






Passive acoustic monitoring of birds facing climate change in the Canadian Arctic




 Laurent Godet

 Joël Bêty

 Nicolas Lecomte

 Nicolas Farrugia

 Isabeau Pratte

Northern terrestrial ecosystem face the fastest pace of global warming (Rantanen et al. 2022, Seddon et al. 2016, Dai et al. 2019, Post et al. 2019)




communications
earth & environment

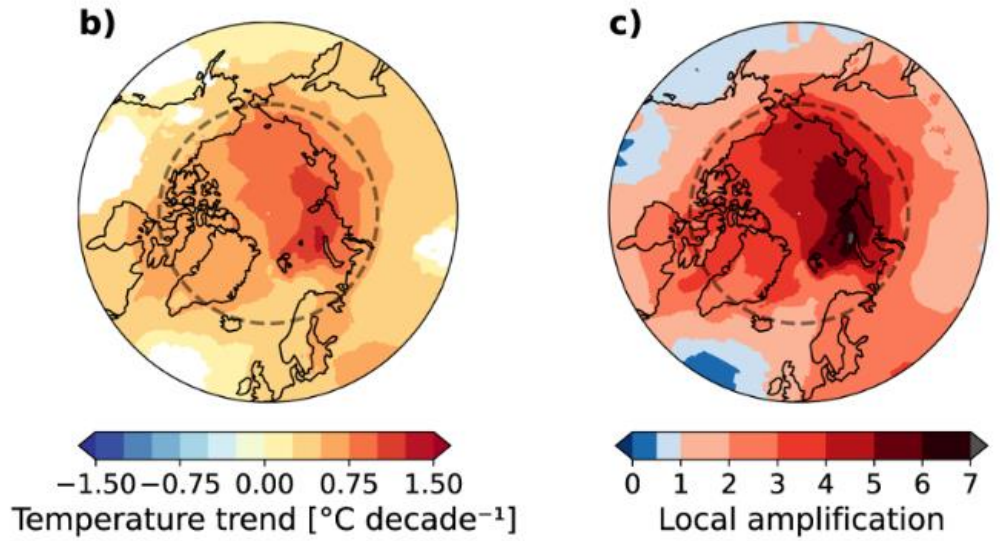
ARTICLE

<https://doi.org/10.1038/s43247-022-00498-3> **OPEN**

 Check for updates

The Arctic has warmed nearly four times faster than the globe since 1979

Mika Rantanen ¹✉, Alexey Yu. Karpechko¹, Antti Lipponen ², Kalle Nordling^{1,3}, Otto Hyvärinen¹, Kimmo Ruosteenoja¹, Timo Vihma ¹ & Ari Laaksonen^{1,4}



Annual mean temperature evolution 1979-2021

AIM OF THE PROJECT

Long-term monitoring of changes in spatial distribution and activity rhythms of birds facing climate change along a 3000 km gradient from the sub-arctic to the arctic region

(1) Local community reassembly

Polewards range shift

Local species temporal turnover (replacement of species by other species)
or nestedness (species enrichment or impoverishment)

