also use artificial aquaculture ponds, rice fields, sewage lagoons and urban stormwater retention ponds. May be on more open ponds with less marsh cover or on still, slow-moving waters. Found with American Coot in many places but requires more marsh growth. Breeds between April and July (Audubon and The Cornell Lab).
Haemorhous purpureus	Purple Finch	S3S4N, S4S5B,S5M				Found throughout the entire province year-round. Purple finches can be found in woods, groves, suburbs. Breeds mostly in coniferous and mixed woods, both in forest interior and along edges. In migration and winter, found in a wide variety of wooded and semi-open areas, including forest, suburbs, swamps, and overgrown fields. Breeding occurs from April to July (The Cornell Lab, Audubon)
Hirundo rustica	Barn Swallow	S3B	Special Concern	Threatened	Endangered	Barn Swallows forage over a wide range of open and semi-open habitats including natural and anthropogenic grasslands, other farmland, open wetlands, open water, savannah, tundra, highways and other cleared rights-of-way, and cities and towns. They avoid forested regions and high mountains. Barn Swallows throughout the world have adapted to nesting in or on human structures, including buildings, barns, bridges, culverts, wells and mine shafts. Use of natural nest sites such as caves or rock cliffs with crevices or ledges protected by overhangs is rarely reported. Nocturnal roosts are typically in reed or cane beds or other dense vegetation, usually in or near water.
Icterus galbula	Baltimore Oriole	S2S3B,SUM				Baltimore Orioles are often very common in open woods and groves in summer. Found in open woods, riverside groves, elms, shade trees. Breeds in deciduous or mixed woodland, generally in open woods or edges rather than interior of dense forest. May be common in trees in towns (Audubon). Breeds between April and July (Audubon and The Cornell Lab).
Ixobrychus exilis	Least Bittern	SUB	Threatened	Threatened		The Least bittern has been observed in every Province in Canada. However, it is only probable to be in Nova Scotia. The Least Bittern breeds strictly in marshes dominated by emergent vegetation surrounded by areas of open water. Most breeding grounds in Canada are dominated by cattails, but breeding also occurs in areas with other robust emergent plants and in shrubby swamps. The presence of stands of dense vegetation is essential for nesting because the nests of Least Bittern sit on platforms of stiff stems. The nests are almost always within 10 m of open water. This small heron prefers large marshes that have relatively stable water levels throughout the nesting period. Needs for wintering habitat are less specific, and appear to be met by a wide variety of wetlands—not only emergent marshes like those used for breeding, but also brackish and saline swamps (Environment Canada Recovery Strategy)
Lanius borealis	Northern Shrike	S3S4N				They occur in open but brushy habitats, and on calm, sunny days they may sit up on utility wires, bushes, and trees (Cornell Lab).Nests are usually placed in a low tree or large shrub, often in spruce or willow, usually 6-15' above the ground. Breeds between April and July (Audubon and The Cornell Lab).

Scientific Name	Common Name	SRank	COSEWIC	*SARA*	*ESA*	Habitat Description
Limosa haemastica	Hudsonian Godwit	S2S3M	Threatened	No Status		Hudsonian Godwit occurs regularly during breeding or migration in all three territories and in provinces from British Columbia to Québec, as well as occasionally in the fall in all the Atlantic provinces. Hudsonian Godwit breeds in wetland habitats (sedge meadows and muskeg) in sub-Arctic and Boreal regions. It uses a wide variety of habitats on migration, including freshwater marshes, saline lakes, flooded fields, shallow ponds, coastal wetlands and mudflats (COSEWIC Assessment and Status Report).
Loxia curvirostra	Red Crossbill	S3S4				Found throughout the entire province year-round. Red Crossbills can be found in conifer forests and groves, and breeds in pines (predominately), spruce, hemlock, Douglas-fir, or other evergreens. Breeding occurs from April to July (The Cornell Lab, Audubon)
Mimus polyglottos	Northern Mockingbird	S1B				Year-round residents throughout Nova Scotia, less common in Cape Breton. Found year-round in areas with open ground and shrubby vegetation (e.g. dense, low shrubs - hedges, fruiting bushes and thickets). When foraging on the ground, it prefers grassy areas, rather than bare spots. Common places include roadsides, parkland, cultivated land, suburban areas, woodland edges and in second-growth habitat at low elevations. Breeds between April and July (Audubon and The Cornell Lab).
Myiarchus crinitus	Great Crested Flycatcher	S1B				Uncommon breeder throughout mainland Nova Scotia, not Cape Breton (MBBA, as of July 2021). Migrates mostly at night. Breeds mainly in deciduous forest or mixed forest but avoids pure stands of conifers. May be found in either continuous deep forest or in more open wooded areas, around edges of clearings or abandoned orchards. Dead snags and dying trees are important sources of the cavities they need for nesting (will even search out cavities in old orchards and in woody urban areas like parks, cemeteries and golf courses). If there are enough trees, they will claim territories in pastures, along streams and rivers, and in swamps and wetlands. Breeds between April and July (Audubon and The Cornell Lab).
Numenius phaeopus hudsonicus	Whimbrel	S2S3M				Common migrant in Nova Scotia. Migrating whimbrels feed mostly on tidal mudflats and sandflats; they also forage in saltmarshes, lagoons, estuaries and on reefs and rocky shorelines where small crabs are available. When not feeding, Whimbrels roost in flocks in marshes, meadows, fields, dunes and oyster beds, as well as on small islands and even in mangrove trees. Migrating Whimbrels are known to also use coastal tundra and heath in Alaska and Canada. North American Whimbrels breed in subarctic and alpine tundra and taiga, nesting in drier upland environments (heath) or (mainly) wetter lowlands with grasses, sedges, mosses, lichens, small shrubs and stunted trees. Breeds between April and July (The Cornell Lab and eBird).
Oxyura jamaicensis	Ruddy Duck	S1B				Uncommon in Nova Scotia during migration. Only a few confirmed sightings in Cumberland and Antigonish county (MBBA, as of July 2021) - Migration extends over a considerable period in both spring and fall. Migrating Ruddy Ducks stop in a variety of habitats, mainly on large, permanent wetlands, ponds, marshes, lakes and reservoirs. About 86 percent of the breeding population is concentrated in the prairie pothole region of south-central Canada, hence why they are uncommon in Nova Scotia. Breeds between April and July (Audubon and The Cornell Lab)
Passerella iliaca	Fox Sparrow	S3S4B,S5M				Found year round in Cape Breton, and throughout the migration season (late March and early November) in the rest of the province. Migrates at night. Found in wooded areas, undergrowth, brush. Breeds in brushy areas including woodland edges and clearings, streamside thickets, scrubby second growth, stunted coastal forest. Winters in similar habitats, also in brushy fields, chaparral, well-vegetated suburbs and parks. Breeds from April to July (The Cornell Lab, Audubon)
Passerina cyanea	Indigo Bunting	S1?B,SUM				This species favors brushy edges rather than unbroken forest. Indigo Buntings breed in brushy and weedy areas. They're common on the edges of woods and fields; along roads, streams, rivers, and powerline cuts; in logged forest plots, brushy canyons, and abandoned fields where shrubby growth is returning. They are also in clearings within deciduous woods, edges of swamps. Breeds between April and July (Audubon and The Cornell Lab).
Perisoreus canadensis	Canada Jay	S3				Year-round resident throughout Nova Scotia and commonly referred to as the Gray Jay. No regular migration. On rare occasions, small invasions of Canada Jays will move a short distance out of boreal forest in winter. Prefers boreal and subalpine forests across northern North America, usually where black or white spruce trees are common (also aspen, white birch, balsam fir, sugar maple, jack pine, red spruce, eastern white cedar, etc.). Found in various kinds of coniferous and mixed forest, but rarely occurs where there are no spruce trees. Mated pairs stay together all year and defend permanent territories. Breeding and nesting for this species begins very early, during late winter, with breeding grounds still snow- covered. Breeds until, approximately, July (Audubon and The Cornell Lab).

Scientific Name	Common Name	SRank	COSEWIC	*SARA*	*ESA*	Habitat Description
Pheucticus ludovicianus	Rose-breasted Grosbeak	S3B				Look for these birds in forest edges and woodlands. Rose-breasted Grosbeaks breed in moist deciduous forests, deciduous- coniferous forests, thickets, and semi open habitats. They gravitate toward second-growth woods, suburban areas, parks, gardens, and orchards, as well as shrubby forest edges next to streams, ponds, marshes, roads, or pastures. They favor edges or openings with combination of shrubs and tall trees, rather than unbroken forest. Breeds from April to July (The Cornell Lab, Audubon)
Picoides arcticus	Black-backed Woodpecker	S3S4				Known throughout Nova Scotia year-round. Not strictly migratory but may move around in response to changing conditions (e.g. destruction of habitat). Eastern birds occasionally stage southward irruptions in winter, with scattered individuals showing up well south of breeding range. Habitat includes boreal forests of firs and spruces (pine, Douglas-fir, hemlock, tamarack and spruce, especially spruce bogs). Favours areas of dead or dying trees (coniferous and deciduous), and may concentrate at burned or flooded areas with many standing dead trees. Frequently lowlands in the North and mountains in the West. Breeds between April and July (Audubon and The Cornell Lab).
Pinicola enucleator	Pine Grosbeak	S3B,S5N,S5M				Found throughout the province year-round. Pine grosbeaks can be found in conifers, in winter, other trees. Breeds in open coniferous forest, especially of spruce and fir. In winter often found in deciduous trees (especially fruiting trees), and in groves of pines and other conifers. Breeding occurs from April to July (The Cornell Lab, Audubon).
Piranga olivacea	Scarlet Tanager	S2B,SUM				These birds can be found in oak forests in summer, but they often remain out of sight as they forage in the leafy upper branches. The next site is in tree (usually deciduous), typically 20-30' above ground. Found in forests and shade trees (especially oaks). Breeds mostly in deciduous forest, predominately oaks but also in maple, beech, mixed pine-oak woods, and coniferous woods dominated by pine or hemlock. Breeding Scarlet Tanagers prefer large forest tracts with large trees. During spring and fall they use similar forest habitats as well as open spaces such as parks and gardens. Breeds between April and July (The Cornell Lab, Audubon)
Pluvialis squatarola	Black-bellied Plover	S3M				Migrates through Nova Scotia. Found in mudflats, open marshes and beaches (tundra in the summer). Nesting occurs in drier tundra, often more barren ridges above lowland lakes and rivers (sometimes in lower wet tundra near coast). In winter, found mostly on open sand beaches and tidal flats. During migration will often stop in short-grass prairie or plowed fields, especially during high tides, when mudflats are underwater. In some places, they forage on rocky shorelines. Black-bellied Plovers roost together at high tide and overnight on beaches, salt marshes and sometimes upland habitats such as farm fields. Most migrate along the coast or over sea, but numbers stop over regularly at some inland sites. Breeds between April and July (Audubon and The Cornell Lab).
Poecile hudsonicus	Boreal Chickadee	S3				Year-round resident throughout Nova Scotia. Occasional small southward invasions in fall, with a few appearing south of breeding range (like Black-capped Chickadees invasions). Boreal Chickadees inhabit mostly mature coniferous forests (sometimes mixed forests), usually spruce and balsam fir, often near water. During late fall and winter irruptions, they tend to be found mostly in areas dominated by coniferous trees. Occurs in low stunted spruces as far North as tree lines (e.g. spruce bogs). May mate for life, the birds remaining together all year. Nests in a hole in a tree, either a natural cavity or one they created (or from another species). Breeds between April and July (Audubon and The Cornell Lab).
Rallus elegans	King Rail	SNA	Endangered	Endangered		The species breeds only in the extreme southern part of Ontario. King Rails are found in a variety of freshwater marshes and marsh-shrub swamp habitats. The species occurs in areas where wild rice grows but also in sedge and cattail marshes. Most importantly, the species requires large marshes with open shallow water that merges with shrubby areas. In fact, birds only return in successive years to large marshes that are not overgrown with cattails. This Species are accidental to Nova Scotia.
Rallus limicola	Virginia Rail	S2S3B				Breeds across Nova Scotia, but more common in the northern region. Nests in a variety of marshy situations, mostly fresh, but also brackish marshes near the coast. Where this species and Sora breed in same marshes, Virginia Rail typically nests in drier spots. Often moves into salt marshes in winter. During migration, sometimes found in odd spots, even city streets. Virginia Rails occupy shallow (sometimes deeper) freshwater wetlands with tall stands of cattails and rushes (need areas with standing water typically less than 6 inches deep with a muddy bottom). They are most common in wetlands with 40–70% coverage of tall emergent vegetation, mixed with open water, mudflats and areas with matted vegetation. During the nonbreeding season, Virginia Rails use similar habitat, but may venture into more open areas. Breeds between April and July (Audubon and The Cornell Lab).

Scientific Name	Common Name	SRank	COSEWIC	*SARA*	*ESA*	Habitat Description
Riparia riparia	Bank Swallow	S2B	Threatened	Threatened		As with other swallow species, migratory stopover points are usually centered on large marshes where birds roost at night and disperse to forage throughout the day. There is little information available for Bank Swallows in terms of the importance of area requirements of these disparate habitats and their proximity to each other.
Setophaga castanea	Bay-breasted Warbler	S3S4B,S4S5M				Bay-breasted warblers are found in woodlands and conifers in summer. Usually breed in northern coniferous forest, in thick stands of spruce and fir. They are preators of spruce budworm and are abundant in spruce forests during outbreaks. Where spruce is not found, will nest in deciduous or mixed second-growth woods of birches, maples, firs, and pines. Breed from April to July, typically in the latter half of the breeding window (The Cornell Lab, Audubon)
Setophaga pinus	Pine Warbler	S2S3B,S4S5M				Pine Warblers live in pine or mixed pine-deciduous forest. Also, sometimes in cedar or cypress. Various observations throughout Nova Scotia, generally in the southern portion of the province. Breeds April to July (The Cornell Lab, Audubon)
Setophaga striata	Blackpoll Warbler	S3B,S5M				The blackpoll warbler can be found in conifers; broadleaf trees in migration. Breeds in low northern spruce forest. In migration, moves through forests, parks and gardens, they stop over in scrubby thickets and mature evergreen and deciduous forests. Found in the southern half of Nova Scotia during migration and the northern half during the breeding season. Breeding occurs from April to July (The Cornell Lab, Audubon).
Setophaga tigrina	Cape May Warbler	S3B,SUM				The Cape May Warbler can be found in spruce forest, other trees in migration. Breeds in spruce forest, especially during spruce budworm outbreaks, either in pure stands or mixed with firs or other trees, generally in more open woods or near the forest edge. During migration often favors conifers, but also forages in deciduous trees and thickets. Breeding occurs from April to July (The Cornell Lab, Audubon)
Sialia sialis	Eastern Bluebird	S3B				Uncommon breeder throughout Nova Scotia. In the north, arrives quite early in spring, and lingers late in fall. These birds live in semi-open country with scattered trees, but with little understory and sparse ground cover. Original habitats probably included open, frequently burned pine savannas, beaver ponds, mature (but open) woods and forest clearings/openings. Today, they are most common along pastures, roadsides, agricultural fields, suburban parks, backyards and golf courses. Breeds between April and July (Audubon and The Cornell Lab).
Spatula clypeata	Northern Shoveler	S2B,SUM				Migrates through all parts of Nova Scotia, except Cape Breton (uncommon for this species to breed in Nova Scotia). The migratory period is quite prolonged in both spring and fall, with many birds moving late in spring and early in fall. Northern Shovelers use shallow wetlands with submerged vegetation during the breeding season, nesting along the margins and in the neighboring grassy fields. Outside of the breeding season they forage in saltmarshes, estuaries, lakes, flooded fields, wetlands, agricultural ponds and wastewater ponds (and fields in vicinity of shallow water) with extensive muddy margins, including stagnant or polluted waters not much favored by other ducks. Pair formation begins in winter and continues during spring migration. Breeds between April and July (Audubon and The Cornell Lab)
Spatula discors	Blue-winged Teal	S3B				Found mainly in fresh ponds and marshes. In summer they use shallow freshwater marshes and ponds in open country, as well as brackish marshes near the coast. In migration and winter, they forage and stop in any kind of shallow waters, whether inland or coastal. Flocks in migration are sometimes seen over the ocean, many miles offshore. They are flightless during their late summer molt, and they spend this time in prairie potholes or large marshes. Blue-winged Teal nest among grasses or herbaceousvegetation. Pair formation begins in early winter and continues during spring migration. Breeds between April and July (Audubon and The Cornell Lab)
Spinus pinus	Pine Siskin	S3				Found throughout the province year-round. Pine Siskins can be found in conifers, mixed woods, alders, weedy areas. Breeds mostly in coniferous and mixed woods, often around edges or clearings; sometimes in deciduous woods, isolated conifer groves. In migration and winter, many kinds of semi-open areas, woodland edges, weedy fields. Breeding occurs from April to July (The Cornell Lab, Audubon)
Toxostoma rufum	Brown Thrasher	S1B				Not common and rarely seen in Nova Scotia, with no recorded sightings in Cape Breton (MBBA, as of July 2021). In eastern North America, Brown Thrashers nest in thickets, brush, shrubbery, hedgerows, forest edges and overgrown clearings in deciduous forest. On rare occasions they breed in backyards and gardens with shrubs and hedges (but in general - areas of dense low growth, especially thickets around edges of deciduous or mixed woods, shrubby edges of swamps or undergrowth in open pine woods). Breeds between April and July (Audubon and The Cornell Lab).

Scientific Name	Common Name	SRank	COSEWIC	*SARA*	*ESA*	Habitat Description
Tringa melanoleuca	Greater Yellowlegs	S3B,S4M				Common migrant in Nova Scotia (migrates in flocks). During migration and throughout the winter, Greater Yellowlegs use a wide variety of fresh and brackish wetlands, including mudflats, estuaries, beaches, marshes, lake and pond edges, wet meadows, sewage ponds and flooded agricultural fields. Breeds in boggy and marshes places within northern coniferous forest. Breeds between April and July (Audubon and The Cornell Lab).
Tringa semipalmata	Willet	S3B				Willets inhabit open beaches, wet meadows, bay shores, marshes, mudflats and rocky coastal zones. During the breeding season, these birds seek salt marshes, barrier islands and barrier beaches for breeding. Often nests in colonies, especially along Atlantic Coast (prefers to nest in extensive salt marsh habitat). Breeds between April and July (Audubon and The CornellLab).
Turdus migratorius	American Robin	S3N, S5B				Common in most of Nova Scotia as a year-round resident and for breeding in the very Northern part of the province (mainly Cape Breton). This species occupies many habitat types, such as lawns, farmland, fields and city parks, as well as in more wild places like woodlands, forests, mountains up to near tree line, recently burned forests and tundra. During winter many robins move to moist woods where berry-producing trees and shrubs are common. Males arrive first in the breeding season. Nests where there are trees and mud for nest-making material. Breeds between April and July (Audubon and The Cornell Lab).
Tyrannus tyrannus	Eastern Kingbird	S3B				Common breeder throughout Nova Scotia. A long-distance migrant that uses many habitats and migrates in flocks. Unlike many of the migratory songbirds, kingbirds may travel mostly by day. The Eastern Kingbird usually breeds in fields with scattered shrubs and trees, in orchards and along forest edges (also clearings, roadsides, parks, newly burned forest, beaver ponds, golf courses and urban environments with tall trees and scattered open spaces). It is drawn to water, often nesting densely in trees that overhang rivers or lakes. In summer, requires open space for hunting. Often common around edges of marshes, farmland and native tallgrass prairie. Breeds between April and July (Audubon and The Cornell Lab).
Vireo gilvus	Warbling Vireo	S1B,SUM				Occurs in deciduous and mixed woods, aspen groves, poplars, shade trees. Breeds in open deciduous or mixed woodland; also in orchards, shade trees of towns (Audubon). They stay high in deciduous treetops (Cornell Lab). Breeds between April and July (Audubon and The Cornell Lab).
Vireo philadelphicus	Philadelphia Vireo	S2?B,SUM				Occurs in second growth, poplars, willows, alders. Breeds in deciduous and mixed woodlands, especially near their edges, or in the young growth of overgrown pastures. Also nests in willows and alders along streams, lakes, and ponds. Breeds between April and July (Audubon).
FISH						
Anguilla rostrata	American Eel	S3N	Threatened	No Status		During their oceanic migrations, eels occupy salt water and in their continental phase (growth in continental waters), they use all salinity zones. In freshwater habitats, preferred habitat can be found in both lentic and lotic waters including all waters extending from the high-water mark down to at least 10 m depth for all reaches currently or formerly used by the American Eel (COSEWIC Assessment and Status Report).
Salmo salar pop. 1	Atlantic Salmon - Inner Bay of Fundy pop.	S1	Endangered	Endangered		When Atlantic Salmon are in fresh water they prefer natural stream channels with rapids and pools, gravel bottoms, and cool water that is free from chemical and organic pollution. Spawning occurs in natal rivers in October and November. In 2010, 10 rivers in New Brunswick and Nova Scotia were identified as containing fresh water critical habitat for the iBoF Salmon: Gaspereau, Stewiacke, Debert, Folly, Great Village, Portapique, Economy, Upper Salmon, Point Wolfe and Big Salmon (Fisheries and Oceans Canada, 2019)
Salmo salar pop. 12	Atlantic Salmon - Gaspe - Southern Gulf of St Lawrence pop.	S1	Special Concern	No Status		Salmon rivers are generally clear, cool and well oxygenated, with gravel, cobble and boulder substrates. This population reproduce in the tributaries of the St Lawrence River's south shore and of the Gulf of St. Lawrence, more specifically between the Sud-Ouest River in Quebec and the rivers in the northern tip of Cape Breton, Nova Scotia. Spawning occurs in October and November (Department of Fisheries and Oceans, 2018).
Morone saxatilis pop.2	Striped Bass – Bay of Fundy population	S2S3B, S2S3N	Special Concern	No Status		Shubenacadie River, Saint John River (historically), and Annapolis River (historically). In most Striped Bass populations, spawning, incubation and early larval development occur in fresh or slightly brackish waters. The Shubenacadie River population, however, spawns in a section of its major tributary, the Stewiake River,affected by a tidal bore. At the juvenile and adult stages, Striped Bass use coastal and estuarine habitats and saltwater systems. Eelgrass plays an important role for several species of fish at different stages of their life cycle, including the Striped Bass for rearing, feeding and sheltering. Young and adult Striped Bass populations undertake a fall migration to estuaries or freshwater habitats to overwinter (see Dispersal and Migration section). This behaviour is considered to enable them to avoid the low winter ocean temperatures. Wintering and spawning sites do not necessarily overlap in distribution or occur in the same drainage (COSEWIC Assessment and Status Report).

Scientific Name	Common Name	SRank	COSEWIC	*SARA*	*ESA*	Habitat Description
Culaea inconstans	Brook Stickleback	S3				Inhabits the clear, cold, densely vegetated waters of small streams and spring-fed ponds and is found along the swampy margins of beach ponds of larger lakes. They are tolerant of salt water for short periods of time. Spawning occurs in shallow water from late April to July, depending on the water temperature (Scott and Crossman, 1973)
Margariscus nachtriebi	Northern Pearl Dace	S3				Cool, clear headwater streams in the south, bog drainage streams, ponds and small lakes in the north, and stained, peaty waters of beaver ponds. Spawning occurs in clear water over sand or gravel in weak or moderate current (Scott and Crossman 1973).
Salvelinus fontinalis	Brook Trout	S3				Most common in cool well-oxygenated waters of lakes and streams. In autumn, brook trout move into smaller, shallower streams and require free passage along streams to move between areas of use. Spawning occurs from October - early December (Gilhen, 1974)
Salvelinus namaycush	Lake Trout	S3				Found in deep-water lakes. During the warm summer months, it spends most of its time near the bottom, and ascends in the fall. Spawning occurs from October-November.
INVERTEBRATE						
Bombus bohemicus	Ashton Cuckoo Bumble Bee	S1	Endangered	Endangered	Endangered	Currently, nothing is known about the mating and overwintering habitat requirements for the Gypsy Cuckoo Bumble Bee. Overwintering habitat for bumble bees in Ontario may include rotting logs, leaf litter and mulch, burrows in soil, and garden compost. Forage habitat includes the plant species mentioned below as well as other flowering plants which bloom early spring (e.g. Willow) to late autumn (e.g. Goldenrod). Forage habitat occurs in old fields, grasslands, dunes, alvars, woodlands (especially in the spring) and roadsides.
Bombus suckleyi	Suckley's Cuckoo Bumble Bee	SH	Threatened	Not on Schedule 1		Suckley's Cuckoo Bumble Bee occurs in most Canadian ecozone including the Atlantic Maritimes. Suckley's Cuckoo Bumble Bee occurs in diverse habitats including open meadows and prairies, farms and croplands, urban areas, boreal forest, and montane meadows. Records are from sea level to 1200 m although the species could potentially occur at higher elevations where its host(s) occur. In the early spring, hosts typically establish nests in abandoned underground rodent burrows or other dry natural hollows; because Suckley's Cuckoo Bumble Bee is a nest parasite these same host residence sites also serve as its habitat. Adults have been recorded feeding on pollen and nectar from many flowers (COSEWIC Assessment and Status Report).
Bombus terricola	Yellow-banded Bumble Bee	S3	Special Concern	Special Concern	Vulnerable	Habitat generalist within open coniferous, deciduous and mixed-wood forests, wet and dry meadows and prairie grasslands, meadows bordering riparian zones, and along roadsides, urban parks, gardens and agricultural areas, subalpine habitats and more isolated natural areas.
Coccinella transversoguttata	Transverse Lady Beetle	SH	Special Concern	Special Concern	Endangered	The Transverse Lady Beetle is reported to be a habitat generalist occurring within agricultural areas, suburban gardens, parks, coniferous forests, deciduous forests, prairie grasslands, meadows, sand dune edges and riparian areas.
Coccinella transversoguttata richardsoni	Transverse Lady Beetle	SH	Special Concern	Special Concern		The Canadian range of the Transverse Lady Beetle stretches from St. John's, Newfoundland and Labrador, west to Vancouver Island. The Transverse Lady Beetle is a habitat generalist and known to occur within agricultural areas, suburban gardens, parks, coniferous forests, deciduous forests, prairie grasslands, meadows, and riparian areas. The Transverse Lady Beetle can also be found in a wide variety of non-agricultural vegetation including birch, pine, spruce, maple, mountain ash, poplar, willow, sage, cherry, alder, thistles, grasslands, and scruff pea plants along the edge of sand dunes. Overwintering adults tend to aggregate in well-ventilated microhabitats such as under stones, rock crevices, in grass tussocks, in leaf litter, or in tree bark (COSEWIC Assessment and Status Report).
Danaus plexippus	Monarch	S2?B,S3M	Endangered	Special Concern	Endangered	The breeding habitat of the Eastern and Western populations in Canada is confined to where milkweeds grow, since leaves of these plants are the sole food of the caterpillars. The different species of milkweeds grow in a variety of environments, including meadows in farmlands, along roadsides and in ditches, open wetlands, dry sandy areas, short and tall grass prairie, riverbanks, irrigation ditches, arid valleys, and south-facing hillsides. Milkweeds are also often planted in gardens. The Monarch is known to breed on native milkweeds within their natural ranges. The most used other sources of nectar are goldenrods (Solidago spp.), asters (Doellingeria, Eurybia, Oclemena, Symphyotrichum and Virgulus), the introduced Purple Loosestrife (Lythrum salicaria), and various clovers (Trifolium spp. and Melilotus spp.)

Scientific Name	Common Name	SRank	COSEWIC	*SARA*	*ESA*	Habitat Description
HERPETOFAUNA						
Chelydra serpentina	Snapping Turtle	S3	Special Concern	Special Concern	Vulnerable	They are common in southwestern Nova Scotia and less common on the northeastern mainland. Although Snapping Turtles occupy a wide variety of habitats, the preferred habitat for this species is characterized by slow-moving water with a soft mud bottom and dense aquatic vegetation. Established populations are most often found in ponds, marshes, swamps, peat bogs, shallow bays, river and lake edges, and slow-moving streams. turtles appear to prefer the following characteristics for their hibernacula: water shallow enough to let the turtle reach the surface to breathe, but deep enough so the water will not freeze to the bottom; a location that is likely to freeze over later in the season and thaw earlier in the spring; a thick layer of mud in which the turtle can bury itself; and additional submerged cover, such as a floating mat of vegetation, roots, stumps, branches or logs, a muskrat dwelling or an overhanging bank.
Chrysemys picta picta	Eastern Painted Turtle	S4	Special Concern	Special Concern		Eastern Painted Turtle is found in New Brunswick, Nova Scotia, and the Atlantic coastal states east of the Appalachian Mountains. Painted Turtles occupy slow moving, relatively shallow and well-vegetated wetlands (e.g., swamps, marshes, ponds, fens, bogs, and oxbows) and water bodies (e.g., lakes, rivers, creeks, and streams) with abundant basking sites and organic substrate. These turtles are found in association with submergent aquatic plants, which are used for cover and feeding. The species is semi-tolerant of human-altered landscapes and may occasionally be found occupying urban ponds and lands subject to anthropogenic disturbance (e.g., farm ponds, impoundments, water treatment facilities). Suitable nesting habitat includes open, often south-facing, and sloped areas with sandy-loamy and/or gravel substrate usually within 1200 m of aquatic active season habitats. Painted Turtles overwinter in shallow water with deep sediment (COSEWIC Assessment and Status Report).
Glyptemys insculpta	Wood Turtle	S2	Threatened	Threatened	Threatened	Wood Turtles are strongly associated with meandering, shallow rivers with sand, gravel, and/or cobble bottoms; these rivers are typically clear, with moderate current and frequent oxbows. Wood Turtles hibernate aquatically in streams and rivers (October to April, depending on location). Overwintering sites are usually on the bottom of deep pools, often with fallen debris that provides structure and prevents dislodging during high flow events. Found throughout the Province with concentrations in Guysborough and Annapolis Counties. Local plants include alders, chokecherry, hawthorn and mixed wood stands of deciduous and coniferous trees. Females lay their eggs in sandy bars along rivers and other gravel areas (driveways, roadsides, borrow pits) in June.
Hemidactylium scutatum	Four-toed Salamander	S3				Four-toed salamanders have specialized habitat requirements which require suitable breeding wetlands within or adjacent to mature forests. They prefer mature, mesic forests with dense canopy cover to preserve body moisture, an abundance of downed woody debris for cover and foraging opportunities, and vernal pools, ponds, bogs, shallow marshes, or other fishless bodies of water for nesting and larval success. Wooded wetlands such as seepage swamps or cedar swamps with many moss mats are ideal. Male adults can be located under leaves, bark, and logs in the upland forest, while females are most often found during the breeding season nesting in moss mats which overhang pools of water. (Harding 1997).
MOLLUSC						
Alasmidonta undulata	Triangle Floater	S2S3				They prefer small, steady-flowing streams close to headwaters. It is sometimes found in lakes or ponds, and most often found in gravelly sand, mud, or between large stones. (Vermont Atlas, 2021a)
Alasmidonta varicosa	Brook Floater	S3	Special Concern	Special Concern	Threatened	Found in rivers, streams, and lakes. They prefer watercourses with a moderate to high water flow with rocks, cobble and sand- pocket areas and may also be found in certain lakes in Nova Scotia. They are typically found clustered in sand-pocket areas behind boulders and stream banks, likely as a means of protection in high-flow velocity. The Brook Floater occurs in a relatively small number of rivers, including the Annapolis, LaHave, Gays, Wallace, East St. Marys and Salmon Rivers in Nova Scotia.
Margaritifera margaritifera	Eastern Pearlshell	S2				The mussels live buried or partly buried in coarse sand and fine gravel in clean, oligotrophic, fast-flowing and unpolluted rivers and streams (Skinner et al., 2003).
Strophitus undulatus	Creeper	S3				Shallow freshwater. Riffles, moderate-low gradient, creek, pool (Nature Serve Explorer, 2021).

APPENDIX G
BAT ACOUSTIC BASELINE REPORT

strum

CONSULTING

BAT ACOUSTIC BASELINE REPORT
Clydesdale Ridge Wind Power Project

July 5, 2024

strum CONSULTING

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July 5, 2024

Mr. Kellan Duke
Clydesdale Holdings Ltd.
1701 Hollis Street, Suite 1200
Halifax, NS B3K 1A5

Dear Mr. Duke,

Re: Bat Acoustic Baseline Report - Clydesdale Ridge Wind Power Project

Attached is the Bat Acoustic Baseline Report prepared for Clydesdale Ridge Wind Power Project.

The report documents our observations and findings.

We trust this to be satisfactory at this time. Once you have had an opportunity to review this correspondence, please contact us to address any questions you may have.

Thank you,

Ryan Gardiner, B.Sc.
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Environmental Assessment & Approvals
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Melanie Juurlink, MREM
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EXECUTIVE SUMMARY

McCallum Environmental Ltd. (now Strum Consulting) was retained by Clydesdale Holdings Ltd. (Clydesdale Wind LP) to complete acoustic bat surveys for the proposed Clydesdale Ridge Wind Project (the Project), located in Mount Thom, Pictou, and Colchester Counties, Nova Scotia. These assessments are to support the preparation and submission of the provincial Environmental Assessment Registration Document (EARD).

Acoustic monitoring surveys for bats were completed at six locations, continuously from June 20 to October 31, 2023, and from April 4, 2024, to June 17, 2024, using Wildlife Acoustic SM4BAT-FS detectors. The following observations were made from the data collected by the SM4BAT detectors:

- 31 total bat passes were recorded.
- 11 migratory bat species passes were recorded (42%).
- The average total passes per detector night for the Project Area over the entire survey period for all species was 0.03. The average migratory passes per detector night for the Project Area over the entire survey period were observed to be 0.01.

There are no thresholds for bat passes and guidance for wind power projects in Nova Scotia. Therefore, Alberta Government protocols (2013) were reviewed and considered herein. Alberta adopts a Precautionary Principle, whereby the following bat passes per night for migratory species is considered when determining project risk:

- Less than 1 migratory bat passes per detector night = potentially acceptable risk
- 1-2 migratory bat passes per detector night = potentially moderate risk
- Greater than 2 bat passes per detector night = potentially high risk of bat fatalities

Based on precautionary guidance from the Alberta Government, the average of 0.01 migratory passes per detector night observed across the Project Area would be considered a potentially acceptable risk.

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COSEWIC	Committee on the Status of Endangered Wildlife in Canada
EA	Environmental Assessment
EARD	Environmental Assessment Registration Document
MET	Meteorological Tower
NSESA	*Nova Scotia Endangered Species Act,* S.N.S., 1998, c.11
NSNRR	Nova Scotia Natural Resources and Renewables
SARA	*Species at Risk Act*

1.0 INTRODUCTION

McCallum Environmental Ltd. (now Strum Consulting) was retained by Clydesdale Holdings Ltd. (Clydesdale Wind LP) to complete acoustic bat surveys for the proposed Clydesdale Ridge Wind Project (the Project), located in Mount Thom, Pictou, and Colchester Counties, in Nova Scotia. These assessments are to support the preparation and submission of the provincial Environmental Assessment Registration Document (EARD).

The objective of the acoustic bat surveys was to:

- Identify species present within the Project Area
- Determine the potential risk to bats caused by the Project based on a comparison of bat observations to regulatory thresholds.

The results of these surveys will be carried forward in the EARD to evaluate the Project's effects on bats.

1.1 Regulatory Context

All seven species of bats known to occur in Nova Scotia are considered priority species, three of which are considered endangered under the *Species at Risk Act* (SARA), and Nova Scotia Endangered Species Act (NSESA). As part of the Nova Scotia Environment and Climate Change (NSECC) Guide to Preparing an EARD for Wind Power Projects in Nova Scotia (NSECC, 2021), The Project is required to determine whether significant numbers[1] of bats migrate through the area.

Migratory bat species have a higher risk of collision with wind turbines than resident species which generally forage between 1 – 10 m above ground level and seldom above 25 m, thus avoiding turbine blades (Erickson *et al*. 2002).

Known species of bats to occur in Nova Scotia, their rankings and migratory or resident species distinction are provided in Table 1.1

[1] Significance is not defined in the guidance.

Table 1.1: Migratory and Resident Bat Species in Nova Scotia

Scientific Name	Common Name	COSEWIC	SARA	NSESA	SRank	Migratory of Resident Species
Myotis lucifugus	Little brown myotis	Endangered	Endangered	Endangered	S1	Resident
Myotis septentrionalis	Northern myotis	Endangered	Endangered	Endangered	S1	Resident
Perimyotis subflavus	Tricolored bat	Endangered	Endangered	Endangered	S1	Resident
Lasiurus cinereus	Hoary bat	Endangered	-	-	SUB, S1M	Migratory
Lasiurus borealis	Eastern red bat	Endangered	-	-	SUB, S1M	Migratory
Lasionycteris novtivagans	Silver-haired bat	Endangered	-	-	SUB, S1M	Migratory
Eptesicus fuscus[1]	Big brown bat	-	-	-	SNA	Migratory

[1]There are very few records of big brown bats in Nova Scotia with Nova Scotia being outside of their documented range (Naughton 2012).

1.2 Project Area

The Project Area is bounded by the communities of Upper Kempton to the west, Comeaus Hill to the north of Earltown, and Loganville to the east, and is situated in Mount Thom, Colchester and Pictou Counties (approximate centre located at 20T 496832 m E 5045535 m N).

Bat acoustic monitoring was completed within the Project Area to confirm species presence and abundance. Acoustic bat detector locations stationed within the Project Area are provided in Drawing 1 (Appendix A).

1.3 Project Team

A Project Team consisting of terrestrial ecologists proficient in bat identification were selected to complete the field studies and reporting for these surveys. Team members with integral roles in the surveying, reporting, and project management are listed below (Table 1.2).

Table 1.2: Project Team

Team Member	Role and Duties
Melanie Juurlink, BSc., MREM	Senior review, project management, regulatory consultation
Nicholas Doane, BSc.	Acoustic monitor deployment
Manminder Singh MSc.	Acoustic monitor maintenance and data collection
Ryan Gardiner, BSc.	Data Analysis and Reporting

2.0 METHODOLOGY

Completion of acoustic monitoring for bats was completed between June 20 to October 31, 2023, and April 4 to June 17, 2024, through the installation of six Wildlife Acoustic SM4BAT FS Bioacoustic data sensors (SM4BAT). SM4BAT detectors record ultrasonic bat calls through a transducer (microphone), and record them on a compact flash card for later download and analysis (Wildlife Acoustics, 2019). Acoustic bat monitoring was conducted to evaluate relative activity patterns by species or species groups over the monitoring period within and adjacent to the Project Area.

The SM4BAT detectors are equipped with SMM-U1 microphones which operate omnidirectionally. The microphones were further equipped with a foam windscreen to reduce wind interference, and exposure to precipitation. Each microphone was pointed just below the horizontal to protect from precipitation while maximizing the volume of detection. The distance of microphone sensitivity to ultrasonic calls is subject to multiple design and environmental factors, with the dominant factor being the atmospheric absorption of frequencies. Manufacture estimates state that the SMM-U1 microphone has a spherical detection volume with a 22.1m radius for 40 kHz frequencies, which increases (38.8 m) for lower (20 kHz) and decreases (6.5 m) for higher (100 kHz) frequencies. Prior to SM4BAT detector deployment, the SMM-U1 microphones were calibrated to the manufacturer's specifications.

All SM4BAT detectors operate in waterproof casements and are powered by 4 D-Cell batteries. Data was downloaded and the function of all SM4BAT detectors was checked at approximately two-week intervals during their operational period.

Detector stations were spaced approximately equidistant apart but offset to maximize east-west, and north-south movement to cover as much of the Project Area as possible, and to identify any potential flyways. Detector stations were placed prior to the Project layout being finalized.

The coordinates and operational periods of the detectors are provided in Table 2.1, and displayed on Drawing 1 (Appendix A). The detector at Bat 1 was repositioned during the Spring 2024 surveys due to the previous location being inaccessible from snow accumulation. The detector at Bat 6 was repositioned to a Meteorological tower (MET) that was installed within the Project Area following the fall 2023 surveys. The microphone at

detector location Bat 6-Fall was affixed to the MET at a height of ~30 m to capture potential bat activity within the lower reaches of the proposed turbine rotor arcs. No additional towers were available within the Project Area and microphones at detector locations Bat 1 to Bat 5 were fixed to tree limbs at heights ranging from 3 m to 4 m. Limbs surrounding the detector microphones were removed from the trees to reduce acoustic obstructions. Photos of each bat detectors and representative surrounding habitat are provided in Appendix B. Each microphone and detector were set to record from 1 hour before sunset to 1 hour after sunrise.

Table 2.1: Acoustic Bat Detector Locations and Operational Periods

Detector ID	UTM Coordinates (Zone 20 T)		Monitoring Commenced	Active Detector Nights	Monitoring Ended	Habitat Description
	Easting	Northing				
Bat 1- Fall	498113	5044782	Sept 7, 2023[1]	29	Oct 16, 2023	Open hardwood forest adjacent a logging road
Bat 1 - Spring	498940	5044326	Apr 4, 2024	74	Jun 17, 2024	
Bat 2	495557	5046721	June 20, 2023 Apr 4, 2024	190[2]	Oct 31, 2023 Jun 17, 2024	Young mixed wood forest adjacent open field
Bat 3	493508	5048689	June 20, 2023 Apr 4, 2024	207	Oct 31, 2023 Jun 17, 2024	Mixedwood forest adjacent a logging road
Bat 4	493860	5049689	June 20, 2023 Apr 4, 2024	207	Oct 31, 2023 Jun 17, 2024	Mixedwood forest adjacent a logging road
Bat 5	492810	5050673	June 20, 2023 Apr 4, 2024	207	Oct 31, 2023 Jun 17, 2024	Open shrub land
Bat 6 - Fall	498661	5042643	Sept 13, 2023[3]	34	Oct 17, 2023	Clearcut
Bat 6 - Spring	498265	5042690	Apr 4, 2024	74	Jun 17, 2024	MET in clearcut

[1]Bat 1 malfunctioned causing data loss from June 20 to September 7, 2023.

[2]Bat 2 malfunctioned causing data loss from April 23 to May 10, 2024.

[3]Bat 6 was added to the survey program at the request of NSNRR on September 13, 2023.

Two specialized software systems, Kaleidoscope Pro and Analook, were used by the undersigned to identify recorded bat files to species or species group. Kaleidoscope Pro (KSPro) uses sophisticated modelling to match recorded calls to an internal reference library, similar to voice recognition techniques. Analook was used to construct frequency/time graphs from the bat calls recorded by the SM4BAT detectors. For each call, the slope, maximum frequency (i.e., the highest frequency), minimum frequency (i.e., the lowest frequency), and duration were determined, as those variables are believed to be species-specific. Each variable was then compared with a library of reference calls collected from

individual bats that had been identified to species. Subsequently, the data was reviewed by a qualified biologist to define the species producing the bat call.

Bat calls (call) were defined as a single, recognizable vocalization from one bat, and a bat pass (pass) as one or more sequential calls, representing calls from a single bat, recorded in one SM4BAT digital file. To best determine bat counts (number of individual bats), multiple bat passes of the same species were grouped as one individual bat if the bat passes occurred within the same 1-minute time block. The 1-minute time block was selected as it provides the most appropriate time scale reflective of subtle changes in bat activity (Miller, 2001).

When calls could be identified to species, they were classified as:

- EPFU – Eptesicus fuscus (big brown bat);
- LABO - Lasionycteris borealis (eastern red bat);
- LACI - Lasiurus cinereus (hoary bat);
- LANO - Lasionycteris noctivagans (silver-haired bat);
- MYLU - Myotis lucifugus (little brown myotis);
- MYSE - Myotis. Septentrionalis (northern myotis); and
- PESU - Perimyotis subflavus (tri-colored bat).

Due to insufficient Calls/Pass or overlap in identifying call characteristics, passes that could not be identified to species were grouped into the following categories:

- Myotis – (MYLU, MYSE).
- HighF – High frequency bats (LABO/PESU/Myotis).

Once identified, bat passes were analyzed for peak seasonal and temporal activity periods observed in the Project Area. Further analysis was completed to determine the abundance of migratory species (i.e., those at higher risk for mortality). Along with the identified migratory species, the HighF species group is also considered in the migratory analysis as a conservative measure, as this group has the potential to contain eastern red bat.

3.0 RESULTS

Data was analyzed from all six bat detectors, the results of which are provided in Table 3.1. Summaries of total bat passes per detector night, average bat passes per detector night, and total presence for each species across the six monitoring locations is provided.

Table 3.1. Bat Species Identified per Detector Location within the Project Area

Species / Species Group	Bat Detector						Total
	Bat 1	Bat 2	Bat 3	Bat 4	Bat 5	Bat 6	
LABO[1]	0	1	1	0	0	0	**2**
LACI[1]	0	2	3	4	2	0	**11**
MYLU	0	1	0	0	1	0	**2**
Myotis	0	3	4	5	2	2	**16**
Total	**0**	**7**	**8**	**9**	**5**	**2**	**31**
Detector Nights	103	190	207	207	207	108	1,022
Average counts per detector night	0	0.04	0.04	0.04	0.02	0.02	0.03

[1]*Considered a migratory species*

During the monitoring period, there were a total of 31 bat passes recorded by six detectors. Of the 31 passes, 13 were of migratory species (silver-haired bat and hoary bat). Activity at the detectors sites was variable, ranging from 0 total passes at Bat 1 to 9 total passes at Bat 4 across the survey period. The average total passes per detector night for the Project Area over the entire survey period for all species was 0.03. The average migratory passes per detector night for the Project Area over the entire survey period was observed to be 0.01.

Migratory species or species group comprised 42% of the bat passes recorded. The most common species groups recorded during the monitoring period was the myotis species group (52%) followed by hoary bat (35%), with little brown bat and silver-haired bat equally comprising the remaining 13% of bat passes observed.

During the Fall 2023 monitoring period (June 20 to October 31, 2023), bat activity was first recorded on June 20, 2023. Bat activity peaked on August 10, with five bat passes occurring in a single night. Following the peak in bat activity on August 10, 2023, bat activity remained low with only one to two observations across 11 nights up until the last recorded observation on October 27, 2023.

During the Spring 2024 monitoring period (April 4 to June 17, 2024), bat activity was limited to only four observations that all occurred on separate days. Bat activity was first observed on May 4, 2024.

Seasonal bat activity levels across the Project Area are displayed in Figure 3.1 and 3.2.