(2) Change in the start date of the breeding season

Migrating species tend arrive earlier at their breeding grounds

Sedentary species tend to start their breeding period earlier

(3) Change in the circadian rhythms

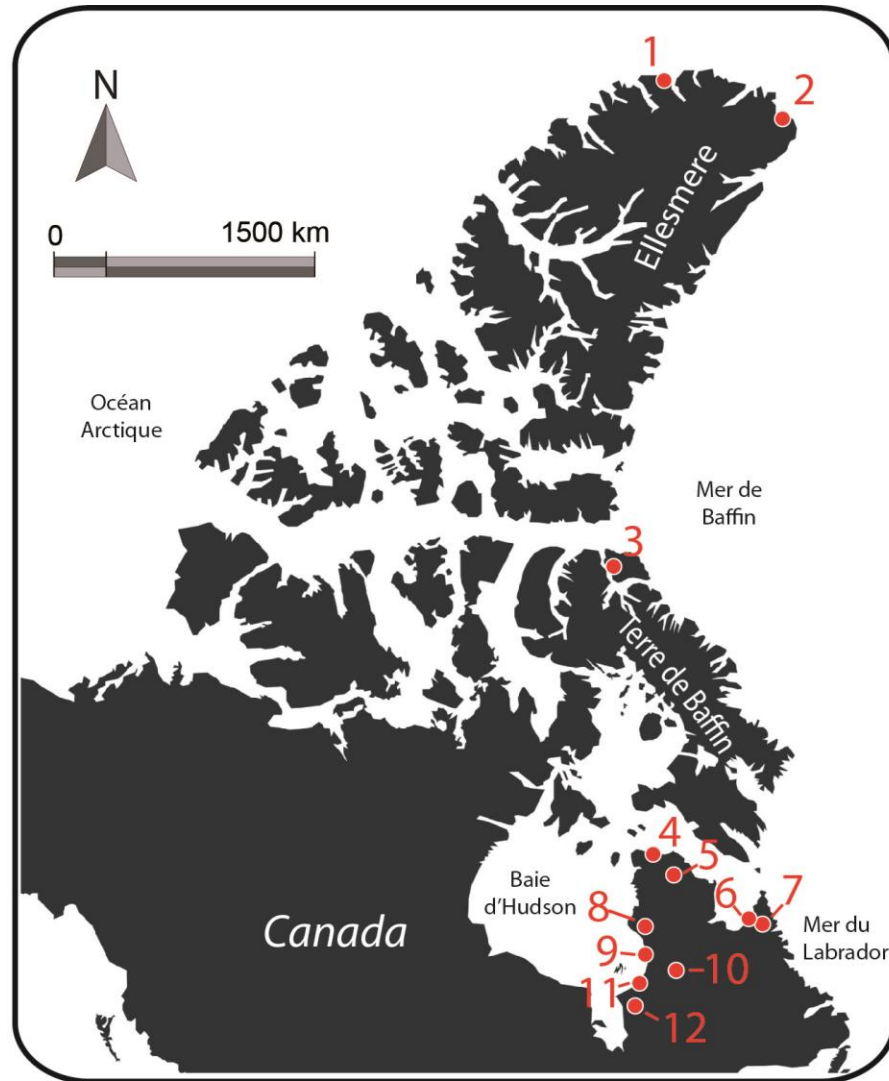
Birds have shorter breeding seasons at higher latitudes and must maintain intense activity levels to ensure successful reproduction. Global warming promotes a longer breeding season and may allow for a slower pace of activity, or, at least, a rhythm increasingly similar to that observed in temperate environments

Quantifying the impacts of climate change on biodiversity often requires costly monitoring and infrastructures



Our project relies on this network of research stations + national park infrastructures + an military base

Our project relies on this network of research stations + national park infrastructures + an military base



1. Ward Hunt* 83°10 N

2. Alert*** 82°49 N

3. Bylot* 73°15 N

4. Salluit* 62°20 N

5. Pingualuit** 61°31 N

6. Kangiqsualujjuaq* 58°70 N

7. Kuururjuaq** 58°61 N

8. Rivière Boniface* 57°74 N

9. Umiujaq* 56°55 N

10. Lac à l'Eau Claire* 56°35 N

11. Kuujjuarapik* 55°28 N

12. Radisson* 53°79 N

* Station du Centre d'Etudes Nordiques (CEN)

** Cabine de parc national

*** Base militaire

2 to 3 recorders in each station



« IN »



« OUT »



« OUT 2 »

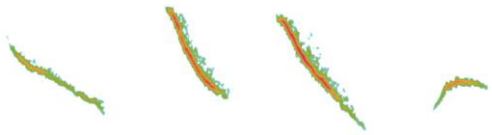
A network of 25 acoustic sensors along the latitudinal gradient



- From April 1st to the date the recorders are retrieved
 - 5 min each morning
 - 3 x 24 h (20, 25, 30 June)
- 250 h of « morning sampling »
- 1800 h of « 24 h sampling »

Acoustic indices

seewave



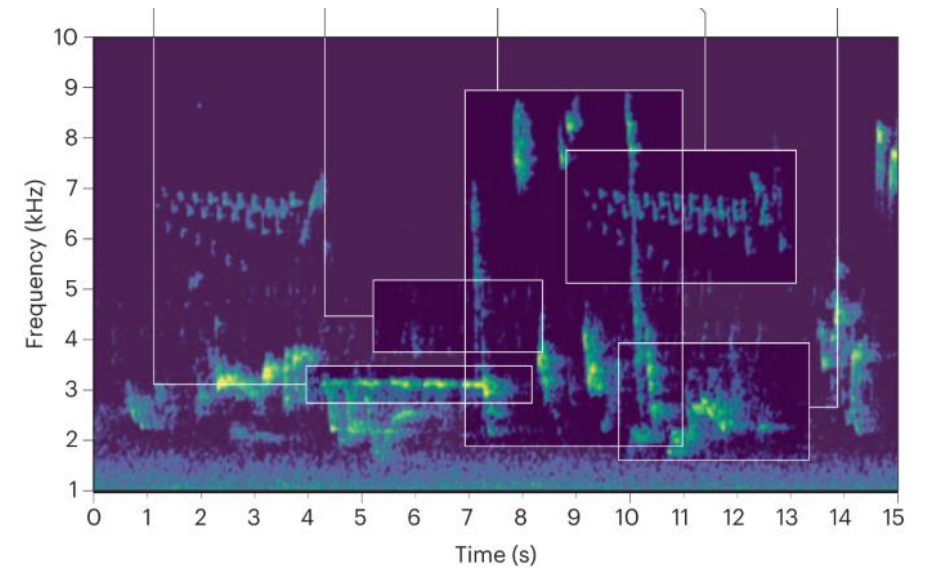
MUSÉUM
NATIONAL
D'HISTOIRE
NATURELLE



Automatic species identification



« Manual » species identification



2025 is the first date of this standardized monitoring



1. Bird communities along the latitudinal gradient
2. Spatial variation in the seasonal timing of vocal activity
3. Spatial variation in the circadian rhythm of vocal activity

Some 2025 sounds and soundscapes....