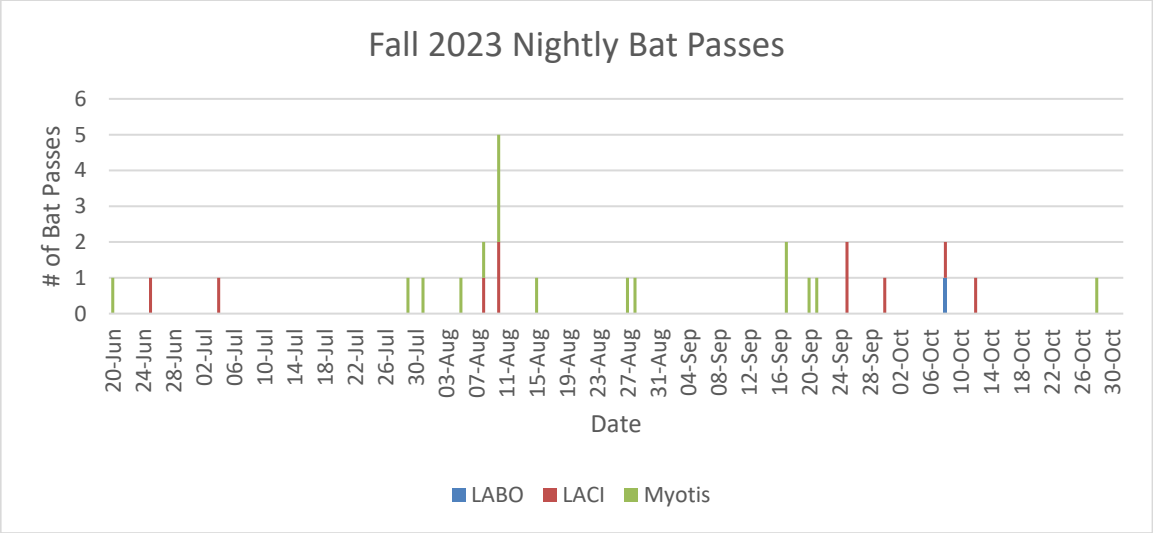

Figure 3.1: Nightly Bat Passes Across the Project Area during Fall 2023 Survey Period

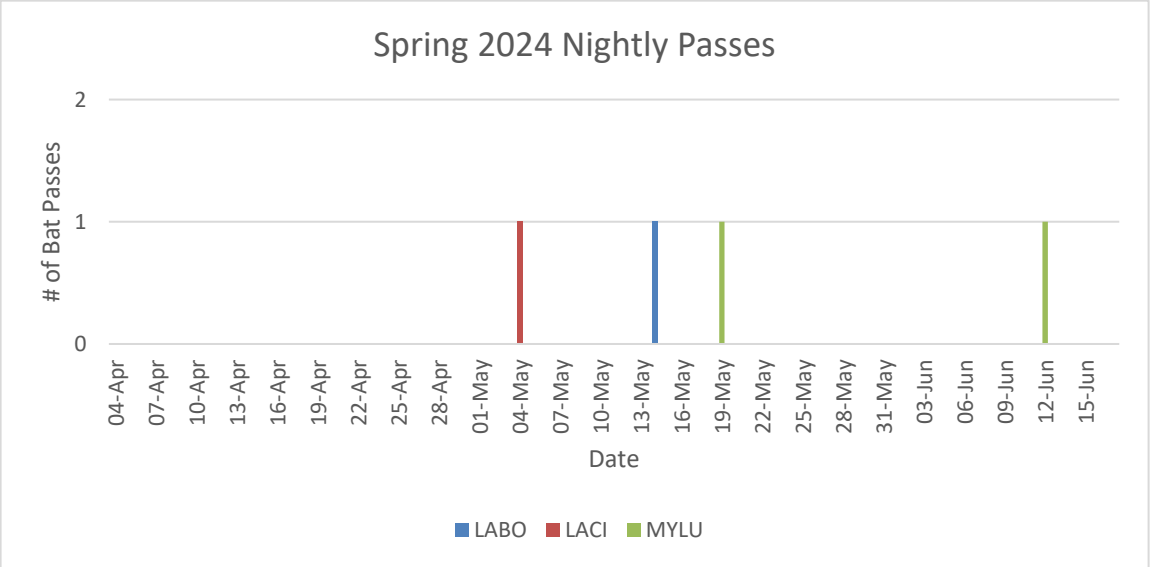

Figure 3.2: Nightly Bat Passes Across the Project Area during Spring 2024 Survey Period

Across the results, bat activity was first observed near dusk (7:00 pm), steadily increasing through the first few hours after sunset (9:00 pm to 11:00 pm), after which activity dropped with and remained low before tapering off and ceasing a few hours before sunrise (4:00 am). Nightly temporal distribution of bat activity is provided in Figure 3.3.

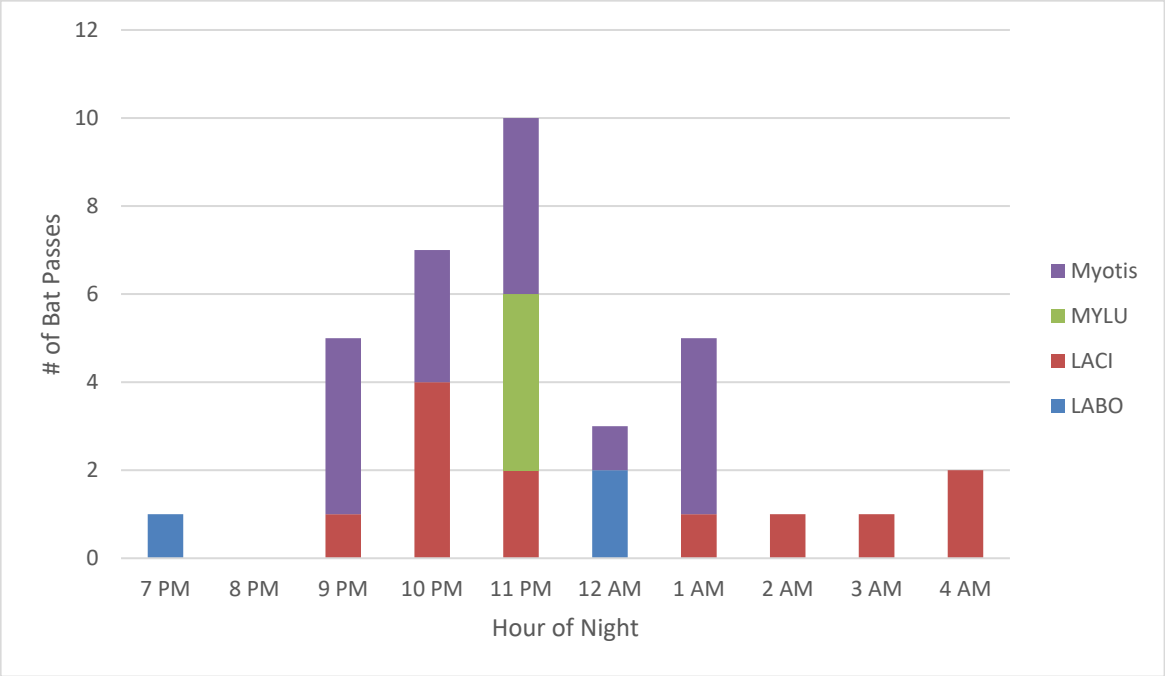

Figure 3.3: Temporal Distribution of Nightly Bat Activity within the Project Area

4.0 SUMMARY

There are low levels of bat activity across the Project Area with a total of 31 bat passes recorded via six bat acoustic detectors between June 20, 2023, and October 31, 2023, and April 4, 2024, to June 17, 2024. Migratory species or species groups comprised 42% of recorded bat passes, and were predominantly determined to be hoary bats. Peak bat activity occurred on August 10, 2024, with a total of five bat passes recorded in a single night. The average total passes per detector night for the Project Area over the entire survey period for all species was 0.03.
On average 0.01 migratory passes per detector night occurred for the Project Area from June 20, 2023, to October 31, 2023, and from April 4, 2024, to June 17, 2024.

Based on precautionary guidance from the Alberta Government, the average of 0.01 migratory passes per detector night observed across the Project Area would be considered a potentially acceptable risk.

5.0 LIMITATIONS

The following limitations are present for the bat acoustic monitoring program:

- Bat detectors were placed prior to Project layout being finalized.
- Bat passes do not necessarily represent individuals as multiple recordings could be from the same bat.
- The extent of bat detector coverage is less than the total Project Area.
- Bat detector microphones can only reliably detect calls within a range of 40 m.

6.0 CLOSING

This report has been prepared to support the Project's development and understand bat species presence and activity use across the Project Area. This report will support the necessary mitigation sequence to reduce or avoid impacts to bats where possible through the Project's EARD.

This report has considered relevant factors and influences pertinent within the scope of the assessment and has completed and provided relevant information in accordance with the methodologies described.

7.0 STATEMENT OF QUALIFICATIONS AND LIMITATIONS

This Report (the "Report") has been prepared by Strum Consulting ("Consultant") for the benefit of Clydesdale Holdings Ltd. (Client") in accordance with the agreement between Consultant and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations, and conclusions contained in the Report (collectively, the "Information"):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations")
- represents Consultant's professional judgement in light of the Limitations and industry standards for the preparation of similar reports
- may be based on information provided to Consultant which has not been independently verified
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued
- must be read as a whole and sections thereof should not be read out of such context
- was prepared for the specific purposes described in the Report and the Agreement
- in the case of subsurface, environmental, or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time

Consultant shall be entitled to rely upon the accuracy and completeness of information that was provided and has no obligation to update such information. Consultant accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental, or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

Consultant agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but Consultant makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

The Report is to be treated as confidential and may not be used or relied upon by third parties, except:

- as agreed in writing by Consultant and Client
- as required by law
- for use by governmental reviewing agencies

Consultant accepts no responsibility, and denies any liability whatsoever, to parties other than Client who may obtain access to the Report or the Information for any injury, loss, or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information ("improper use of the Report"), except to the extent those parties have obtained the prior written consent of Consultant to use and rely upon the Report and the Information. Any damages arising from improper use of the Report or parts thereof shall be borne by the party making such use.

This Statement of Qualifications and Limitations forms part of the Report and any use of the Report is subject to the terms hereof.

Should additional information become available, Strum requests that this information be brought to our attention immediately so that we can reassess the conclusions presented in this report. This report was prepared by Ryan Gardiner, BSc., Senior Environmental Scientist, and was reviewed by Melanie Juurlink, MREM, Senior Environmental Scientist.

8.0 REFERENCES

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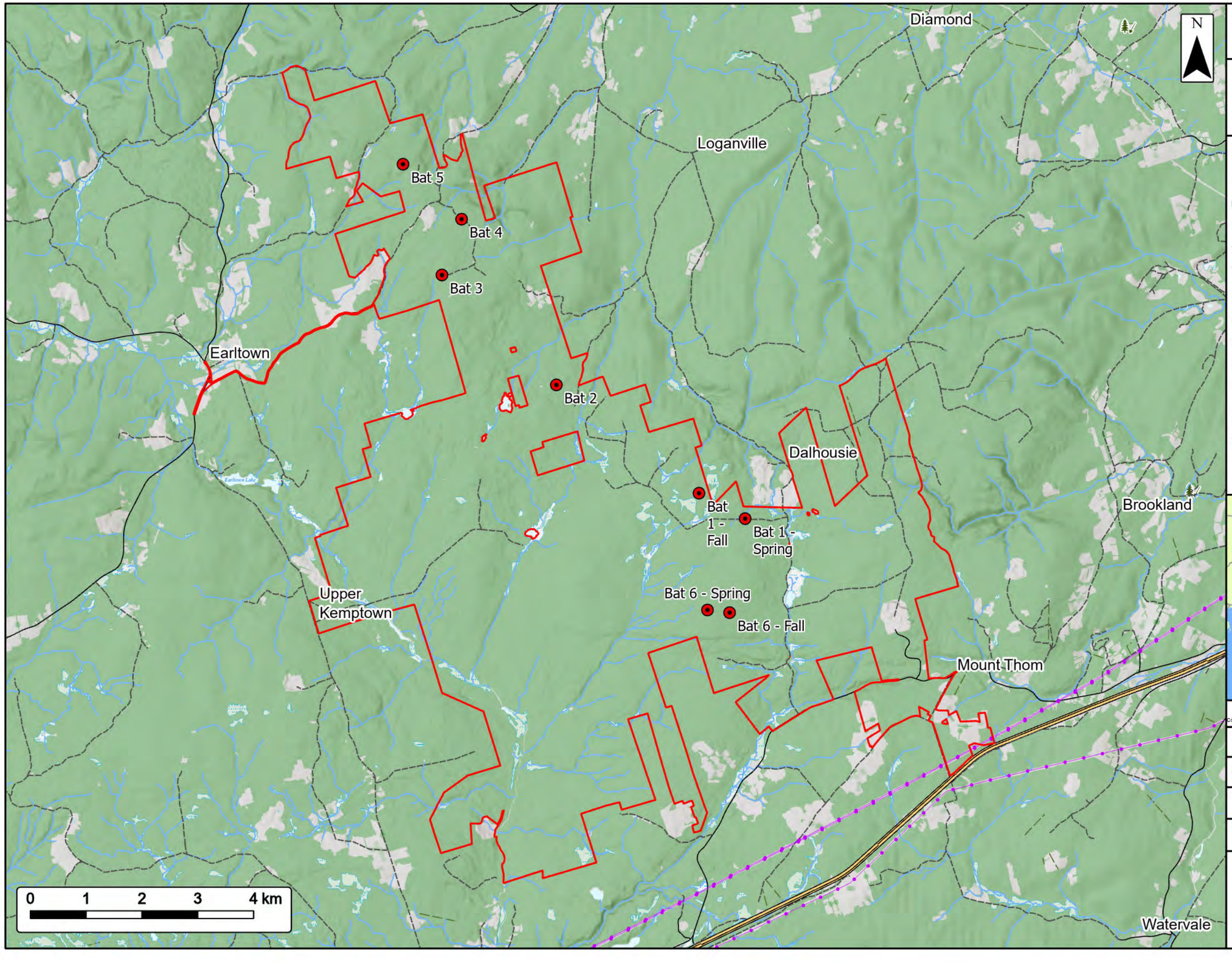
APPENDIX A
DRAWINGS

Clydesdale Ridge Wind Project

Bat Assessment

RMS energy



Project Area

Bat Monitoring Location

Utilities (line)

Existing Transmission Lines

Transportation

Trans-Canada Highway

Road

Unpaved Road

Water Features

Mapped Stream

Mapped Indefinite Stream

Mapped Lakes and Rivers

Mapped Wet Areas

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, SNSIS, NSNRR, ACCDC, IBA Canada, CNWI, HERE, Garmin, USGS

Date: Jul 2024	Project #: 24-10018
Scale: 1:65,000	Drawing #: 1
Drawn By: K. Wallace	
Checked By: M. Juurlink	

strum CONSULTING

APPENDIX B
PHOTOLOG

Photo 1: Bat 1 microphone installed on tree branch

Photo 2: Representative habitat surrounding Bat 1

Photo 3: Bat 2 microphone installed on tree branch

Photo 4: Representative habitat surrounding Bat 2

Photo 5: Bat 3 microphone installed on tree branch

Photo 6: Representative habitat surrounding Bat 3

Photo 7: Bat 5 installed on tree

Photo 8: Representative habitat surrounding Bat 5

Photo 9: Bat 6 microphone installed on MET

Photo 10: Representative habitat surrounding Bat 6

APPENDIX H
CLYDESDALE RIDGE WIND 2022 AND 2023 RADAR AND ACOUSTIC MONITORING

Final Report

Clydesdale Ridge Wind 2022 and 2023 Radar and Acoustic Monitoring

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May 22, 2024

Document Control			
Lead Author	Florian Reurink	**Contributing Author(s)****	Lorraine Andrusiak, Phil Taylor
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Version Control			
Version	**Date**	**Issued by**	**Description**
1.0	2024 January 24	Florian Reurink	Draft to Client
1.3	2024 May 22	Robert McMahon	Final to Client

Disclaimer

This work was performed in accordance with the Professional Services Agreement dated 29 of March 2023 (Contract) between Ausenco Sustainability ULC, a wholly owned subsidiary of Ausenco Engineering Canada Inc. (Ausenco), and Clydesdale Wind LP Ltd (Client). This report has been prepared by Ausenco, based on fieldwork conducted by Ausenco, for sole benefit and use by the Client. In performing this work, Ausenco has relied in good faith on information provided by others and has assumed that the information provided by those individuals is both complete and accurate. This work was performed to current industry standard practice for similar environmental work, within the relevant jurisdiction and same locale. The findings presented herein should be considered within the context of the scope of work and project terms of reference; further, the findings are time sensitive and are considered valid only at the time the report was produced. The conclusions and recommendations contained in this report are based upon the applicable guidelines, regulations, and legislation existing at the time the report was produced; any changes in the regulatory regime may alter the conclusions and/or recommendations.

Table of Contents

List of Tables (Within text)

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List of Appendices

List of Acronyms and Abbreviations

Acronym / Abbreviation	Definition
AI	Artificial Intelligence
agl	above ground level
Ausenco	Ausenco Sustainability ULC
COSIWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
EA	Class I Environmental Assessment
ECCC	Environment and Climate Change Canada
FLAC	Free Lossless Audio Codec
GB	Gigabyte
IAA	Impact Assessment Agency of Canada
MBCA	*Migratory Bird Convention Act* [SC 1994, c. 22]
MBR	Migratory Bird Regulations (SOR /2022-105)
NCEP	National Centre for Environmental Prediction
NFC	nocturnal flight call(s)
NS Environment	Nova Scotia Department of Environment and Climate Change
NS ESA	Nova Scotia *Endangered Species Act* [SNS 1998, c. 11]
NSDLF	Nova Scotia Department of Lands and Forestry
rpm	revolutions per minute
RSZ	rotor-swept zone
SARA	*Species at Risk Act* [SC 2002, c. 29]
SD	secure digital
SSD	solid-state drive

List of Symbols and Units of Measure

Symbol / Unit of Measure	Definition
kHz	kilohertz
km	kilometre
kW	kilowatt
m	metre
MW	megawatt
MHz	megahertz

1.0 Introduction

Clydesdale Wind LP Ltd (Client) retained Ausenco Sustainability ULC (Ausenco), to conduct radar and acoustic monitoring of nocturnal migratory birds at the proposed Clydesdale Ridge Wind Project (the Project) in 2022 and 2023. Ausenco conducted this work with the technical support of Dr. Phil Taylor of Tabanid Consulting Ltd. The Project is being developed by a partnership between Natural Forces and Rotor Mechanical Services Co. (RMS) (the Partnership c/o RMS).

This report provides a summary of the data collected during two years of monitoring over four seasons, during the spring and fall of 2022 and 2023. The primary objective of this study was to measure and describe the general patterns of nocturnally migrating birds at the Project site prior to construction. Flight patterns of birds were evaluated by comparing the total flight volumes across the migratory periods and comparing the flight volumes within and above the proposed rotor-swept zone (RSZ), which is the area between lowest and highest rotor tip height.

1.1 Project Details

The Project is located 6.5 kilometres (km) northeast of Earltown in Colchester County in northern Nova Scotia (NS), approximately 30 km northeast of the Town of Truro (**Figure 1.1**). The Project design includes 10 to 16 turbines, each with an individual energy capacity of between 4.2 and 7.0 megawatts (MW). Turbine models being considered include, but are not limited to, the Nordex 6.X or the Enercon E-138. The Nordex is the larger of the two and has an approximate maximum height of 200 metres (m) above ground level (agl), which includes a tower height of 120 m and a blade length of approximately 80 m. The total Project rated capacity will be up to 70 MW.

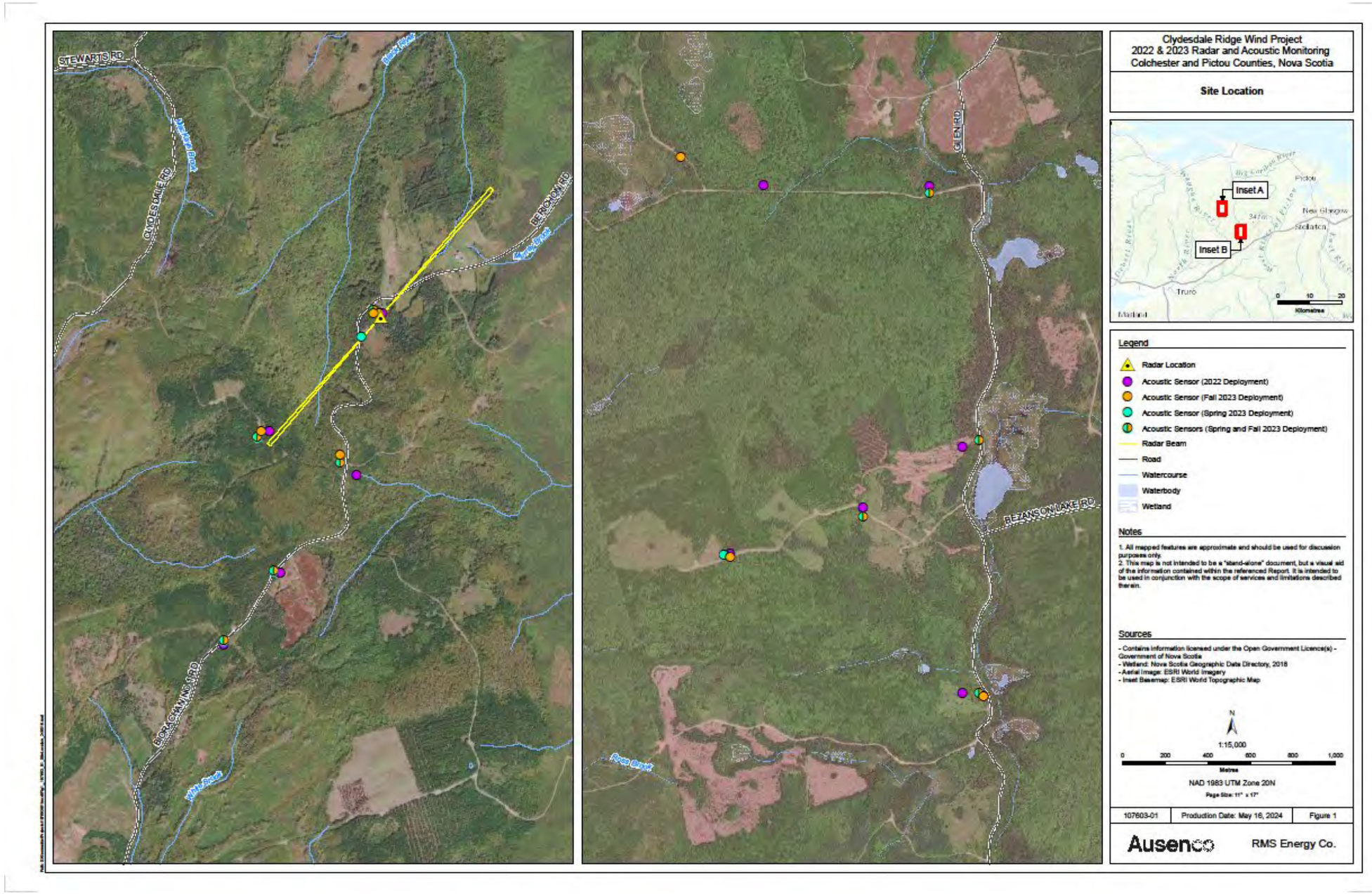


Figure 1.1 Project Area

1.2 Regulatory Context

Nova Scotia

The Nova Scotia *Environment Act* [SNS 1994-95, c 1] requires all wind energy projects that produce at least 2 MW of energy to submit a Class I Environmental Assessment (EA) to the NS Department of Environment and Climate Change (NS Environment). An EA registration document must be prepared and assessed by the EA Branch of NS Environment. Avian radar study is required for projects that include turbines greater than 150 m in height (Nova Scotia Government 2021). Radar baseline studies should be designed in consultation with the Canadian Wildlife Service of Environment and Climate Change Canada (ECCC-CWS) and NS Environment. The following guidance document has been used to implement the regulatory requirements into this report: *Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia* (NSEAB 2021).

Federal

Key federal legislation relevant to environmental aspects of wind energy development includes the *Migratory Bird Convention Act* [SC 1994, c 22] (MBCA), the Migratory Bird Regulations [SOR/2022-105] (MBR), and the *Species at Risk Act* [SC 2009, c 29] (SARA), particularly Schedule 1 of the Act (COSEWIC 2021). Additional statutes under the jurisdiction of NAV Canada, Transport Canada, and Natural Resources Canada may also be relevant to wind energy development. A federal EA pursuant to the *Impact Assessment Act* [SC 2019, c. 28, s. 1] (IAA; Government of Canada 2019) is not required for land-based wind project development in Canada. Sections 42 through 45 of the Physical Activity Regulations under the IAA [SOR 2019-285] identify thresholds for renewable energy facilities. Recently, the Supreme Court of Canada found that the Physical Activity Regulations are in part unconstitutional. At the time of writing, no new projects are being assessed under IAA until new regulations are in place.

Key federal regulatory requirements relevant to environmental studies for wind energy development include *Wind Turbines and Birds: A Guidance Document for Environmental Assessment* (Government of Canada 2007a)*, Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds* (Government of Canada 2007)*,* and *CWS Atlantic Region – Wind Energy & Birds Environmental Assessment Guidance Update* (Government of Canada 2022). The latter document was prepared by ECCC-CWS Atlantic Region to provide updated standards and best approaches related to impact assessment for wind energy development in Atlantic Canada. ECCC-CWS Atlantic Region recommends using radar and acoustic monitoring during the spring and fall migration periods, in addition to standard avian surveys, for a minimum of 2 years of consecutive monitoring. These monitoring periods are designed to facilitate an assessment of impacts to multiple avian species groups which use coastal regions.

2.0 Methods

This study uses radar and acoustic monitoring to evaluate the species and numbers of birds that migrate through the Project area during spring and fall migration. The methods used to collect and analyse radar and acoustic data at the Project are described in the following sections.

2.1 Radar Monitoring

The purpose of radar monitoring was to characterize the volume (i.e. the passage rate) and the flight height of nocturnal migrating birds in the Project area. Radar is a technology which uses electromagnetic energy to measure the distance and position of objects, also known as targets, relative to the instrument. Biologists use this technology to record the presence and height of migrating birds at night, which cannot be observed with the unaided eye. Radar data are used in conjunction with acoustic data to assess the potential risk to birds interacting with an operational wind facility in the future.

2.1.1 Radar Data Collection

Automated radar monitoring was conducted during the 2022 and 2023 spring and fall migration season. The radar was programmed to begin operation approximately 30 minutes before sunset, which is when nocturnal migrants generally initiate nightly flights (Alerstam et al. 1990). The radar was programmed to end operation approximately 30 minutes after sunrise. Radar data were collected in 10-minute increments, three times each hour, throughout the night. The location of the radar was selected based on availability of participating landowners to host the radar, access throughout the Project area, site security, and clear sight lines with minimal clutter to get a representative sample of the nocturnal migrants that pass over and through the Project area. The radar was oriented perpendicular to the anticipated flight direction to maximize the likelihood of target detection (**Figure 1.1**).

Ausenco employed a Furuno 1962 BB marine radar operating in the microwave X-band (9410 ± 30 megahertz (MHz), 25 kilowatt (kW)) with a 1.8 metre XN13A open-array antenna. This system has a beam width of approximately 22 degrees in the horizontal plane and approximately 1.35 degrees in the vertical plane. The radar was mounted on a custom support framework in a vertical orientation, which allows for a more accurate measurement of flight elevation compared to a horizontal orientation. The radar ran in a short pulse mode (2100 pulses per second) at 24 revolutions per minute (rpm). The top of the radar was oriented at 19 degrees from true north, which meant that the radar beam was projecting 289 and 109 degrees from true north. The radar signal was digitized at 4.5 m range resolution with an azimuth resolution of 1.35 degrees using a DSPNOR ScanStreamer (Bergen, Norway). Before deployment, the radar was calibrated in a horizontal orientation using targets set at a known distance.

It is important to note that the total number of targets detected includes all organisms using the airspace above the radar, which may include birds, bats, and insects. Our radar data filtering approach is not able to remove all non-bird targets, which is why this report refers to targets rather than birds when presenting radar results. Methods to identify and remove non-avian targets are described in **Section 2.1.2**.

The radar registers movement of targets from 70 m up to approximately 1000 m agl. This radar system has been an effective tool to evaluate migration activity in the Atlantic Region over the past three years.

The system has been proven to provide an adequate representation of target flight volume and flight heights at two other wind energy projects (Ausenco 2022; Hemmera 2021).

Raw radar data (i.e. unprocessed radar scans) were stored locally on an SSD (solid-state drive) during the sampling period. At the end of each field season, raw radar data were copied to external hard drives and archived. Raw radar data were processed locally throughout the sampling period. Processed data were uploaded to a remote server each hour as described below.

2.1.2 Radar Data Processing

Radar processing is a two-step process: 1) autonomous hourly processing during recording in the field and 2) secondary data cleaning after the radar data has been uploaded.

During the first step of radar data processing, radar scans are processed using standalone software that captures radar sweeps. Radar sweeps are numerical data from a single rotation of the antenna. Every hour, radar sweeps are automatically amalgamated and converted into blipmovies, which are a data format similar to a video, using the open-source software package radR (Taylor et al. 2010). The processed data include an associated SQLite database of target detections. The parameters for these locally processed data are liberal, in the sense that they include radar clutter and smaller non-bird and non-bat targets. Radar clutter is defined as surfaces or particles such as grass, trees, water, clouds, or atmospheric particles, etc. which obscure target detection.

During the second step of radar data processing, blipmovies are processed again with radR using more conservative parameters to eliminate radar clutter and non-bird targets. These parameters vary by site, so professional judgment is required to effectively filter out unwanted data while retaining a sufficiently large sampling area. The data are also filtered to include only detections within an 'area' that is a specific distance from the radar, thus effectively capturing the activity in a vertical column a set distance from the radar. This step helps reduce bias caused by the radar beam sampling a larger area of space at greater ranges. Finally, periods of heavy rain are filtered from the processed dataset using automated methods because targets cannot be detected in the presence of rain. Rain is readily identified by sharp changes in the presence of targets, such that very large numbers of targets occur at all altitudes, and usually appear quite suddenly. Analysts examine processed radar files to validate the presence of rain. In addition, targets below 70 m agl are filtered out because they are often masked by ground clutter and are located below the RSZ of turbines determined based on the turbine models currently proposed for the site. The remaining targets form the dataset used for further analysis and data visualization.

Representative nights with large numbers of radar and acoustic detections were selected to illustrate the different migration activity patterns observed throughout the study. The seasonal radar datasets are provided in a visual format in the appendices to this report: the 2022 spring dataset is in **Appendix A**; the 2022 fall dataset is in **Appendix B**; the 2023 spring dataset is in **Appendix C**; the 2023 fall dataset is in **Appendix D**.

2.2 Acoustic Monitoring

Automated acoustic monitoring sensors were used to assess the composition of bird species migrating through the Project area. The acoustic sensors detect and record nocturnal flight calls (NFC) of migratory

birds with a microphone as the birds fly through the microphone's detection cone. These data are used in conjunction with the radar data to assess presence of species and species groups at the Project.

2.2.1 Acoustic Data Collection

AudioMoth™ full-spectrum acoustic recorders were deployed to detect migrating bird calls at 11 sampling locations in the Project area (**Figure 1.1**) which had a clear view of the sky. Acoustic data collection occurred each night during the spring and fall migration in 2022 and 2023. Acoustic recordings were programmed to start at 30 minutes before sunset, which is when nocturnal migrants generally start flight (Alerstam 1990) and to end 30 minutes after sunrise, which prevents interference with daytime calls of non-migratory birds (Smith et al. 2014).

Recordings were made in 10-minute increments, three times each hour, throughout the night to align with radar data collection. Acoustic data were recorded at a sample rate of 32 kHz to allow NFC to be filtered at a frequency range of 0-16 kHz, which is the typical range of passerine NFC (Evans and O'Brien 2002). The recording units were checked approximately every 30 days to replace batteries and download data onto an external hard drive. The recording units have a maximum detection range of approximately 200 m, which is within the range of the RSZ for turbines under consideration for the Project (i.e. 40 to 200 m agl). Acoustic data were stored locally on 64 GB (Gigabyte) micro-SD (secure digital) cards. Data cards were retrieved monthly; a new data card is swapped in the field, and the used card is returned to the lab. All SD cards are uniquely identified with a 4-digit number which is recorded upon deployment and associated with a given recording unit and location.

When SD cards are returned to the lab, analysts copy the data stored on each card into folders on a portable drive with the same name as the SD card. These files are then bulk processed to create a set of new files that are compressed using Free Lossless Audio Codec (FLAC) format. The compressed files are also renamed using a master metadata spreadsheet, such that each file retains its original timestamp, but also includes a site name, unit number and the site's latitude and longitude. This information is used in subsequent audio manipulation.

2.2.2 Acoustic Data Processing

Bird species and species groups were identified from the acoustic recordings using an AI (Artificial Intelligence) model trained on ~12,000 0.5 sec clips of classified NFCs validated by Tabanid Consulting. The model was built using OpenSoundScape V0.90 (Lapp et al. 2023; www.opensoundscape.org). Score thresholds were determined separately for each species by calculating precision-recall curves using the yardstick package in program R (R Core Team 2021).

From these curves we determined a score threshold for each species, where the 'recall' (the proportion of calls that are truly positive that were identified as such) exceeded 0.7. For each of these thresholds, the 'precision' (the proportion of the calls classified as true that were actually true) was then calculated. For most species, precision exceeded 0.9 (that is, the model classified these calls very well). Herein, we only report on species where model precision exceeded 0.5.

The model was subsequently run across all recordings obtained from all units at the site. Model precision and recall can change when a model is presented with novel data (recordings from new locations, or using new equipment) so, we further validated the results by sampling calls for each species that exceeded

the value of two units below the threshold calculated above. Samples were obtained using a stratified random approach, with up to five calls selected for each week of the year, recording unit, and score group (calculated by rounding the score to the nearest two units). These samples were then manually confirmed as valid (or not) and provided a means of estimating the precision and recall for the novel data.

We then selected a new threshold for each species, as above, but with a minimum recall of 0.85, and filtered all detections of all calls from all recording units at the site that exceeded that threshold. For the most part, precision was near 1.0 for this set; species were dropped where precision was less than 0.5. A full list of species detected (and retained), along with estimated values of precision and recall used for each, are presented in **Table 2.1**. For auditory and visual examples of these calls for each species group see Rhinehart et al. (2022).

Table 2.1 Nocturnal Flight Call Species Categories

Species Categories	Potential Species
Cup-Sparrows	• Chipping Sparrow (*Spizella passerina*) • Field Sparrow (*Spizella pusilla*) • American Tree Sparrow (*Spizelloides arborea*)
Fox / Song Sparrow Complex	• Fox Sparrow (*Passerella iliaca*) • Song Sparrow (*Melospiza melodia*)
Zeeps	• Bay-breasted Warbler (*Setophaga castanea*) • Blackburnian Warbler (*Setophaga fusca*) • Blackpoll Warbler (*Setophaga striata*) • Cape may Warbler (*Setophaga tigrina*) • Magnolia Warbler (*Setophaga magnolia*) • Northern waterthrush (*Parkesia noveboracensis*) • Yellow Warbler (*Setophaga petechia*)
Single-banded downsweep	• Pine Warbler (*Setophaga pinus*) • Northern Parula (*Setophaga americana*) • Yellow-throated Warbler (*Setophaga dominica*) (very rare) • Prairie Warbler (*Setophaga discolor*) (very rare)
Double-up	• Black-throated green Warbler (*Setophaga virens*) • Tennessee Warbler (*Leiothlypis peregrina*) • Nashville Warbler (*Leiothlypis ruficapilla*) • Orange-crowned Warbler (*Leiothlypis celata*)
Thrushes – group 1	• Hermit Thrush (*Catharus guttatus*) • American Robin (*Turdus migratorius*) • Grey-cheeked Thrush (*Catharus minimus*) (very rare) • Bicknell's Thrush (*Catharus bicknelli*) (very rare) • Eastern bluebird (*Sialia sialis*) (very rare) • Wood Thrush (*Hylocichla mustelina*) (very rare)
Thrushes – group 2	• Swainson's Thrush (*Catharus ustulatus*) • Veery (*Catharus fuscescens*) • Rose-breasted Grosbeak (*Pheucticus ludovicianus*) (very rare) • Scarlet Tanager (*Piranga olivacea*) (very rare)
Full Species	Sparrows:

Species Categories	Potential Species
	▫ White-throated Sparrow (*Zonotrichia albicollis*) ▫ Savannah Sparrow (*Passerculus sandwichensis*) Warblers: ▫ American Redstart (*Setophaga ruticilla*) ▫ Black-and-white Warbler (*Mniotilta varia*) ▫ Canada Warbler (*Cardellina canadensis*) ▫ Chestnut-sided Warbler (*Setophaga pensylvanica*) ▫ Common yellowthroat (*Geothlypis trichas*) ▫ Mourning Warbler (*Geothlypis philadelphia*) ▫ Ovenbird (*Seiurus aurocapilla*) ▫ Palm Warbler (*Setophaga palmarum*) ▫ Wilson's Warbler (*Cardellina pusilla*) ▫ Yellow-rumped Warbler (*Setophaga coronata*) Other: ▫ Common Nighthawk (*Chordeiles minor*) ▫ American Woodcock (*Scolopax minor*) Poorly detected/classified: ▫ Red-breasted Nuthatch (*Sitta canadensis*) ▫ Pine Siskin (*Spinus pinus*) ▫ Golden-crowned Kinglet (*Regulus satrapa*)

2.3 Weather Data

Weather may influence migration patterns and thus alter the degree of risk to birds flying through the Project area. Weather variables were collected to assess the effects of weather on flight volumes and the proportion of flights within the RSZ. Avian migrants generally prefer to fly with positive tailwind assistance (Bagg et al. 1950; Muller 1976; Åkesson & Hedenström 2000; Peckford and Taylor 2008) and as such collision risk may be higher when strong southern winds occur during the spring migration. Rain also plays an important part in predicting migration activity. In general, flight activity is reduced during periods of rainfall (Parslow 1969; Erni et al. 2002), which is likely due to the increased energetic cost of flying in rain (Erni et al. 2002). Birds generally wait for rain to pass before continuing migration, which often leads to increased flight activity on the first day after heavy rainfall (Erni et al. 2002). In cases where birds continue flight in rain, flight heights tend to be lower in altitude which increases the risk of collision, drowning, or heat loss (Kennedy 1970; Richardson 1978).

Another factor which influences migration activity is temperature. Spring migration is generally triggered by higher and rising temperatures (Muller 1976), although temperature was found to be less consistent in predictor of migration activity than wind and rain (Richardson 1990). Atmospheric pressure, humidity and cloud cover have also been argued to influence migration intensity (Muller 1976; Richardson 1978; Akesson et al. 2001).

The following weather variables were selected to quantify weather effects on the radar and acoustic data:

- wind speed
- wind direction
- precipitation.

Weather data were acquired from the National Centers for Environmental Prediction (NCEP) and National Center for Atmospheric Research (NCAR) Reanalysis data product (NCEP-NCAR Reanalysis 1; https://psl.noaa.gov/data/gridded/data.ncep.reanalysis.html) and downloaded via the RNCEP package (Kemp et al. 2011).

2.4 Data Analysis

The two response variables in our radar data analysis are:

1. flight volume, which is the total number of targets
2. the proportion of targets within the RSZ, which is the ratio of number of targets within the RSZ compared to the number of targets above the RSZ.

Flight volume is used to describe temporal trends in targets detected at the Project location, and flight elevation is used to evaluate the likelihood of flights occurring within the RSZ. Targets were divided in two groups:

1. low-risk targets were located above RSZ (i.e. above 200 m)
2. high-risk targets were located within the RSZ (i.e. between 40 and 200 m).

Targets below 70 m were excluded from analysis because ground clutter made it impossible to reliably identify targets, as described in **Section 2.1.2**. Airspeed was calculated with the vector addition procedure called “triangle of velocities” (Pennycuick 1968), using flight direction, flight speed, wind direction and wind speed as input variables. Since the exact flight trajectory of the birds are unknown, a heading of 45 degrees was assumed for the spring migration and a heading of 225 degrees was assumed for the fall migration. Tailwind assistance is then calculated as the difference between the ground speed (speed relative to the ground) and airspeed (speed relative to the air). When a flying bird’s power output remains constant, but the wind behind the bird increases, the airspeed remains unchanged, whereas the ground speed increases. This results in a positive tailwind assistance. When wind blows against a flying bird (e.g. wind from the south during fall migration), birds experience a headwind, indicated by a negative tailwind assistance.

To determine the effect of weather on flight volume and proportion of targets within the RSZ, tailwind assistance plotted against the flight volume and proportion of targets within the RSZ. Time of night was added as additional explanatory variable and was grouped as:

- Sunset (sunset until 2 hours after sunset)
- Sunrise (2 hour before sunrise until sunrise)
- Middle (representing the remaining hours in the night).

3.0 Results

Spring migration was observed for 54 nights between April 15 and June 8, 2022, which corresponded to approximately 450 hours of recording, and for 62 nights between April 7 and June 8, 2023, which corresponded to approximately 530 hours of recording. In spring 2022 the radar could not record for two nights due to heavy rain. Fall migration was observed 138 nights between July 15 and November 30, 2022, which corresponded to approximately 1490 hours of recording, and 131 nights between July 15 and November 22, 2023, which corresponded to approximately 1380 hours of recording. In fall 2023 the radar could not record for ten nights due to heavy rain. Overall, the radar was able to record successfully during 98 percent of all spring nights and approximately 97 percent of all fall nights.

During spring migration, eleven acoustic recording units recorded successfully between April 19 and June 8, 2022. The following year, two acoustic recording units recoded successfully between April 3 and May 9, 2023 and ten acoustic recording units recorded successfully between May 9 and June 8, 2023. During fall migration, eleven acoustic recording units recorded successfully between July 14 and November 4, 2022, and ten acoustic recording units recorded successfully between July 7 and November 3, 2023. The following sections describe the observed flight volumes, flight patterns, and species composition.

3.1 Data Visualization

During the spring monitoring periods a total of 17,516 targets were detected below 250 meters in 2022, and a total of 18,855 were detected below 250 meters in 2023. The highest flight volumes were observed in early May in 2022**,** and in late April in 2023. The greatest proportion of flights within the RSZ was observed between mid- and late-May in both 2022 and 2023 (**Figure 3.1** and **Figure 3.2**).

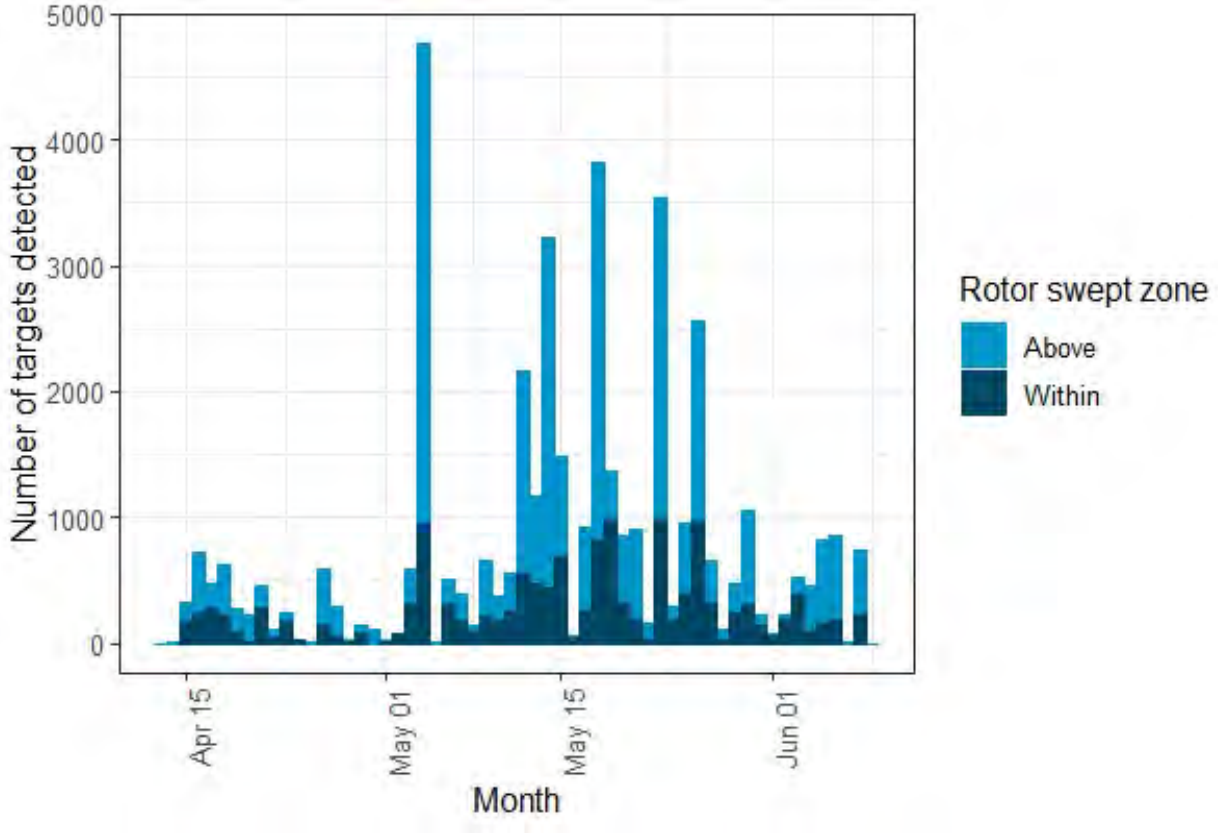


Figure 3.1 Radar Detections Per Survey Night During Spring 2022

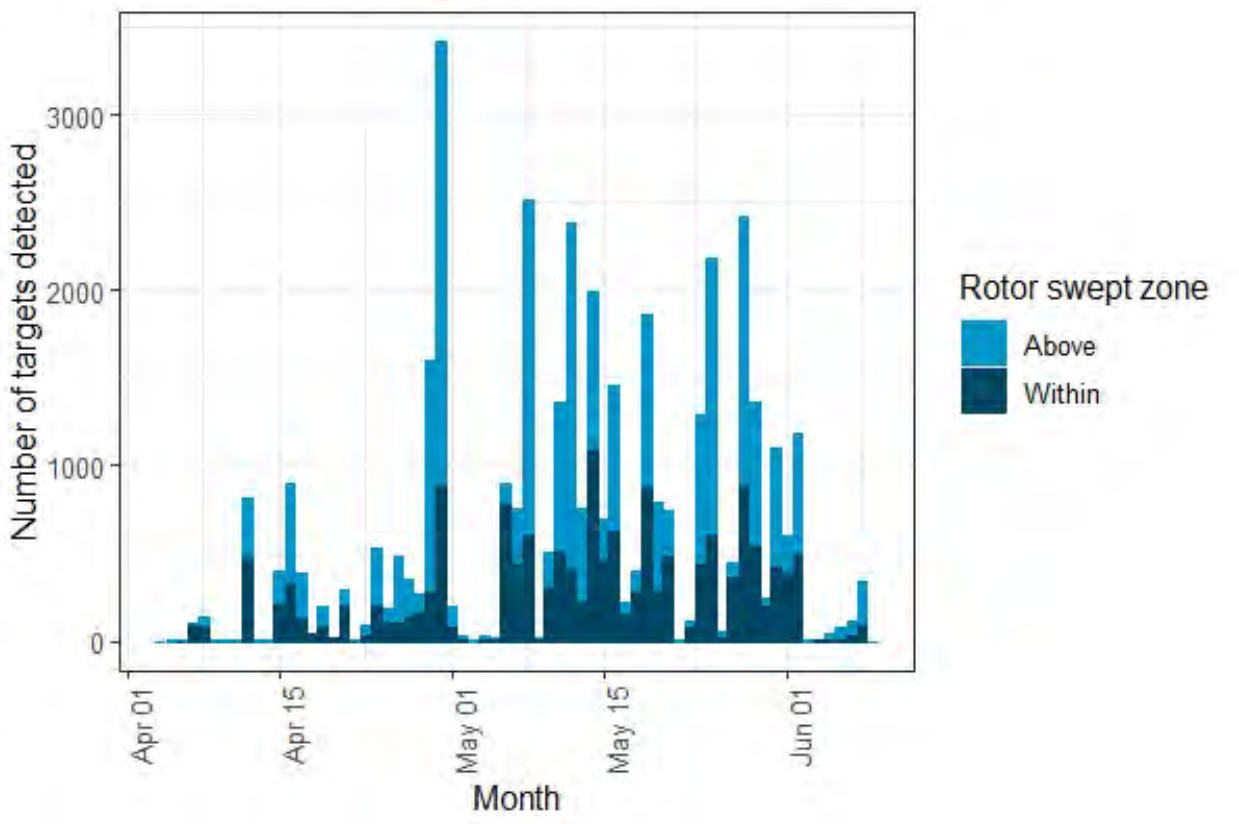


Figure 3.2 Radar Detections Per Survey Night During Spring 2023

During the fall monitoring periods a total of 34,508 targets were detected below 250 meters in 2022, and a total of 55,914 were detected below 250 meters in 2023. The highest flight volumes were observed in early August and mid-September 2022**,** and in mid-August and early October 2023. The greatest proportion of flights within the RSZ was observed between mid and late September in both 2022 and 2023 (**Figure 3.3** and **Figure 3.4**).