Kuujuarapik, 14/06/2025



Rivière Boniface, 27/05/2025



Pingualuit, 30/06/2025

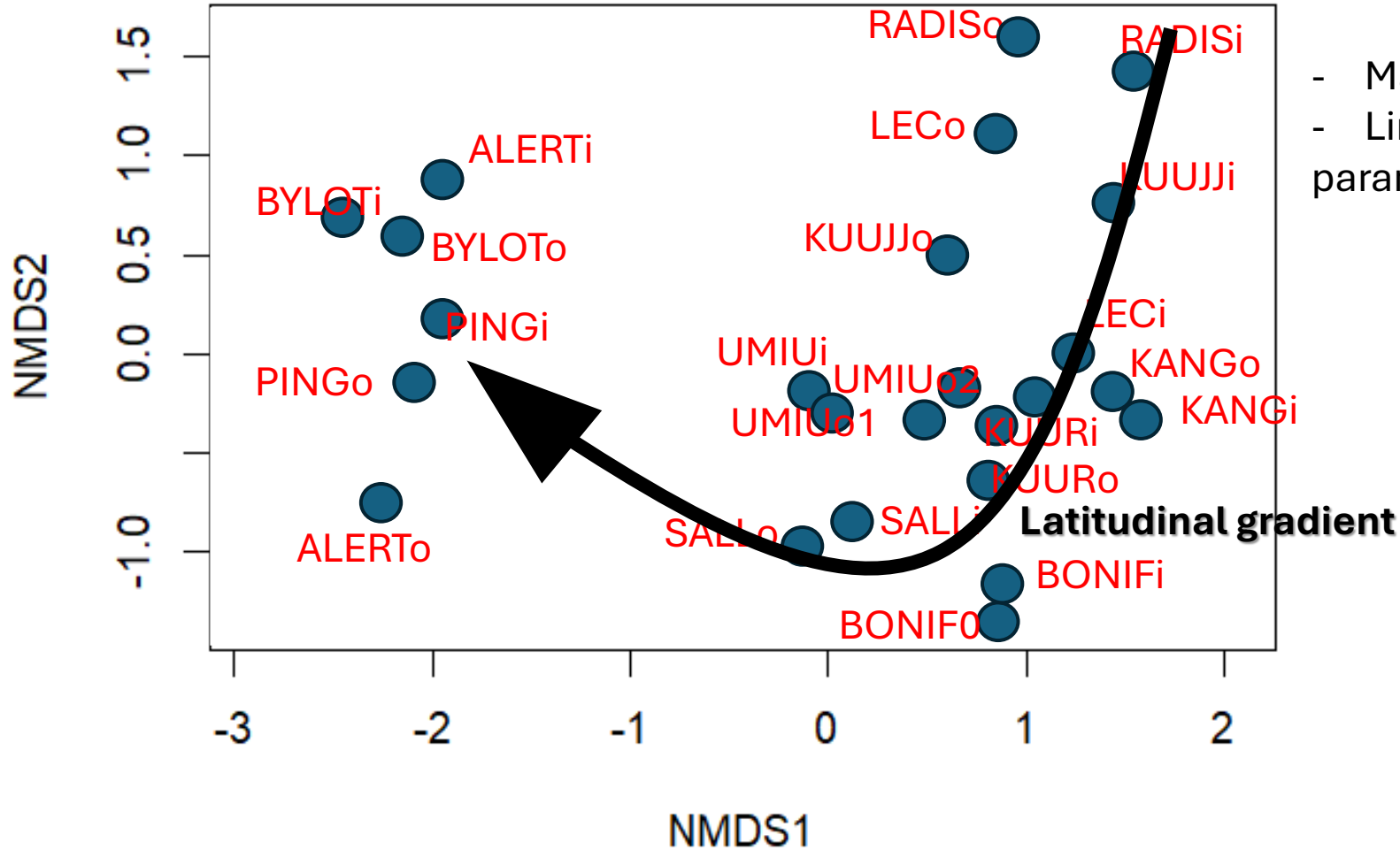