It is important to note that the total number of targets detected includes all organisms using the airspace above the radar, which may include birds, bats, and insects. The radar data filters cannot remove all non-bird targets (see **Section 2.1.2**).

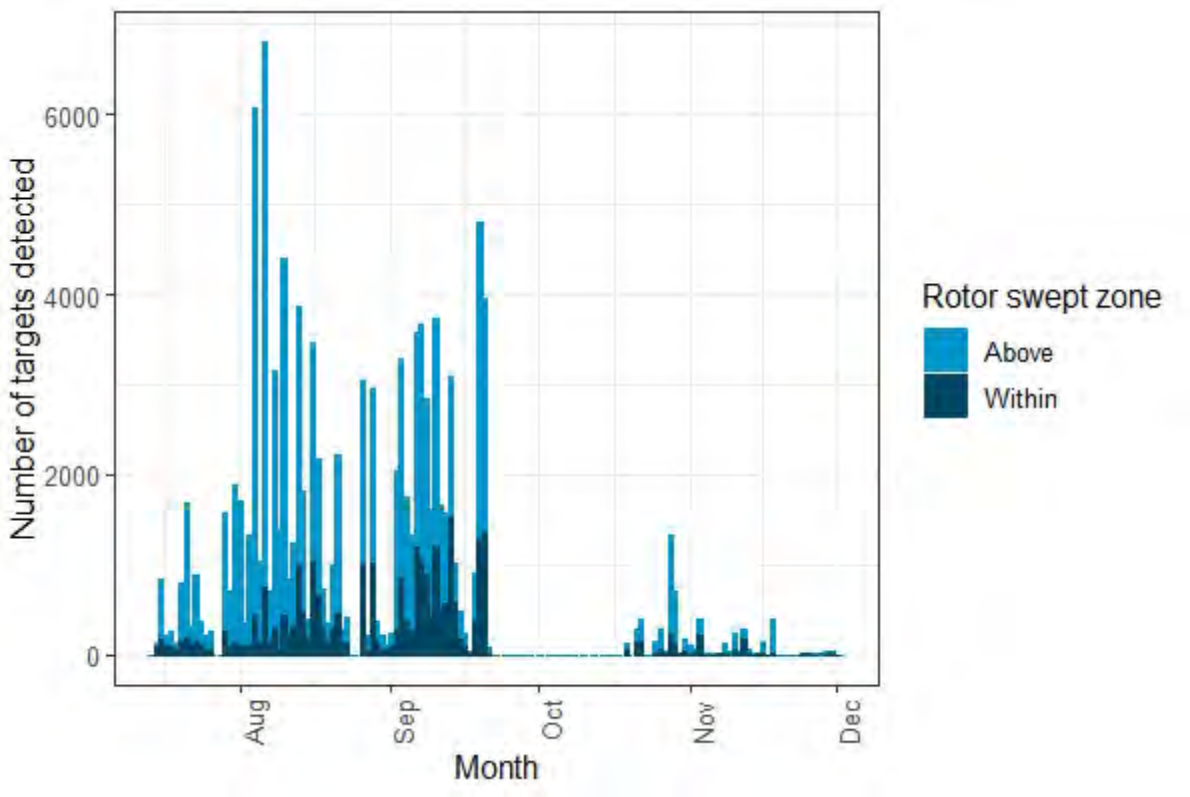


Figure 3.3 Radar Detections Per Survey Night During Fall 2022

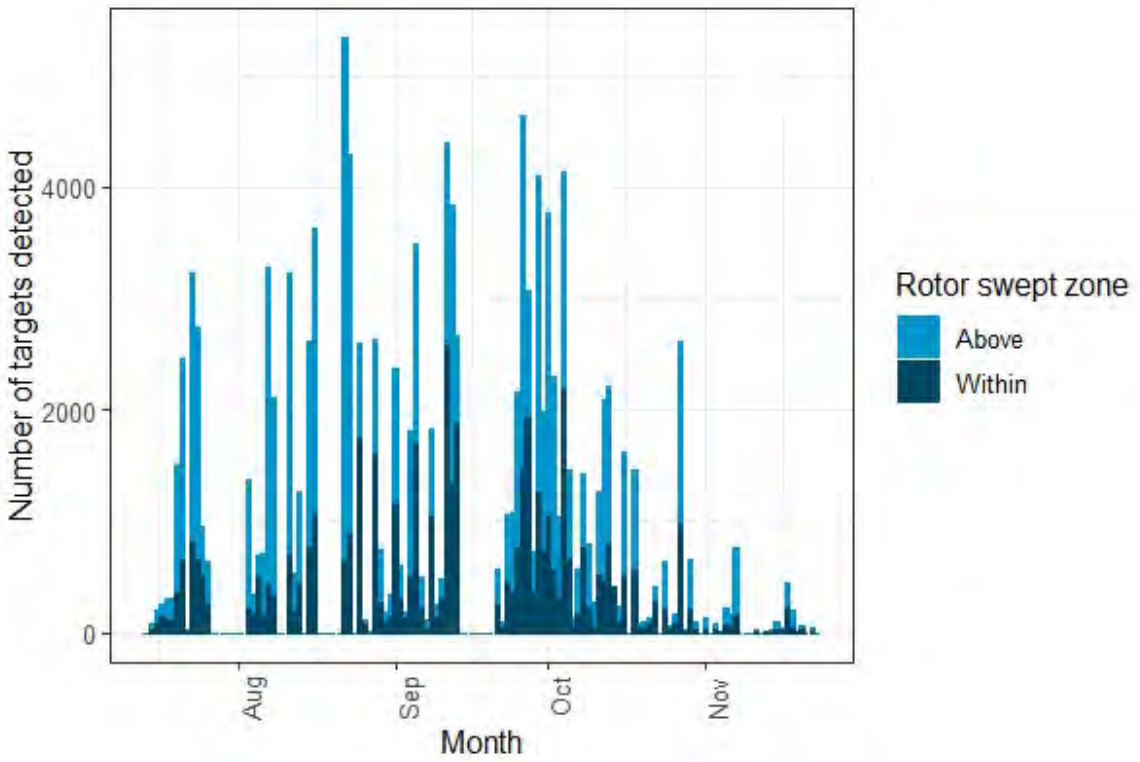
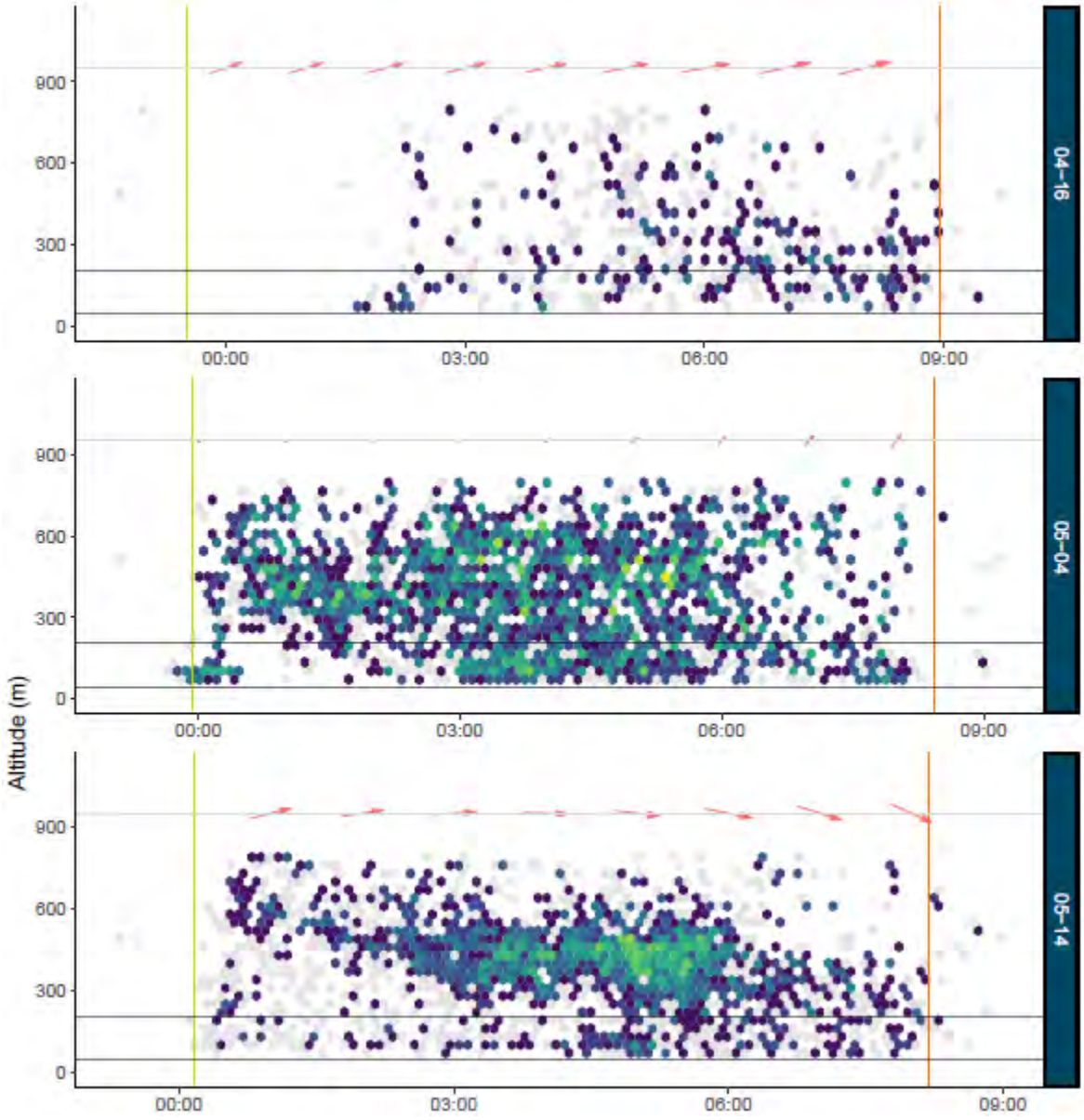


Figure 3.4 Radar Detections Per Survey Night During Fall 2023

To illustrate how flight volumes can change throughout the night, radar data have been visualized for a subset of high-volume nights. For the spring migration these nights include April 16, May 4, 14, 23, 26 and 30, 2022 (**Figure 3.5**), and April 16, 30, May 8, 12, 19 and June 2, 2023 (**Figure 3.6**). During these selected nights, flight volumes were generally high and distributed throughout the night. Note that during most nights birds experienced tailwind assistance with the wind coming mostly from the south, indicated with the red arrows at the top of the graphs. During the nights of May 14, 26 and 30, 2022 and June 2, 2023, the wind switched from a tailwind to a headwind, which generally resulted in lower flight altitudes.



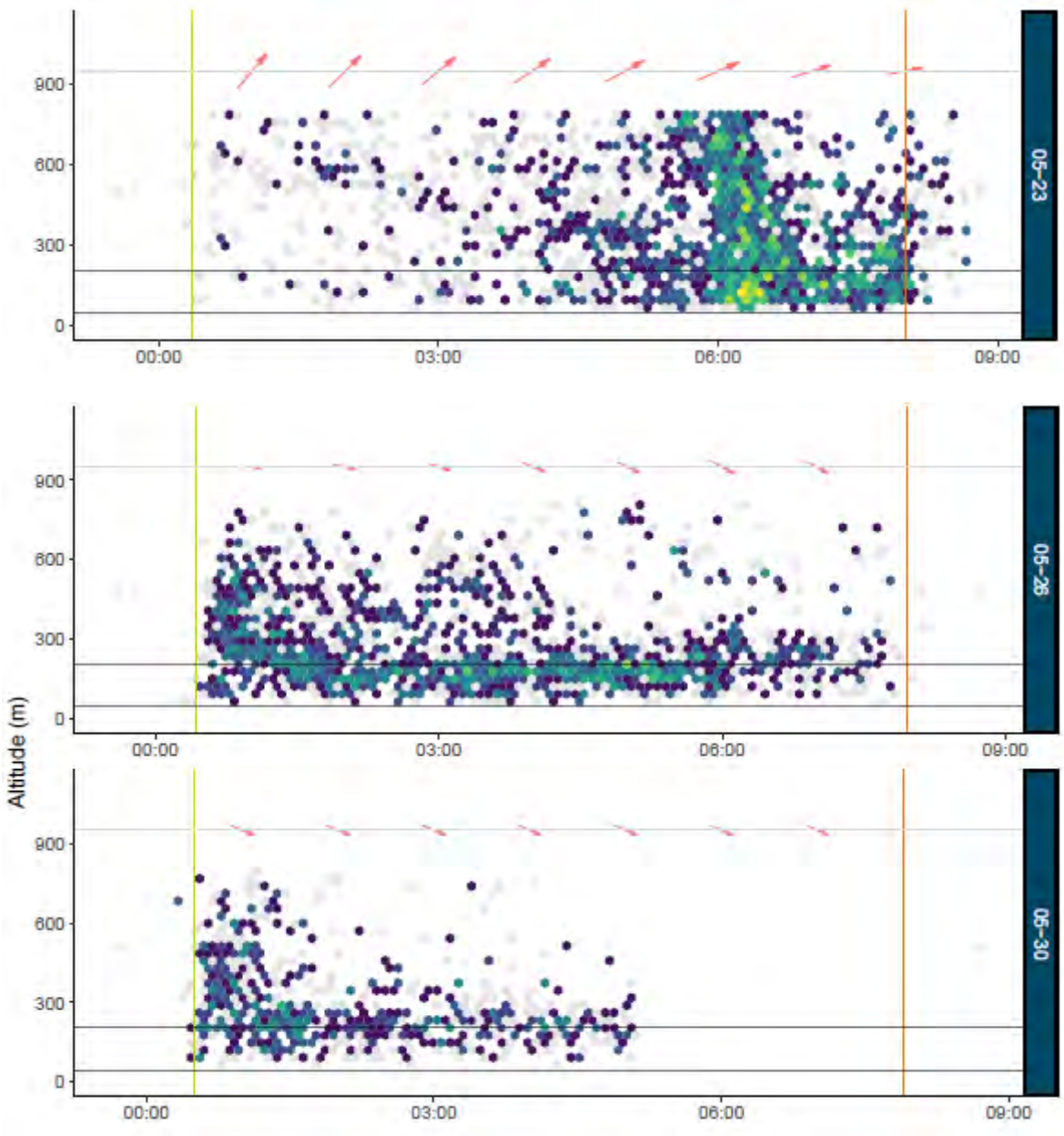
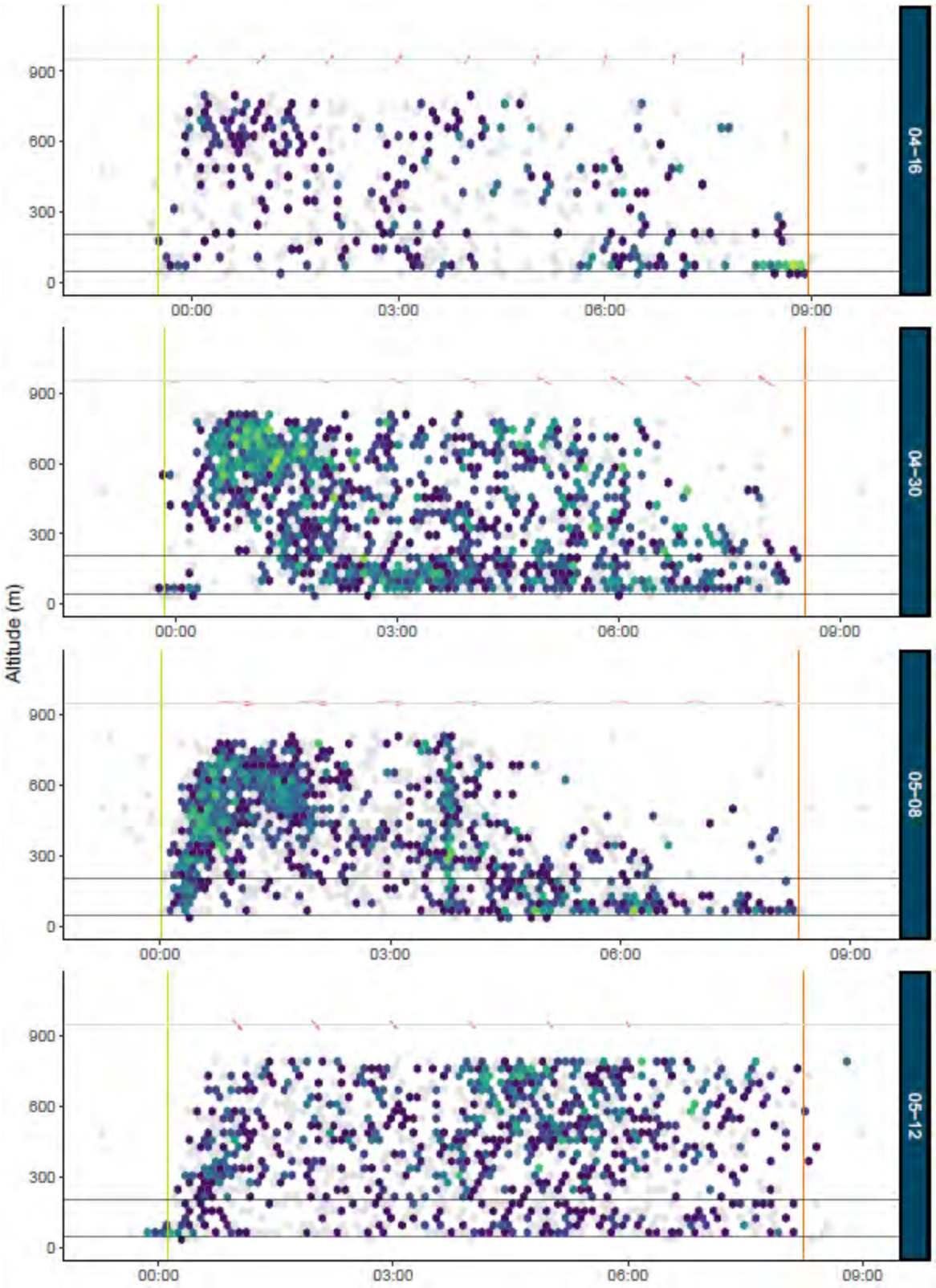


Figure 3.5 Targets Detected by Radar on April 16, May 4, 14, 23, 26 and 30, 2022

Each panel in the figures is a separate survey night. Time is indicated using Global Mean Time (GMT) on the x-axis with the beginning and end of civil twilight indicated by the vertical green and orange lines, respectively. Target altitude is on the y-axis, including the proposed RSZ indicated with black horizontal lines. Data points are radar detections scaled from light grey (few detections) through dark purple, to yellow (many detections). Wind direction (cardinal direction of red arrow) and wind strength (arrow size) at approximately 700 m agl is indicated for each hour at the top of each plot.


Altitude (m)
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09:00
04-16
04-30
05-08
05-12

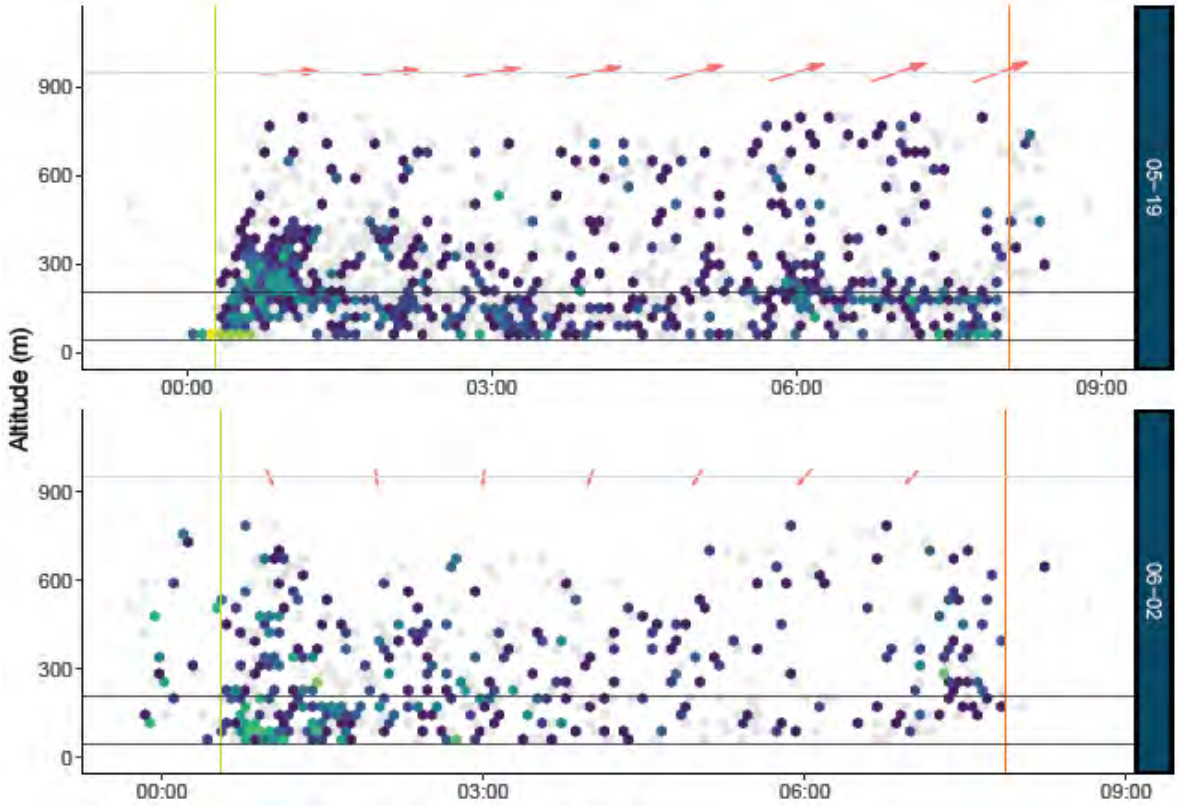
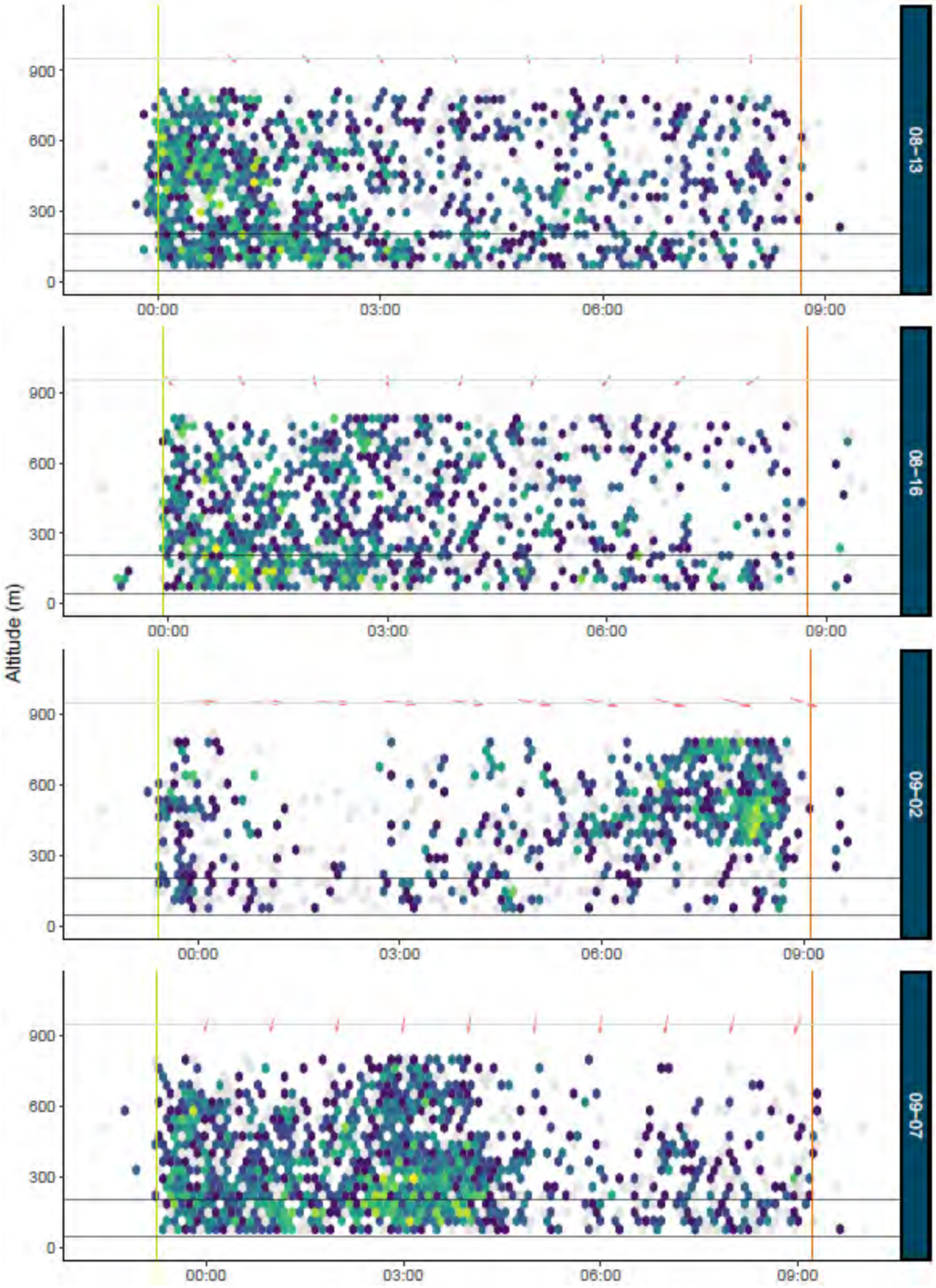


Figure 3.6 Targets Detected by Radar on April 16, 30, May 8, 12, 19 and June 2, 2023

Each panel in the figures is a separate survey night. Time is indicated using Global Mean Time (GMT) on the x-axis with the beginning and end of civil twilight indicated by the vertical green and orange lines, respectively. Target altitude is on the y-axis, including the proposed RSZ indicated with black horizontal lines. Data points are radar detections scaled from light grey (few detections) through dark purple, to yellow (many detections). Wind direction (cardinal direction of red arrow) and wind strength (arrow size) at approximately 700 m agl is indicated for each hour at the top of each plot.

For the fall migration the selected nights include August 13, 16, September 2 and 7, 19, and October 28, 2022 (**Figure 3.7**), and July 23, August 11, 28, September 5, 26, October 1, 8 and 24, 2023 (**Figure 3.8**). During these selected nights, most flight activity occurred at the start of the night. On September 2, 2022, and October 24, 2023, there was greater flight activity at the end of the night, likely caused by strong side winds and heavy rain respectively. Flight altitudes were generally high throughout the night except during the night of October 8, 2023, when there was a strong headwind. Flight altitudes continued to be high during moderate headwinds on July 23, 2023.


Altitude (m)
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09-07

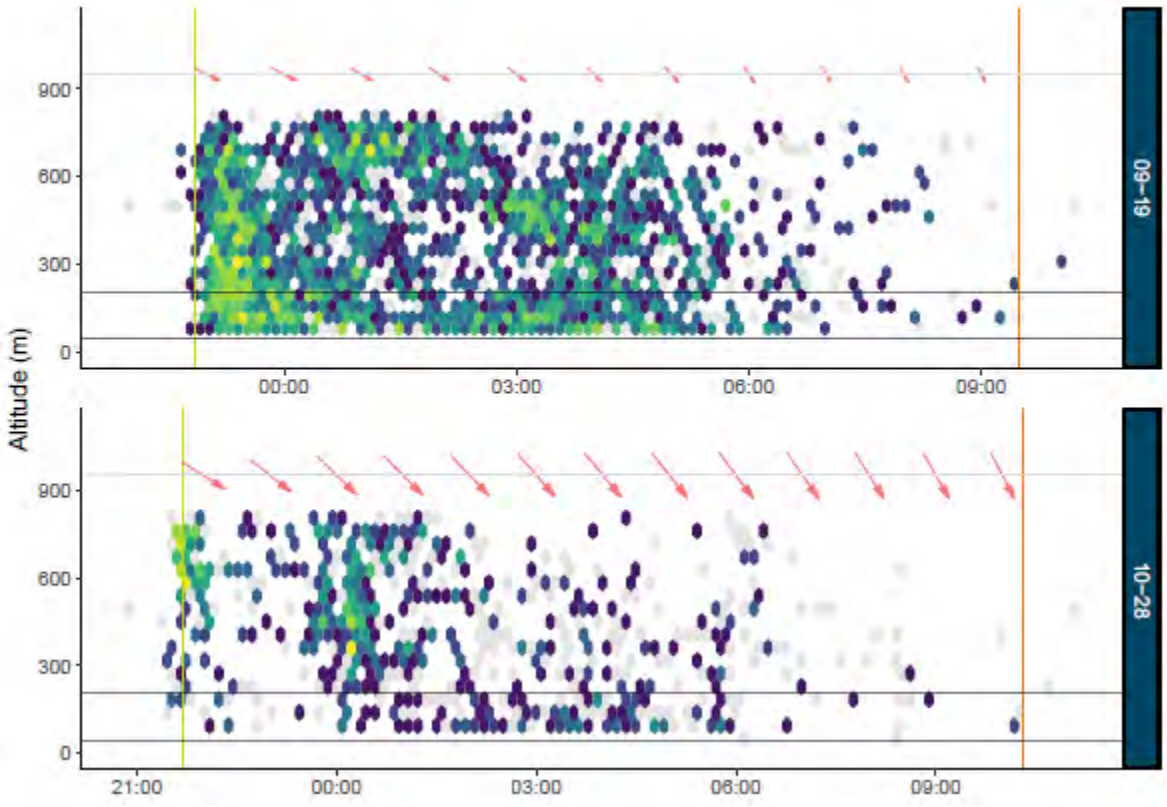
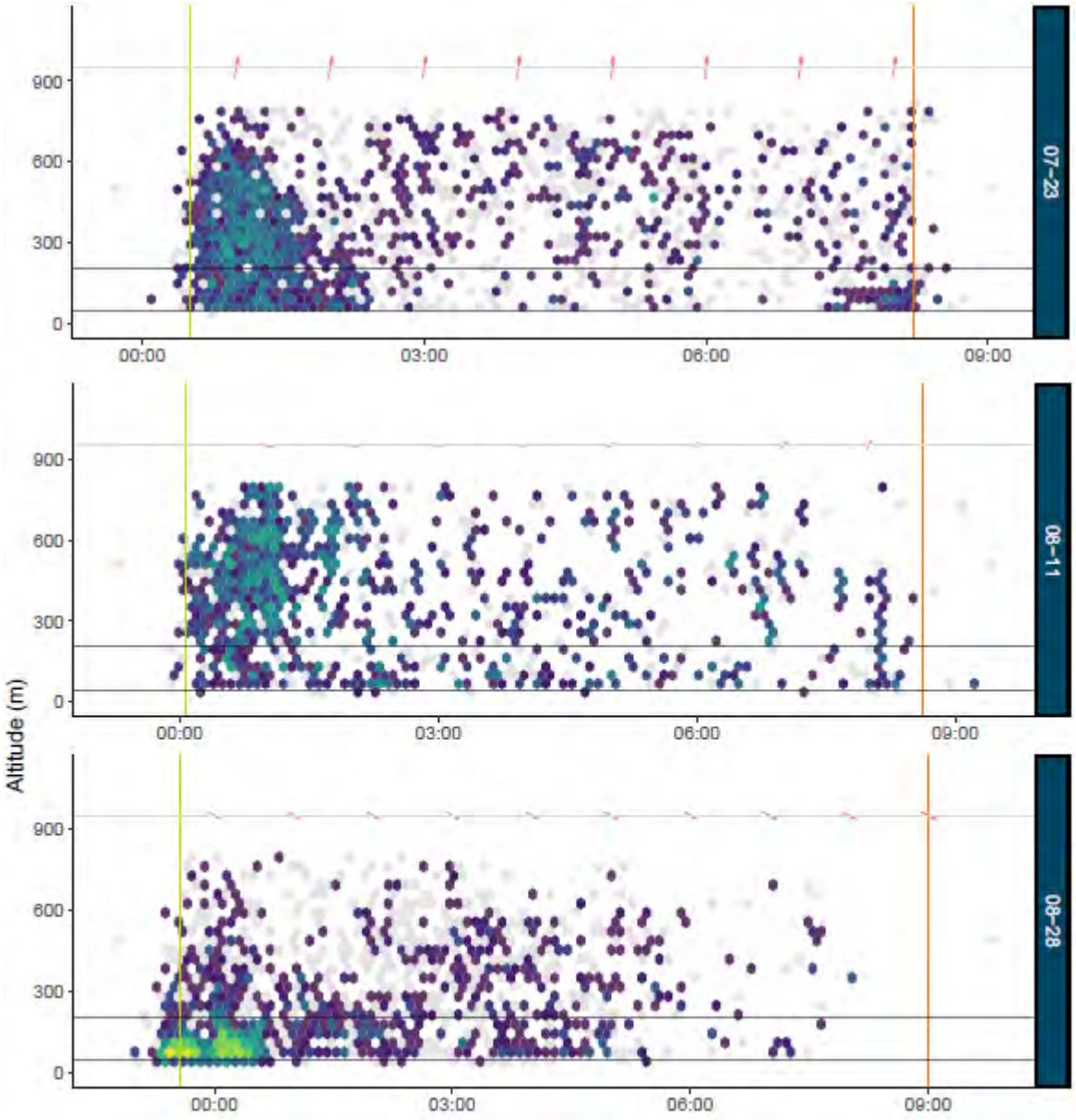


Figure 3.7 Targets Detected by Radar on August 13, 16, September 2, 7, 19, and October 28, 2022

Each panel in the figures is a separate survey night. Time is indicated using Global Mean Time (GMT) on the x-axis with the beginning and end of civil twilight indicated by the vertical green and orange lines, respectively. Target altitude is on the y-axis, including the proposed RSZ indicated with black horizontal lines. Data points are radar detections scaled from light grey (few detections) through dark purple, to yellow (many detections). Wind direction (cardinal direction of red arrow) and wind strength (arrow size) at approximately 700 m agl is indicated for each hour at the top of each plot.


Altitude (m)
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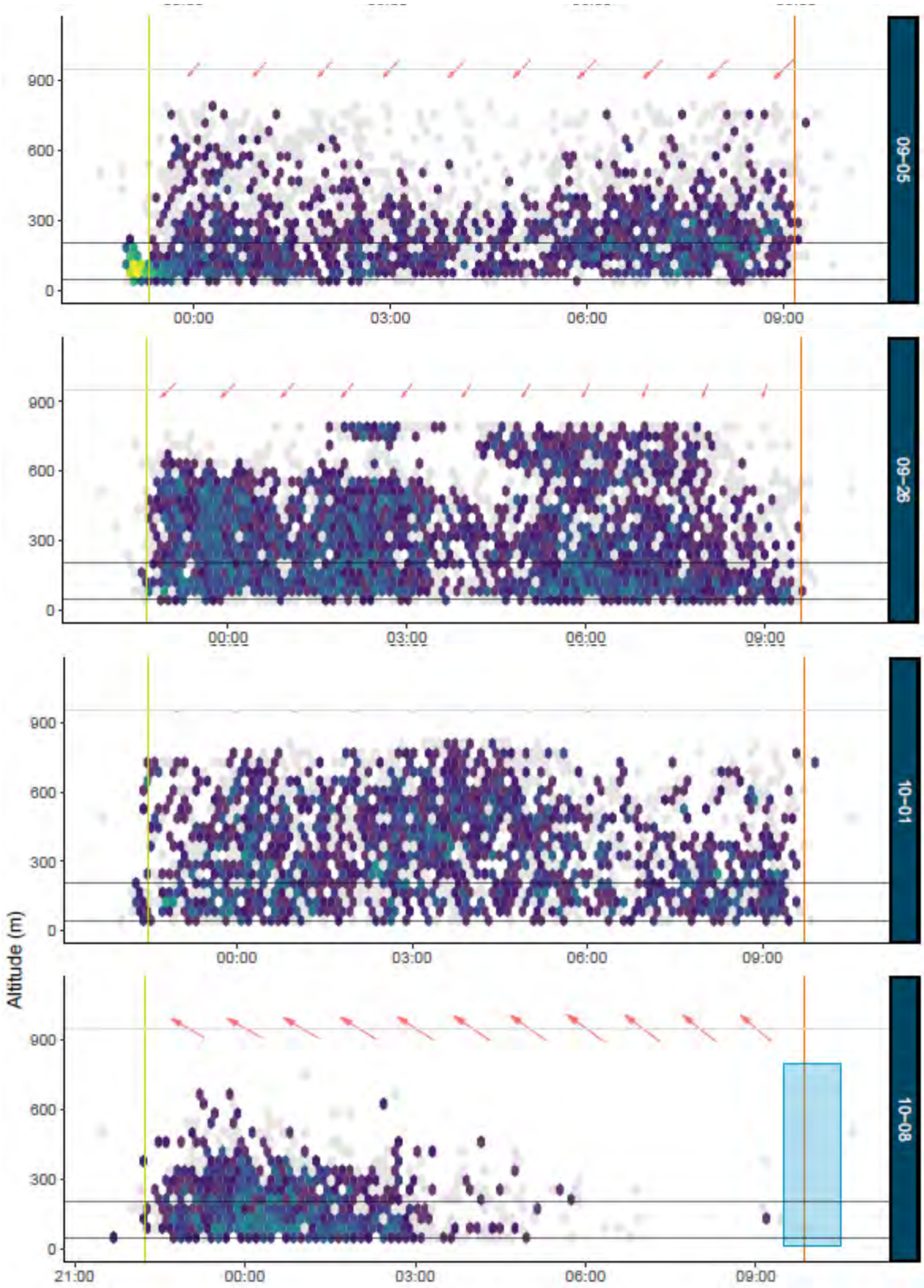
06:00
09:00
07-23
08-11
08-28


Altitude (m)
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10-08

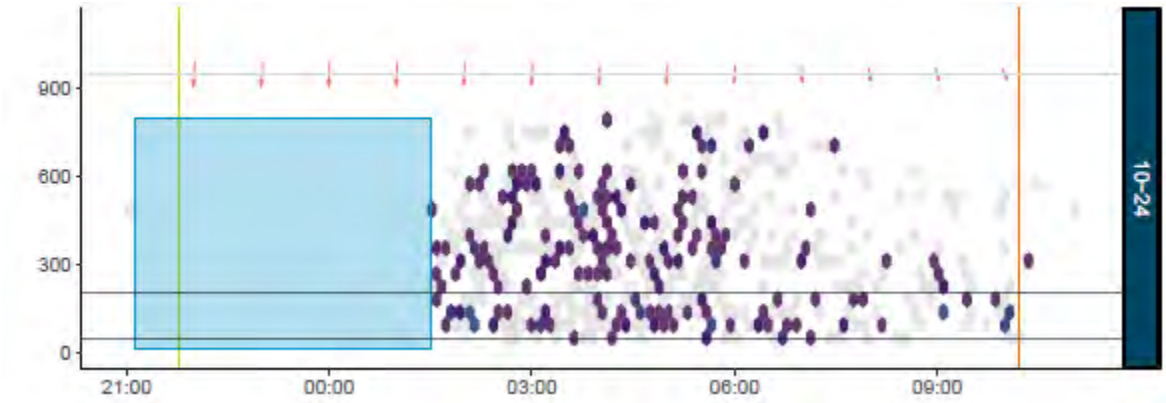

Figure 3.8 Targets Detected by Radar on July 23, August 11, 28, September 5, 26, October 1, 8 and 24, 2023

Each panel in the figures is a separate survey night. Time is indicated using Global Mean Time (GMT) on the x-axis with the beginning and end of civil twilight indicated by the vertical green and orange lines, respectively. Target altitude is on the y-axis, including the proposed RSZ indicated with black horizontal lines. Data points are radar detections scaled from light grey (few detections) through dark purple, to yellow (many detections). Wind direction (cardinal direction of red arrow) and wind strength (arrow size) at approximately 700 m agl is indicated for each hour at the top of each plot. The blue boxes represent periods of heavy rain.

During the spring migration season, flight volumes peaked at altitudes between 100 and 150 m with approximately 6000 detections in 2022 (**Figure 3.9**), and between 70 and 100 m with more than 6500 detections in 2023 (**Figure 3.10**). Although most targets were detected above the RSZ on a cumulative basis, many targets were also detected within the RSZ during spring.

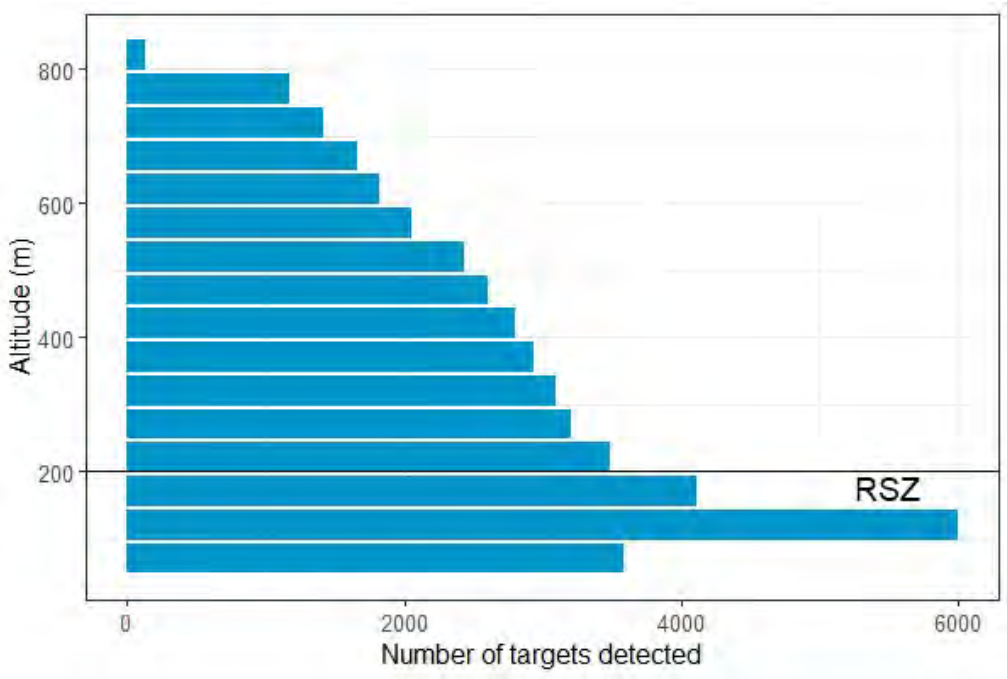

Figure 3.9 Altitudinal Profile of Targets Detected in Spring 2022

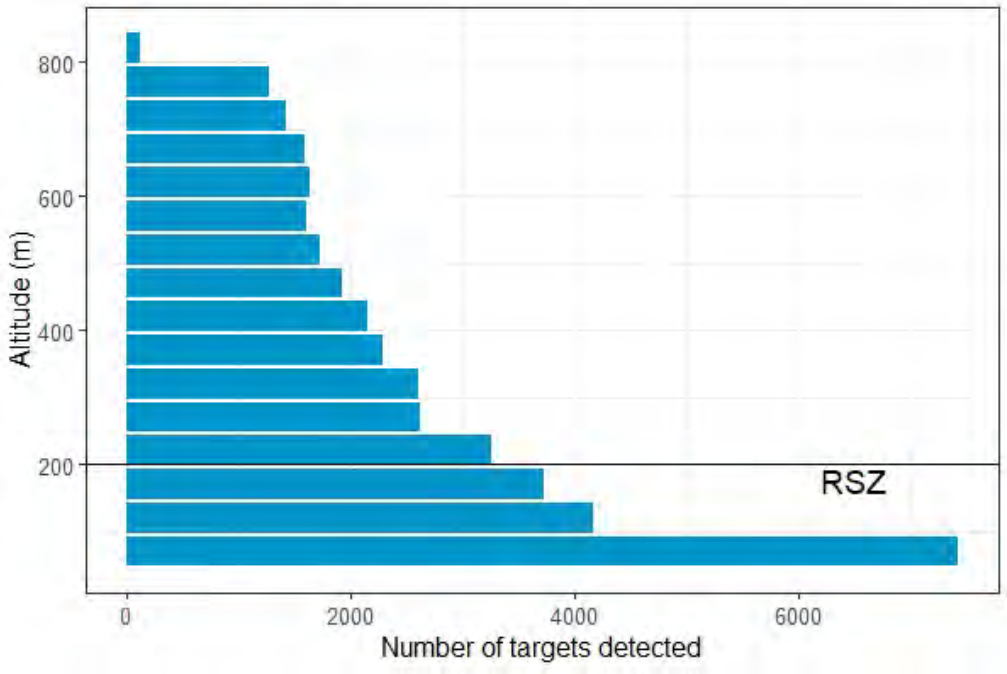

Figure 3.10 Altitudinal Profile of Targets Detected in Spring 2023

During the fall migration season flight volumes peaked at altitudes between 100 and 150 m with approximately 11,000 detections in 2022 (**Figure 3.11**) and between 70 and 150 m with more than 12,000 detections in 2023 (**Figure 3.12**). Although most targets were detected above the RSZ on a cumulative basis, many targets were also detected within the RSZ.

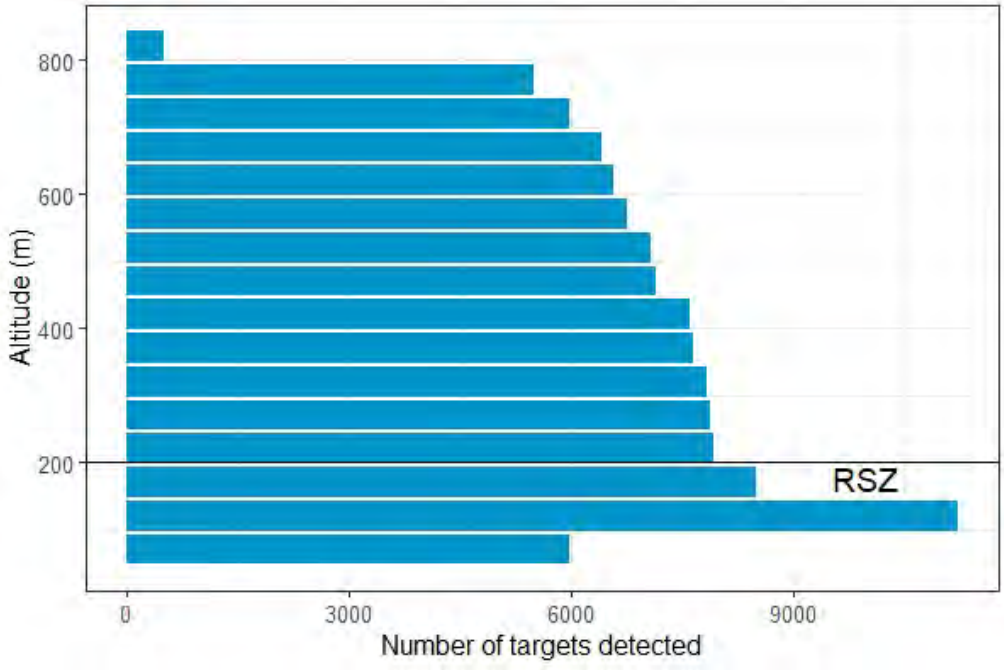

Figure 3.11 Altitudinal Profile of Targets Detected in Fall 2022

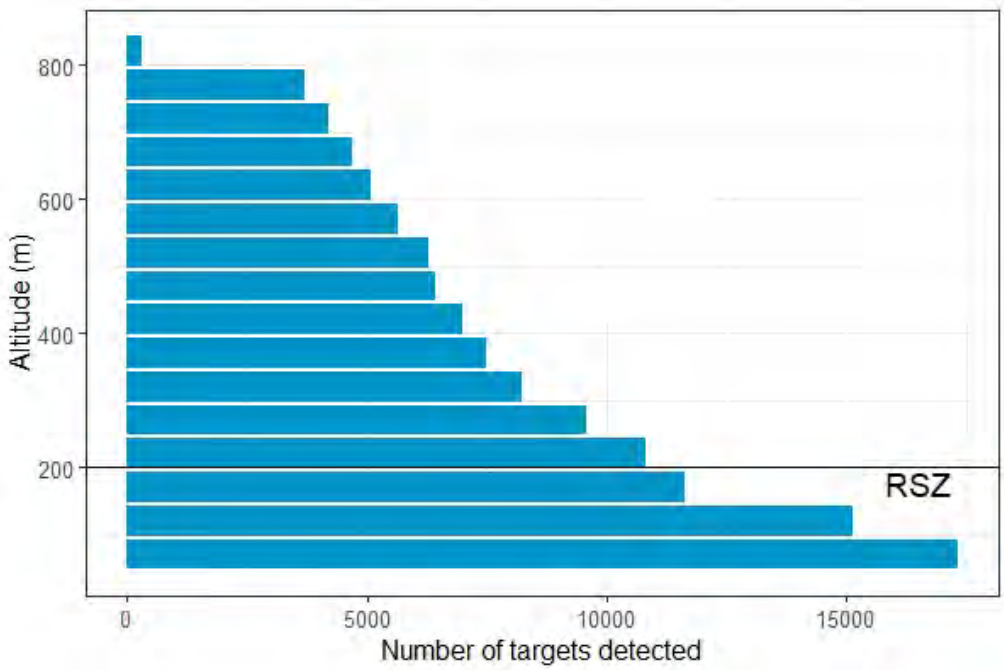

Figure 3.12 Altitudinal Profile of Targets Detected in Fall 2023

During the spring migration seasons, the altitudinal profiles of targets detected by the radar varied widely between nights. Flight altitudes are likely driven by seasonality and atmospheric conditions suitable for migratory flights. The number of targets peaked within RSZ during some nights. Nights with high springtime flight activity are shown in **Figure 3.13** and **Figure 3.14.** These figures show that flight volume generally decreases with altitude and that flight altitudes vary over time. Cumulatively, the greatest number of targets detected were above the RSZ.

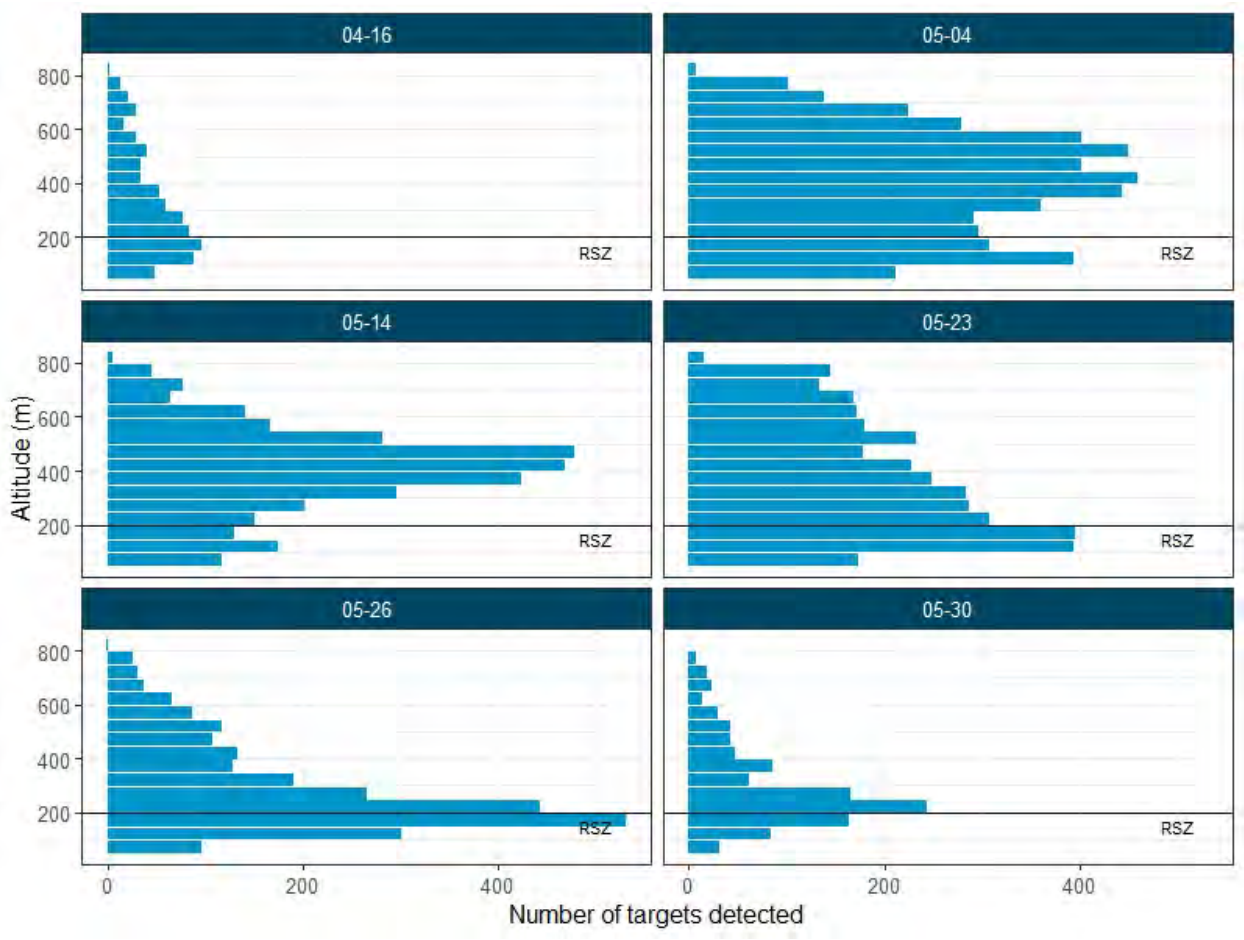

Figure 3.13 Altitudinal Profiles of Targets Detected on April 16, May 4, 14, 23 26 and 30, 2022

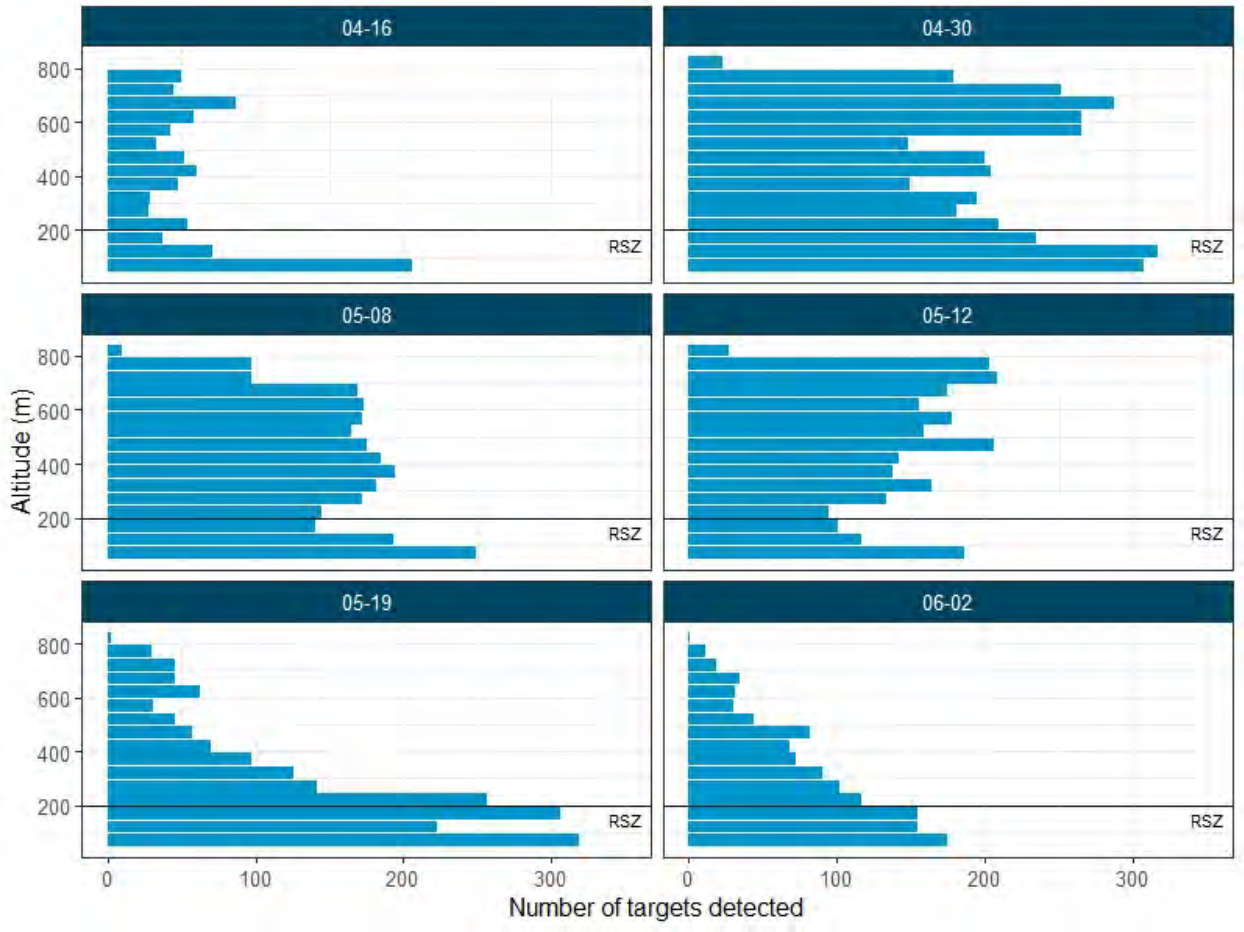

Figure 3.14 Altitudinal Profiles of Targets Detected on April 16, 30, May 8, 12, 19 and June 2, 2023

During the fall migration seasons, the altitudinal profiles of targets detected by the radar varied widely between nights. Flight altitudes are likely driven by seasonality and atmospheric conditions suitable for migratory flights. The number of targets peaked within RSZ during some nights. Nights with high springtime flight activity are shown in **Figure 3.15** and **Figure 3.16.** These figures show that flight volume generally decreases with altitude and that flight altitudes vary over time. Cumulatively, the greatest number of targets detected were above the RSZ.

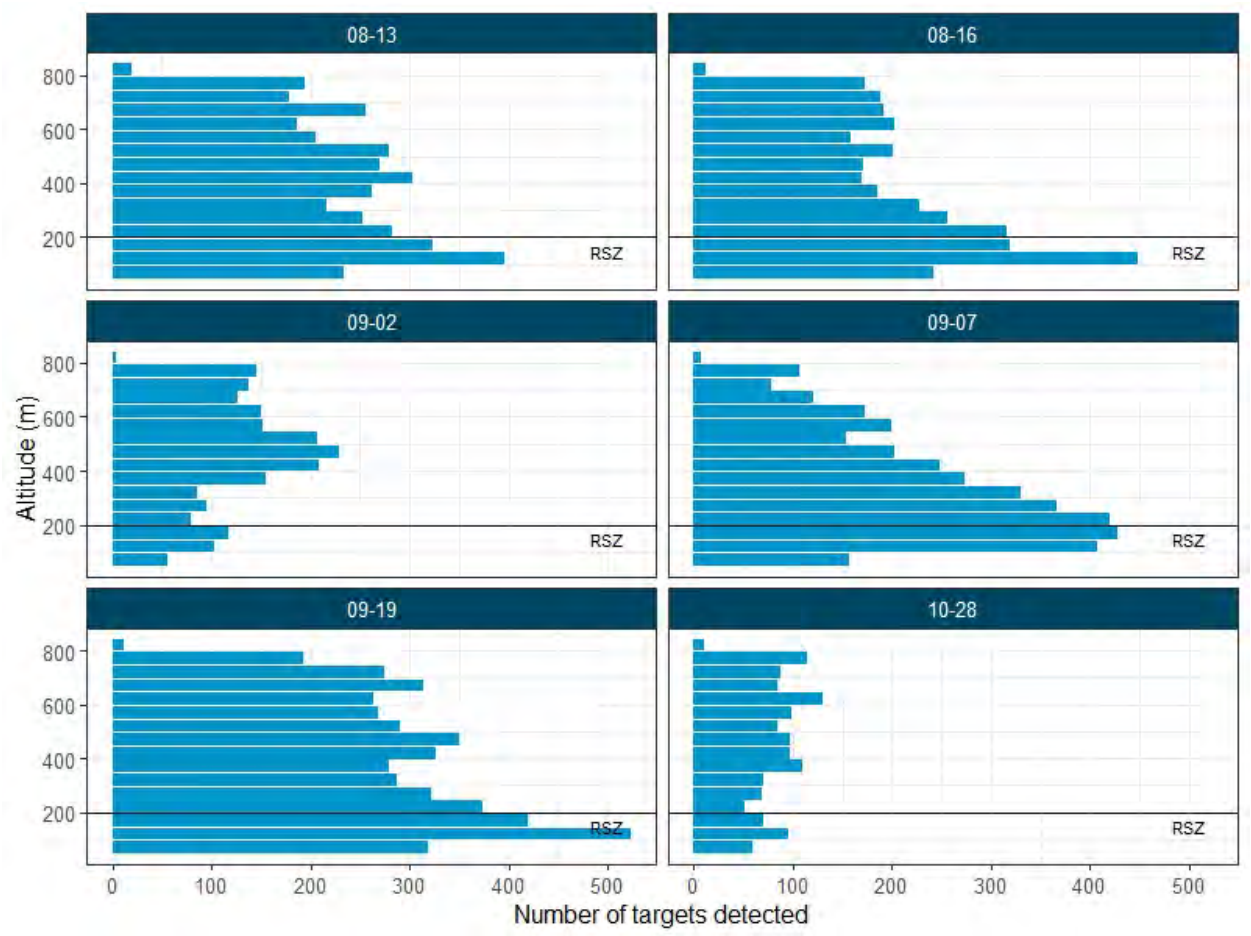

Figure 3.15 Altitudinal Profiles of Targets Detected on August 13, 16, September 2, 7, 19 and October 28, 2022

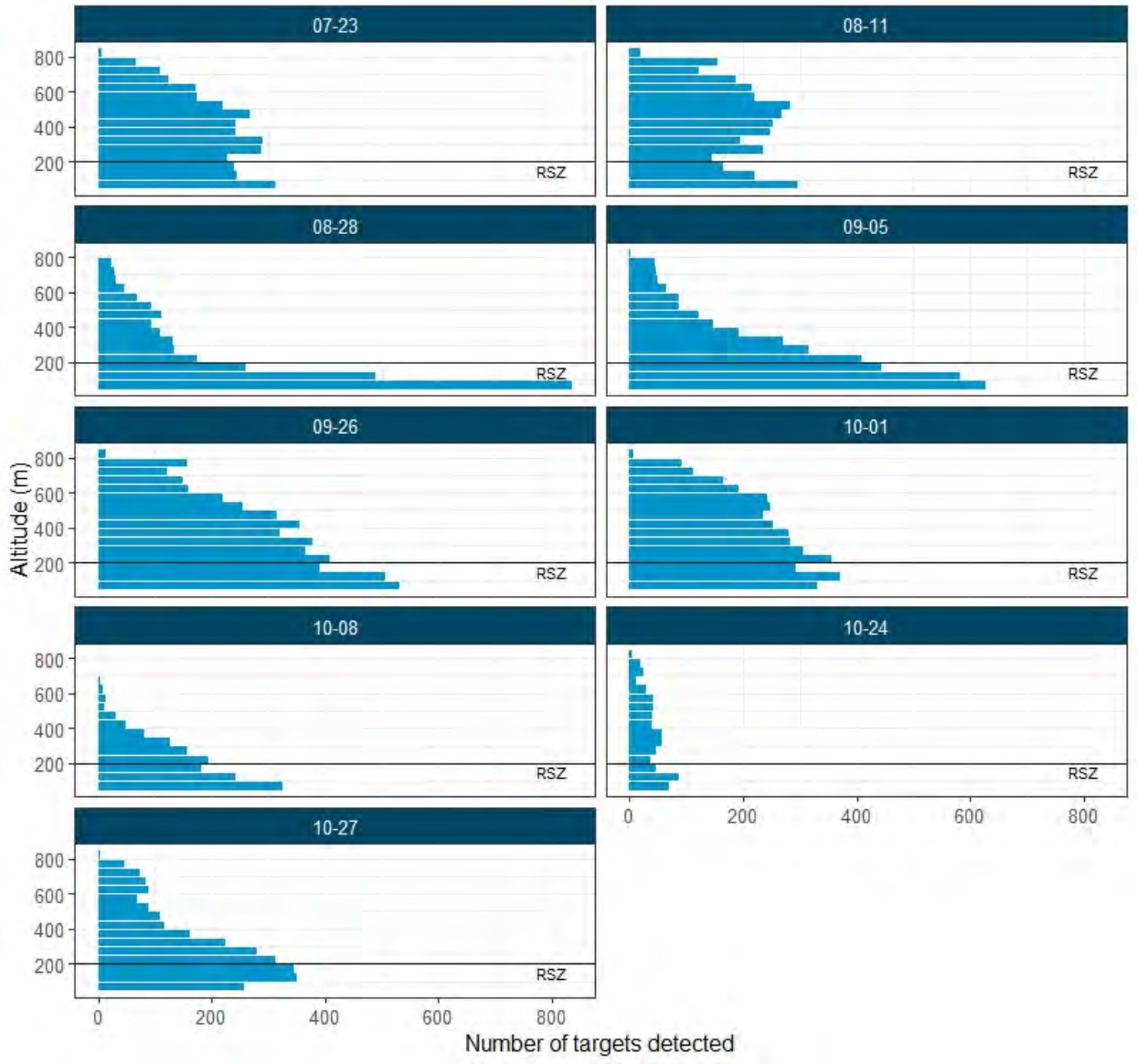

Figure 3.16 Altitudinal Profiles of Targets Detected on July 23, August 11, 28, September 5, 26, October 1, 8, 24 and 27, 2023

An analysis of radar data supports the hypothesis that birds migrate through the Project area in higher volumes when tailwinds are present to support migratory flights. Target detections increase steeply with tailwind assistance during all months in spring 2022 and 2023 (**Figure 3.17** and **Figure 3.18**). Only a slight decrease can be seen during the middle of the night in April 2023.

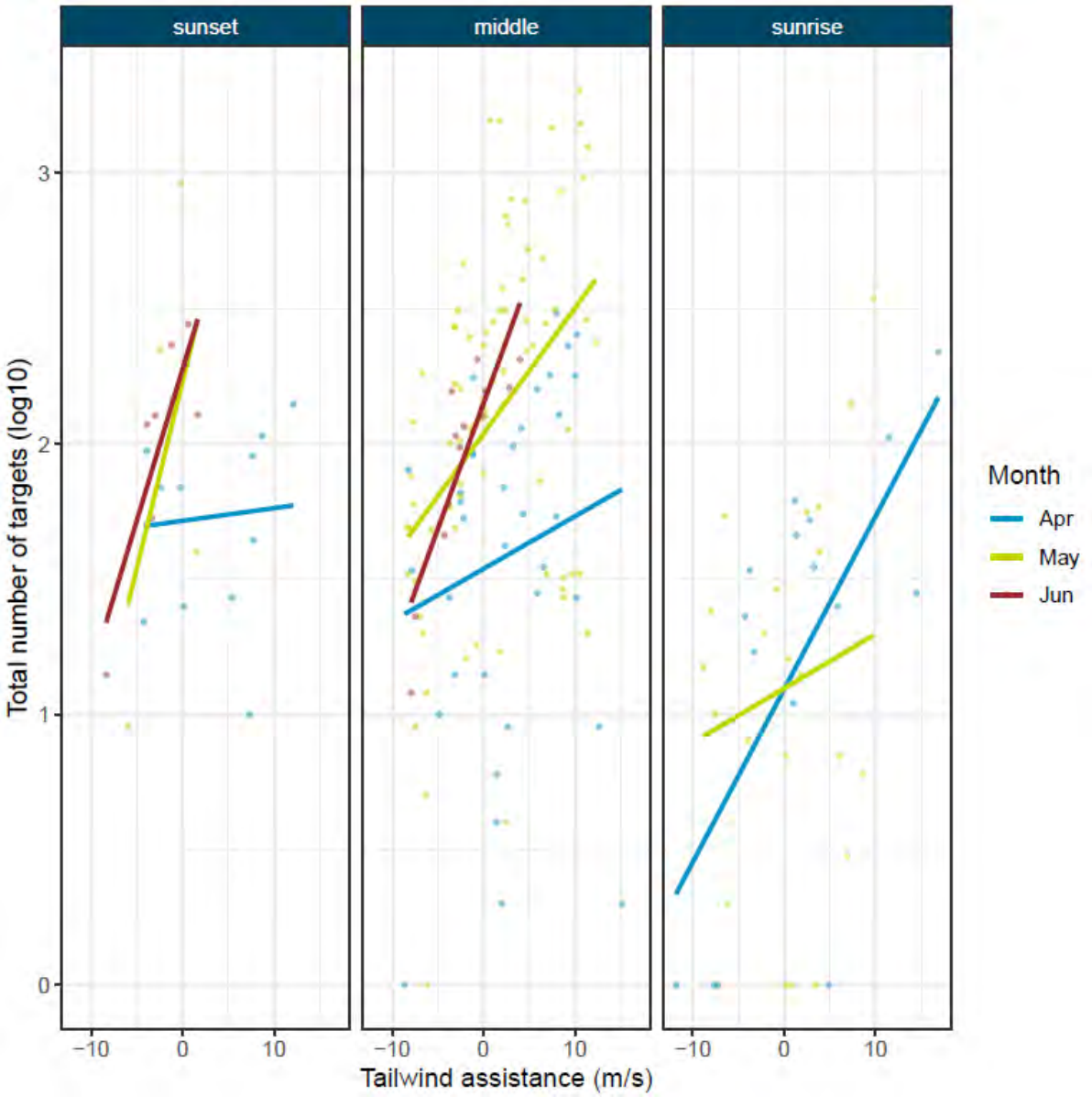

Figure 3.17 Relationship Between Tailwind Assistance and the Total Number of Targets Across Time of Night and Season During Spring 2022
Tailwind assistance is plotted on the x-axis, with negative numbers representing headwind and positive numbers representing tailwind. Coloured lines represent the trend between total number of detections (log10) and tailwind assistance in metres per second (m/s). Horizontal lines indicate no effect from tailwind assistance on total number of targets and inclining lines mean a positive effect from tailwind assistance on total number of targets.

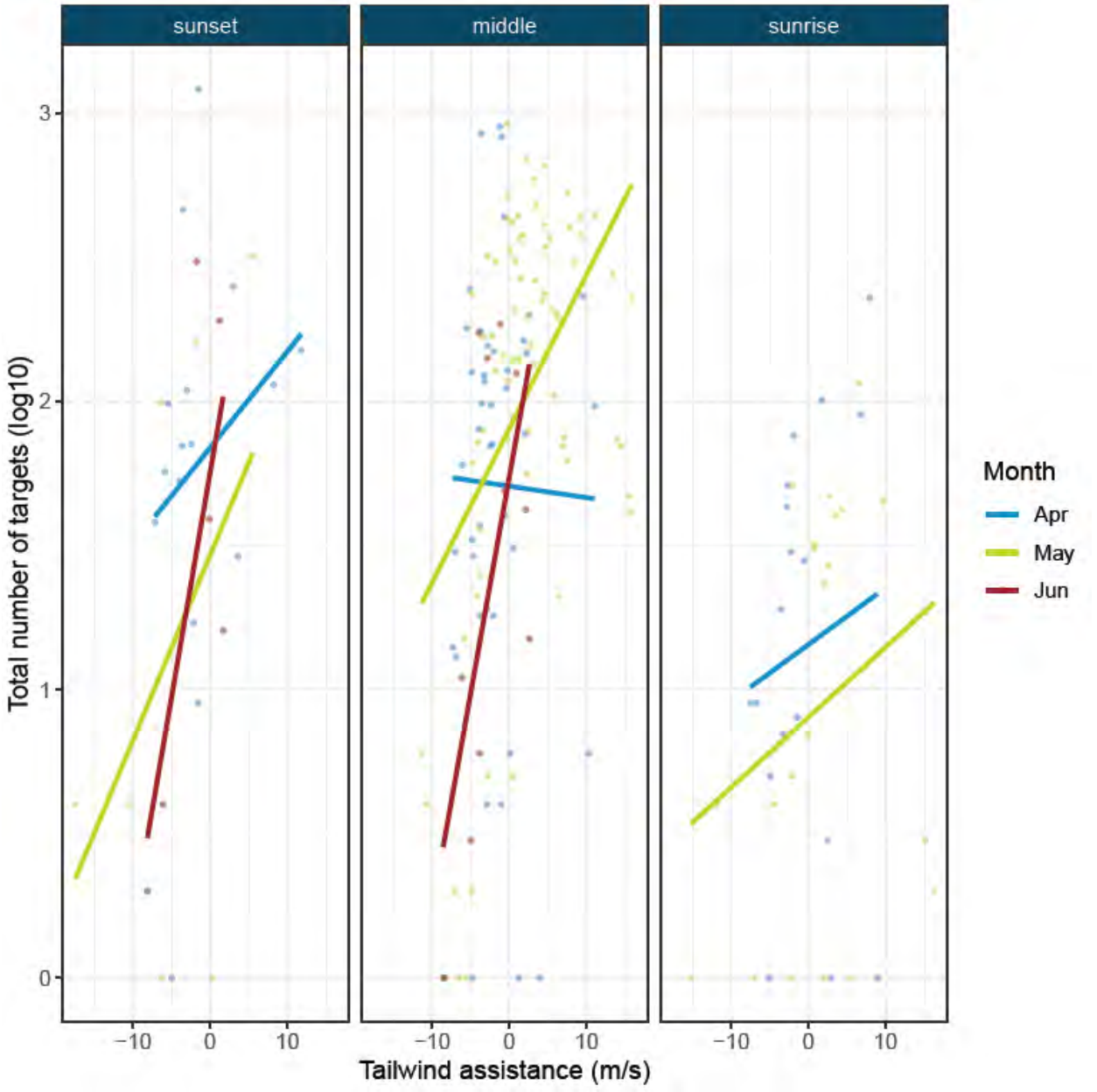

Figure 3.18 Relationship Between Tailwind Assistance and the Total Number of Targets Across Time of Night and Season During Spring 2023

Tailwind assistance is plotted on the x-axis, with negative numbers representing headwind and positive numbers representing tailwind. Coloured lines represent the trend between total number of detections (log10) and tailwind assistance in metres per second (m/s). Horizontal lines indicate no effect from tailwind assistance on total number of targets and inclining lines mean a positive effect from tailwind assistance on total number of targets.

During fall migration target detections also increase steeply with tailwind assistance during all months in in both fall 2022 and 2023 (**Figure 3.19** and **Figure 3.20**). Only a slight decrease can be seen during the sunrise in October 2022, and a steep decrease can be seen during sunrise in September and October 2023.

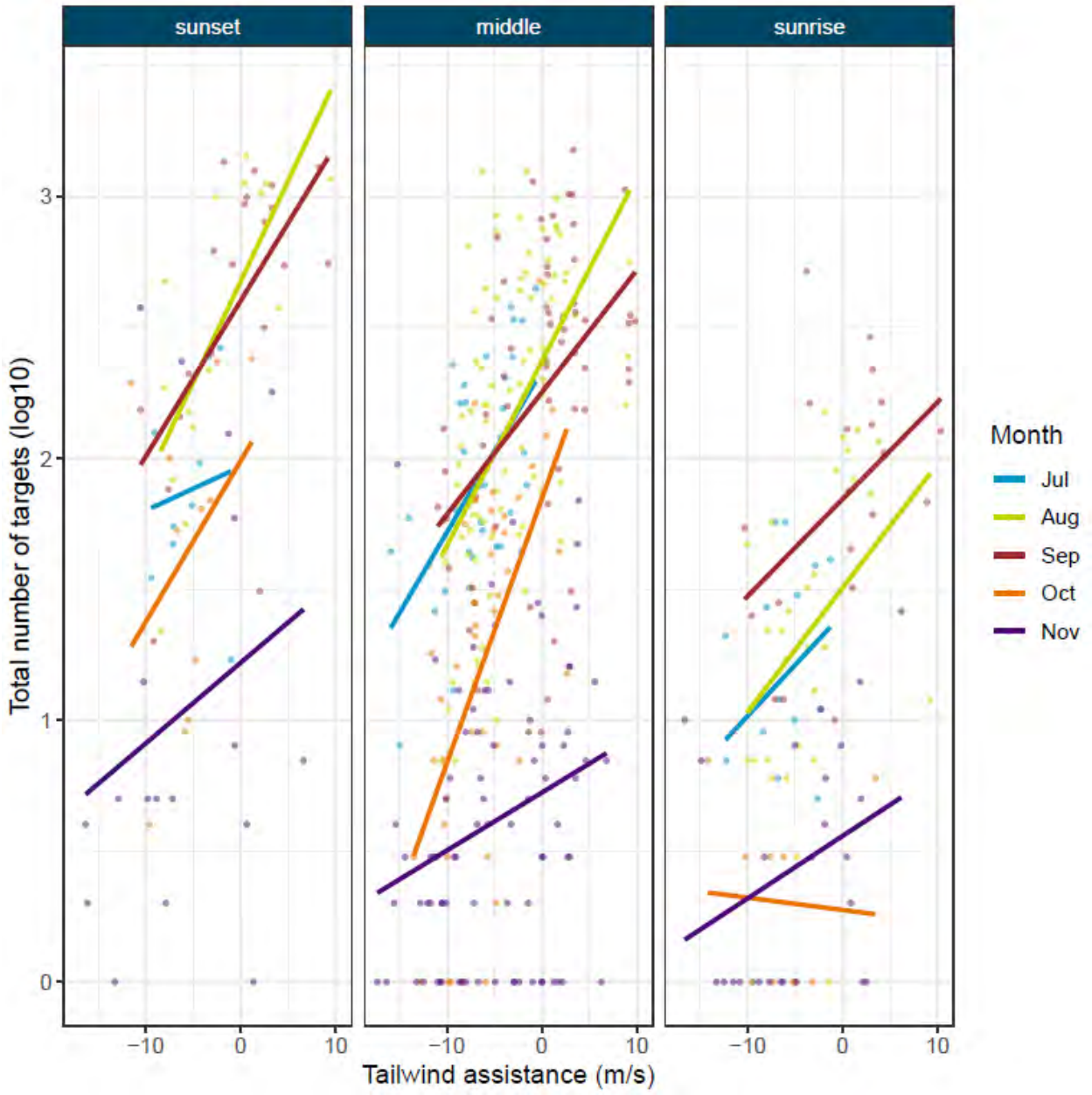

Figure 3.19 Relationship Between Tailwind Assistance and the Total Number of Targets Across Time of Night and Season During Fall 2022
Tailwind assistance is plotted on the x-axis, with negative numbers representing headwind and positive numbers representing tailwind. Coloured lines represent the trend between total number of detections (log10) and tailwind assistance in metres per second (m/s). Horizontal lines indicate no effect from tailwind assistance on total number of targets and inclining lines mean a positive effect from tailwind assistance on total number of targets.

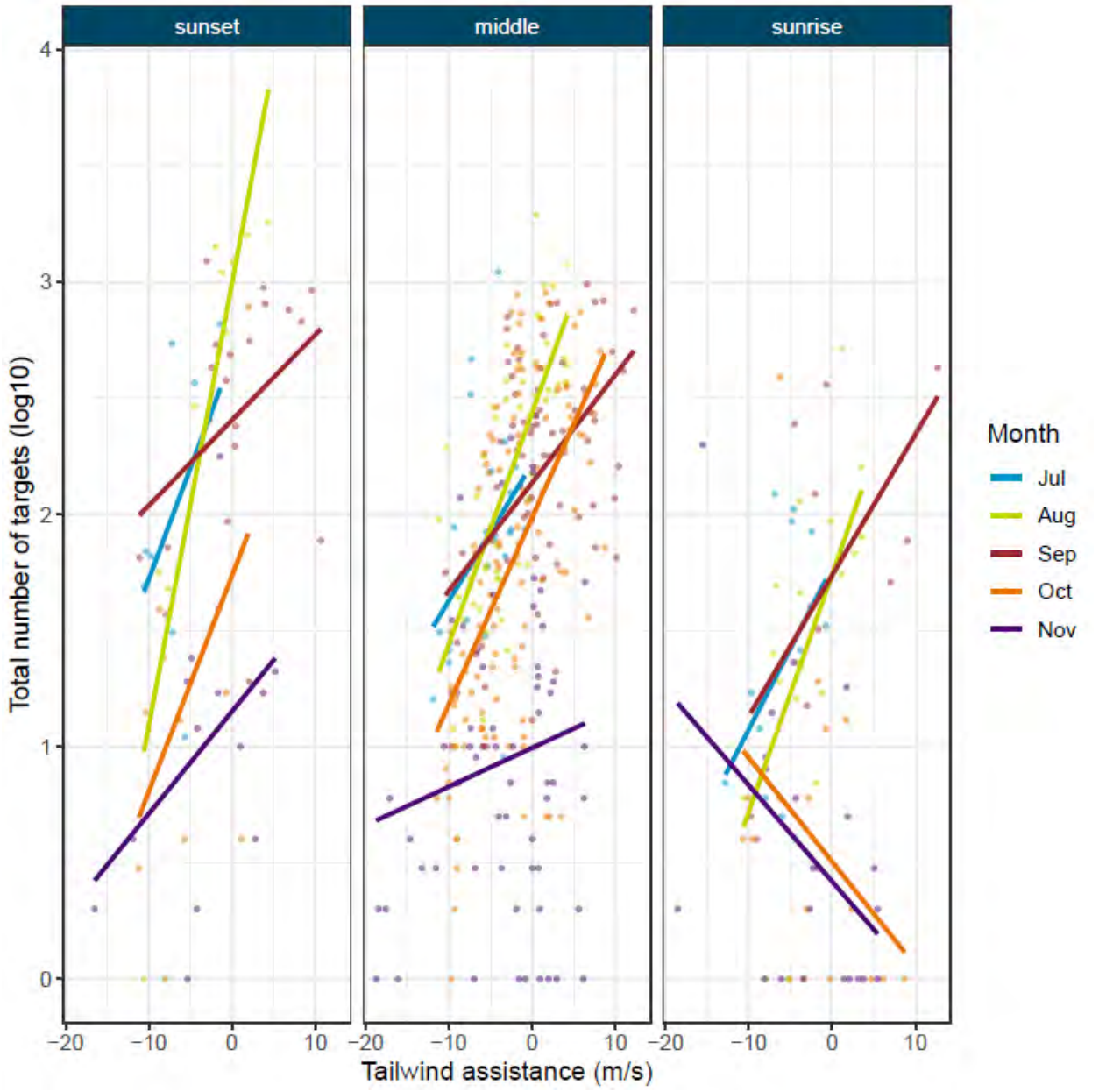

Figure 3.20 Relationship Between Tailwind Assistance and the Total Number of Targets Across Time 0f Night and Season During Fall 2023.
Tailwind assistance is plotted on the x-axis, with negative numbers representing headwind and positive numbers representing tailwind. Coloured lines represent the trend between total number of detections (log10) and tailwind assistance in metres per second (m/s). Horizontal lines indicate no effect from tailwind assistance on total number of targets and inclining lines mean a positive effect from tailwind assistance on total number of targets.

When tailwind assistance is plotted against the proportion of flights within the RSZ the proportion of targets within the RSZ generally increases with headwinds during spring migration (**Figure 3.21** and **Figure 3.22**). The total number of targets also decreases when headwind increases, indicated by the narrower boxplots with increasing headwinds.

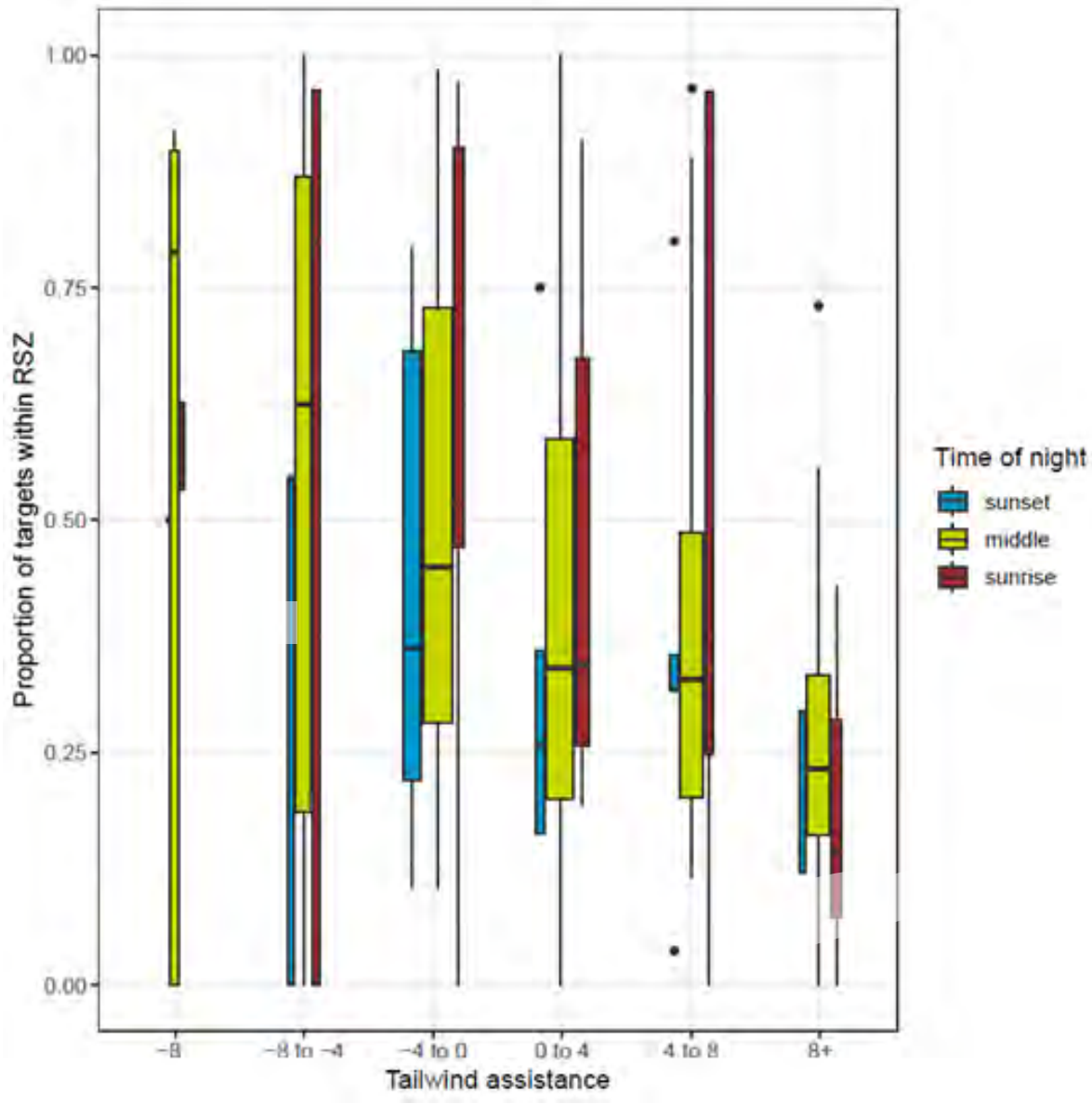

Figure 3.21 Relationship Between Tailwind Assistance and the Proportion of Targets Within RSZ Across Time of Night During Spring 2022

Tailwind assistance is plotted on the x-axis, with negative numbers representing headwind and positive numbers representing tailwind. The proportion of targets within RSZ are grouped by time of night indicated with blue, green, and red. Each boxplot shows 50 percent of the data centred around the median in colour, and the median is shown with a black horizontal line. The upper and lower 25 percent of the data is shown with black vertical lines, and outliers are shown as black points. The total number of targets is illustrated by the width of the boxplot, a wider boxplot means a greater number of targets.

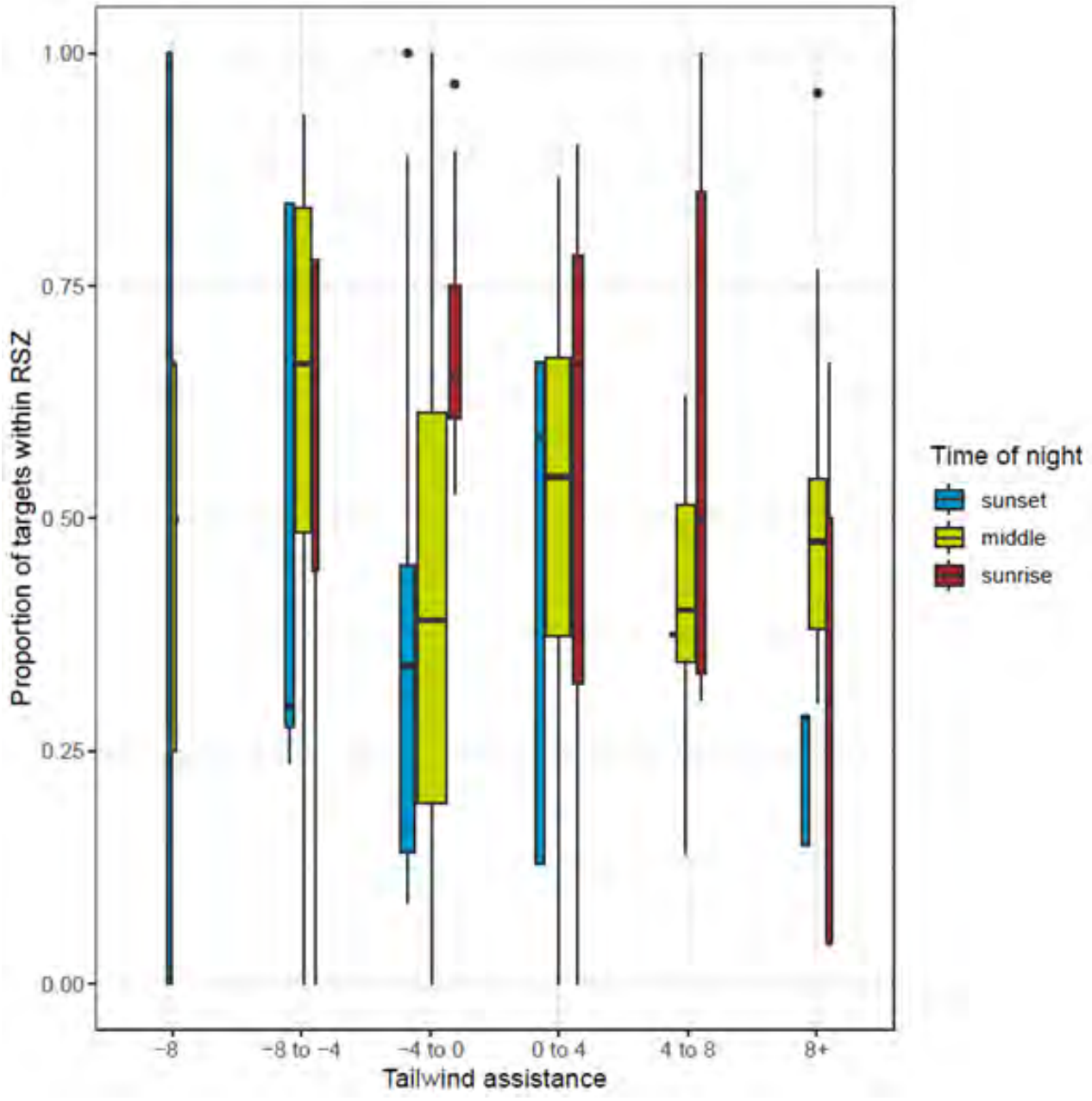

Figure 3.22 Relationship Between Tailwind Assistance and the Proportion of Targets Within the RSZ Across Time of Night During Spring 2023

Tailwind assistance is plotted on the x-axis, with negative numbers representing headwind and positive numbers representing tailwind. The proportion of targets within RSZ are grouped by time of night indicated with blue, green, and red. Each boxplot shows 50 percent of the data centred around the median in colour, and the median is shown with a black horizontal line. The upper and lower 25 percent of the data is shown with black vertical lines, and outliers are shown as black points. The total number of targets is illustrated by the width of the boxplot, a wider boxplot means a greater number of targets.