Alert, début juin 2025



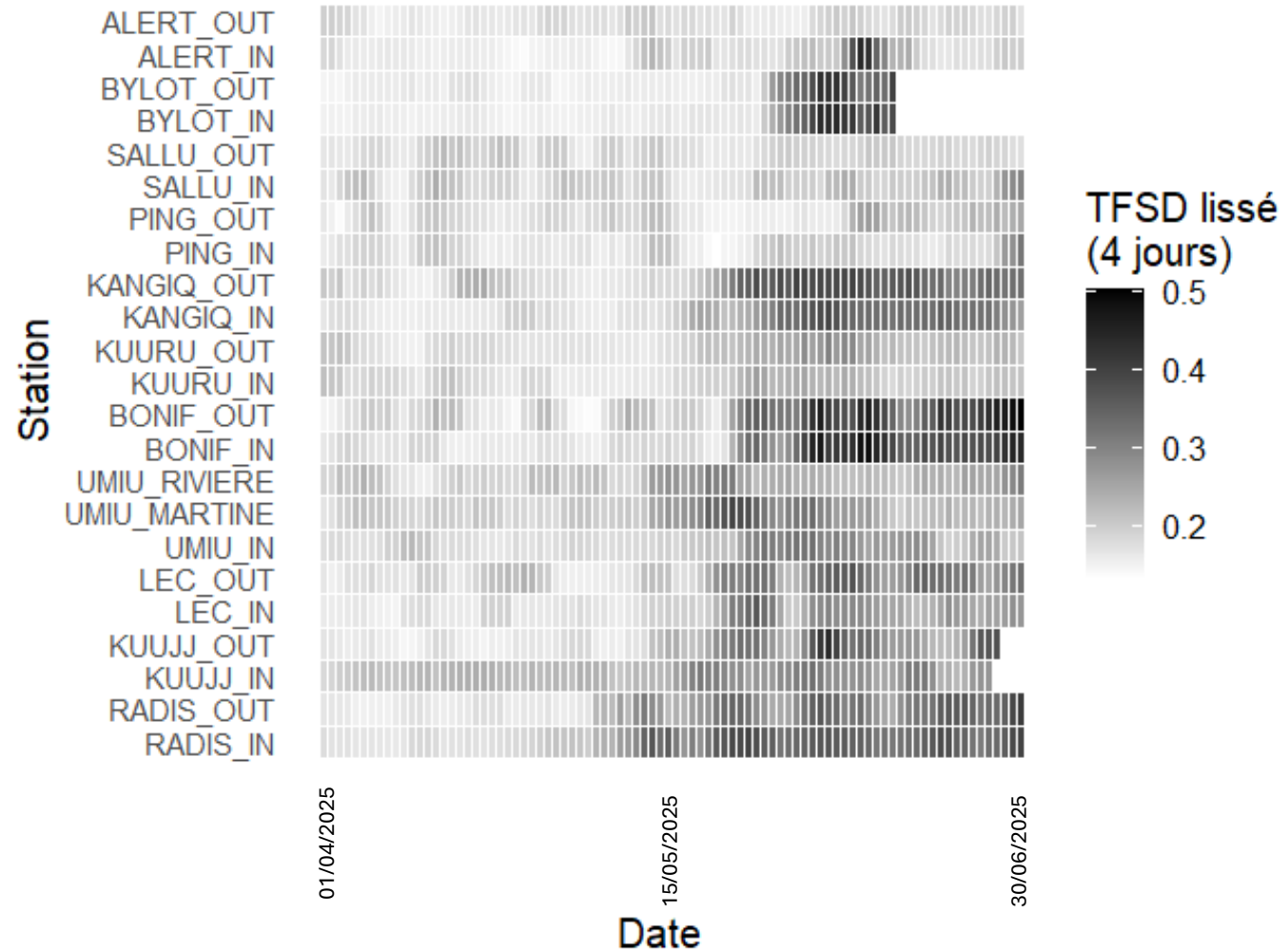
1. Bird communities along the latitudinal gradient