During the fall migration the proportion of targets within the RSZ notably didn't increase much in 2022 (**Figure 3.23**), but increased in 2023 (**Figure 3.24**). It appears that large numbers of targets migrated through the Project area even during strong headwinds in the fall of 2022 as indicated by the width of the boxplots (**Figure 3.23**). This pattern of a large number of targets throughout the airspace can also be seen in **Figure 3.7** and **Figure 3.10**.

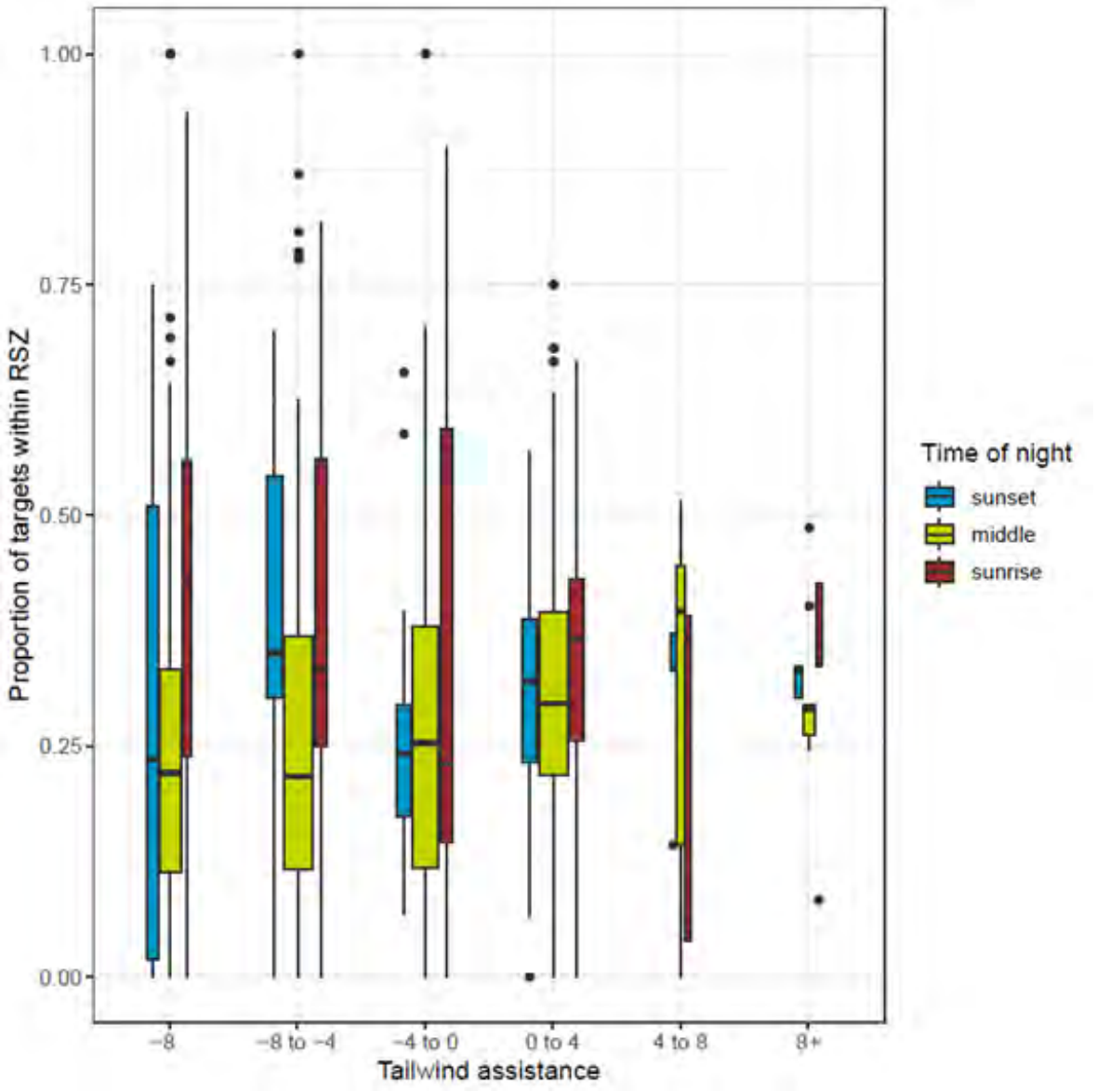

Figure 3.23 Relationship Between Tailwind Assistance and the Proportion of Targets Within the RSZ Across Time of Night During Fall 2022

Tailwind assistance is plotted on the x-axis, with negative numbers representing headwind and positive numbers representing tailwind. The proportion of targets within RSZ are grouped by time of night indicated with blue, green, and red. Each boxplot shows 50 percent of the data centred around the median in colour, and the median is shown with a black horizontal line. The upper and lower 25 percent of the data is shown with black vertical lines, and outliers are shown as black points. The total number of targets is illustrated by the width of the boxplot, a wider boxplot means a greater number of targets.

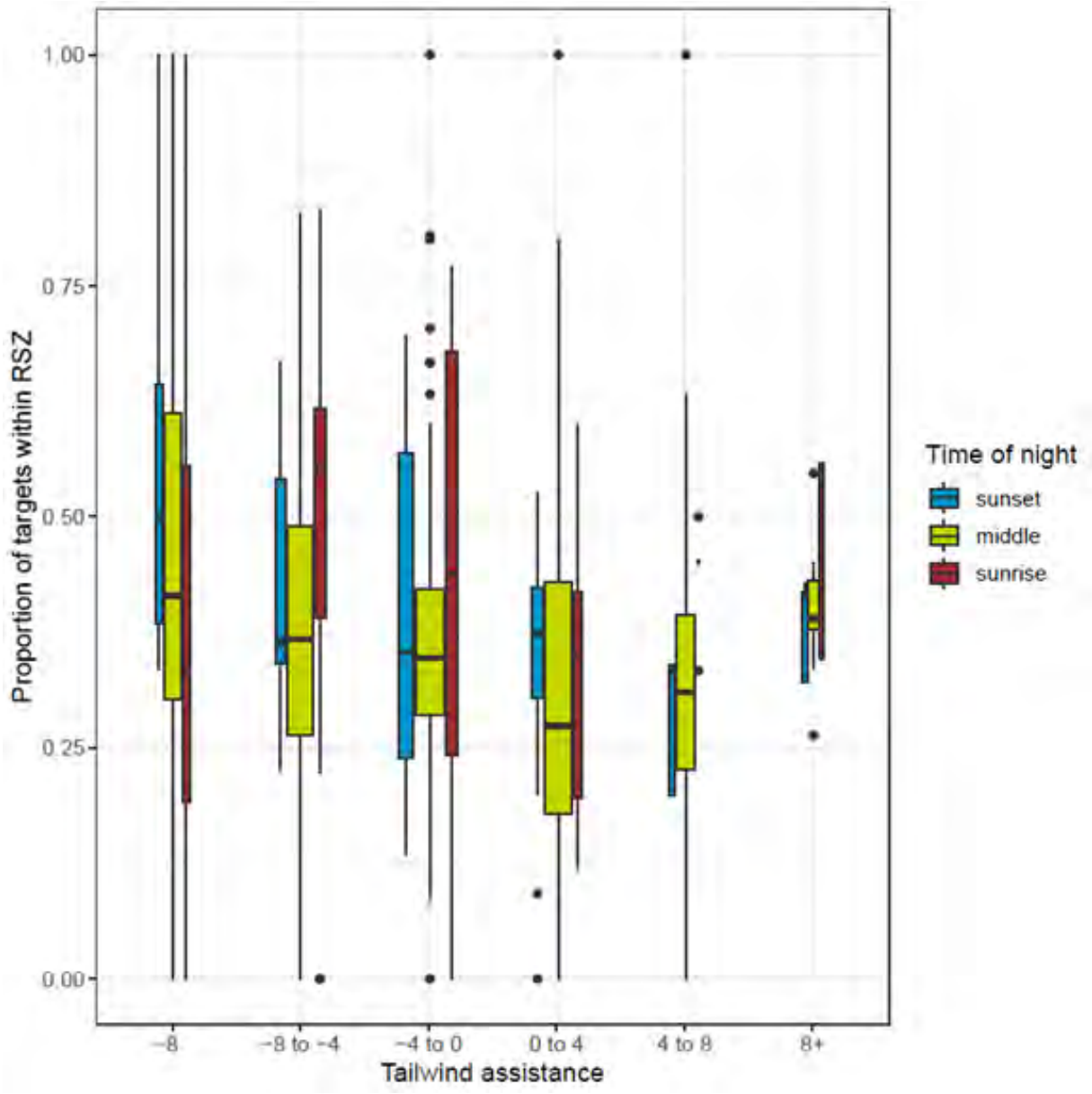

Figure 3.24 Relationship Between Tailwind Assistance and the Proportion of Targets Within the RSZ Across Time of Night During Fall 2023

Tailwind assistance is plotted on the x-axis, with negative numbers representing headwind and positive numbers representing tailwind. The proportion of targets within RSZ are grouped by time of night indicated with blue, green, and red. Each boxplot shows 50 percent of the data centred around the median in colour, and the median is shown with a black horizontal line. The upper and lower 25 percent of the data is shown with black vertical lines, and outliers are shown as black points. The total number of targets is illustrated by the width of the boxplot, a wider boxplot means a greater number of targets.

3.2 Nocturnal Migration Species Composition

Acoustic data were used to characterize the avian community and to identify specific species occurring in the Project area during migration. During spring 2022 a total of 13 distinct species and two species groups were identified with the nocturnal flight call recordings. Song or Fox Sparrow was the species group that was most commonly detected and comprised 37.1 percent of the total detections. The second most commonly detected species was the White-throated Sparrow which comprised 30.3 percent of all detections. A summary of all nocturnally migrating species detected in spring 2022 is provided in **Table 3.1**. The species listed in the table represent nocturnal migratory activity below approximately 200 m in agl., which corresponds with the maximum detection distance of the audio recorders (**see Section 2.2.1**).

Table 3.1 Nocturnal Flight Call Detections By Species and Species Group In Spring 2022

Species or Species Group[(a)]	Total Number of Calls Detected	Proportion of Calls Detected
Song or Fox Sparrow	1008	37.1
White-Throated Sparrow	822	30.3
Ovenbird	208	7.7
Northern WaterThrush	200	7.4
Black-and-White Warbler	106	3.9
Common Yellowthroat	98	3.6
Northern Parula	69	2.5
Canada Warbler	53	2.0
Double up[a]	42	1.5
Mourning Warbler	38	1.4
Black-Throated Blue Warbler	32	1.2
Hermit Thrush	30	1.1
American Redstart	3	0.1
Chestnut-Sided Warbler	3	0.1
Cup sparrow[b]	3	0.1
Total	**2715**	**100**

(a) "Double up" species group includes black-throated green Warbler, Tennessee Warbler, Nashville Warbler and Orange-crowned Warbler.

(b) "Cup sparrow" species group includes Chipping Sparrow, Field Sparrow and American Tree Sparrow.

During spring 2023 a total of 15 distinct species and two species groups were identified with the nocturnal flight call recordings. Song- or Fox Sparrow was again the species group that was most commonly detected and comprised 48.1 percent of the total detections. The second most commonly detected species was again the White-throated Sparrow which comprised 15.6 percent of all detections. A summary of all nocturnally migrating species detected in spring 2023 is provided in **Table 3.2**.

Table 3.2 Nocturnal Flight Call Detections by Species and Species Group in Spring 2023

Species or Species Group[(a)]	Total Number of Calls Detected	Proportion of Calls Detected
Song or Fox Sparrow	617	48.1
White-Throated Sparrow	200	15.6
Solitary Or Spotted Sandpiper	122	9.5
Northern WaterThrush	90	7.0
Ovenbird	63	4.9
Common Yellowthroat	42	3.3
Northern Parula	42	3.3
Black-And-White Warbler	36	2.8
Double up[a]	17	1.3
Black-Throated Blue Warbler	13	1.0
Cup sparrows[b]	12	0.9
Canada Warbler	9	0.7
Mourning Warbler	9	0.7
Hermit Thrush	7	0.5
American Redstart	2	0.2
Chestnut-Sided Warbler	1	0.1
Veery	1	0.1
Total	**1283**	**100**

(a) "Double up" species group includes black-throated green Warbler, Tennessee Warbler, Nashville Warbler and Orange-crowned Warbler.

(b) "Cup sparrow" species group includes Chipping Sparrow, Field Sparrow and American Tree Sparrow.

During fall 2022 a total of 18 distinct species and four species groups were identified with the nocturnal flight call recordings. American Redstart was the species that was most commonly detected and comprised 11.9 percent of the total detections. The second most common detected species was the Ovenbird which comprised 7.7 percent of all detections. The most detected species groups are Zeep accounting for 31.4 percent, and Double up accounting for 11.2 percent of all detections. A summary of all nocturnally migrating species detected in fall 2022 is provided in **Table 3.3**.

Table 3.3 Nocturnal Flight Call Detections by Species and Species Group in Fall 2022

Species or Species Group[(a)]	Total Number of Calls Detected	Proportion of Calls Detected
Zeep[a]	8934	31.4
American Redstart	3367	11.9
Double up[b]	3168	11.2
Ovenbird	2190	7.7
Northern Parula	2109	7.4
Black-And-White Warbler	1169	4.1
Mourning Warbler	1142	4.0
Northern WaterThrush	1088	3.8
Chestnut-Sided Warbler	763	2.7
White-Throated Sparrow	748	2.6
Single-banded downsweep[b]	743	2.6
Song or Fox Sparrow	704	2.5
Canada Warbler	699	2.5
Common Yellowthroat	641	2.3
Swainson's Thrush	410	1.4
Savannah Sparrow	184	0.6
Solidary- or Spotted Sandpiper	118	0.4
Hermit Thrush	104	0.4
Black-Throated Blue Warbler	63	0.2
Cup sparrows[c]	40	0.1
American Robin	20	0.1
Veery	3	0.1
Total	**28407**	**100**

(a) "Zeep" species groups includes Bay-breasted Warbler, Blackburnian Warbler, Blackpoll Warbler, Cape May Warbler, Magnolia Warbler, Northern WaterThrush and Yellow Warbler.

(b) "Double up" species group includes black-throated green Warbler, Tennessee Warbler, Nashville Warbler and Orange-crowned Warbler.

(c) "Single-banded downsweep" species group includes Pine Warbler, Northern Parula, Yellow-throated Warbler, and Prairie Warbler.

(d) "Cup sparrow" species group includes Chipping Sparrow, Field Sparrow and American Tree Sparrow.

During fall 2023 a total of 18 distinct species and four species groups were identified with the nocturnal flight call recordings. American Redstart was the species that was most commonly detected and comprised 13.6 percent of the total detections. The second most common detected species was the Northern Parula which comprised 9.6 percent of all detections. The most detected species groups are Zeep accounting for 30.0 percent, and Double up accounting for 4.3 percent of all detections. A summary of all nocturnally migrating species detected in fall 2023 is provided in **Table 3.4**.

Table 3.4 Nocturnal Flight Call Detections by Species and Species Group in Fall 2023

Species or Species Group[(a)]	Total Number of Calls Detected	Proportion of Calls Detected
Zeep[a]	8852	30.0
American Redstart	4021	13.6
Northern Parula	2820	9.6
Common Yellowthroat	2256	7.6
Ovenbird	1934	6.6
Double Up[b]	1282	4.3
White-Throated Sparrow	1106	3.7
Song or Fox Sparrow	1042	3.5
Swainson's Thrush	1041	3.5
Chestnut-Sided Warbler	938	3.2
Hermit Thrush	726	2.5
Mourning Warbler	621	2.1
Black-And-White Warbler	541	1.8
Northern WaterThrush	497	1.7
Canada Warbler	461	1.6
Single-banded downsweep[c]	376	1.3
Savannah Sparrow	374	1.3
Veery	280	0.9
Solitary or Spotted Sandpiper	228	0.8
Black-Throated Blue Warbler	51	0.2
Cup sparrows[d]	35	0.1
American Robin	19	0.1
Total	**29501**	**100**

(a) "Zeep" species groups includes Bay-breasted Warbler, Blackburnian Warbler, Blackpoll Warbler, Cape May Warbler, Magnolia Warbler, Northern WaterThrush and Yellow Warbler.

(b) "Double up" species group includes black-throated green Warbler, Tennessee Warbler, Nashville Warbler and Orange-crowned Warbler.

(c) "Single-banded downsweep" species group includes Pine Warbler, Northern Parula, Yellow-throated Warbler, and Prairie Warbler.

(d) "Cup sparrow" species group includes Chipping Sparrow, Field Sparrow and American Tree Sparrow.

The most-commonly detected species group during spring in both 2022 and 2023 was the Song or Fox Sparrow. In 2022 this species was first detected in late April, and detections peaked in early May with almost 250 detections per night (**Figure 3.25**). In 2023 the Song or Fox Sparrow group was first detected in early April and peaked in mid-May with over 75 detections (**Figure 3.26**). Most detections were at midnight and dawn, with only a few detections at dusk. Interesting to note are the shorebird detections in early April in 2023, comprised of either Solitary or Spotted Sandpipers (**Table 3.2**).

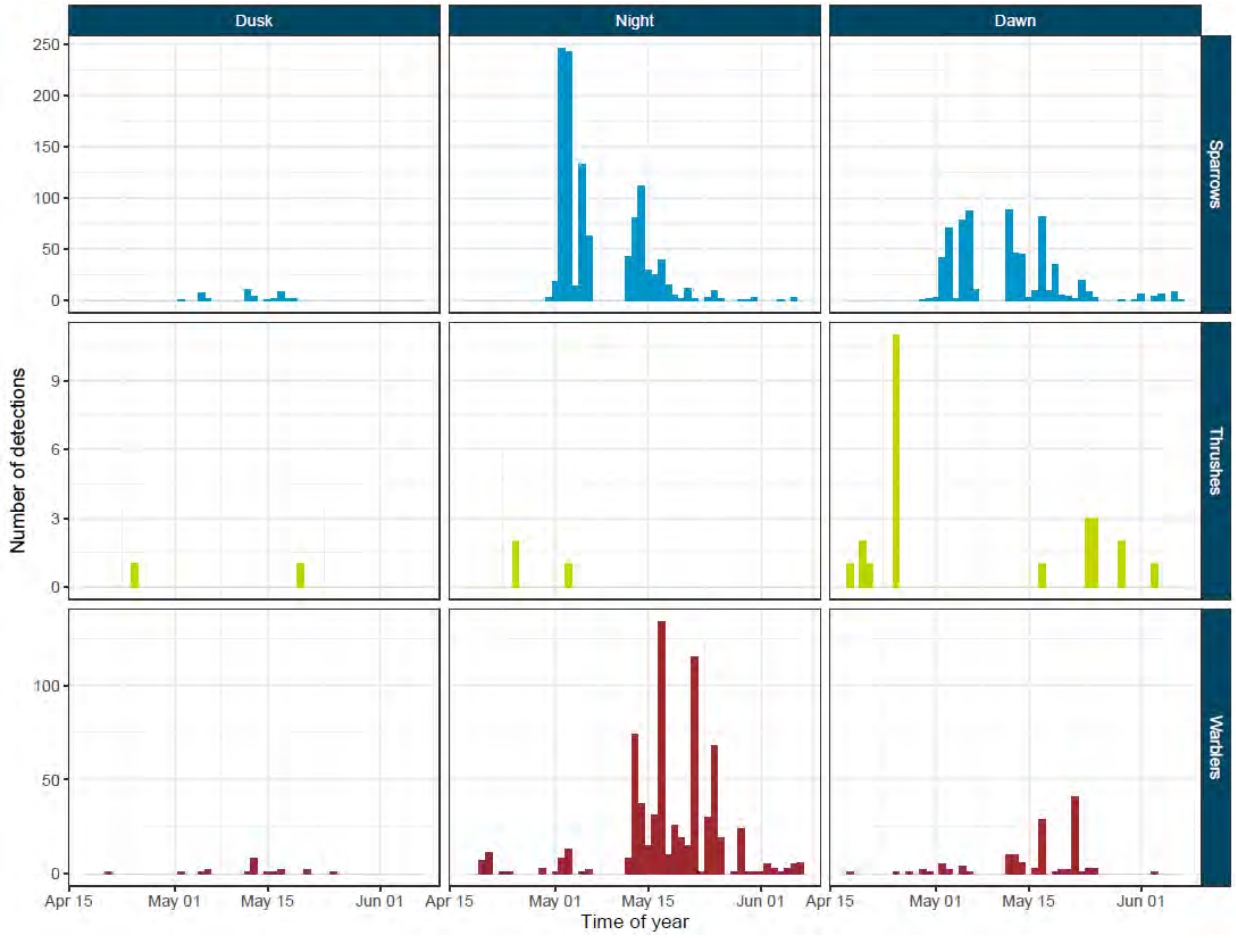

Figure 3.25 Acoustic Detections by Species Groups During Spring 2022. Detections are grouped by species and time of night in panels and displayed as number of detections per day.

Figure 3.26 Acoustic Detections by Species Groups During Spring 2023. Detections are grouped by species and time of night in panels and displayed as number of detections per day.

The most-commonly detected species during fall in both 2022 and 2023 was the American Redstart, which is part of the Warbler family. In 2022 Warblers were first detected in late July, and detections peaked in mid-August and again in mid-September with more than 1000 and 2000 detections per night respectively (**Figure 3.27**). In 2023 Warblers were first detected in early July and peaked in early August and again in early September with nearly 1000 and 1250 detections per night respectively (**Figure 3.28**). Most detections were at midnight, with only a few detections at dawn and dusk.

Figure 3.27 Acoustic detections by species groups during fall 2022. Detections are grouped by species and time of night in panels and displayed as number of detections per day.

Figure 3.28 Acoustic detections by species groups during fall 2023. Detections are grouped by species and time of night in panels and displayed as number of detections per day.

3.3 Species at Risk

One species at risk was detected during the acoustic surveys, the Canada Warbler (**Table 3.5**). The status and threats for this species are described below.

Table 3.5 Species at Risk Detected Within the Project Area

Common Name	Scientific Name	Federal Status	Provincial Status
Canada Warbler	*Cardellina canadensis*	Special Concern	Endangered

The Canadian population of Canada Warbler is estimated at approximately 3,000,000 birds, which accounts for roughly 75% of the total population (Partners in Flight Science Committee 2013). The Canada Warbler population declined by approximately 71 percent between 1970 and 2012 (Environment Canada 2014d). The species was listed as Threatened under Schedule 1 of the SARA in 2010 (S.C. 2002, c. 29), and was listed as Endangered in the Nova Scotia endangered species legislation (S.N.S 1998, c.11).

In 2021, the Nova Scotia Department of Lands and Forestry (NSDLF) developed a recovery plan for the Canada Warbler in Nova Scotia. The provincial plan adopted sections from the federal Recovery Strategy (NSDLF 2021) that are relevant to Nova Scotia. The short-term population objective for the Canada Warbler is to stop the population decline by 2025, while ensuring that the population does not decline more than 10 percent between 2015 to 2025. The long-term objective is a positive population trend after 2025. The distribution objective is the maintain the current range throughout Canada (Environment Canada 2015).

The Canada Warbler nocturnal call was detected 53 times in spring 2022, and 9 times in spring 2023. These numbers are comparatively low when compared to the total NFC detected during the study. Canada Warbler calls account for 2.0 and 0.7 percent of the total spring 2022 and 2023 detections respectively. The species was more frequently detected in the fall, with 699 detections in 2022, and 461 detections in 2023. Because the overall number of detections were much greater in the fall, this still only accounted for 2.5 and 1.6 percent of all 2022 and 2023 fall detections respectively.

It is possible that the Canada Warbler also breeds in or nearby the Project area, though it is unclear if the habitat inside or nearby the Project area is suitable for this species. In Nova Scotia, the Canada Warbler is known to prefer moist sites with cinnamon fern (*Osmunda cinnamomea*), speckled alder (*Alnus incana*) or other deciduous shrubs, and the birds are often associated with sphagnum (NSDLF 2021).

4.0 Discussion

The radar and acoustic data collected for this study characterize migratory bird activity in the Project area during spring and fall of 2022 and 2023 and inform potential impacts to migratory birds resulting from operation of a wind facility in the Project area.

The radar data show that most targets were detected above the RSZ in both 2022 and 2023 spring and fall season. Some periods of our study identified peaks of flight activity within the RSZ, such as during the fall of 2023 with more than 40,000 total detections below 200 m agl (**Figure 3.11**). It is unclear exactly why so many targets were detected at low altitudes. A potential explanation may be periods of rain as birds are known to fly at lower altitudes during rain (Kennedy 1970; Richardson 1978). There were many periods of rain during the 2023 fall migration period (**Appendix D**), potentially forcing the birds to fly at low elevations. Periods of low clouds may also cause birds to have flown at low altitudes during the fall (Richardson 1978). In contrast, during the 2022 fall season there was much less heavy rain, less than 30 percent of all nights (**Appendix B**), and the percentage of migrants flying above RSZ was much greater in this year than in 2023.

Because birds generally fly at lower elevations when experiencing headwinds (Day et al., 2004; Krijgsveld et al., 2011), it was predicted that the proportion of targets within RSZ would increases with headwinds. This is largely supported with the data from both 2022 and 2023 spring and fall season (**Figure 3.21 – Figure 3.24**). Most target detections within the RSZ also seem to occur during nights with headwinds or side winds (**Appendices A to D**). Because birds flew overall lower and within the RSZ during strong headwinds, it is likely that periods with strong headwinds increases the risk of avian collision with turbines. The risk of collision is therefore generally expected to increase during strong northern winds during spring migration, and during strong southern winds during fall migration.

The most detected species in 2022 and 2023 spring and fall season are the Song or Fox Sparrow and the American redstart (**Table 3.1 – Table 3.4**). These species are not identified as sensitive or at risk, but like all migratory birds they are protected under the MBCA, and the MBR. During the 2022 and 2023 spring and fall season only one species at risk was detected, the Canada Warbler. The Canda Warbler is listed as Special Concern on Schedule 1 of the SARA and as Endangered in the NS ESA. Only a small percentage of all detections were from Canada Warbler, comprising no more than 2.5% of all detected species (**Table 3.1 – Table 3.4**). The Canada Warbler was also only detected as a migrant and this species is less likely to use the Project area for foraging and nesting, where the risk of collision is higher due to the much higher potential passage rate through the wind turbines. The collision risk for Canada Warbler is therefore judged to be low. Post-construction monitoring will be required to accurately predict potential mortality for the Canada Warbler in the Project area.

It is important to note that prediction of collision risk of migratory birds with turbines using pre-construction radar and acoustic data is complex and has not been well established in Atlantic Canada. The best indicator of risk is the volume of birds migrating within the RSZ, though only a small fraction of the birds migrating at this height may collide with the turbine rotors. Several models have been developed to predict the collision risk based on the flight volume, species, rotor height, RSZ, etc. (Band et al. 2007; Masden and Cook 2016; Kleyheeg-Hartman et al. 2018). Although these models are useful to predict potential mortality and may be used to prevent potentially high collision rates by allocating turbines to less risky locations, post-construction research has shown that model predictions often underestimate the actual mortality (Ferrer et al. 2012; Schippers et al. 2020), indicating the importance of post-construction monitoring. Although the risk of collision may be correlated with volume of migration, without multiple, standardized radar/acoustic studies conducted across a broader region (i.e. across Nova Scotia), and without post-construction mortality data to validate predictions, forecasts will have substantial error and uncertainty.

5.0 Data limitations

The following are limitations related to the data collected that should be considered when drawing conclusions from the data presented in this report.

5.1 Radar Data

Radar data can provide a good understanding of nocturnal avian migration trends at proposed wind energy projects. However, there are limitations to how the data are collected and can be interpreted, such as:

- While it is assumed that most targets are migratory birds, some proportion of targets may be insects, bats, ground clutter and or precipitation.
- Detection probability of targets varies with several external factors such as: distance from radar, atmospheric conditions, ground clutter, altitudinal coverage, interference from large objects, and radar orientation. Given that target density varies with these external factors, direct comparison of passage rates across sites can be difficult.
- Targets at very low altitudes (i.e. below the RSZ) are difficult to detect with a radar due to ground clutter and background noise from vegetation.

5.2 Acoustic Data

Acoustic data provide information about the avian community migrating through the Project area, including species identification and passage volumes, although there are several factors that may affect calling rates and detectability, such as:

- Microphone sensitivity may cause detection rates to change due to rainfall, background noise, vegetation cover, and technology (microphones need to be calibrated frequently).
- Because the acoustic microphones have a limited range of approximately 200 metres, birds flying at elevations higher than 200 metres will not be picked up by the microphones, and therefore may underestimate the total number of migratory birds (detections) within the study area.
- Weather conditions have the potential to influence calling rates. Data collected during cold or rainy conditions may underestimate the number of birds (detections) or species within the study area.
- The density of migrants has the potential to influence calling rates.
- Calling rates may vary with species composition as not all species call, and some species may call more frequently than others.

6.0 Recommendations

The pre-construction data shows that the highest volumes of birds fly within the RSZ during strong headwinds and during particularly rainy seasons. The risk of collision is therefore expected to increase with strong northern winds during spring migration, and during strong southern winds during fall migration. To determine whether mitigation measures are needed, Ausenco recommends 2-year post-construction monitoring to determine collision risk at the Project as per federal recommendations (Government of Canada 2022). Post-construction monitoring will also help determine what type of mitigation is best suited for the Project.

The presence and local abundance of the Canada Warbler in the Project area is notable. The species is federally and provincially protected under the MBCA, and MBR, and is listed on Schedule 1 of the SARA, as well as the provincial Nova Scotia *Endangered Species Act*. No SARA protection is conferred to species listed as Special Concern and a SARA permit is unlikely to be required for the Project. However, mortality from collision with the wind turbines should be minimized to meet the recovery strategy objectives for this species (NSDLF 2021). To determine whether mitigation measures are needed for this species, Ausenco recommends 2-year post-construction monitoring to determine the mortality rate of this species at the Project area. Post-construction monitoring will also help determine what type of mitigation is best suited for this species.

7.0 Closure

We sincerely appreciate the opportunity to have assisted you with this Project and if there are any questions, please do not hesitate to contact the undersigned.

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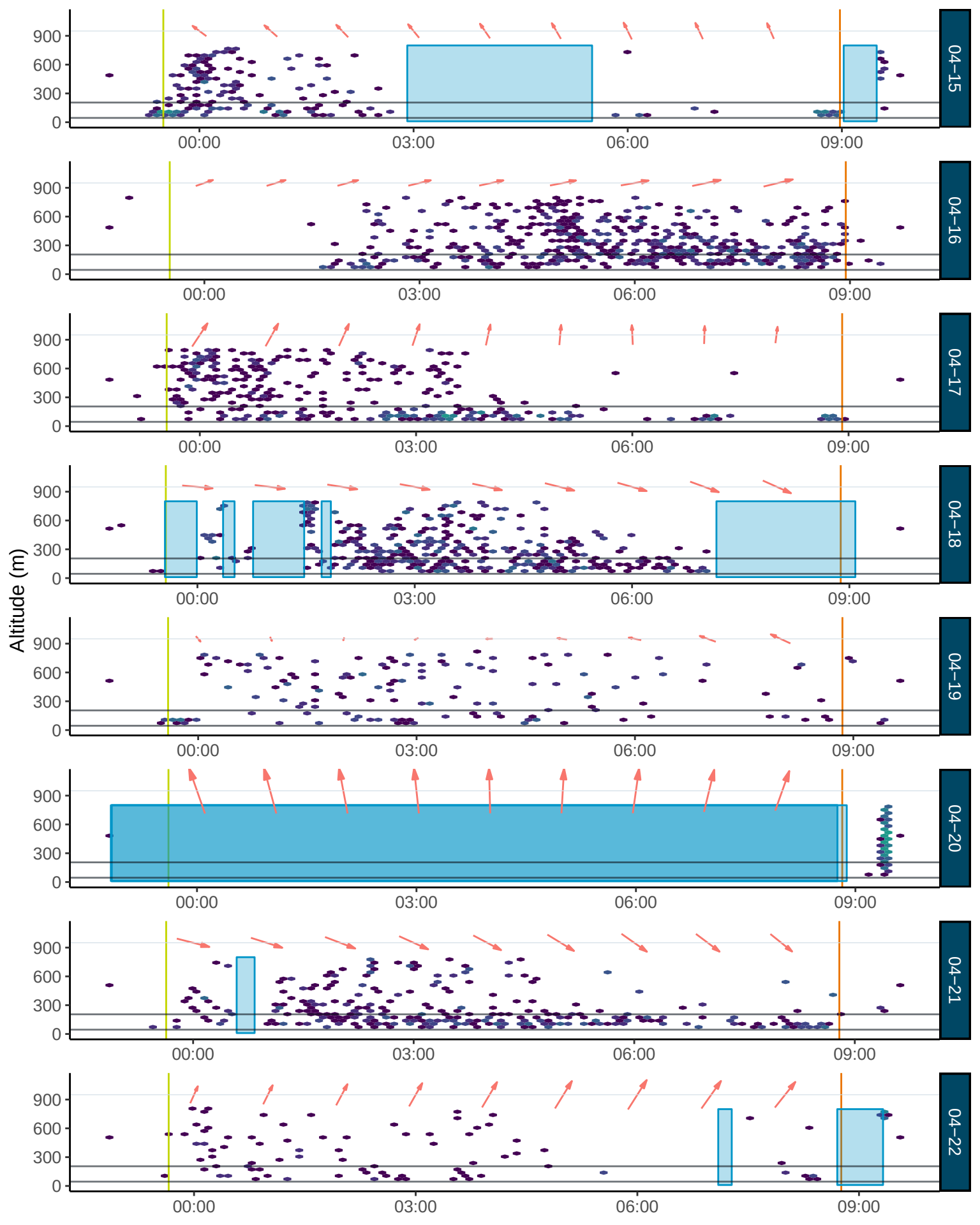
Appendix A

Complete Spring 2022 Radar Data

OVERVIEW

The entire radar and acoustic detections for the spring 2022 monitoring period are provided below. Each panel in the figures is a separate night. Time is indicated using Global Mean Time (GMT) on the x-axis with the beginning and end of civil twilight indicated by the vertical green and yellow lines, respectively. Target altitude is on the y-axis, including the proposed rotor swept zone (i.e. 0-200 m) indicated with red horizontal lines. Data points are radar detections divided into hexagonal time and altitude bins, which are scaled from light grey (i.e. few detections) through dark purple to yellow (i.e. many detections). Acoustic detections are red dots along the base of each plot. Wind direction (i.e. cardinal direction of red arrow) and wind strength (i.e. arrow size) at approximately 700 m agl is indicated for each hour at the top of each plot. The blue box represents a period of rain when raindrops could not be distinguished from bird detections.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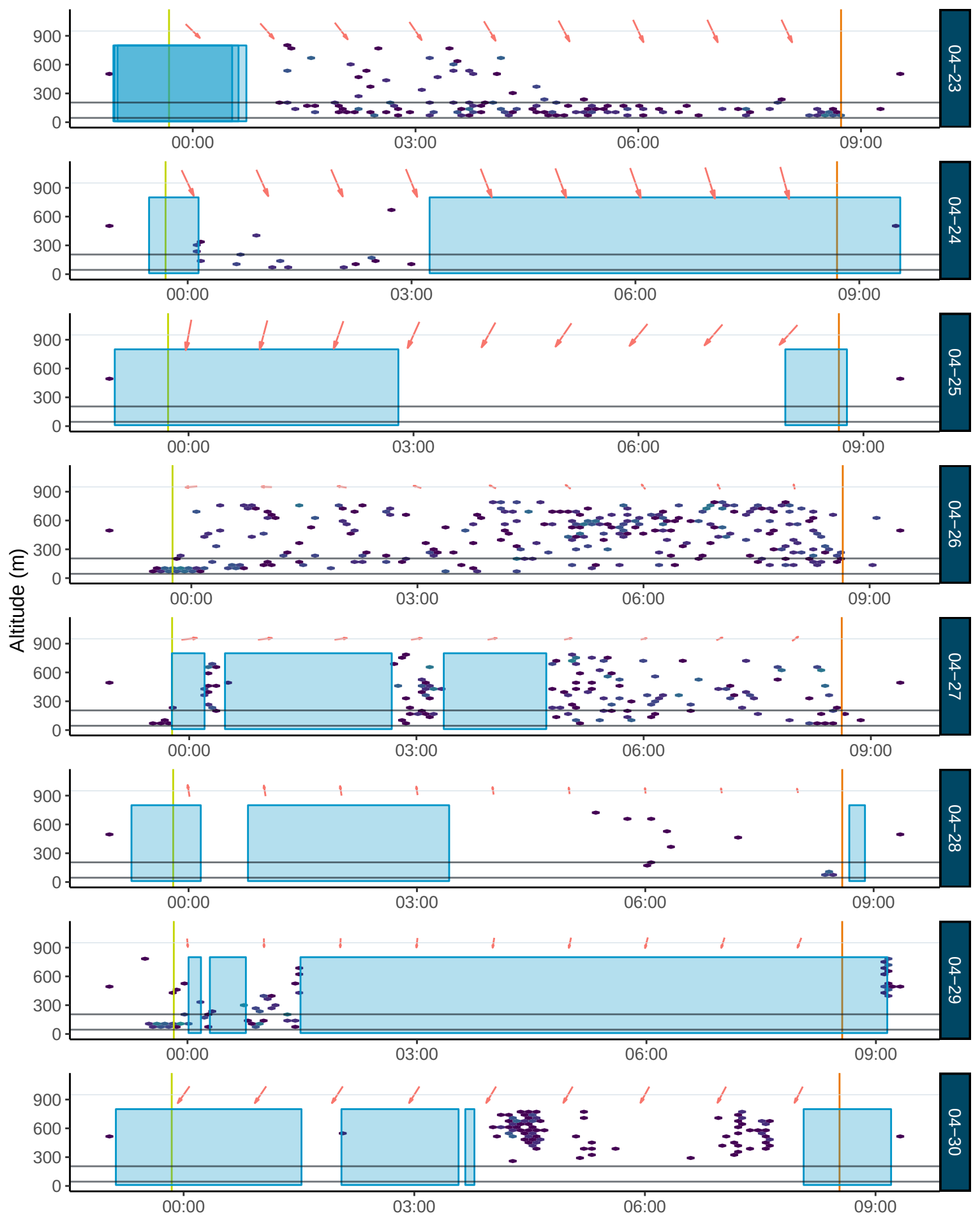
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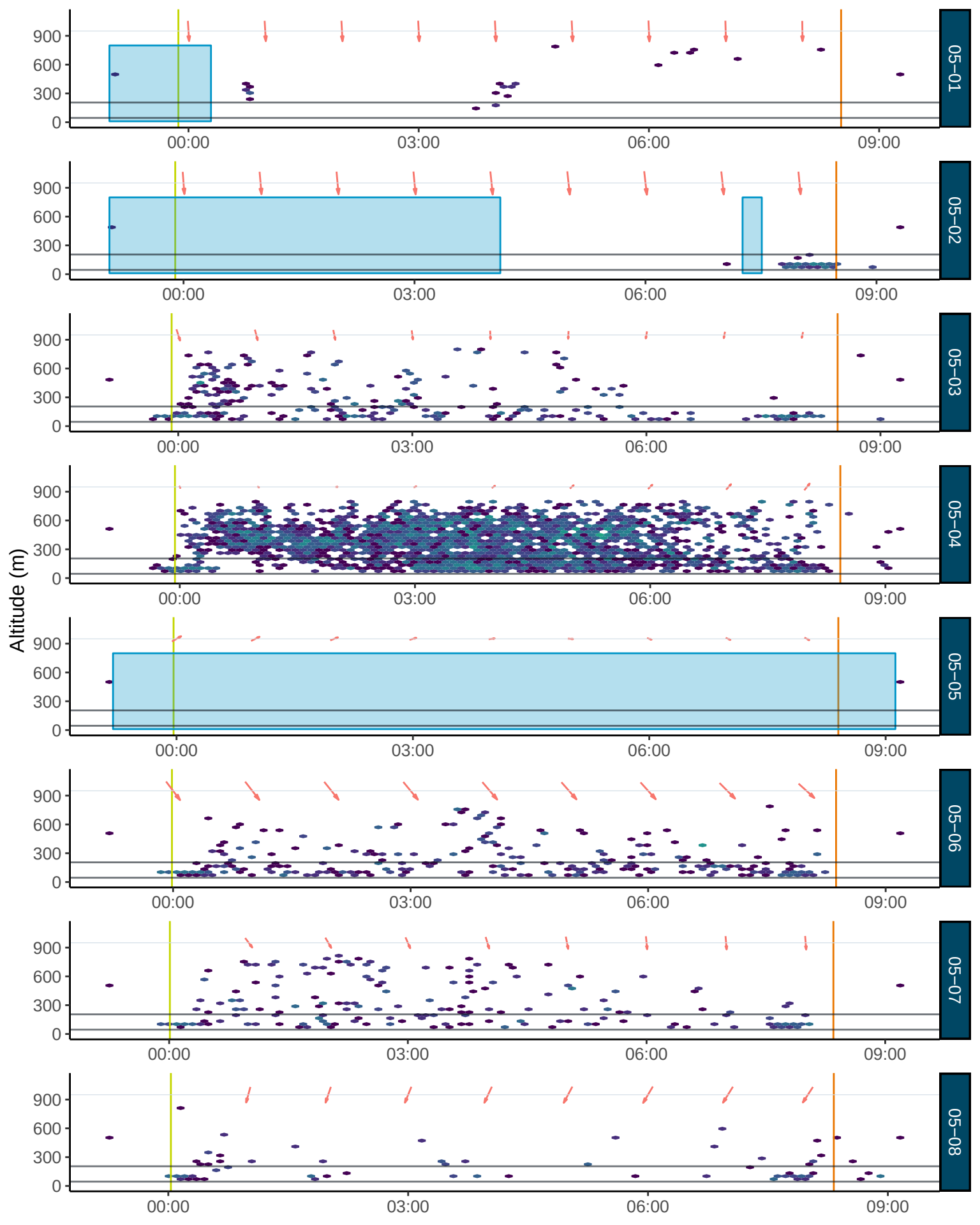
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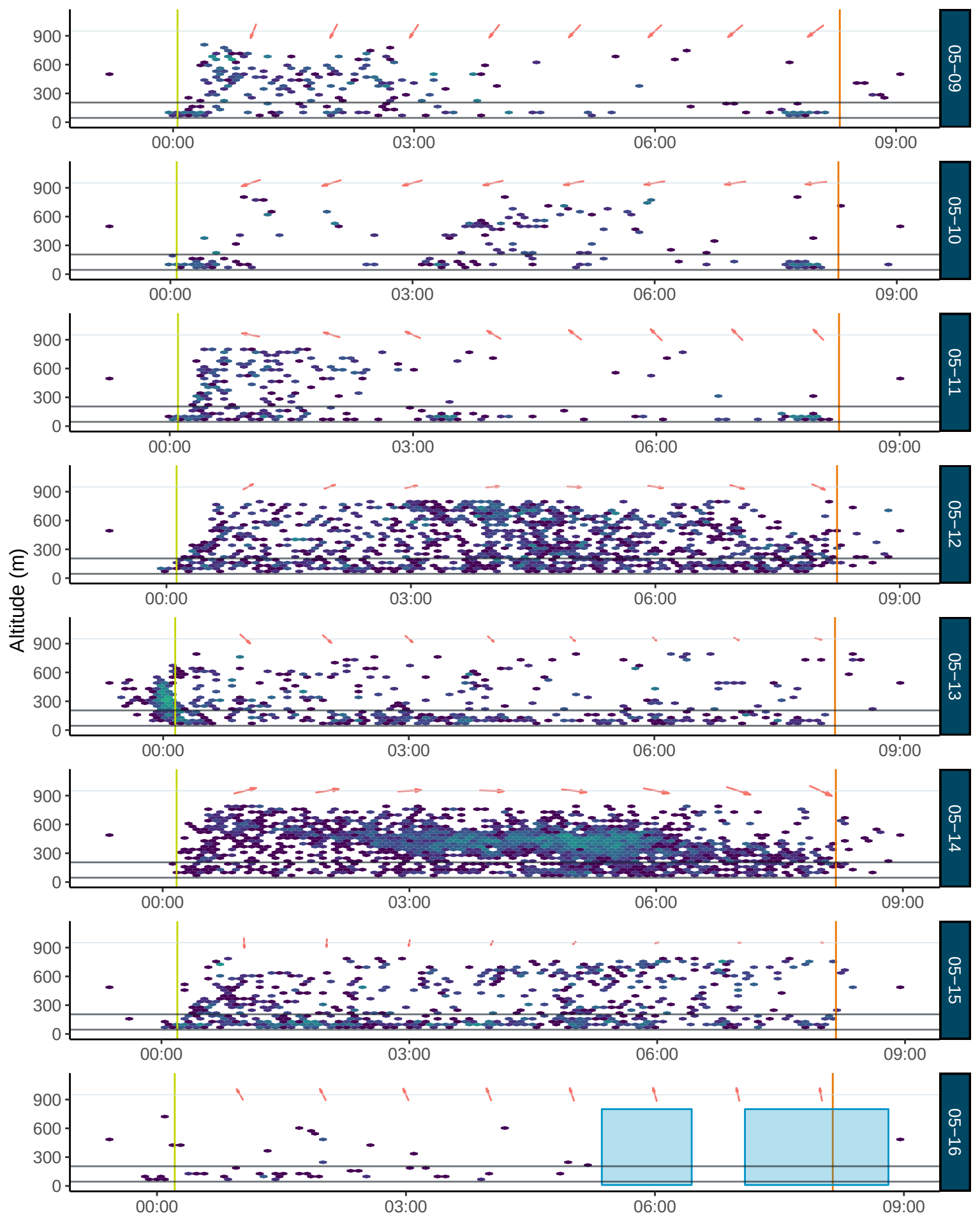
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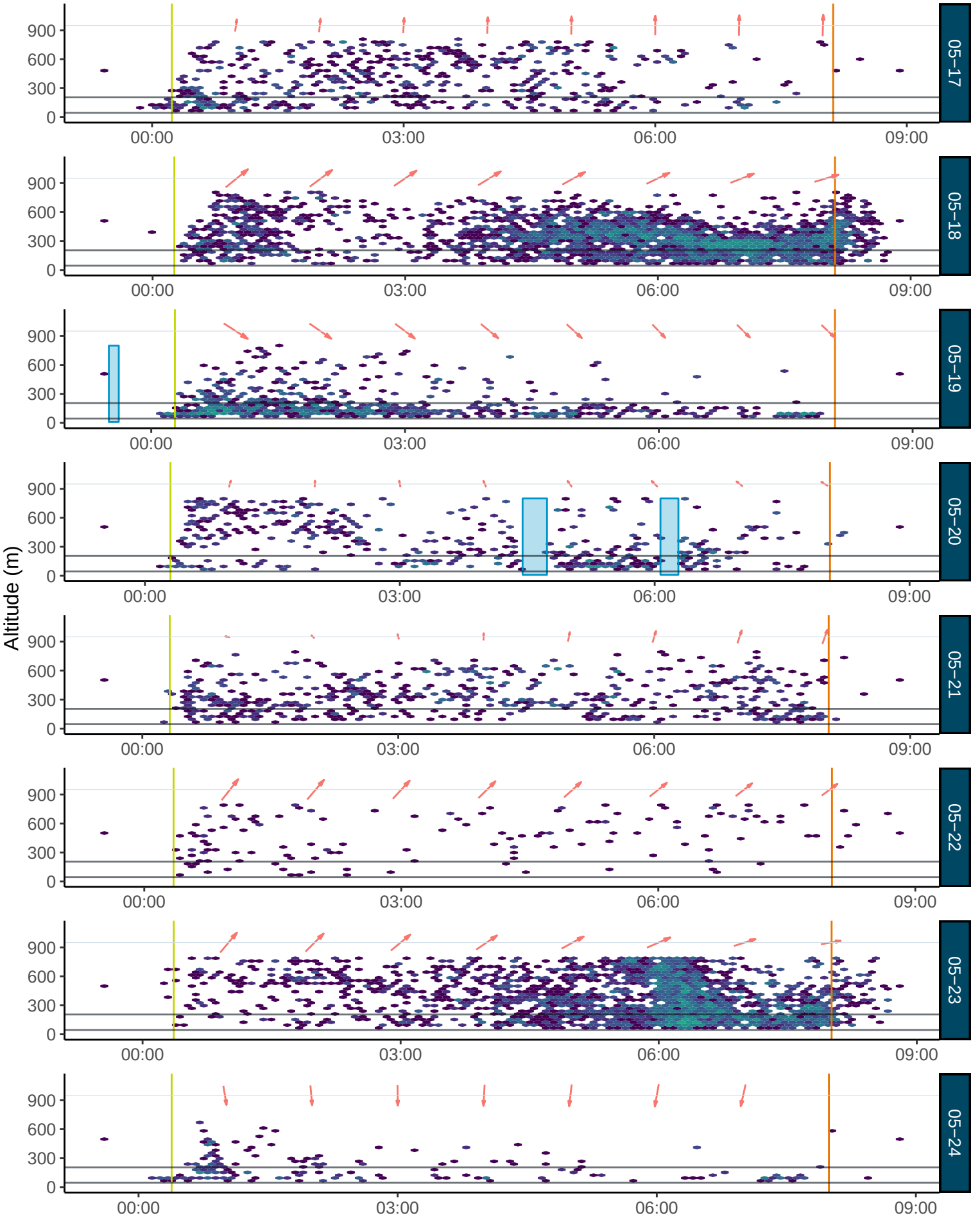
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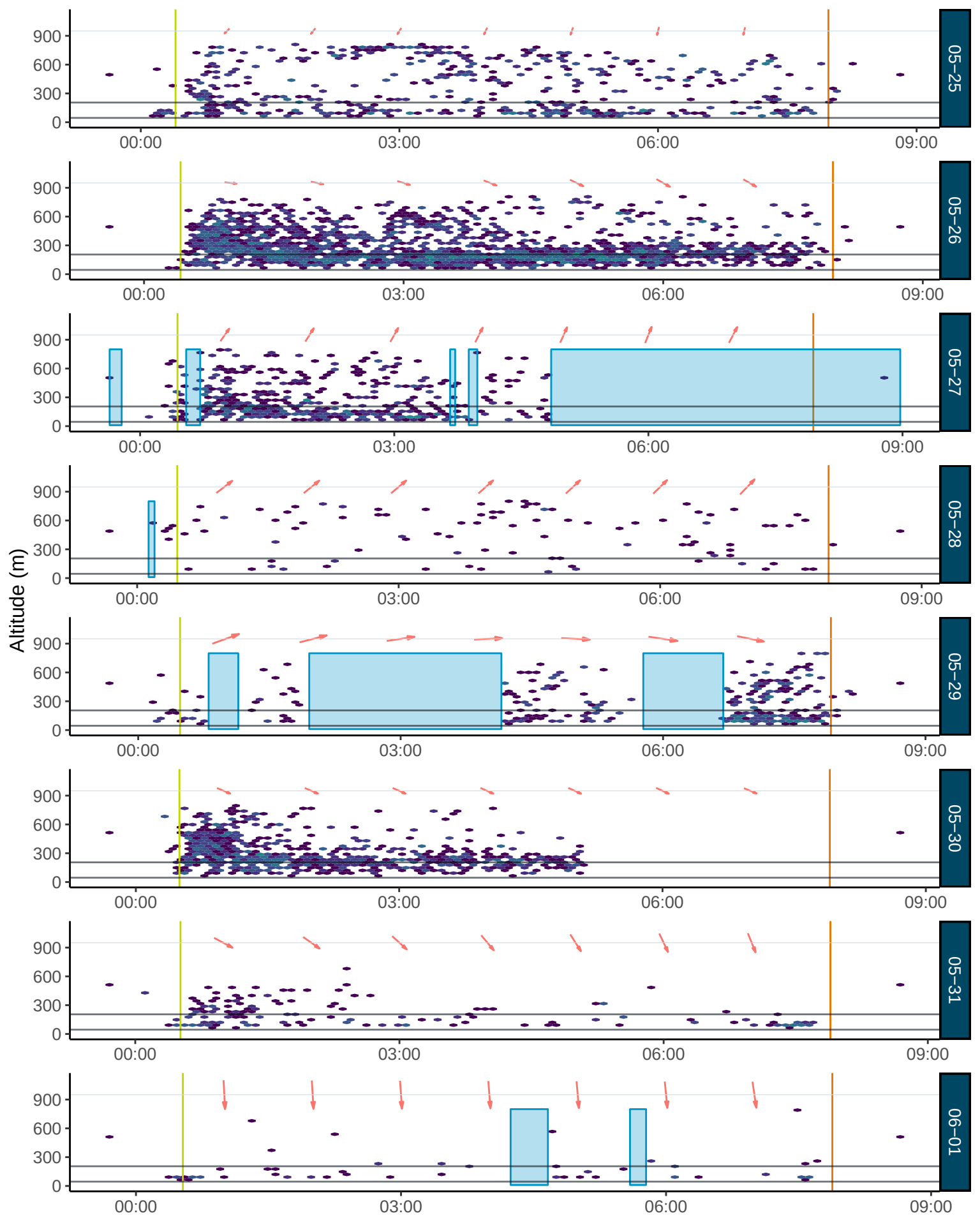
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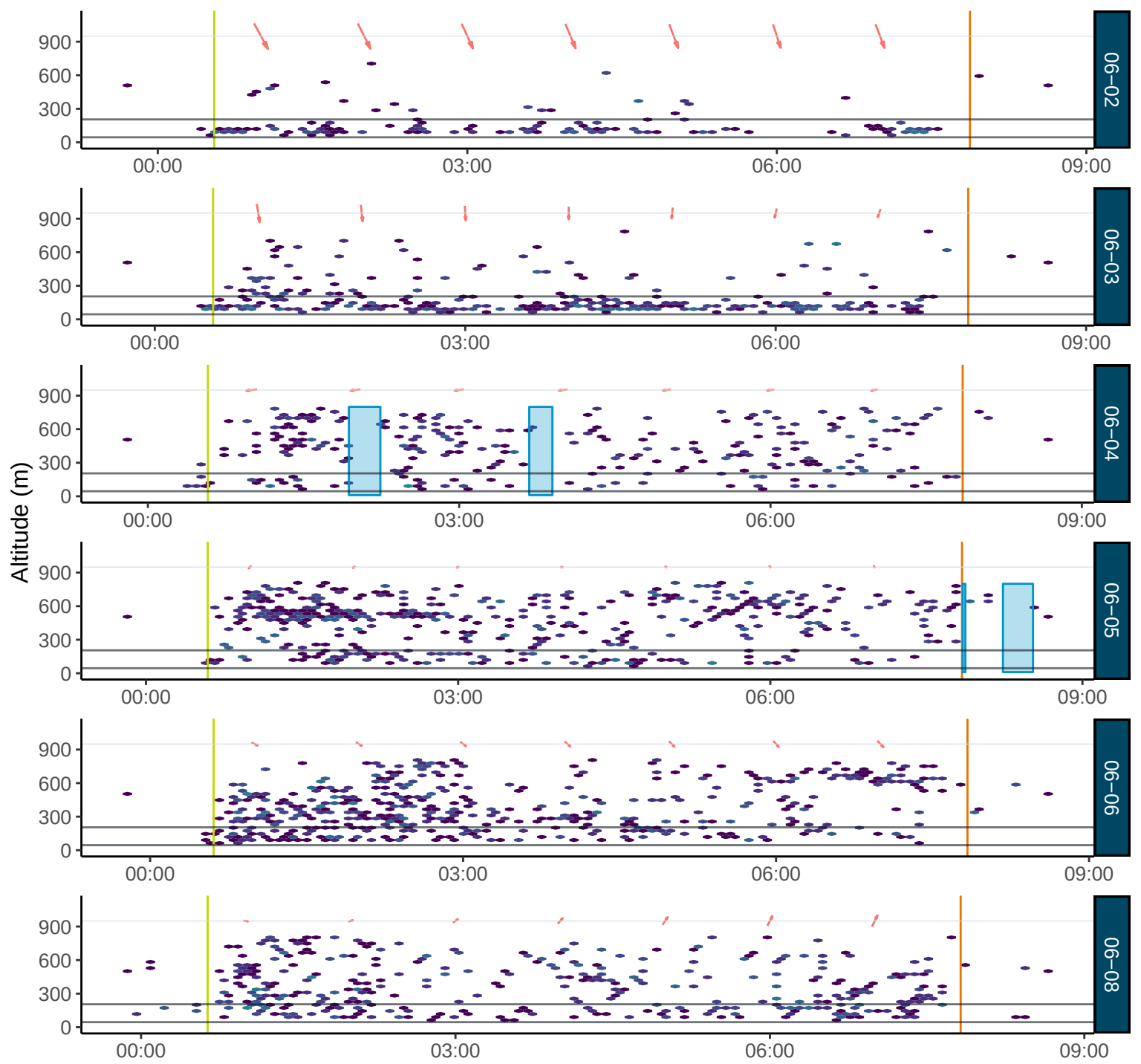
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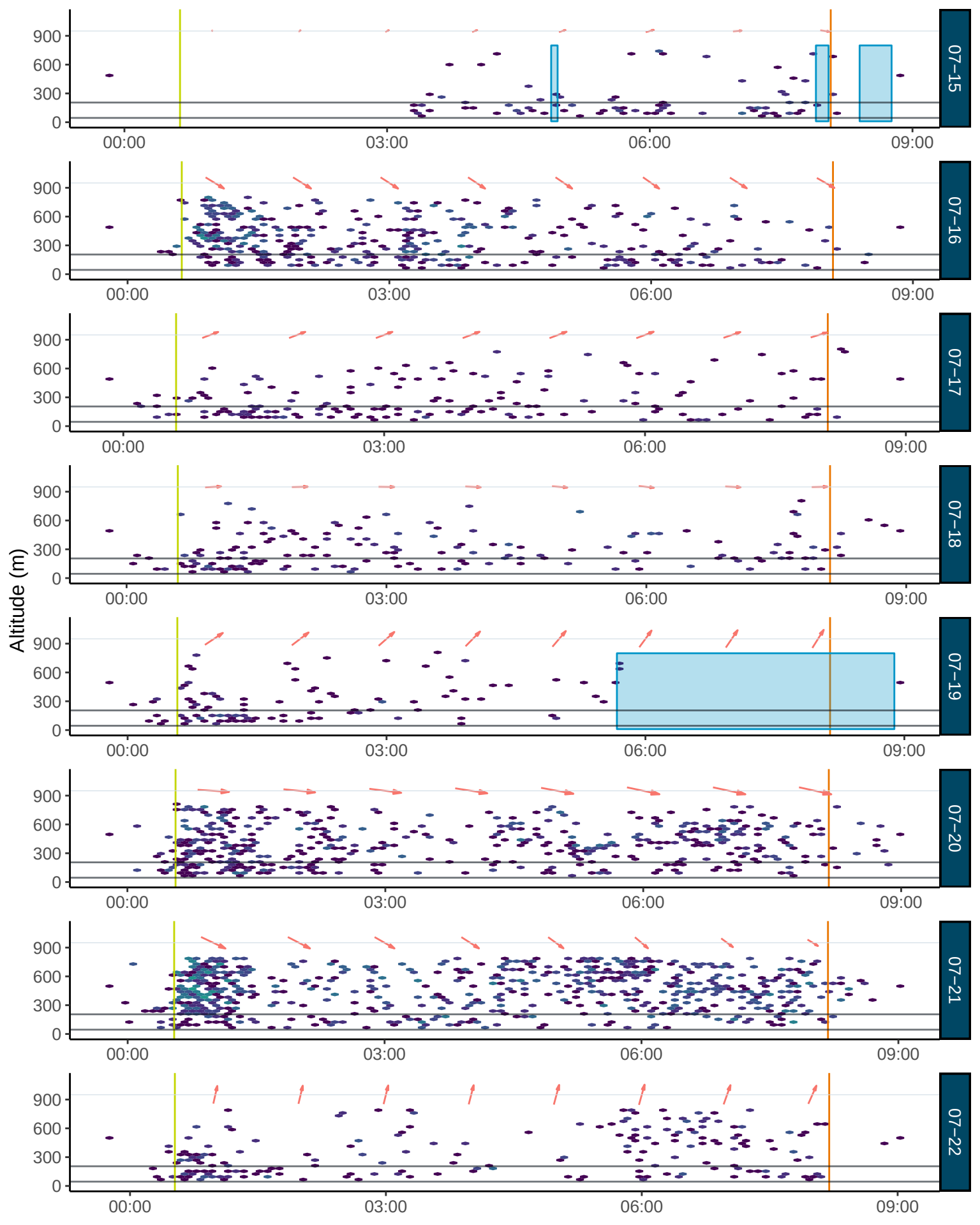
Appendix B

Complete Fall 2022 Radar Data

OVERVIEW

The entire radar and acoustic detections for the fall 2022 monitoring period are provided below. Each panel in the figures is a separate night. Time is indicated using Global Mean Time (GMT) on the x-axis with the beginning and end of civil twilight indicated by the vertical green and yellow lines, respectively. Target altitude is on the y-axis, including the proposed rotor swept zone (i.e. 0-200 m) indicated with red horizontal lines. Data points are radar detections divided into hexagonal time and altitude bins, which are scaled from light grey (i.e. few detections) through dark purple to yellow (i.e. many detections). Acoustic detections are red dots along the base of each plot. Wind direction (i.e. cardinal direction of red arrow) and wind strength (i.e. arrow size) at approximately 700 m agl is indicated for each hour at the top of each plot. The blue box represents a period of rain when raindrops could not be distinguished from bird detections.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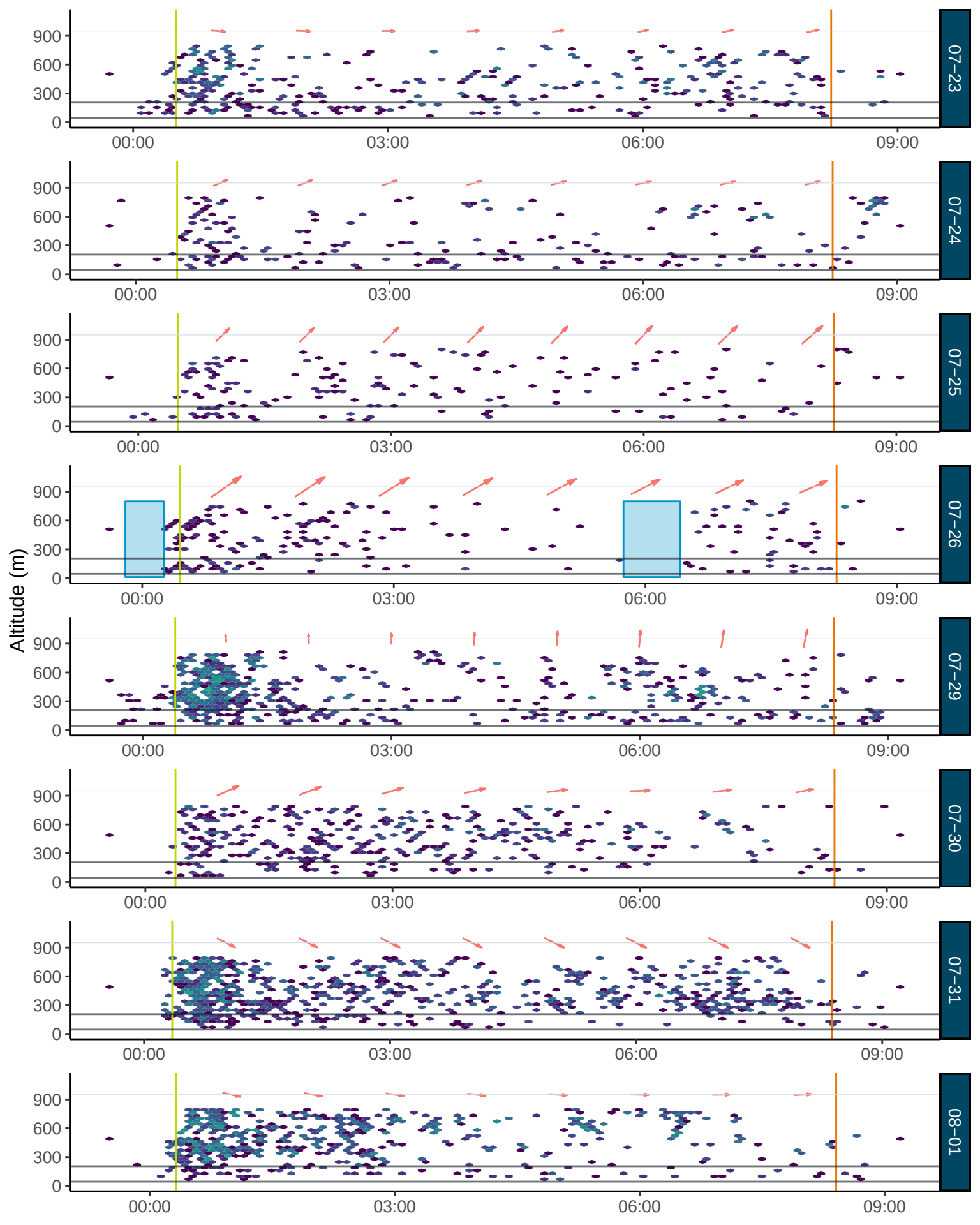
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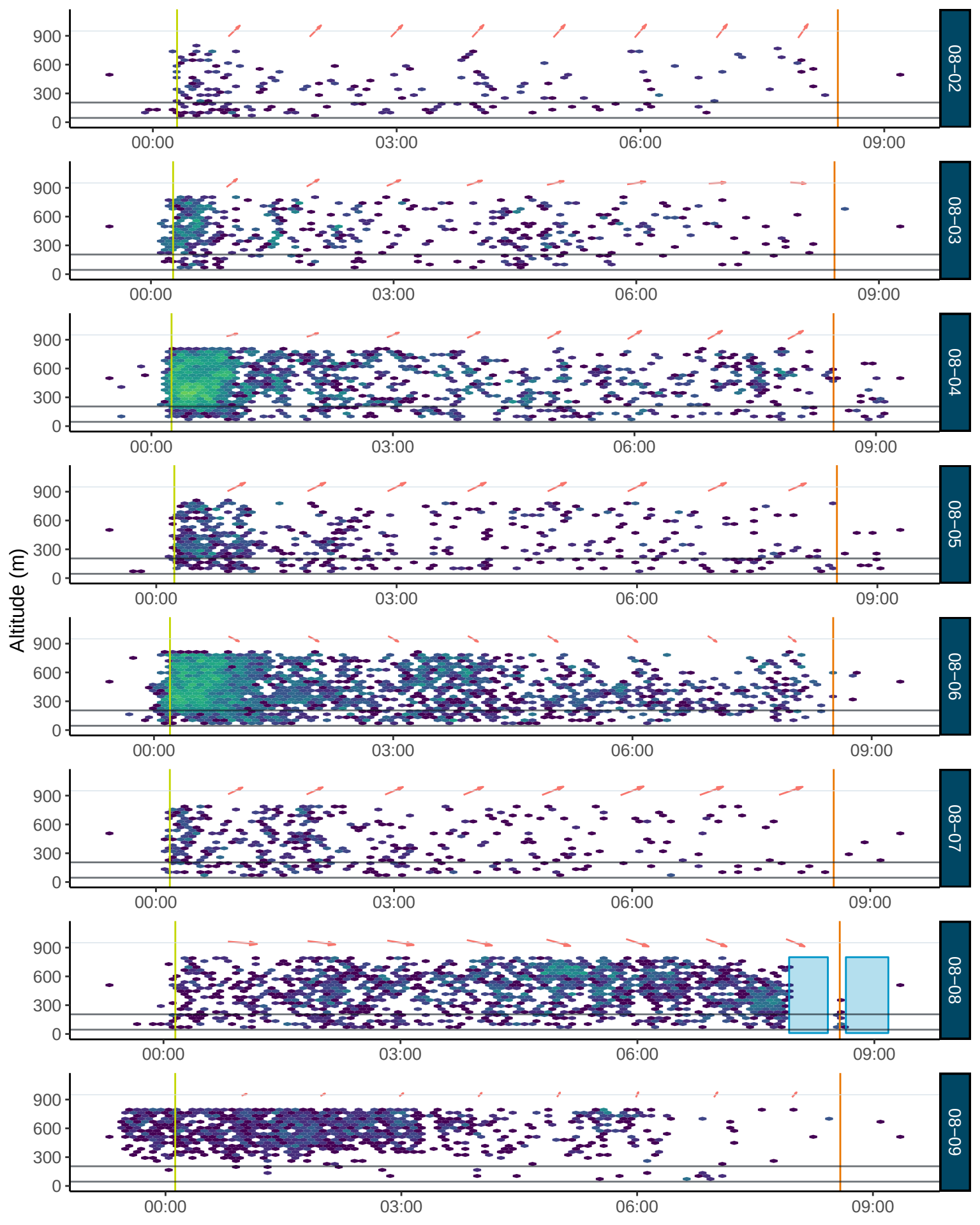
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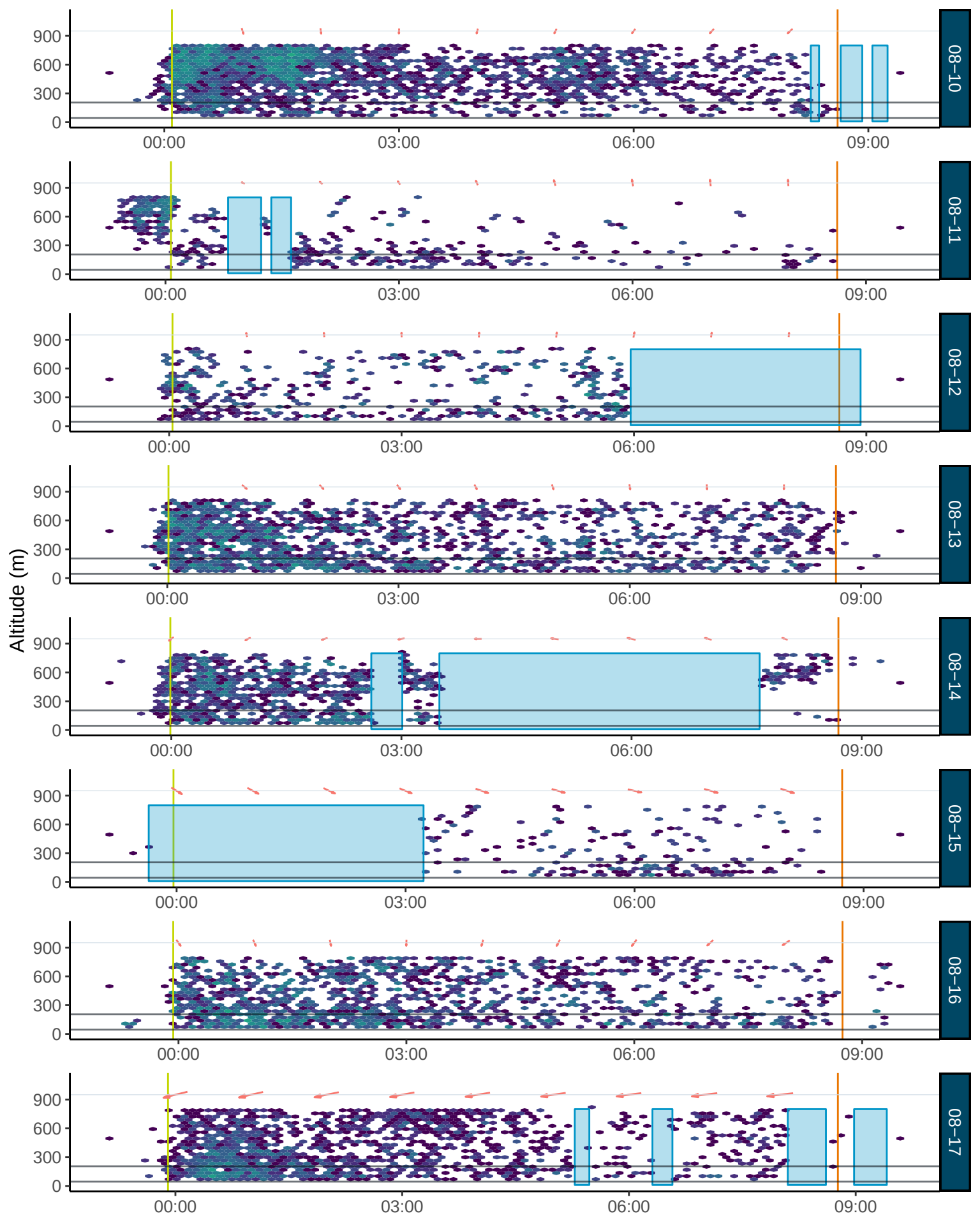
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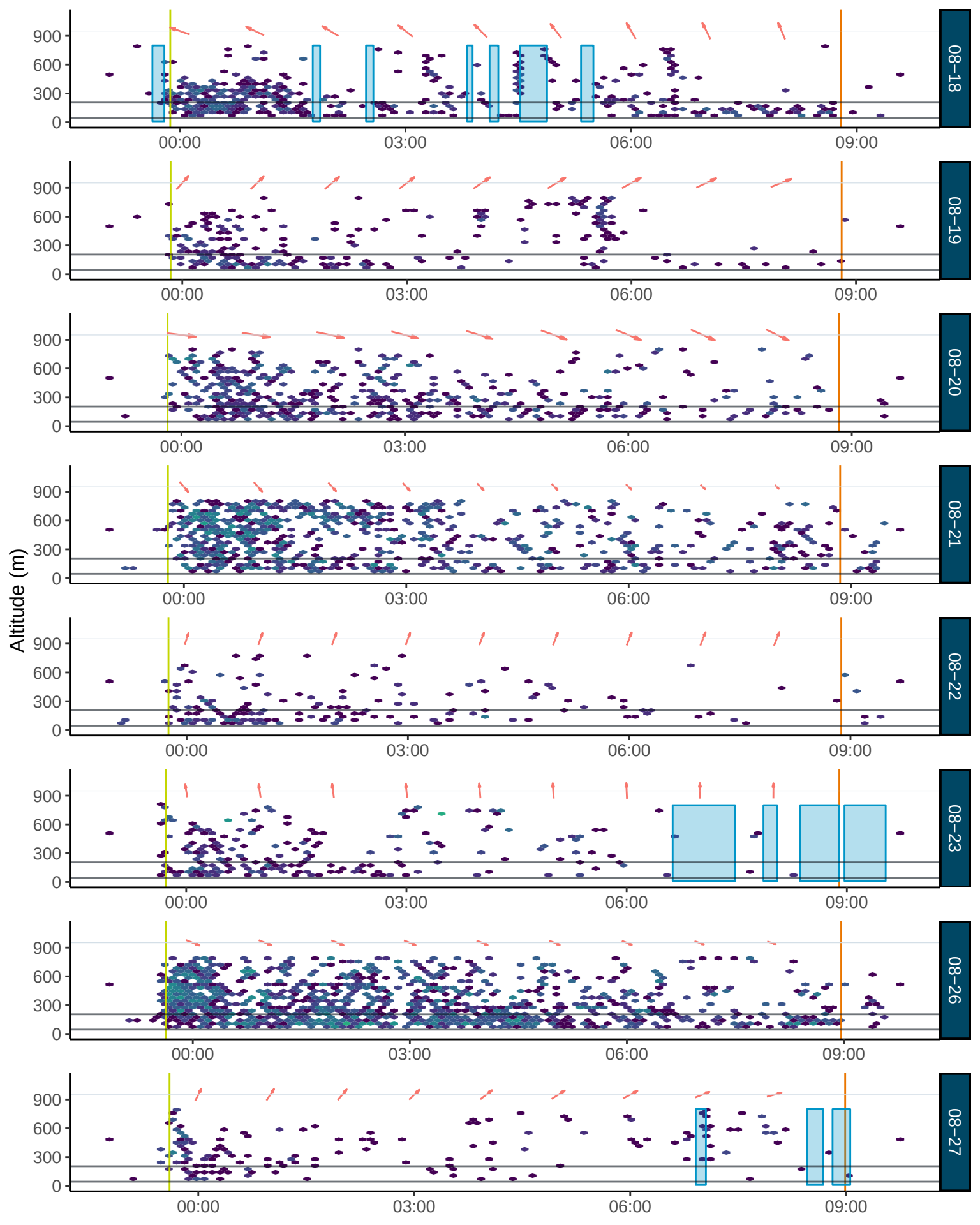
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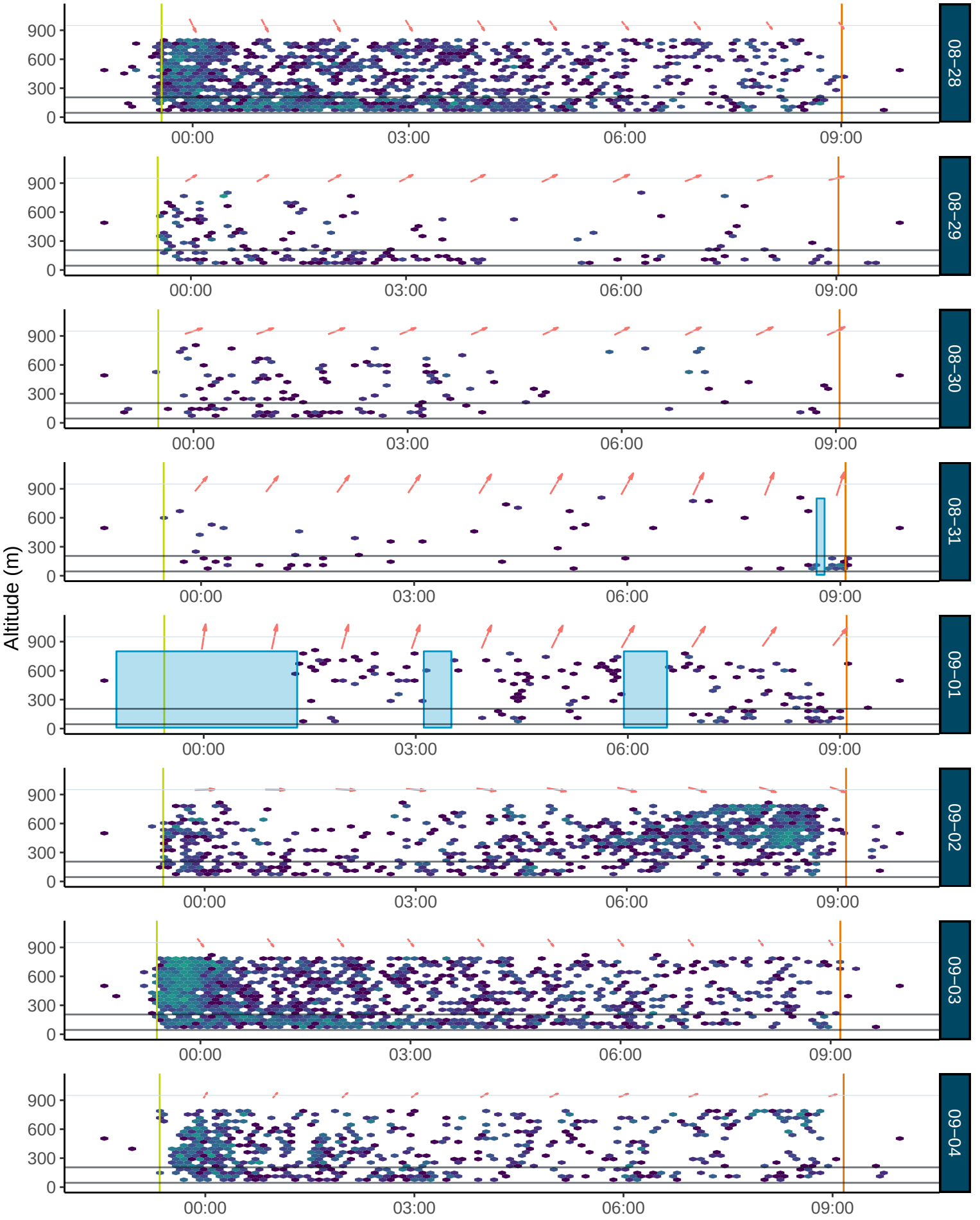
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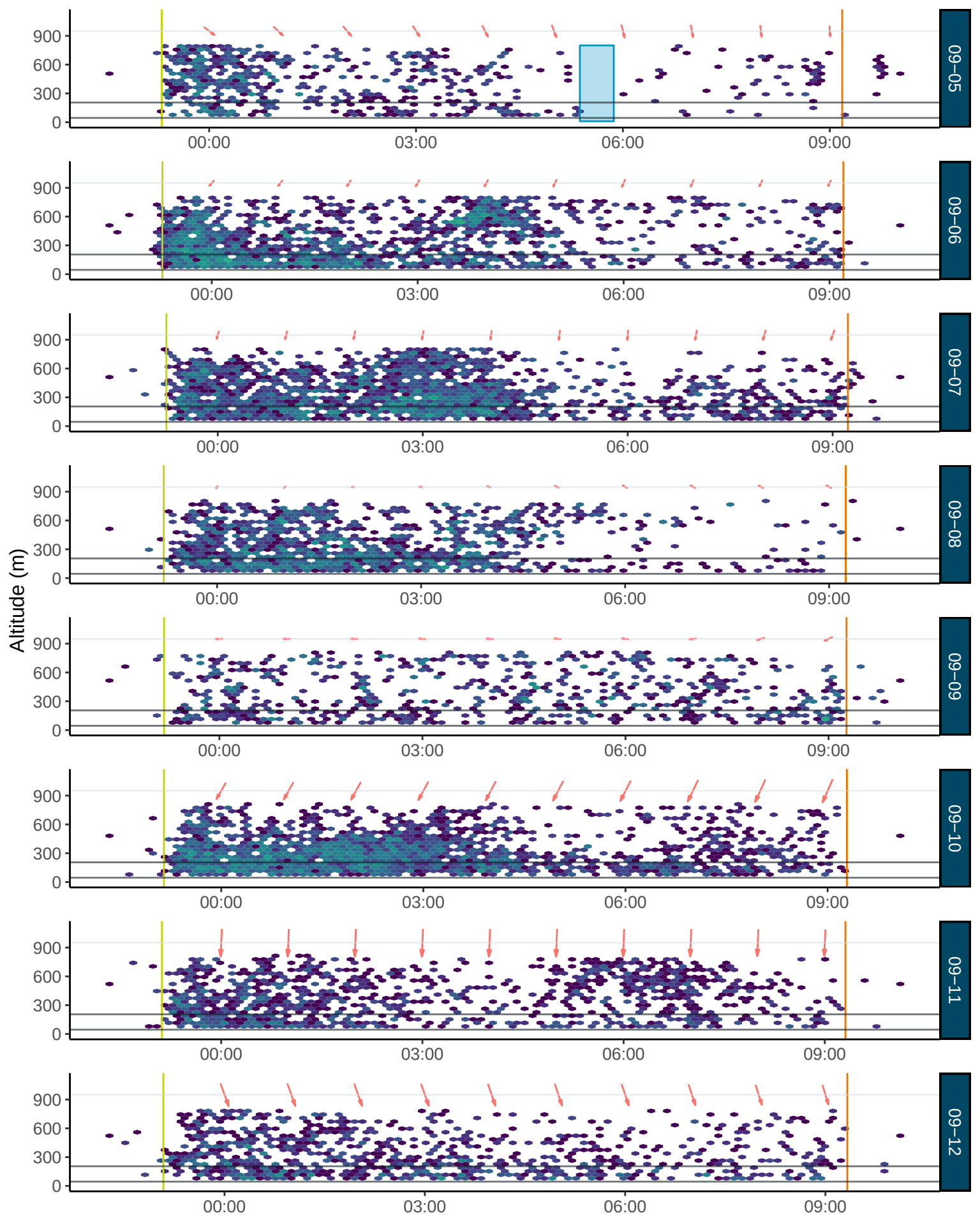
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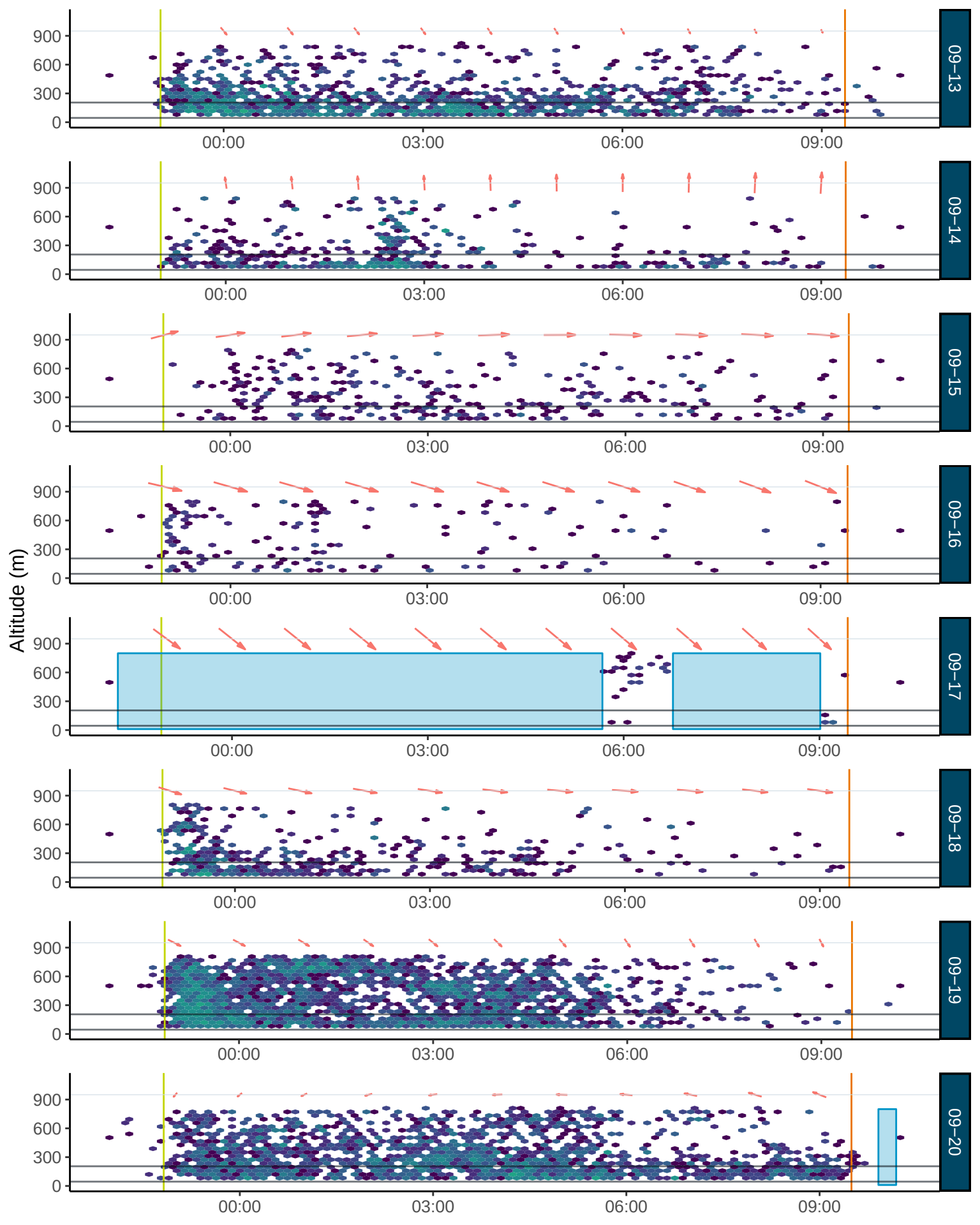
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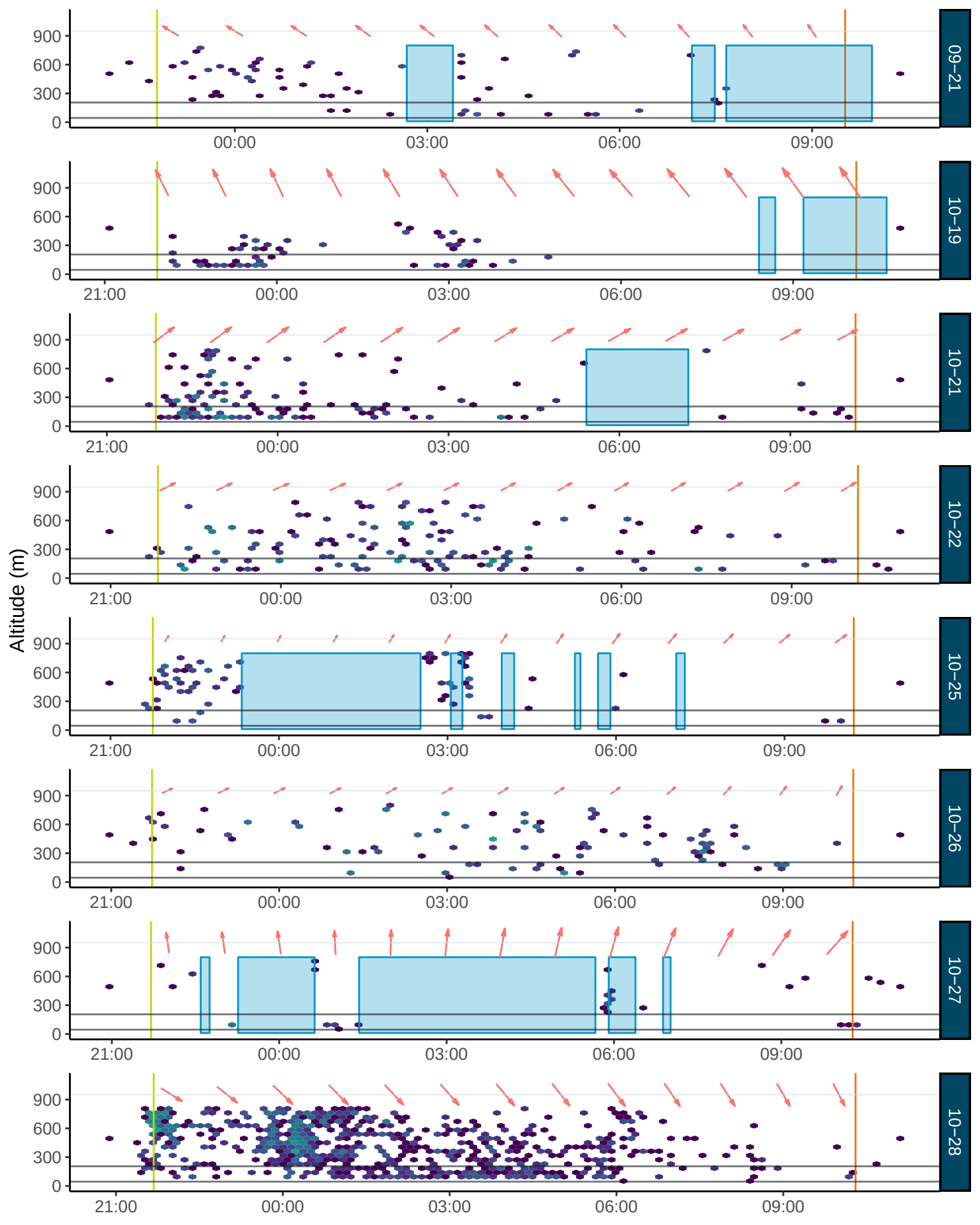
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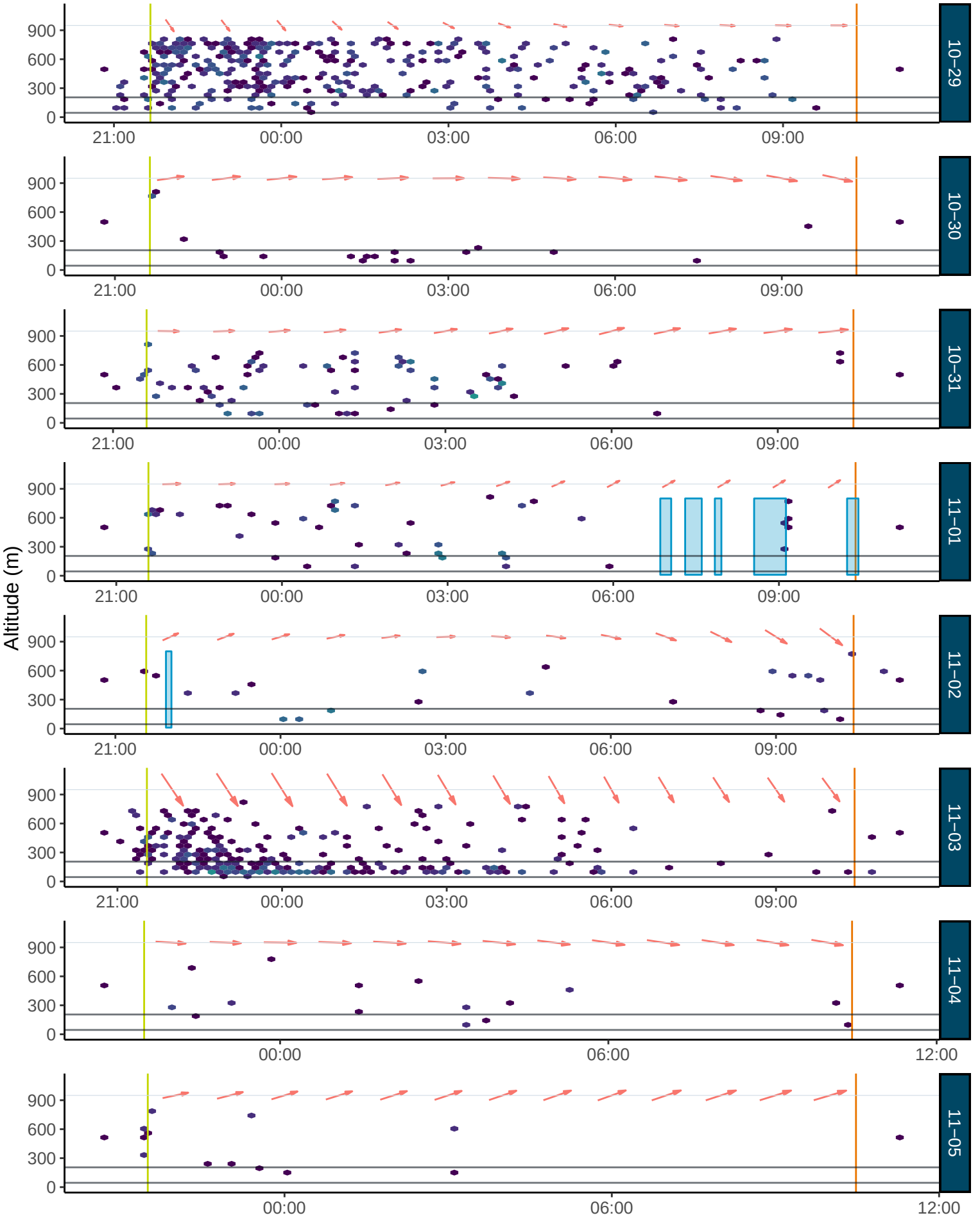
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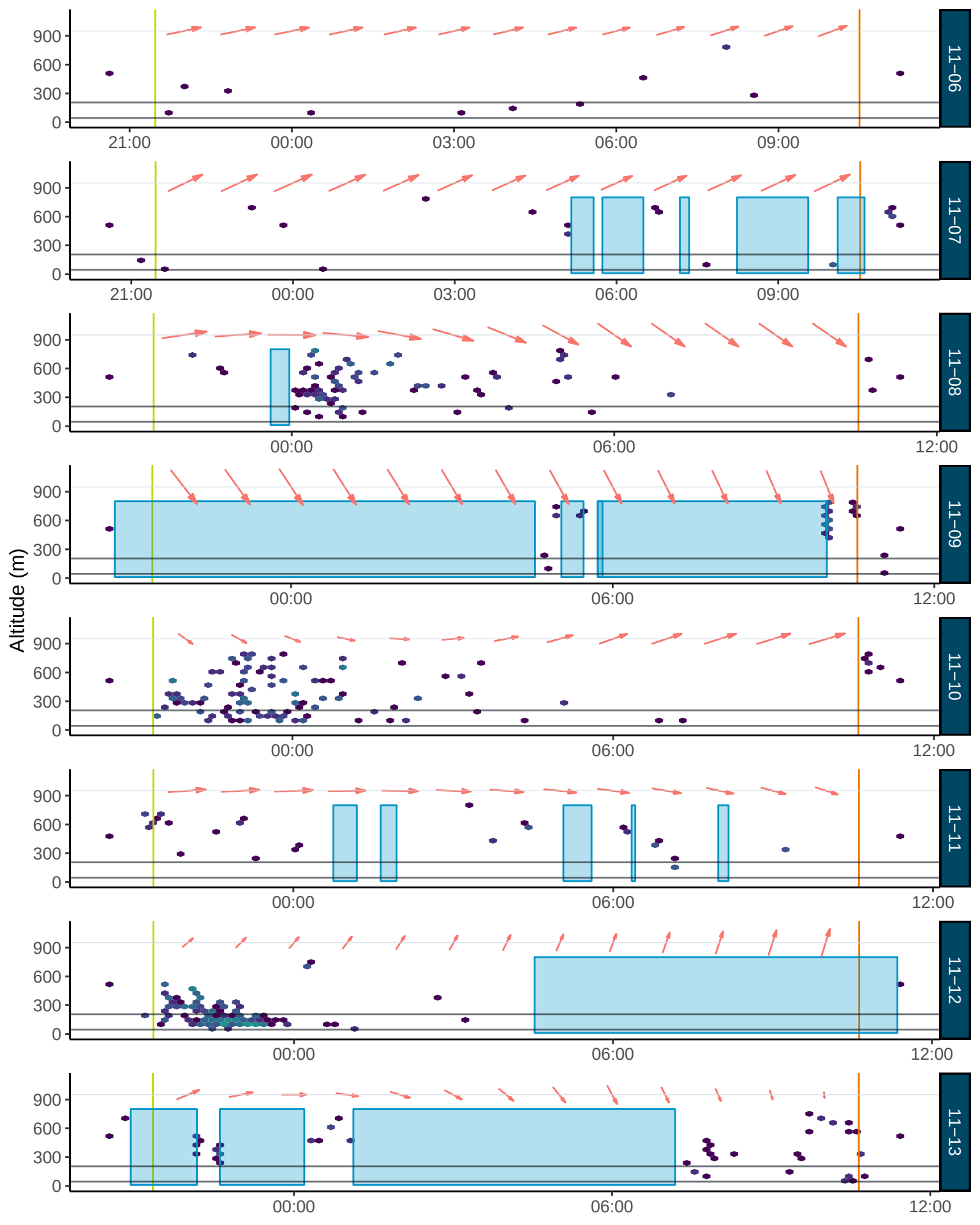
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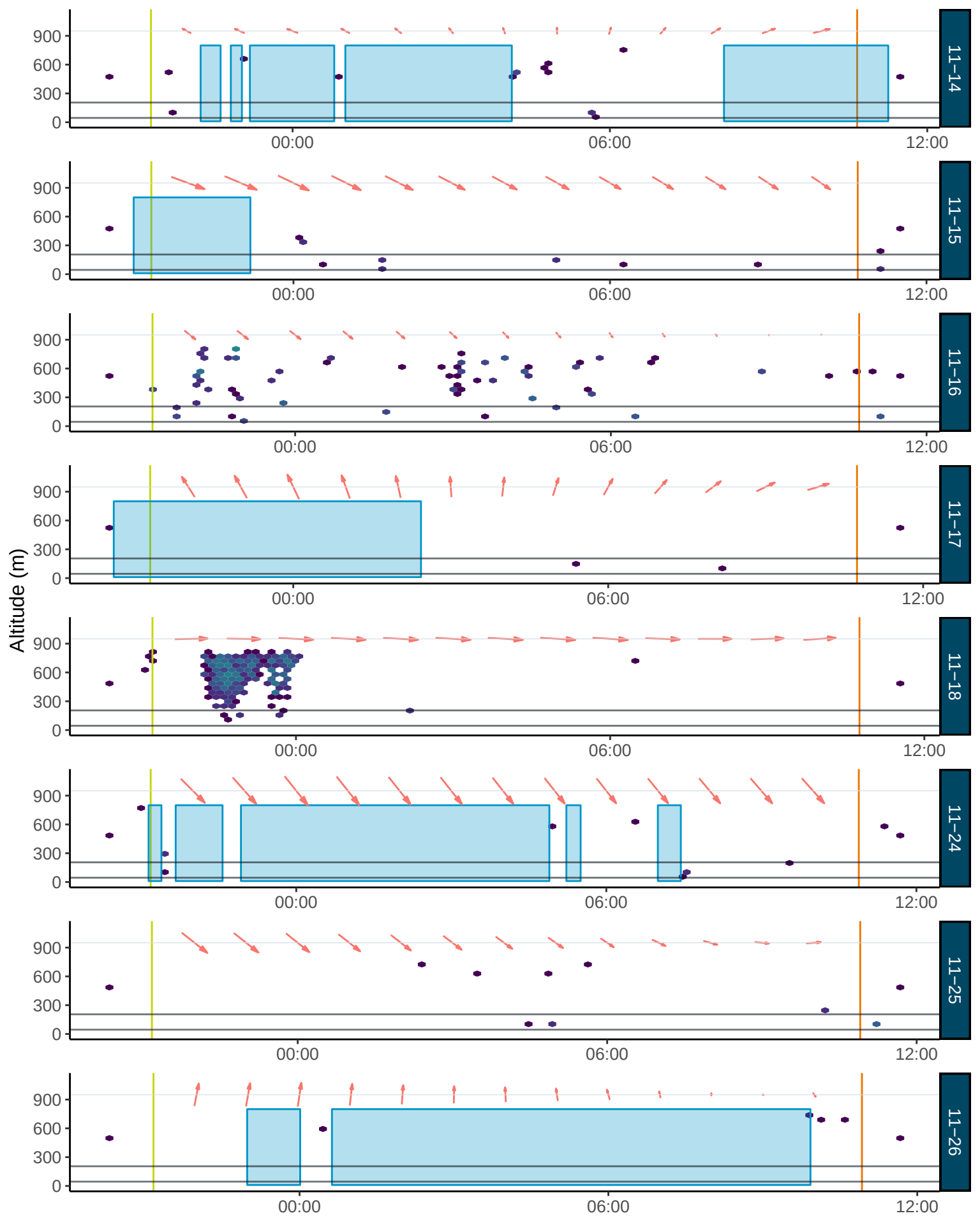
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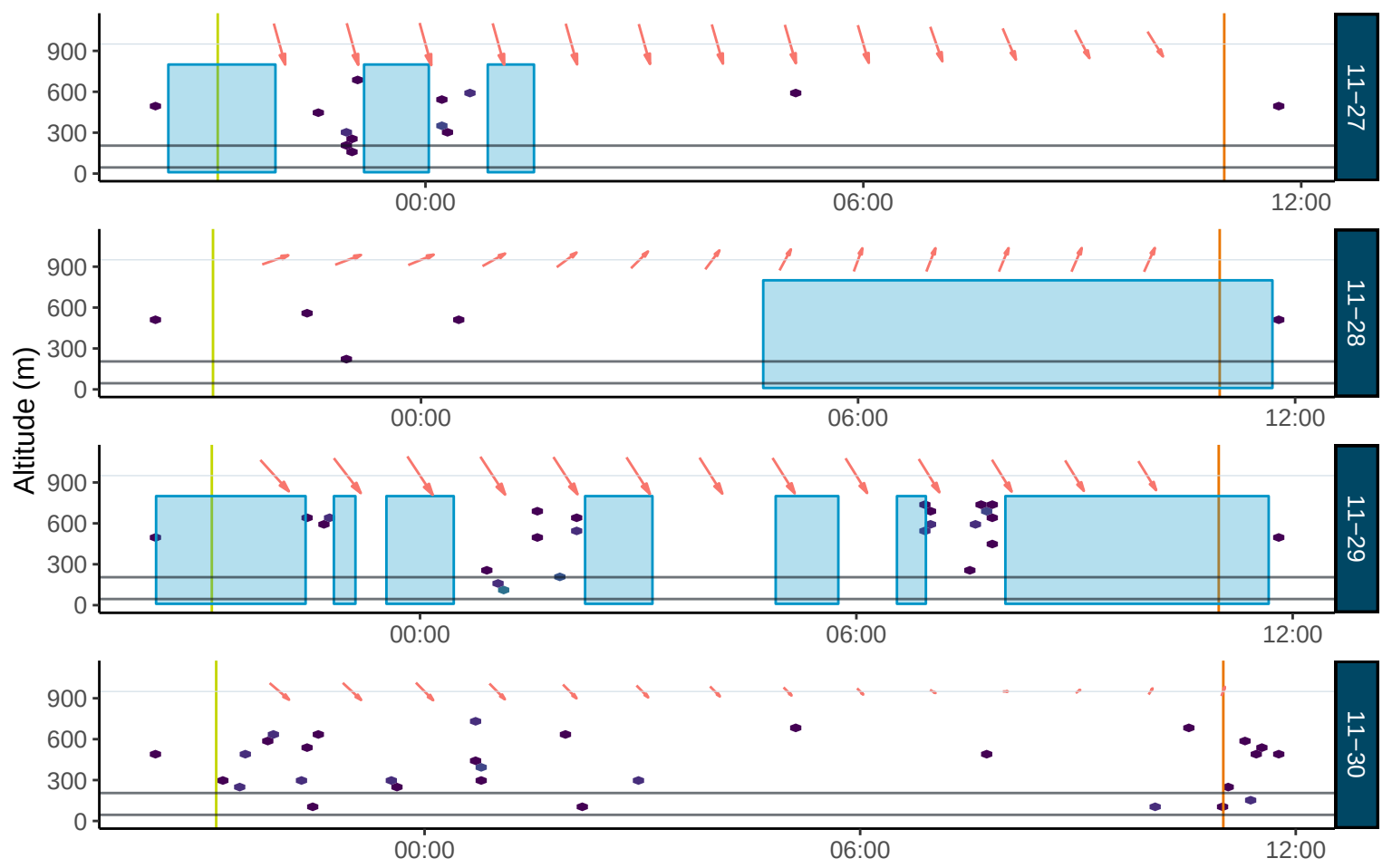
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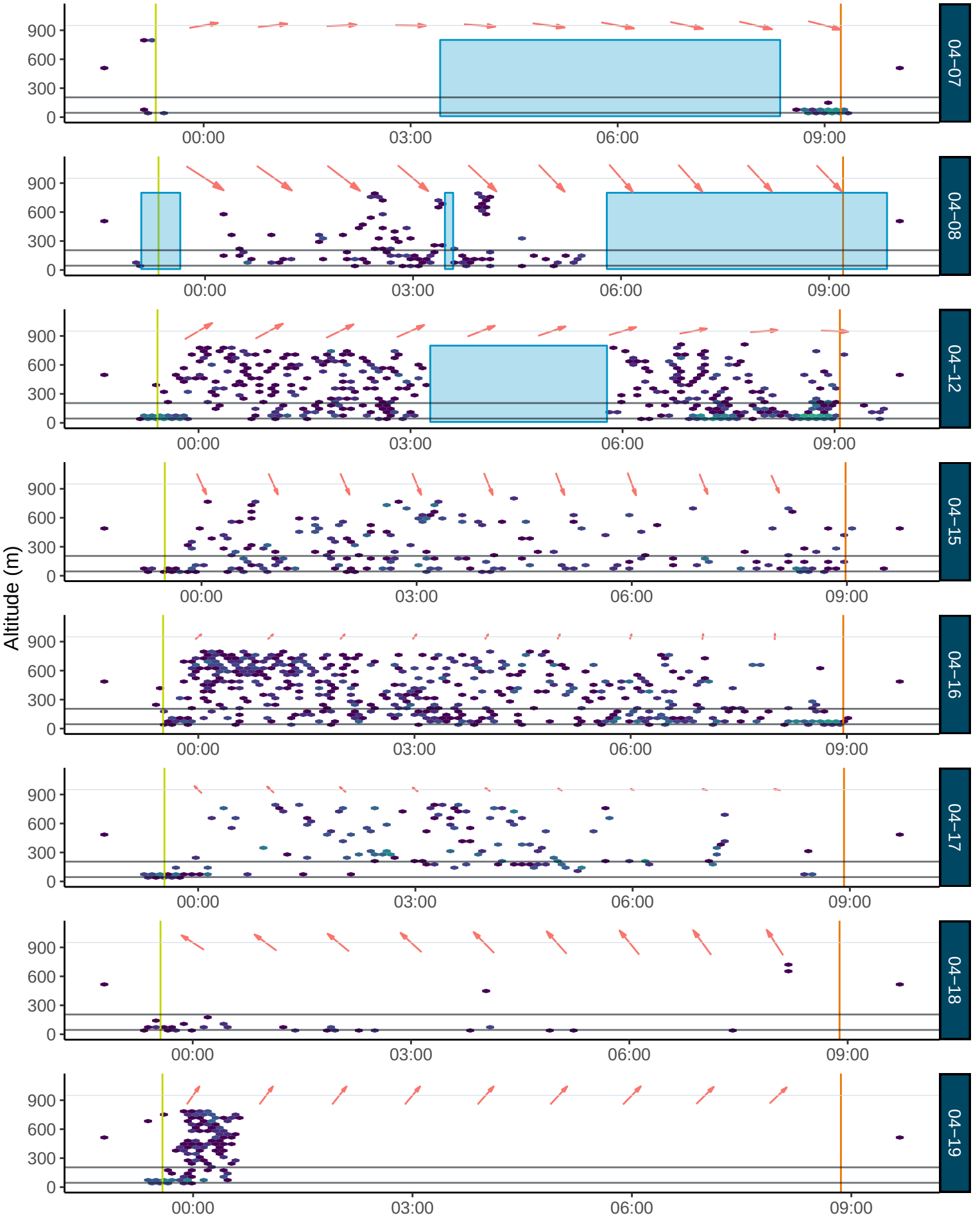
Appendix C