Community structure (nMDS)



- Manual annotation required
- Linking community structure to environmental parameters (habitats)

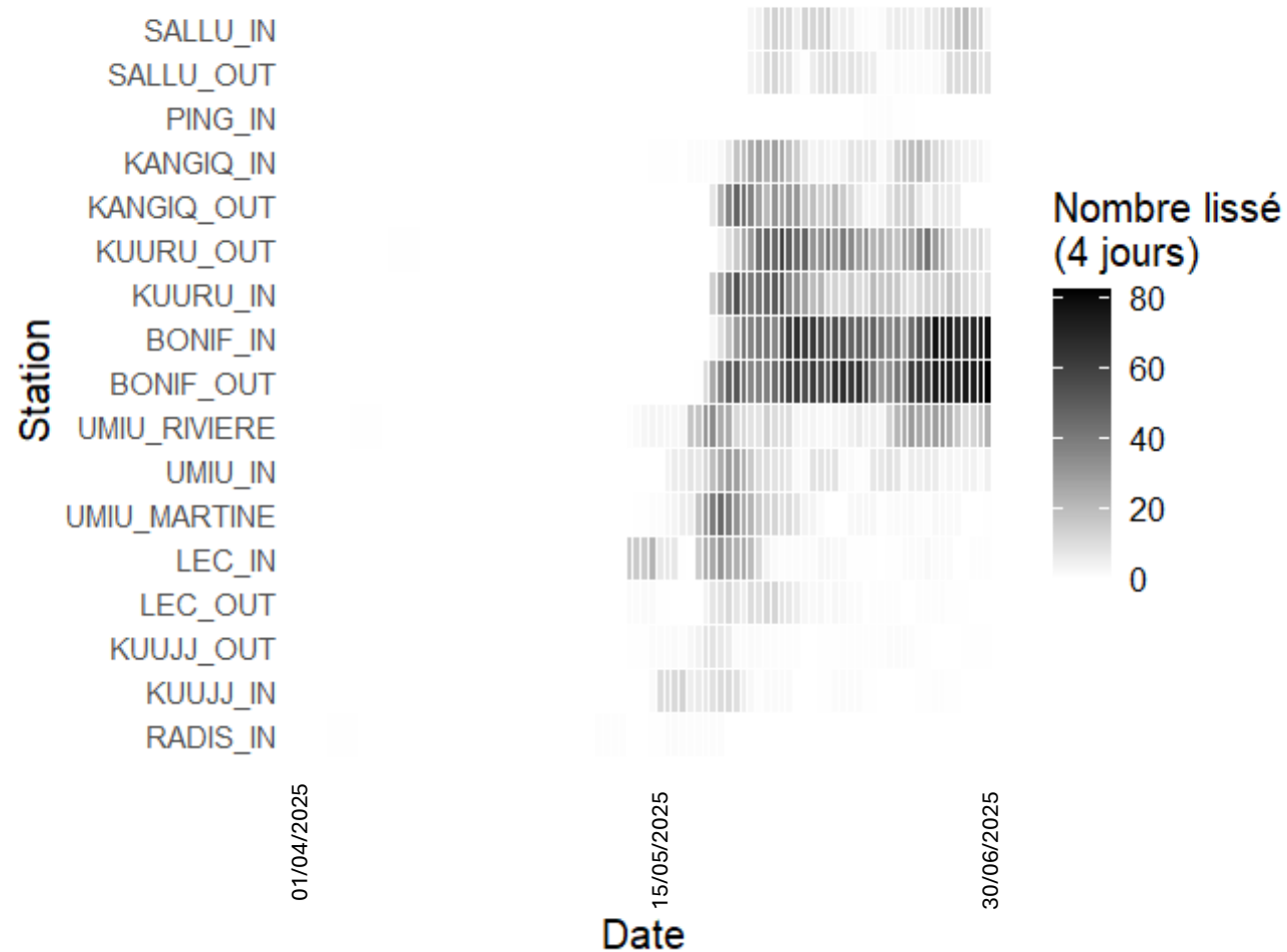
2. Spatial variation in the seasonal timing of vocal activity



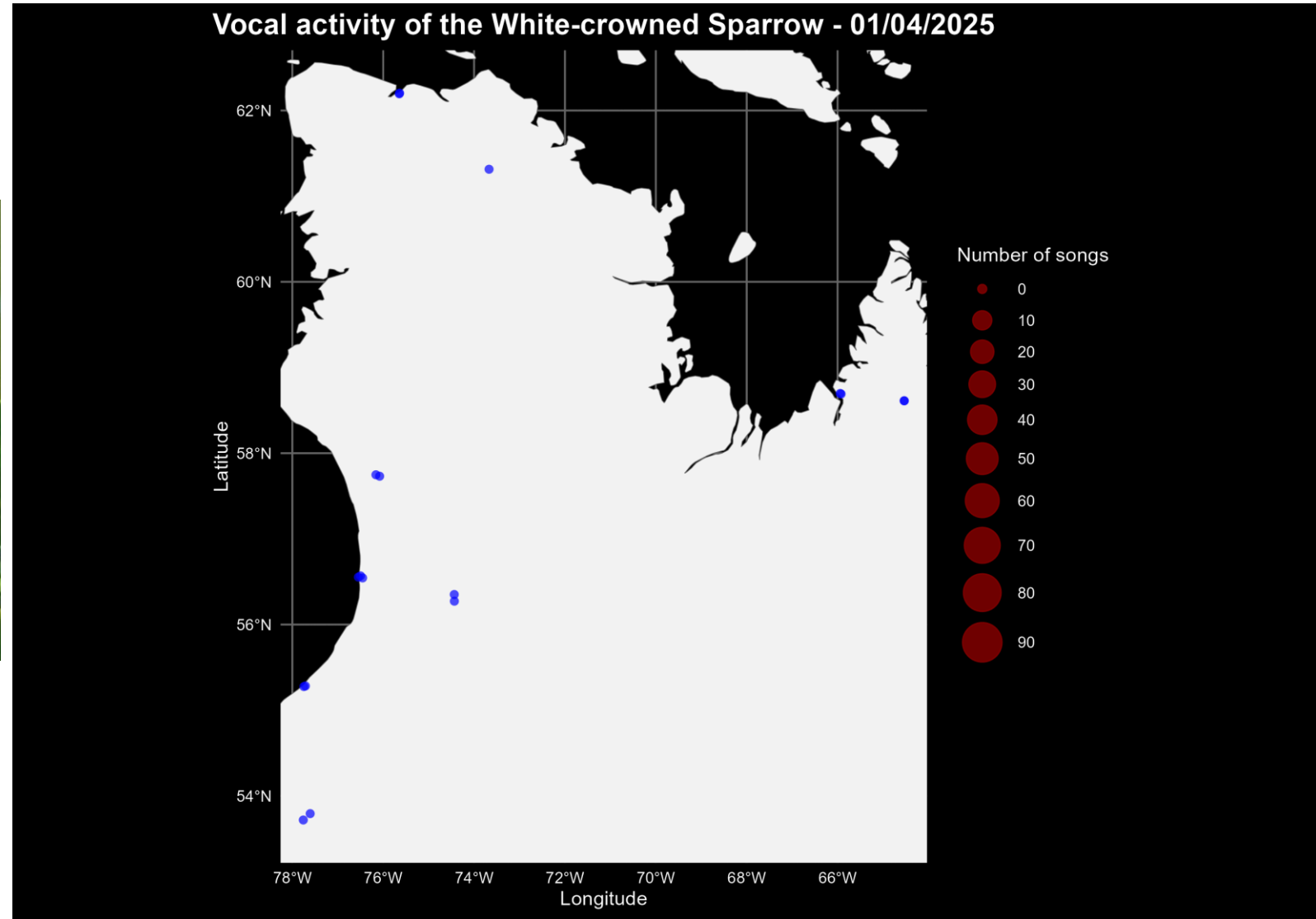
2. Spatial variation in the seasonal timing of vocal activity