Complete Spring 2023 Radar Data

OVERVIEW

The entire radar and acoustic detections for the spring 2023 monitoring period are provided below. Each panel in the figures is a separate night. Time is indicated using Global Mean Time (GMT) on the x-axis with the beginning and end of civil twilight indicated by the vertical green and yellow lines, respectively. Target altitude is on the y-axis, including the proposed rotor swept zone (i.e. 0-200 m) indicated with red horizontal lines. Data points are radar detections divided into hexagonal time and altitude bins, which are scaled from light grey (i.e. few detections) through dark purple to yellow (i.e. many detections). Acoustic detections are red dots along the base of each plot. Wind direction (i.e. cardinal direction of red arrow) and wind strength (i.e. arrow size) at approximately 700 m agl is indicated for each hour at the top of each plot. The blue box represents a period of rain when raindrops could not be distinguished from bird detections.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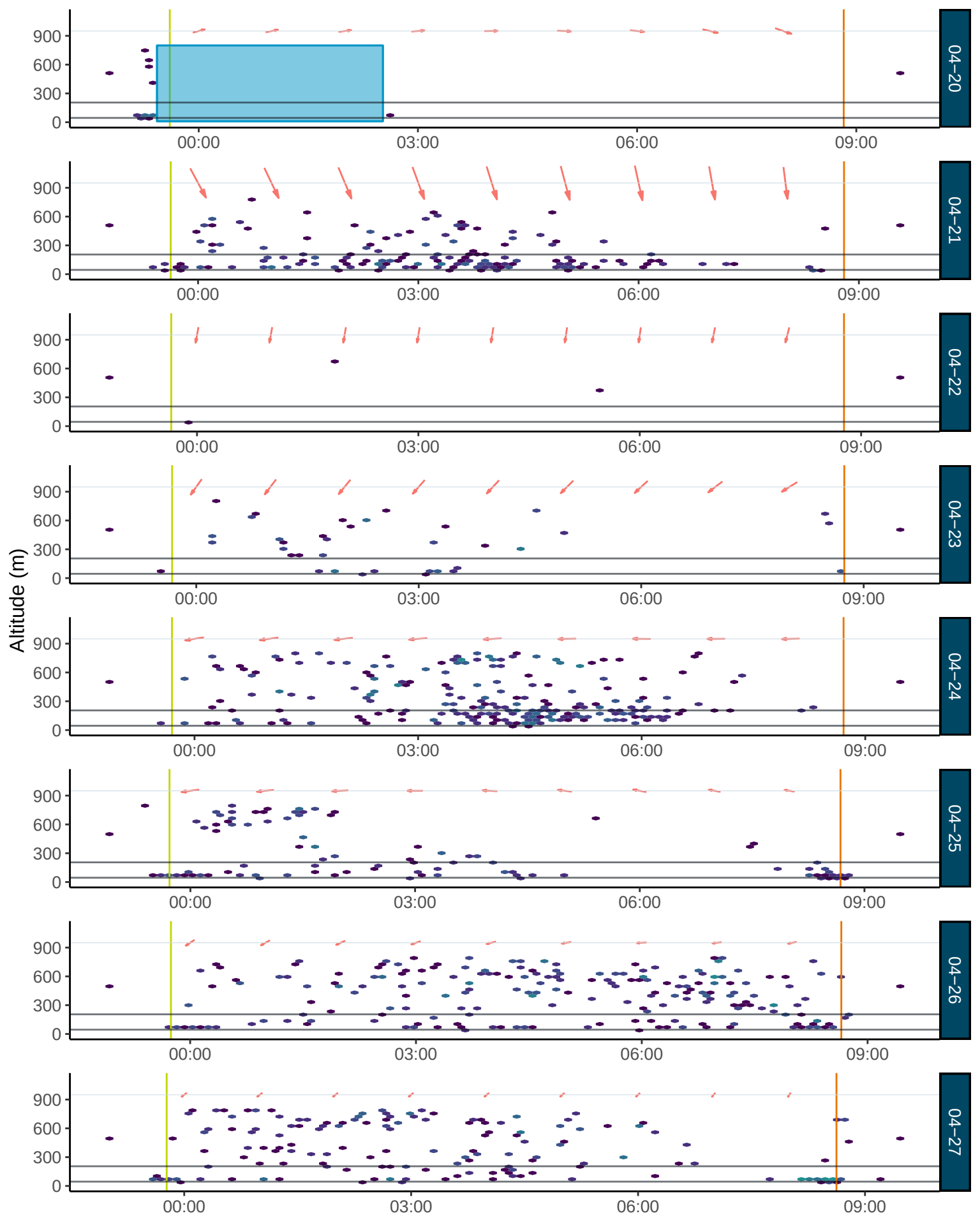
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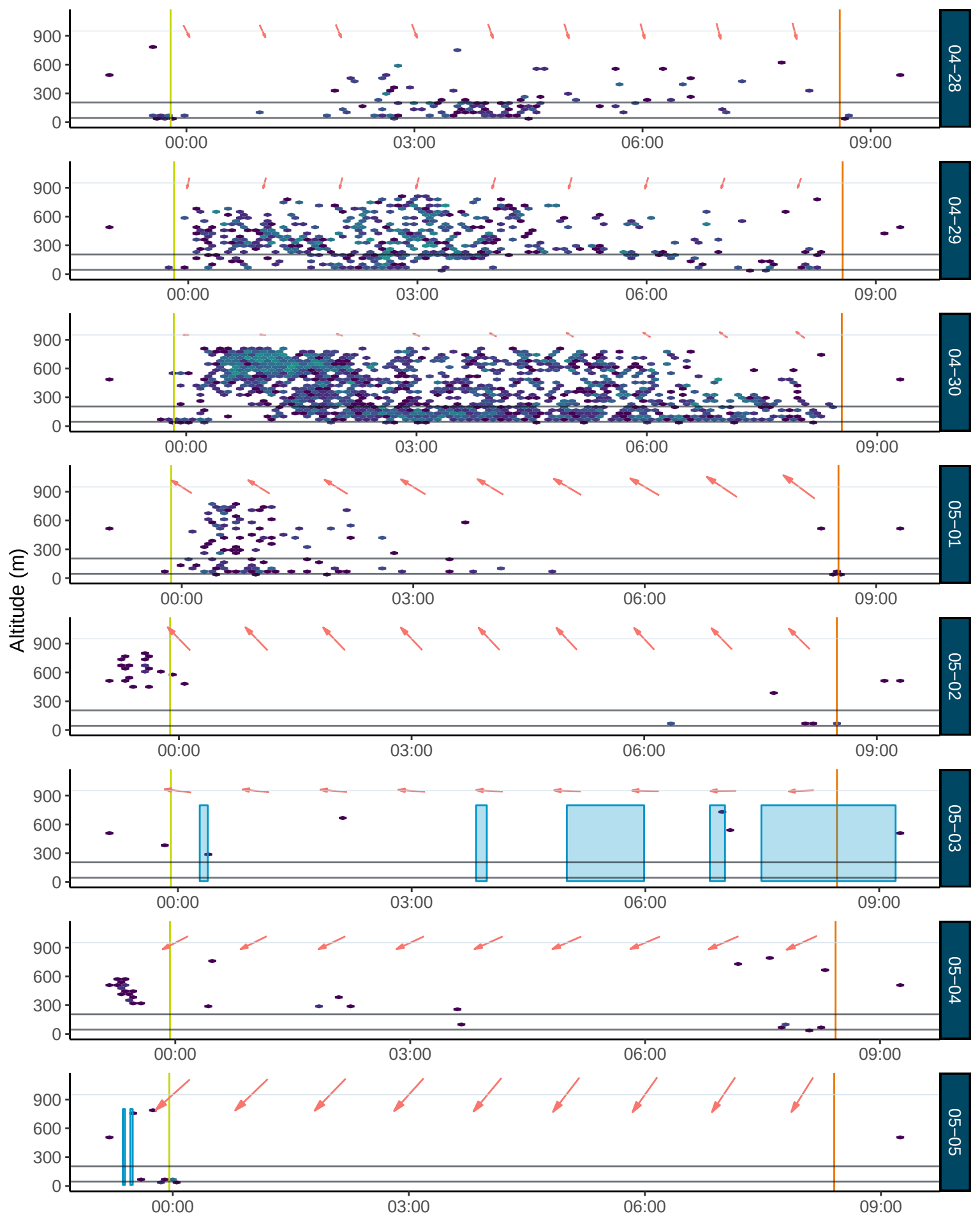
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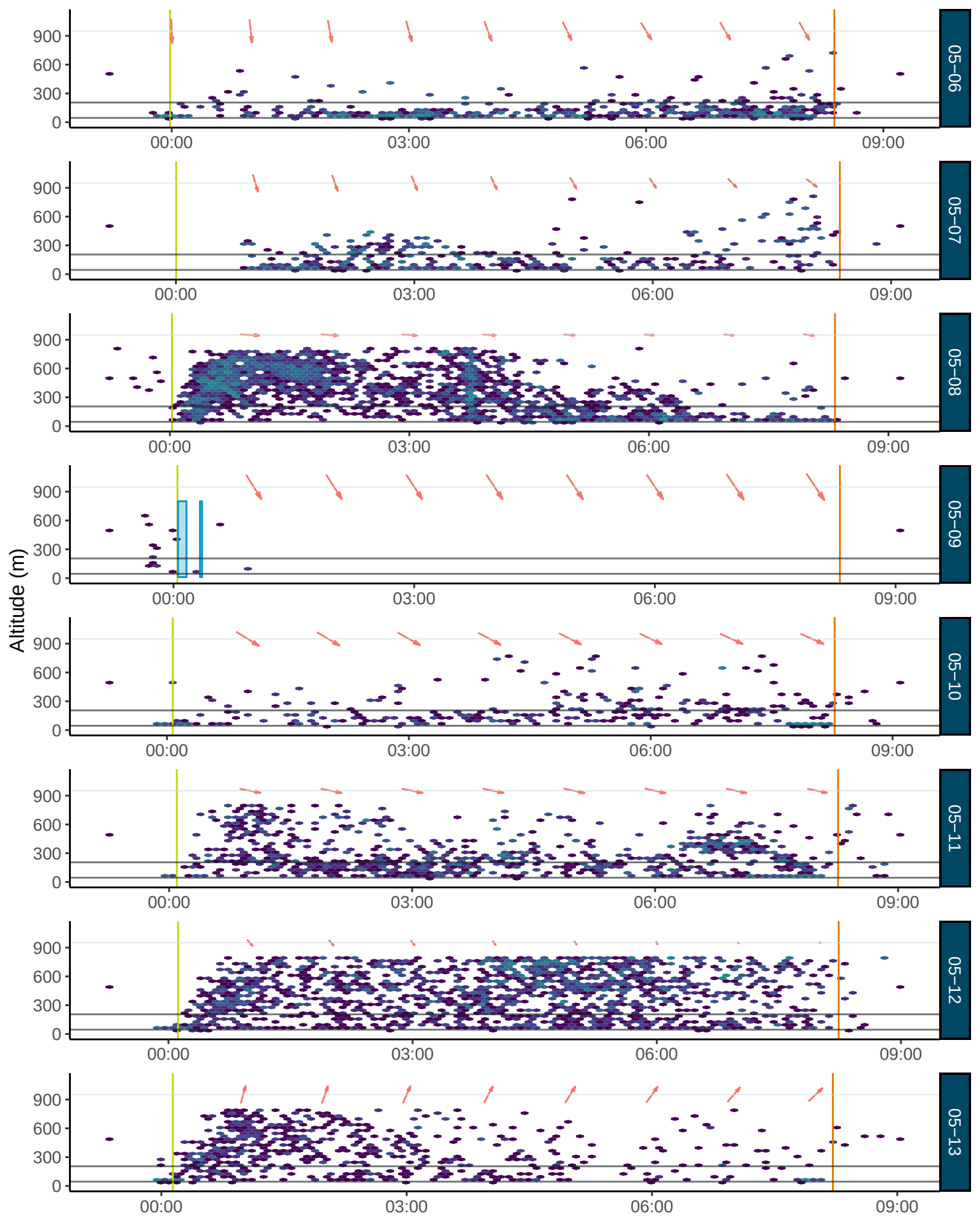
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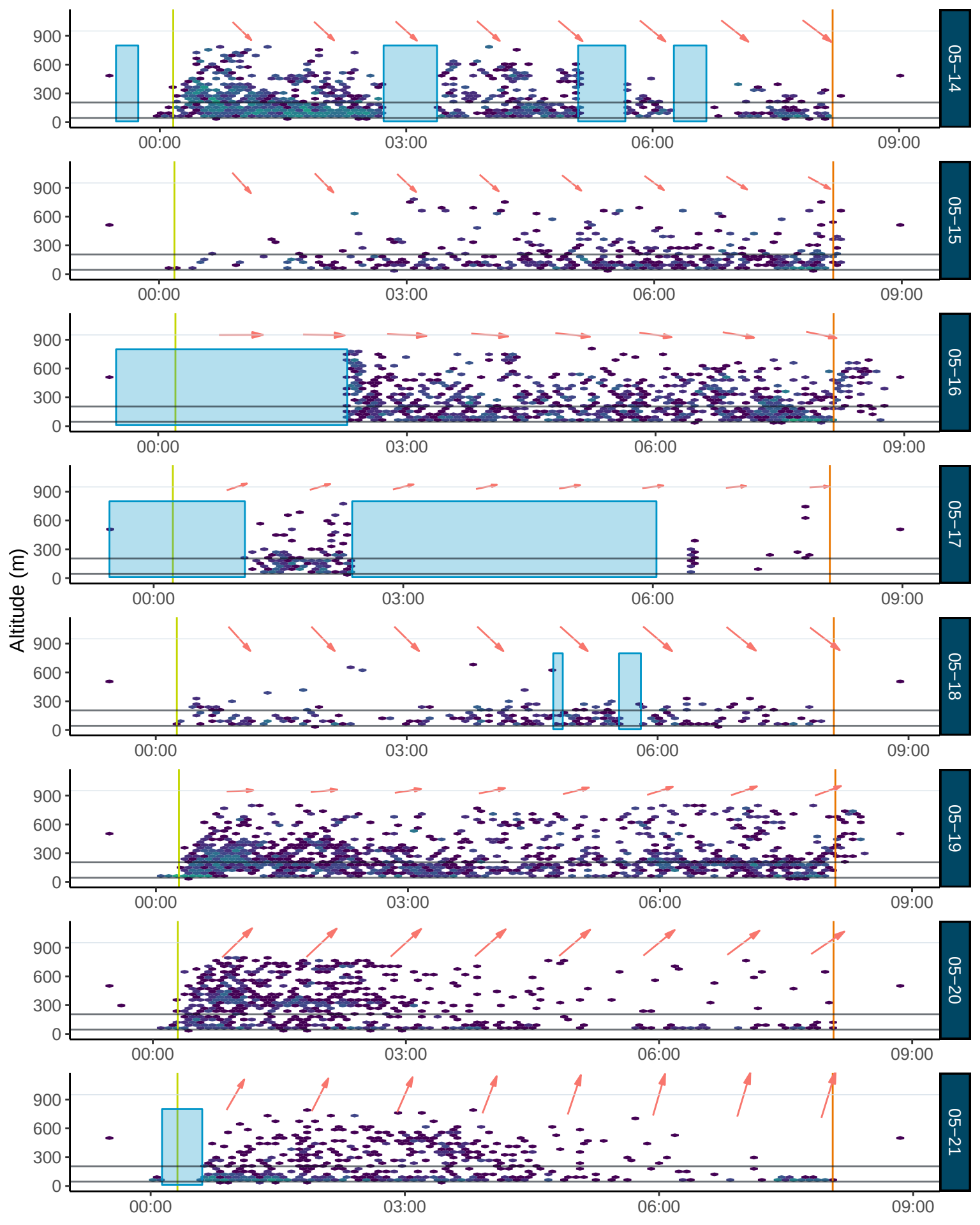
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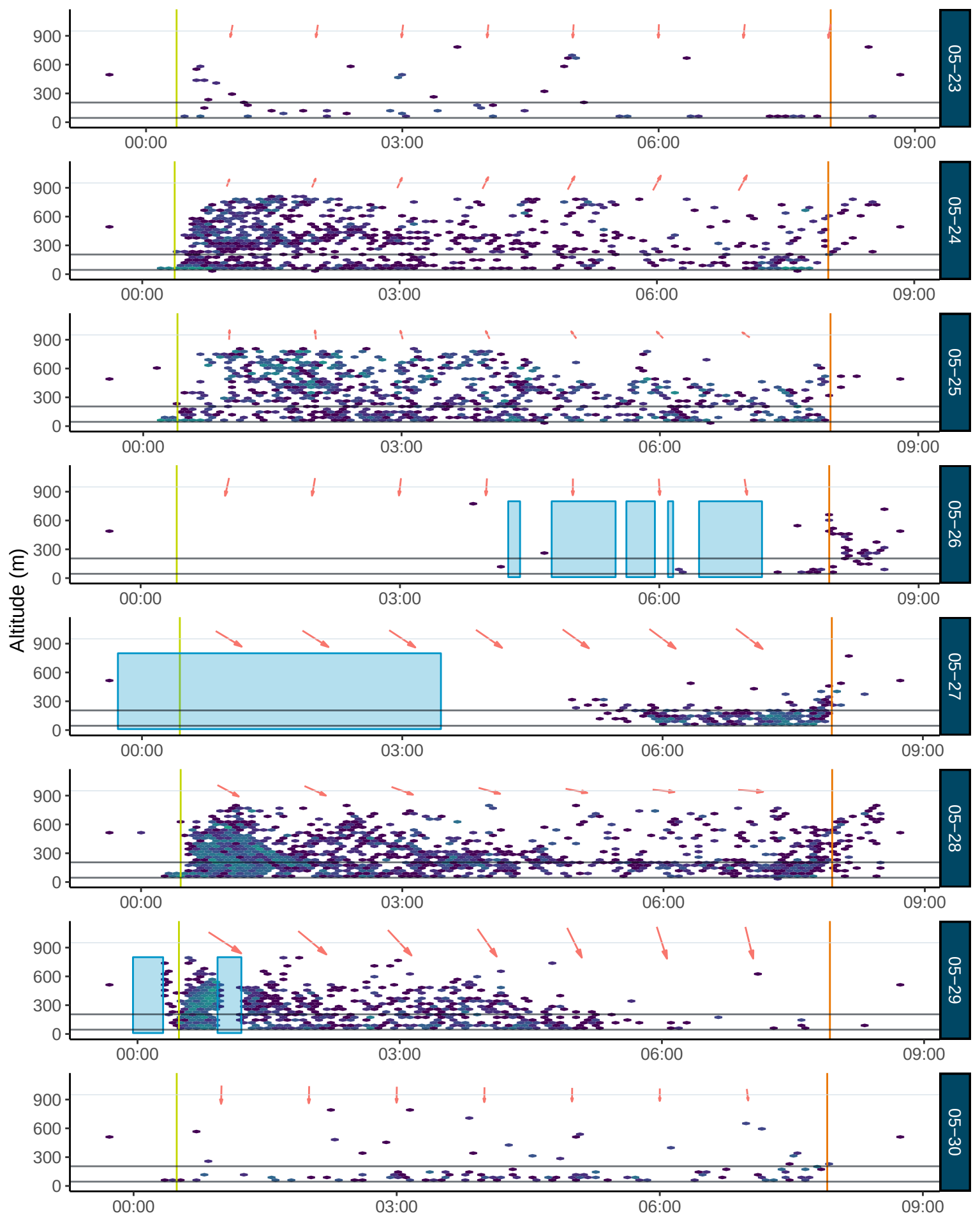
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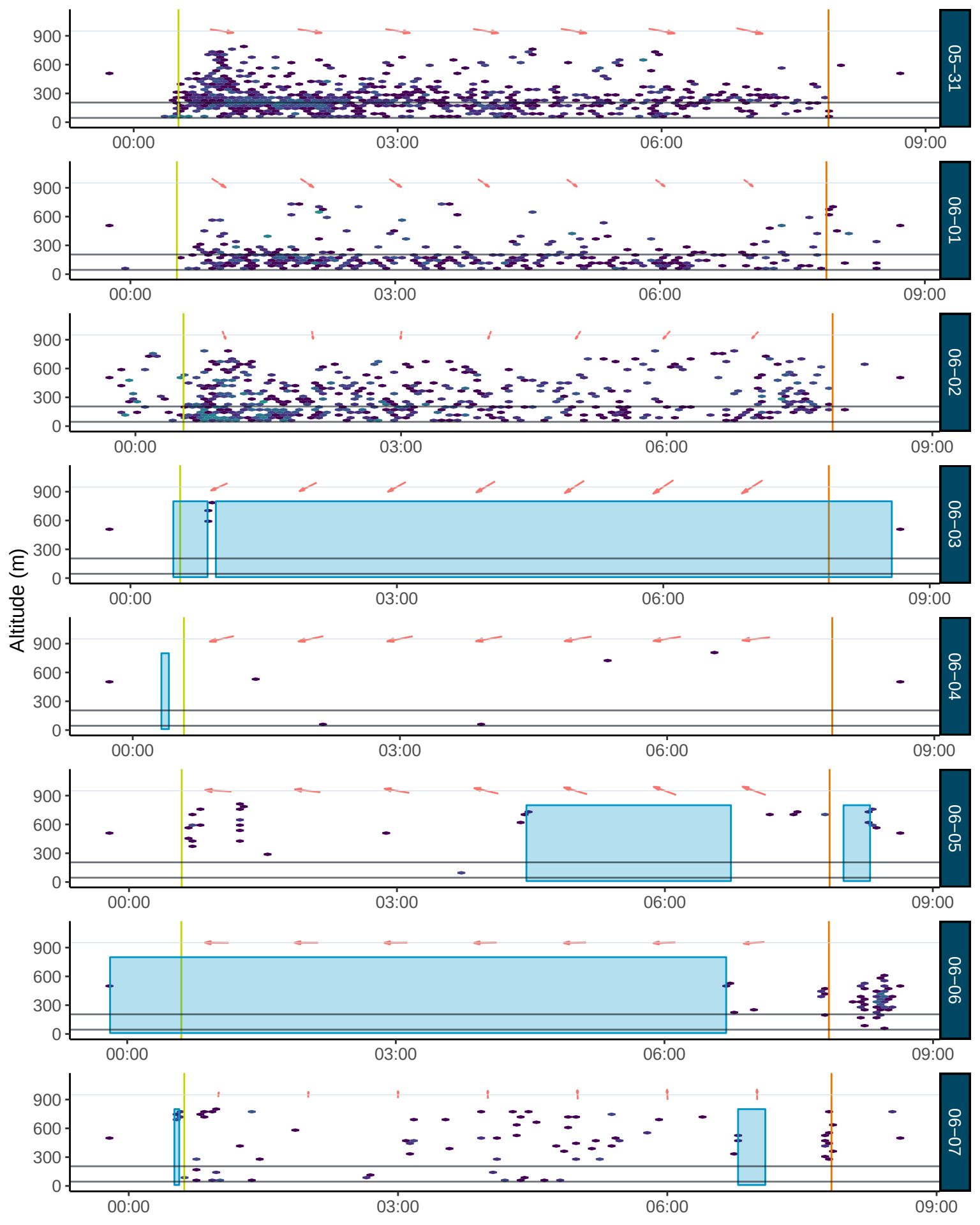
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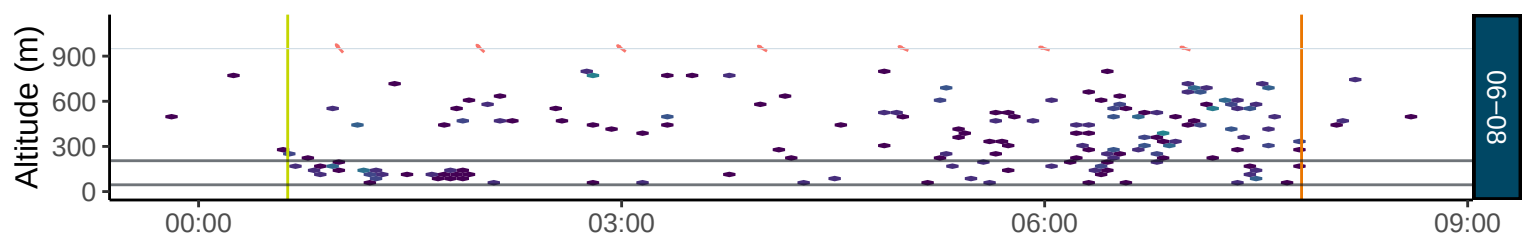
Altitude (m)
900
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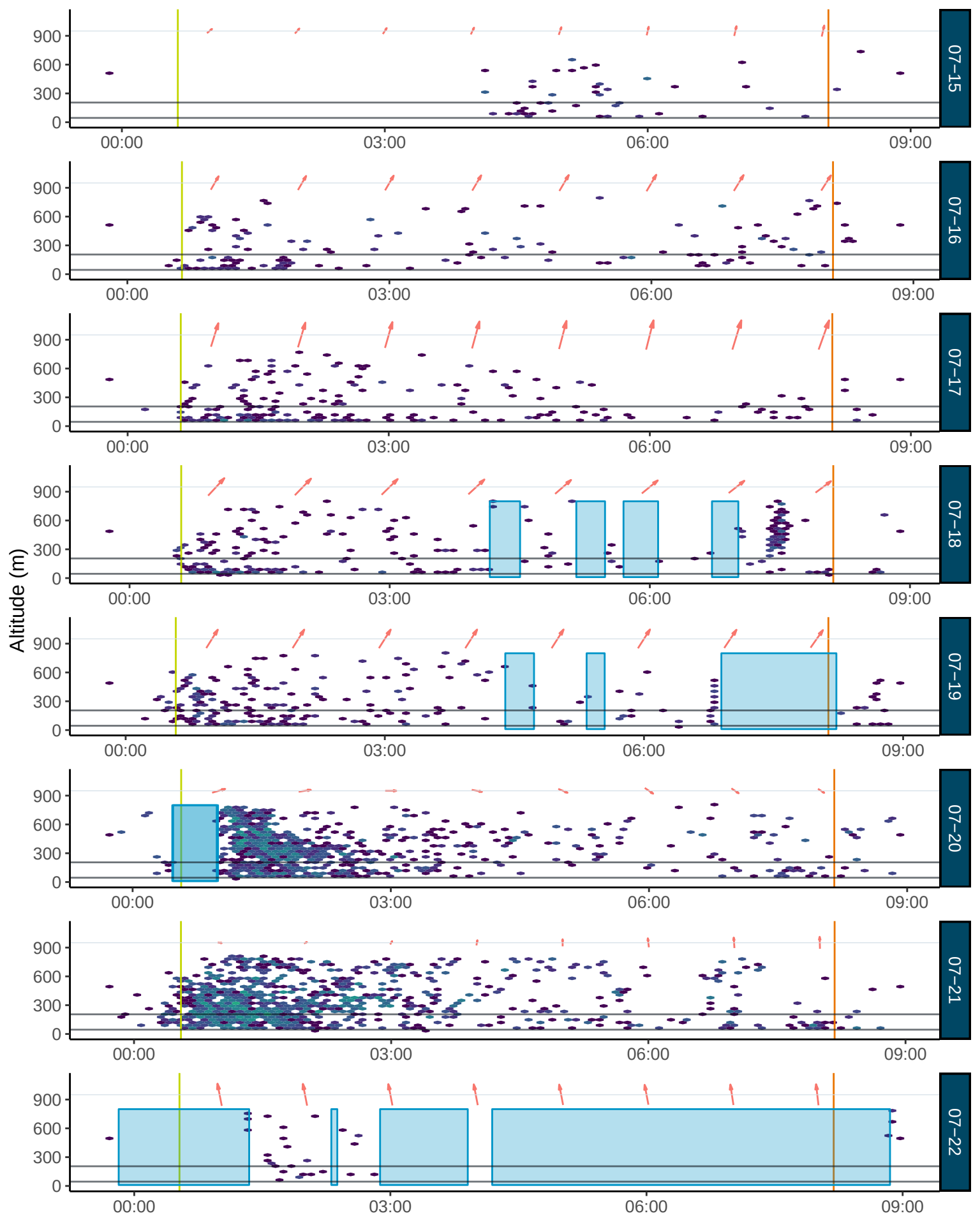
Appendix D