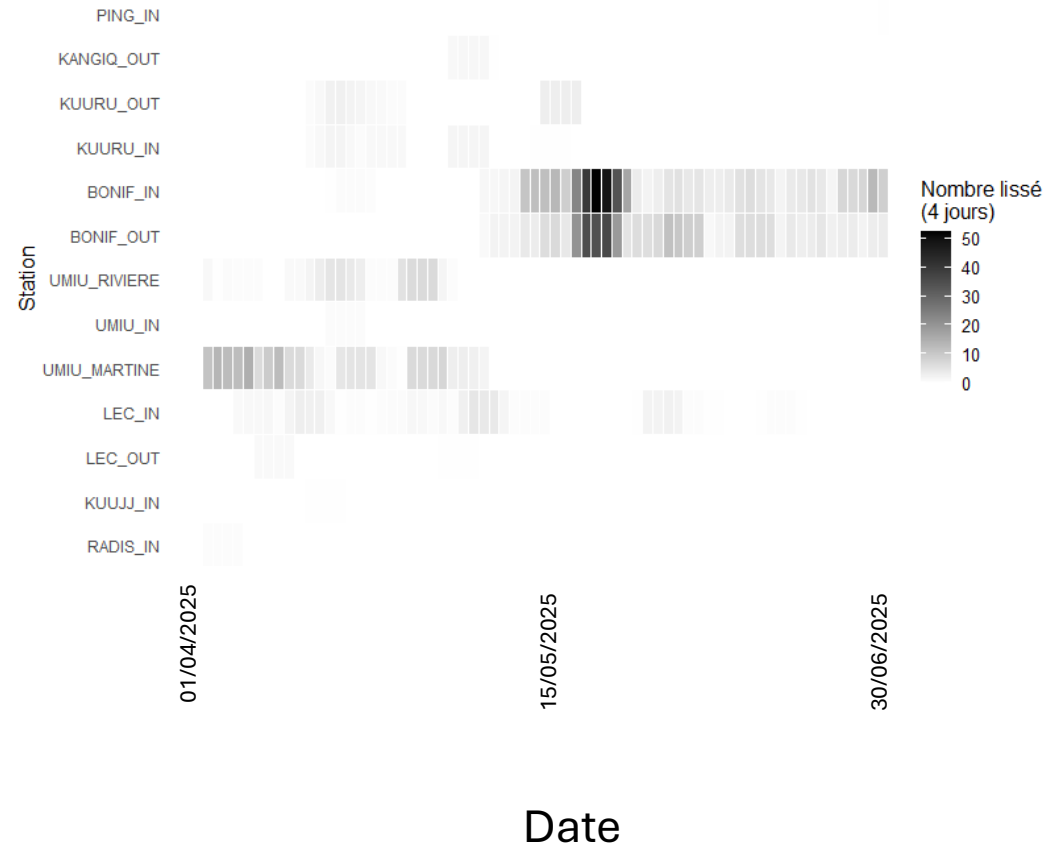
White-crowned sparrow vocal activity



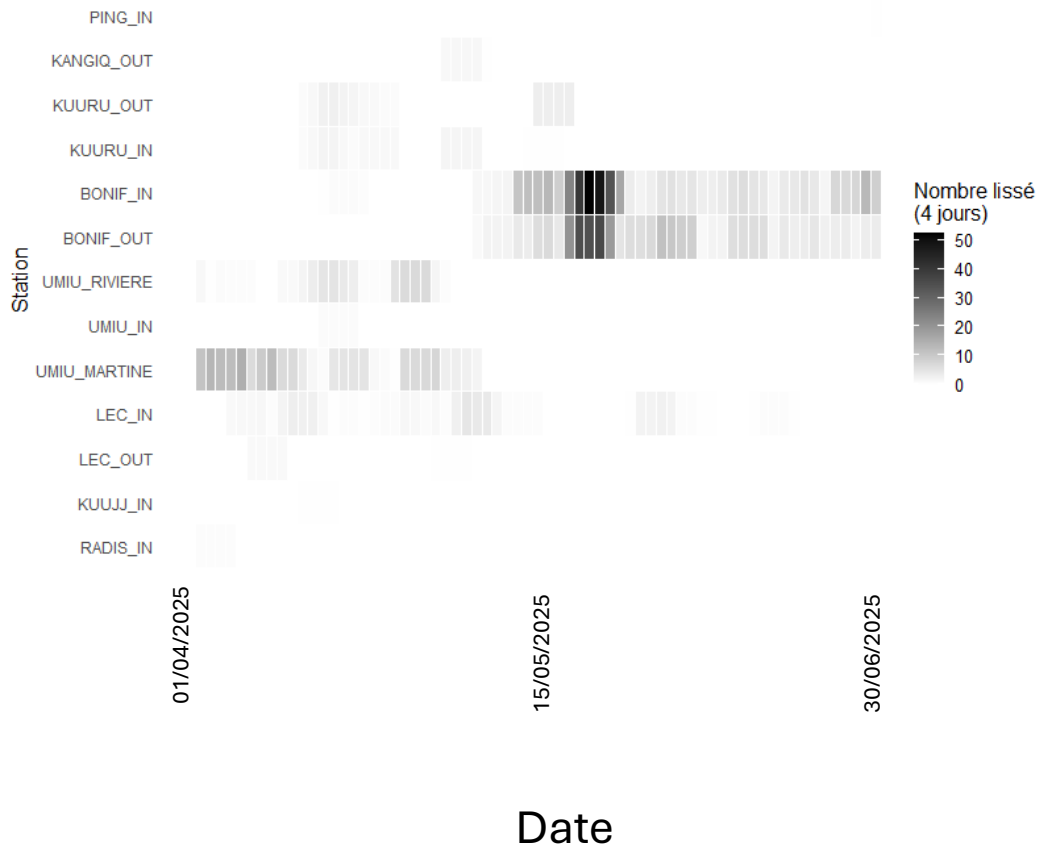
2. Spatial variation in the seasonal timing of vocal activity



2. Spatial variation in the seasonal timing of vocal activity



2. Spatial variation in the seasonal timing of vocal activity



- Linking the start of vocal activity with local meteorological parameters (e.g., snow cover).

Conclusion

- 1. Community are structured along a latitudinal gradient**
- 2. The arrival of birds can vary by up to three weeks depending on the latitude**
- 3. The circadian rhythm changes depending on the latitude: dawn and dusk chorus, then only dawn chorus, then no more chorus**

Short-term perspectives:

- **« Manual » annotations for all the 2025 sounds**
- **Coupling sound data with environmental data to understand community (re)assembly**
- **Coupling sound data with meteorological data to understand the drivers of arrival dates**
- **Coupling solar data to understand the spatial change in the circadian rhythm**

First publications (2025-2026):

- **List of the species observed/recorded from 2022 to 2025 in Nunavik**
- **Circadian rhythm of birds along the latitudinal gradient**