Complete Fall 2023 Radar Data

OVERVIEW

The entire radar and acoustic detections for the fall 2023 monitoring period are provided below. Each panel in the figures is a separate night. Time is indicated using Global Mean Time (GMT) on the x-axis with the beginning and end of civil twilight indicated by the vertical green and yellow lines, respectively. Target altitude is on the y-axis, including the proposed rotor swept zone (i.e. 0-200 m) indicated with red horizontal lines. Data points are radar detections divided into hexagonal time and altitude bins, which are scaled from light grey (i.e. few detections) through dark purple to yellow (i.e. many detections). Acoustic detections are red dots along the base of each plot. Wind direction (i.e. cardinal direction of red arrow) and wind strength (i.e. arrow size) at approximately 700 m agl is indicated for each hour at the top of each plot. The blue box represents a period of rain when raindrops could not be distinguished from bird detections.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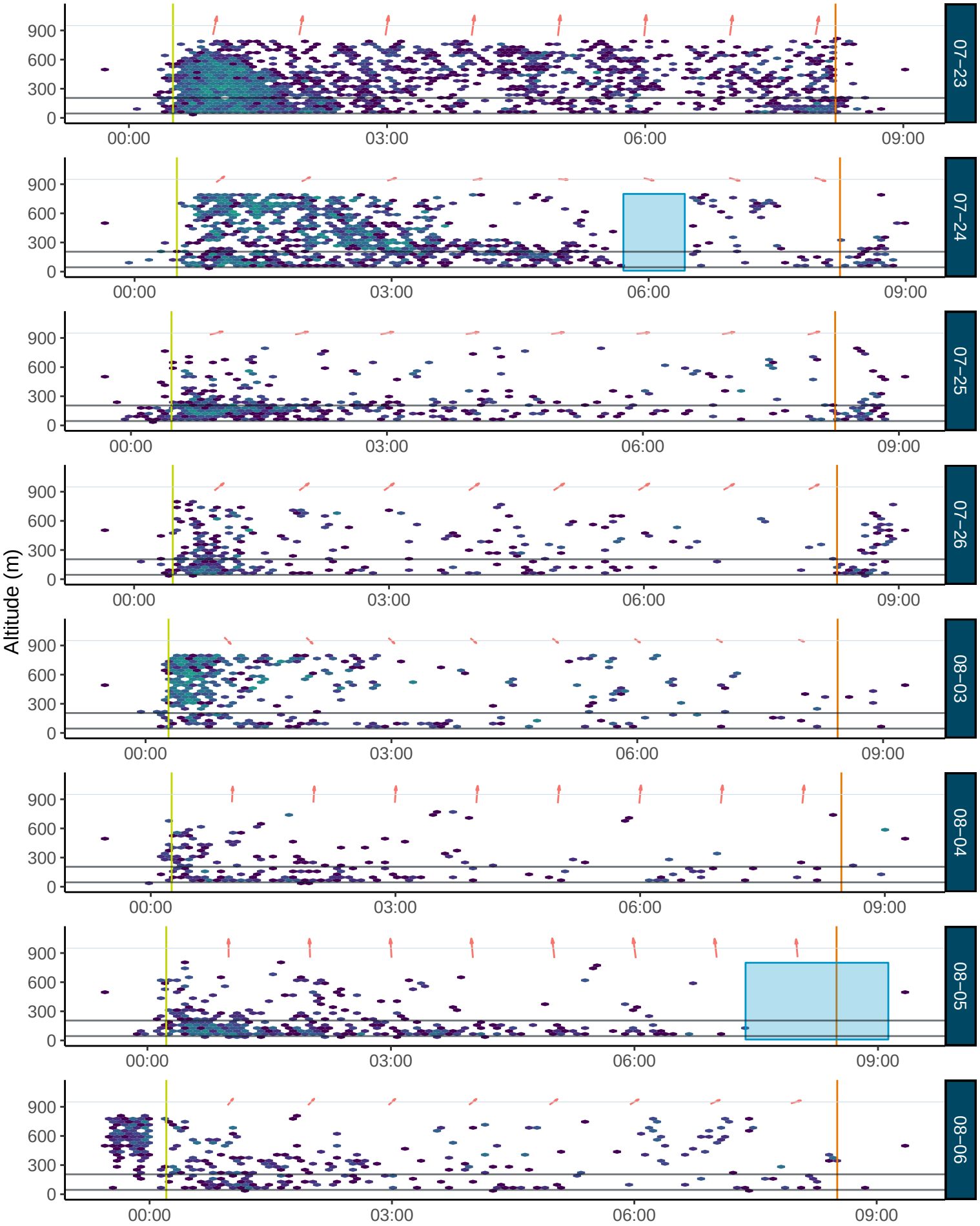
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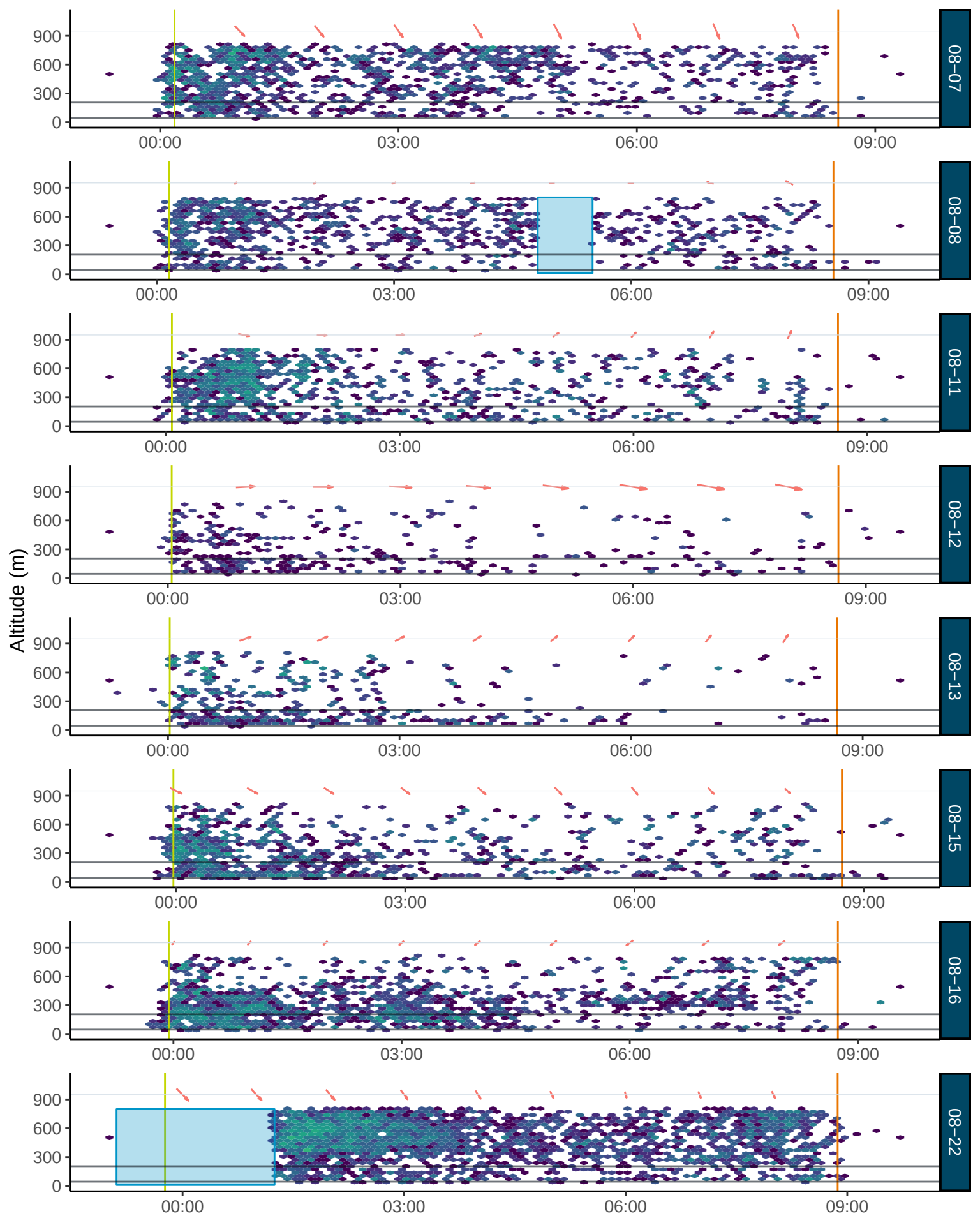
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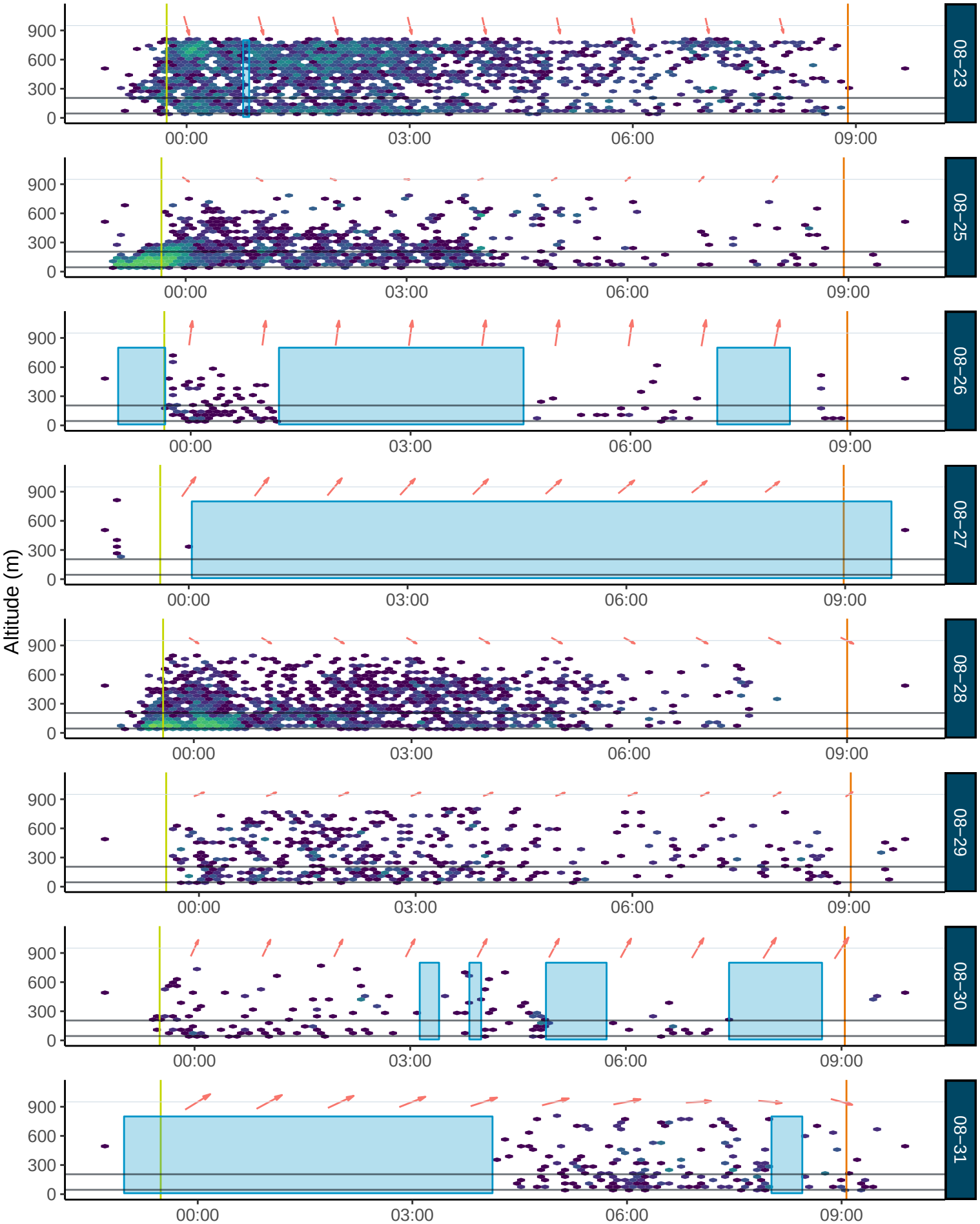
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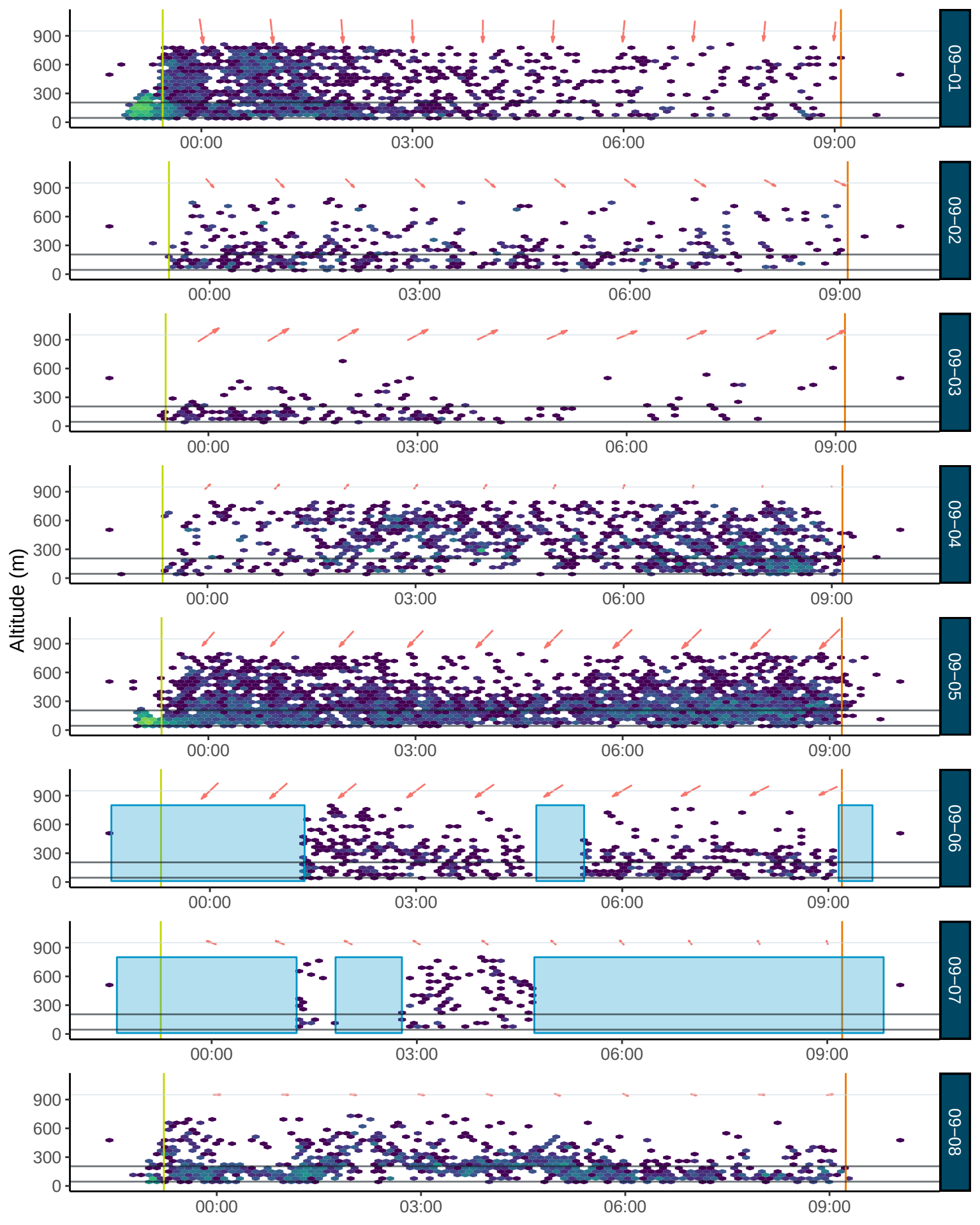
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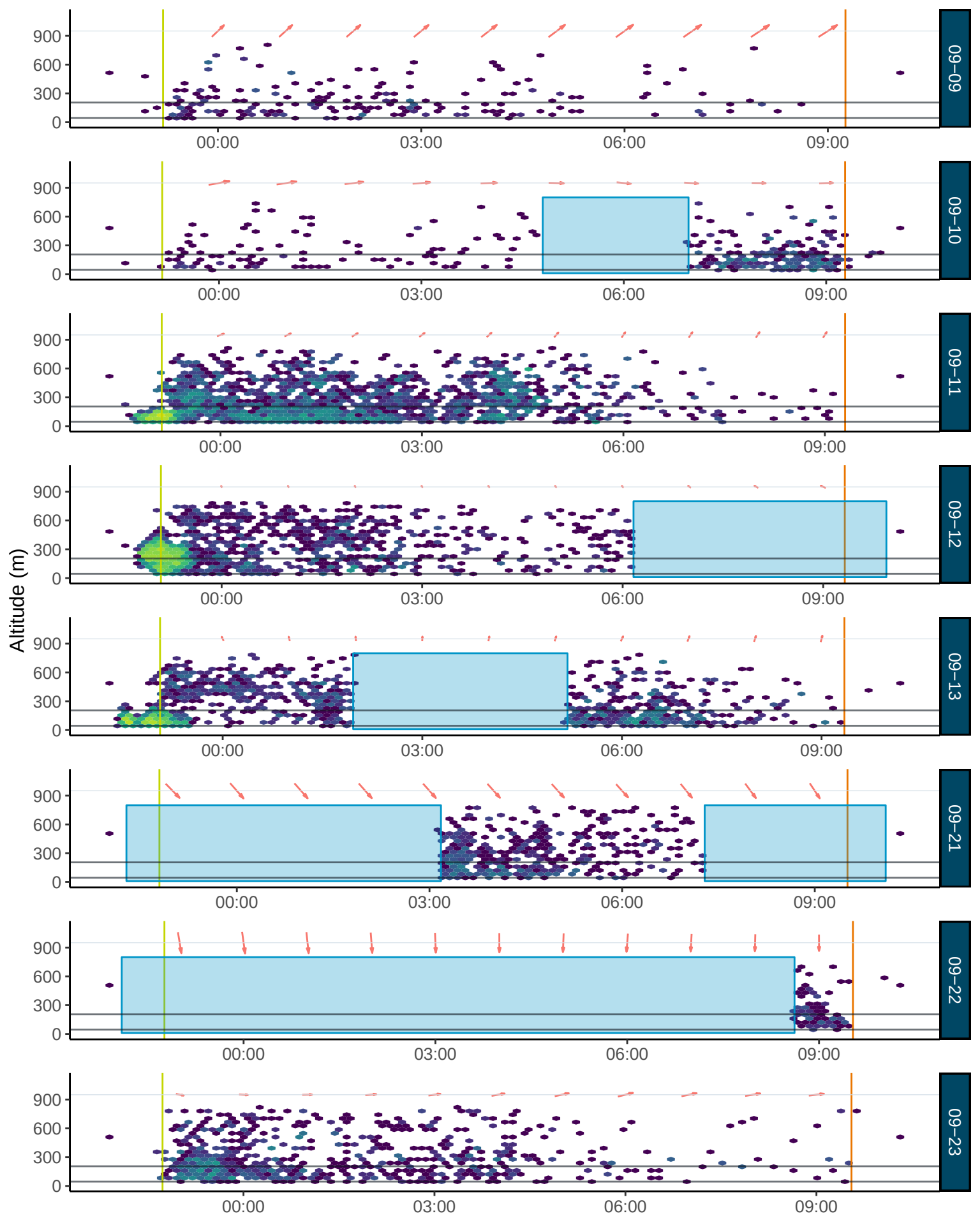
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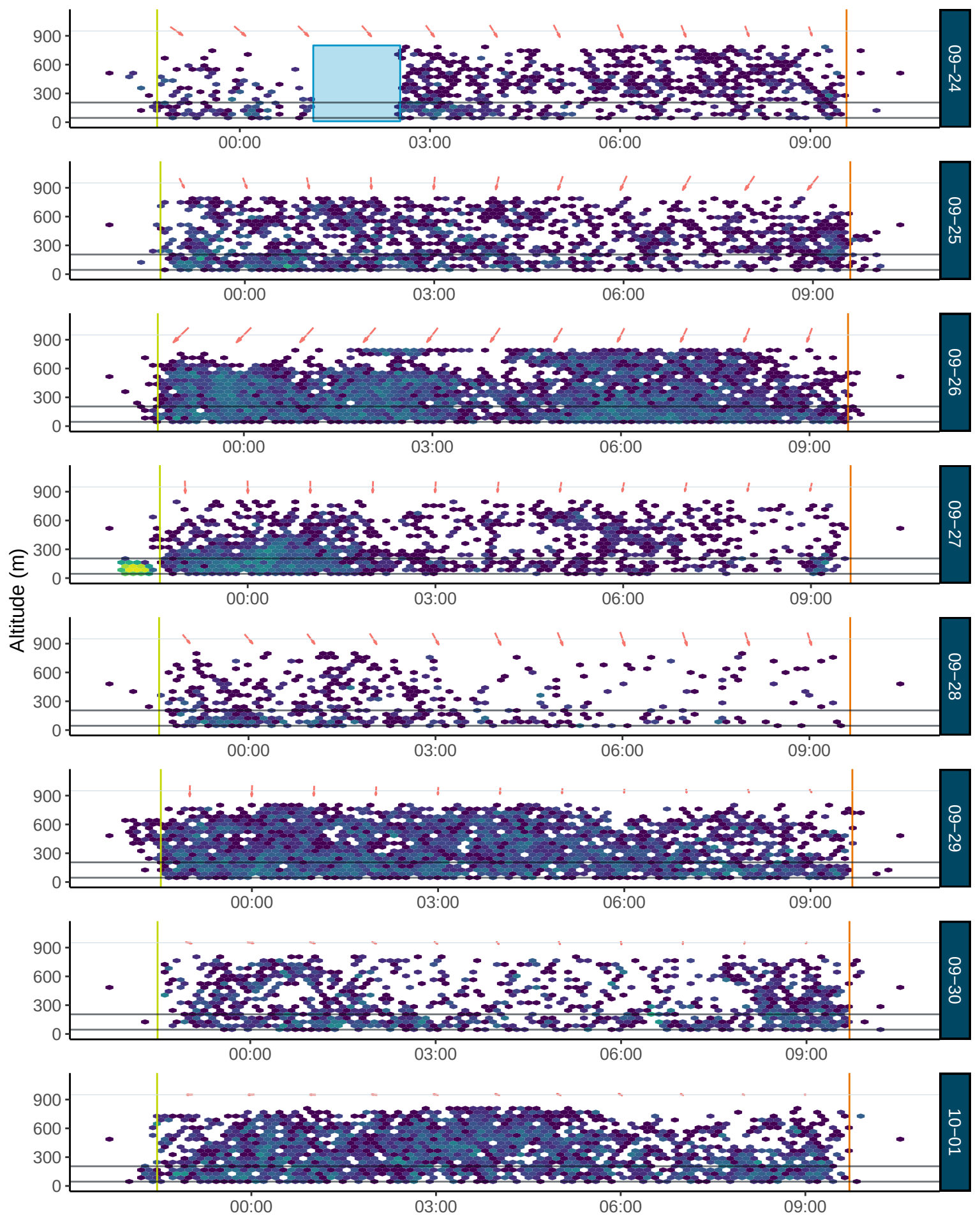
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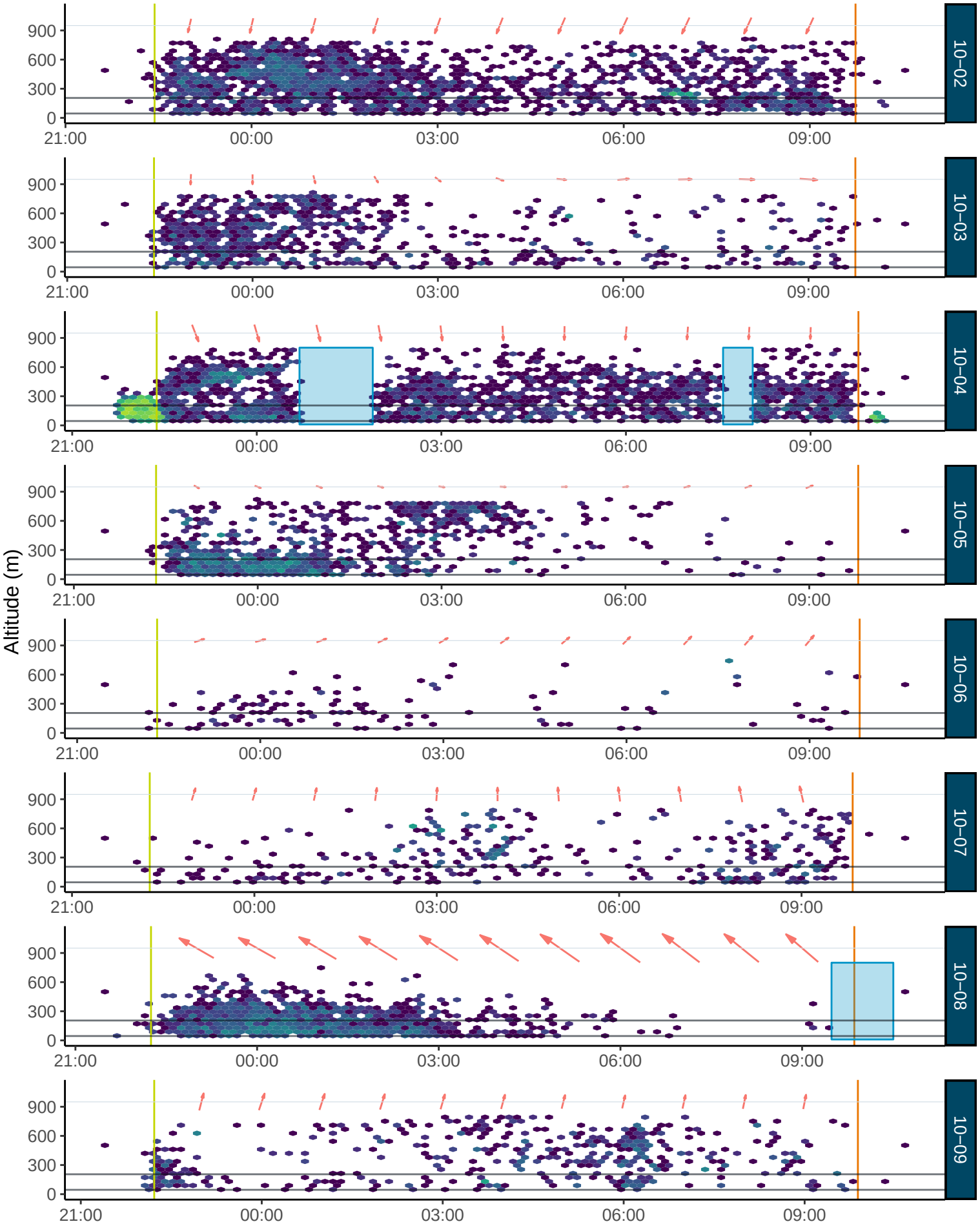
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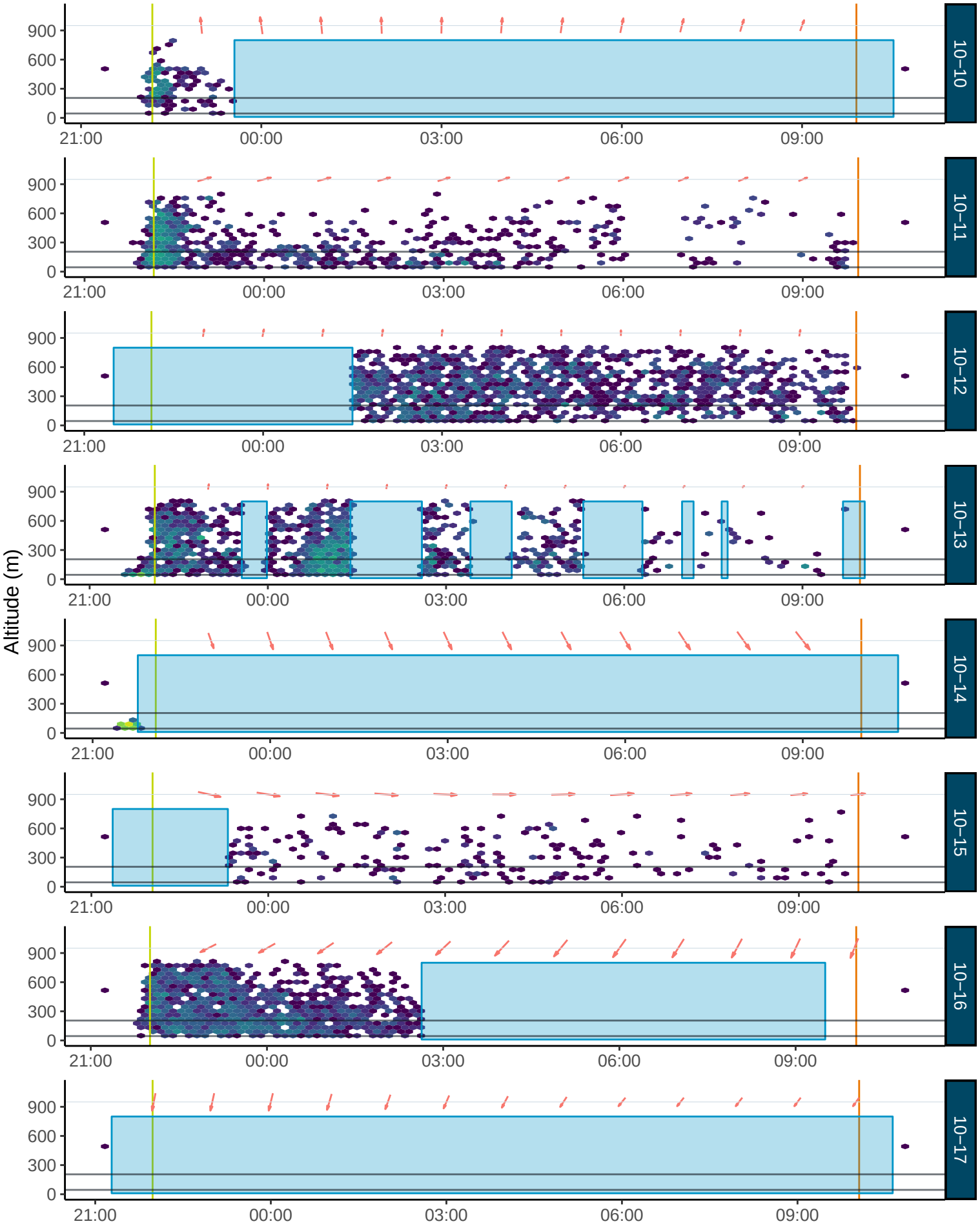
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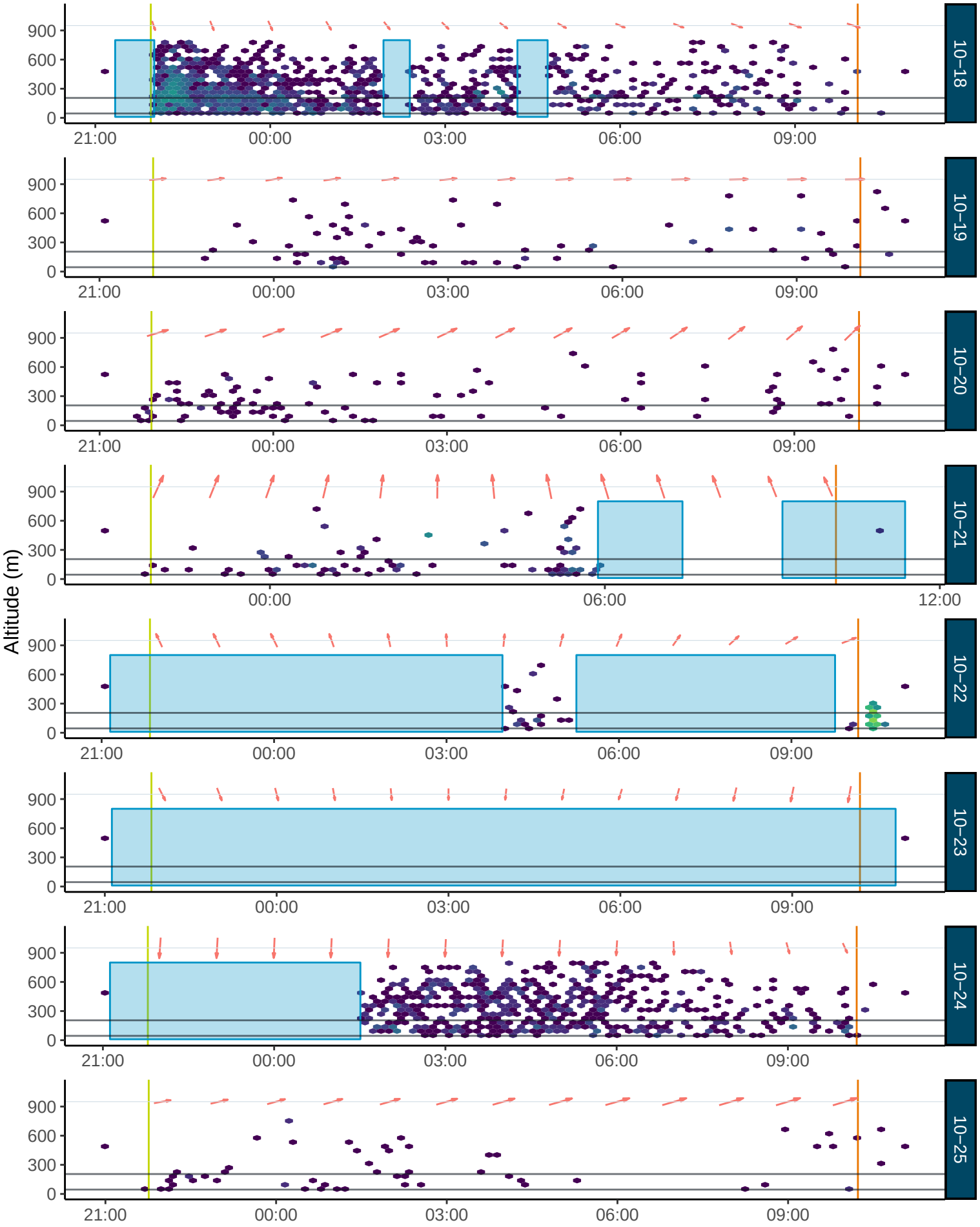
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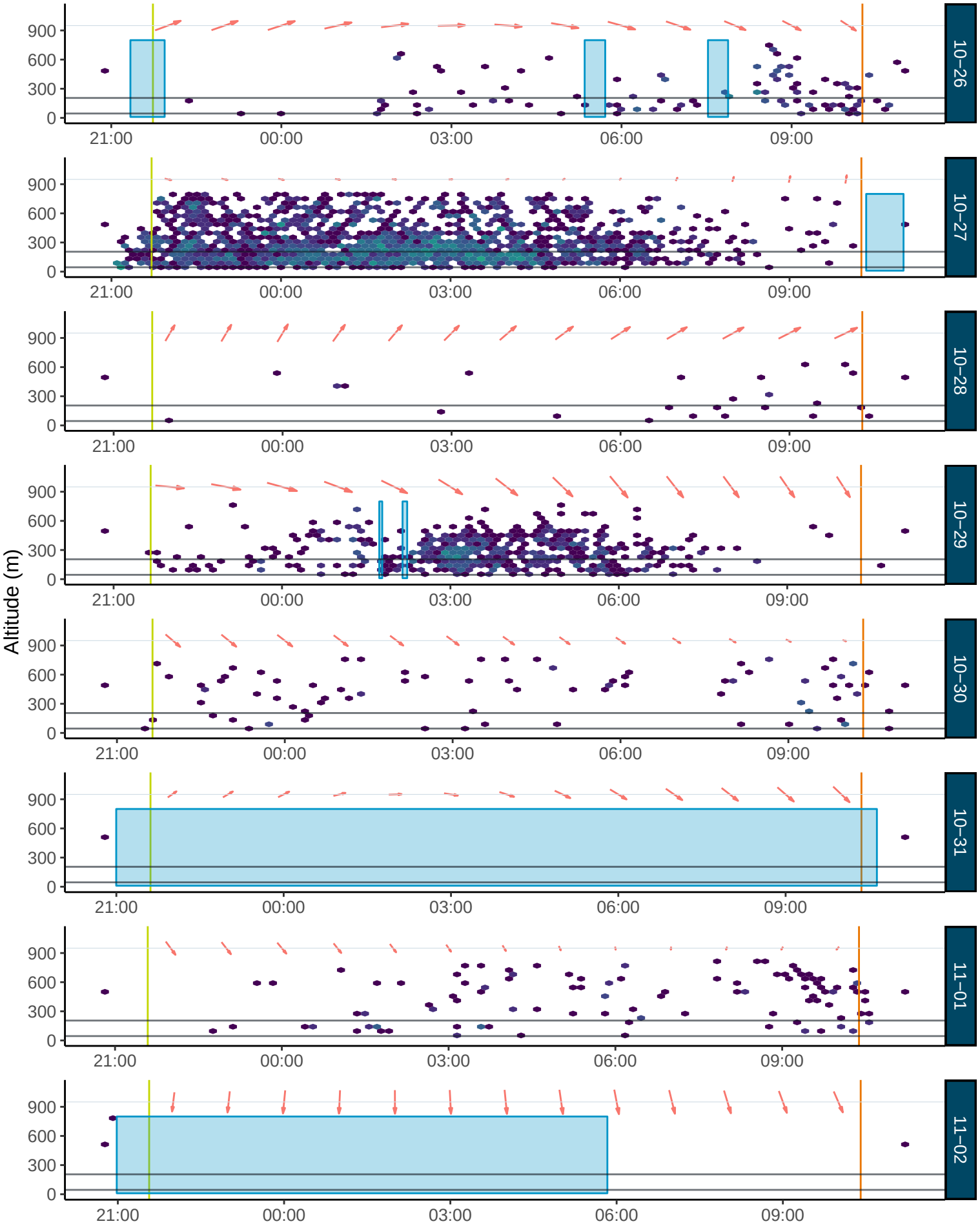
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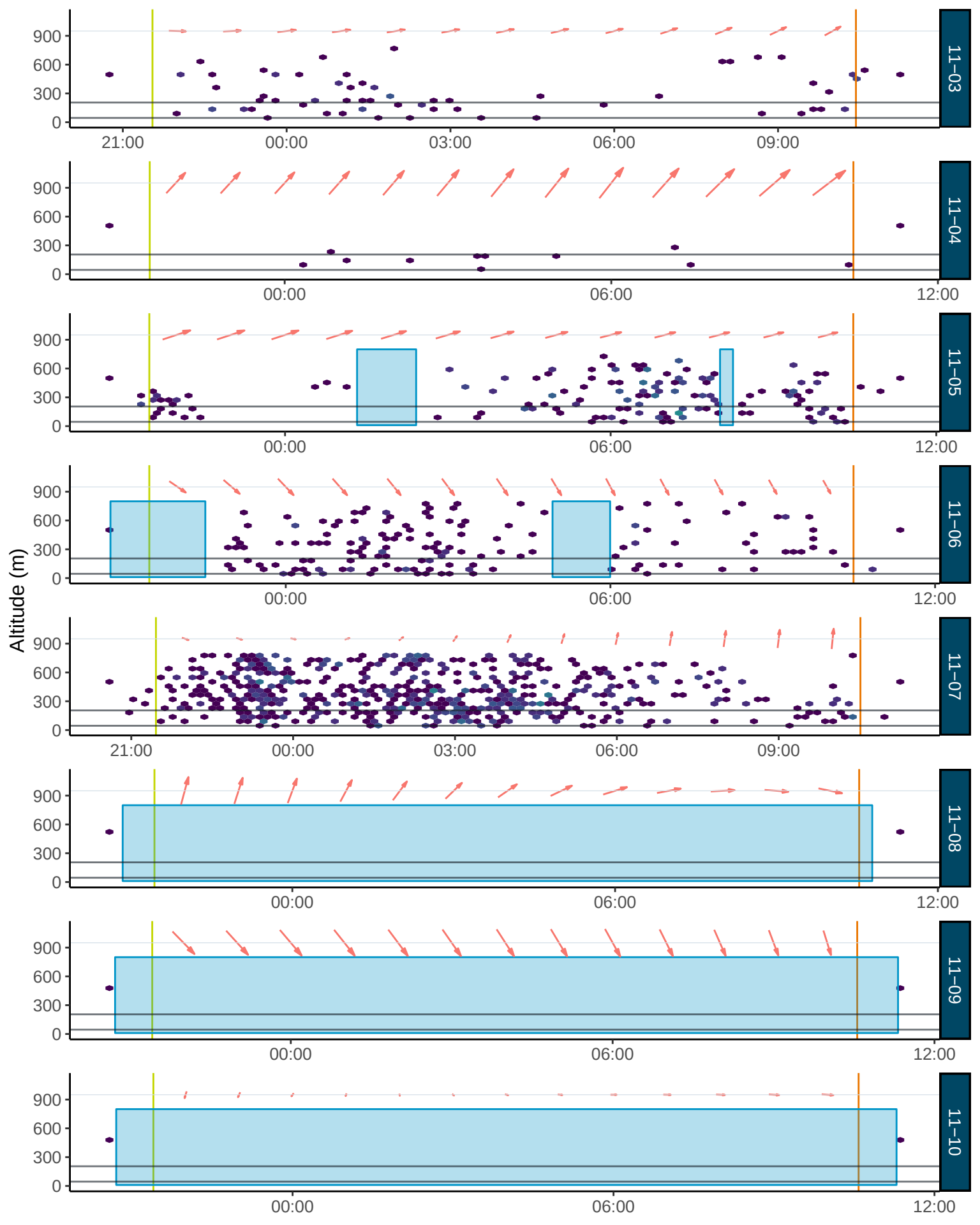
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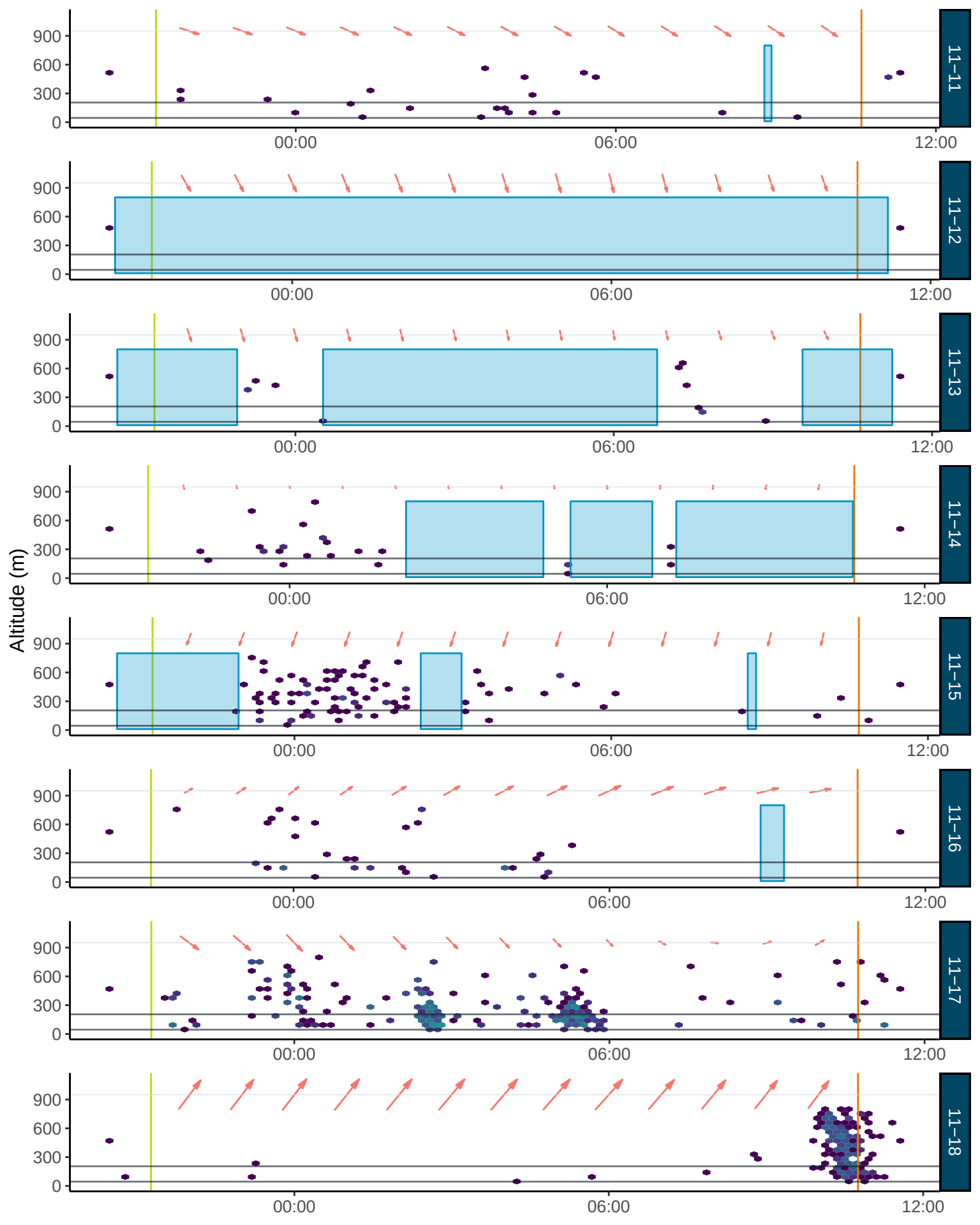
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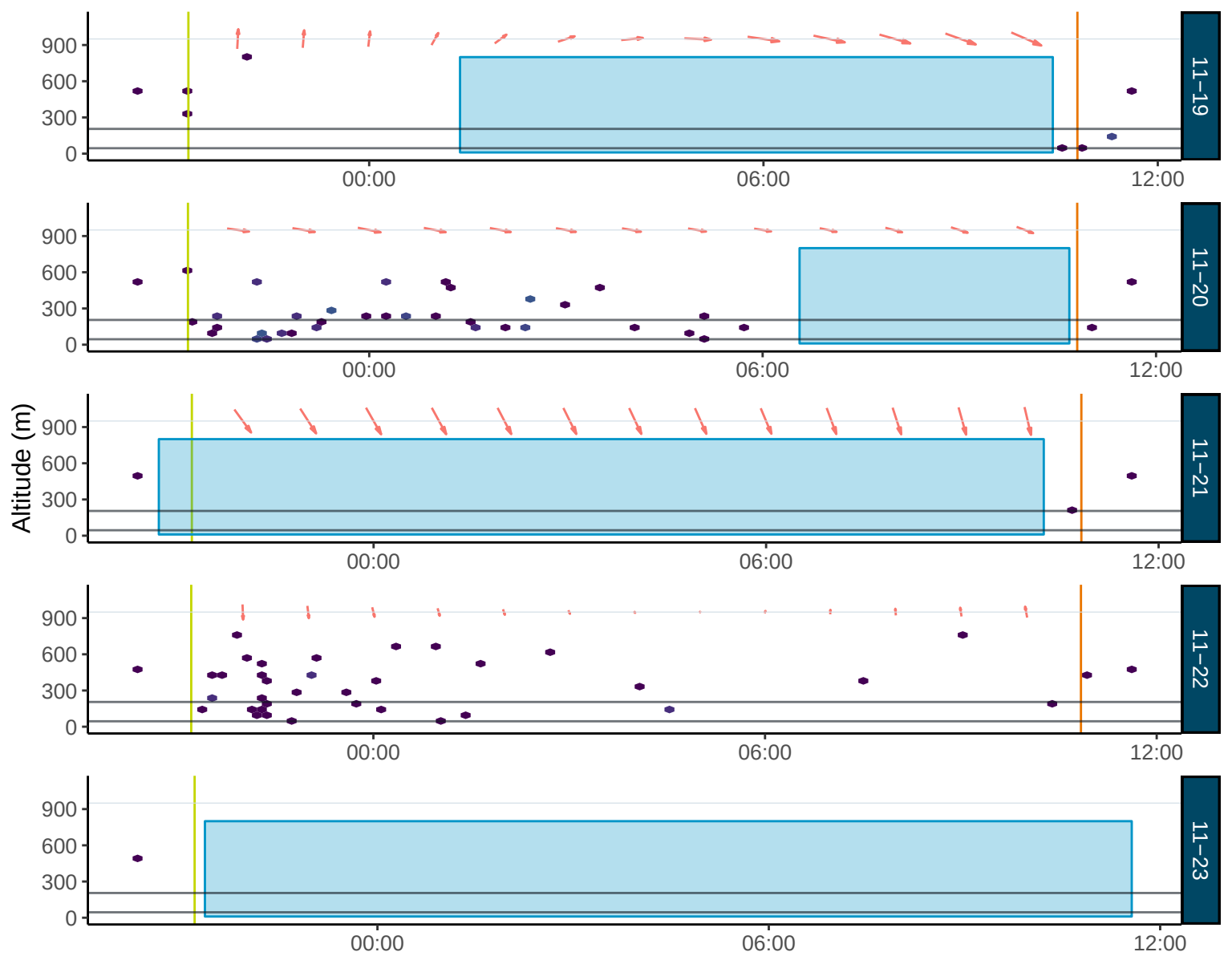
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