

Avian Radar Data Integration and Complementarity with Field Observations: A Key to Success

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Collaborators

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- Amanda Rollinson
- Tim Nohara
- Pierre Molina
- Paul Woods



Toronto Pearson
For You. The World.



What Do Radars Provide?

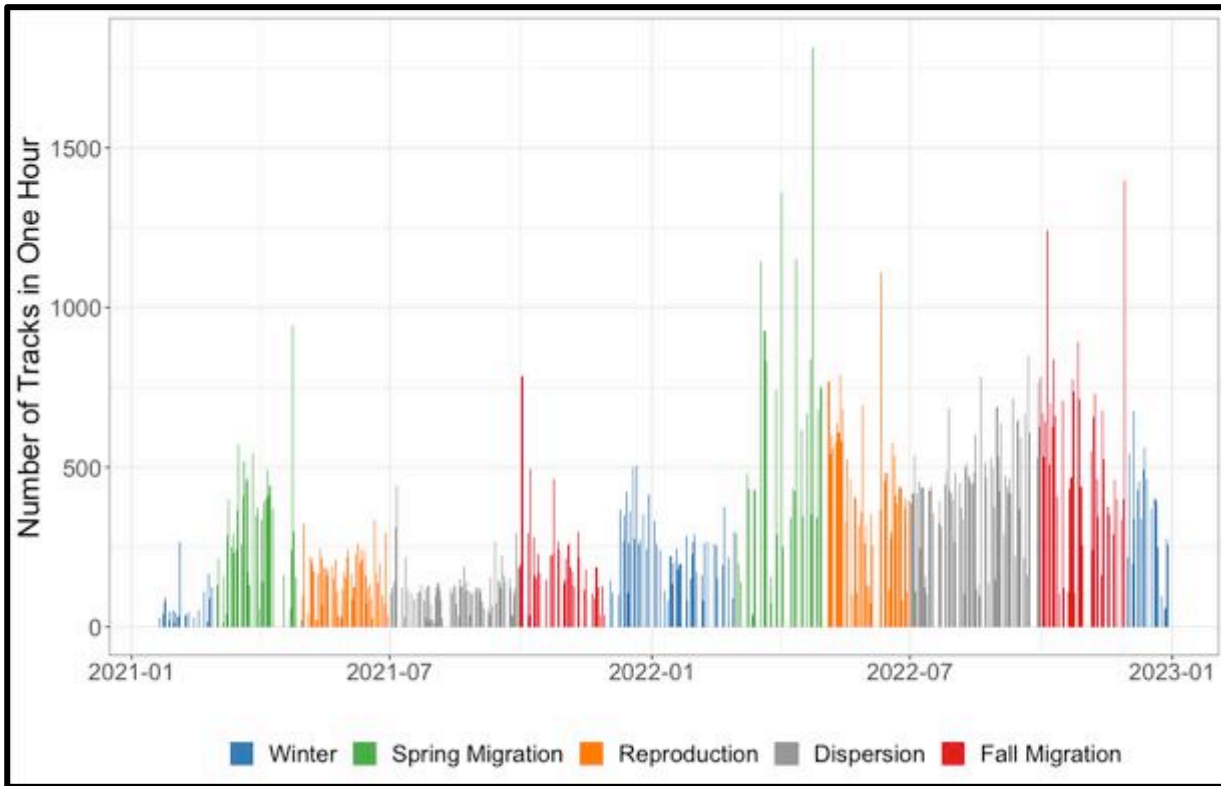
- Event investigation
- Operational alerts
- Target size and behaviour
- Spatial and temporal pattern



What Do Radars Provide?



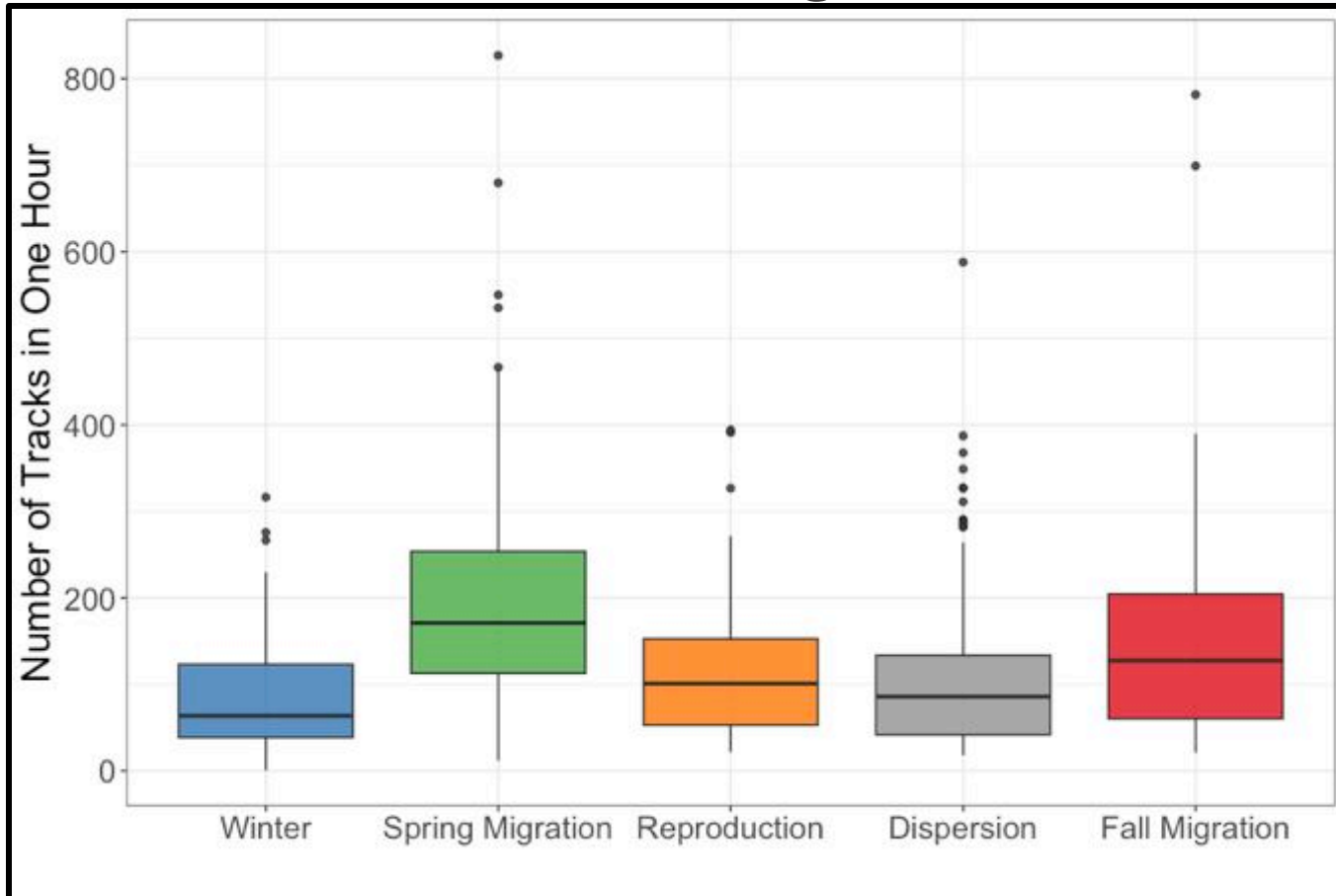
Seasonal changes



What Do Radars Provide?



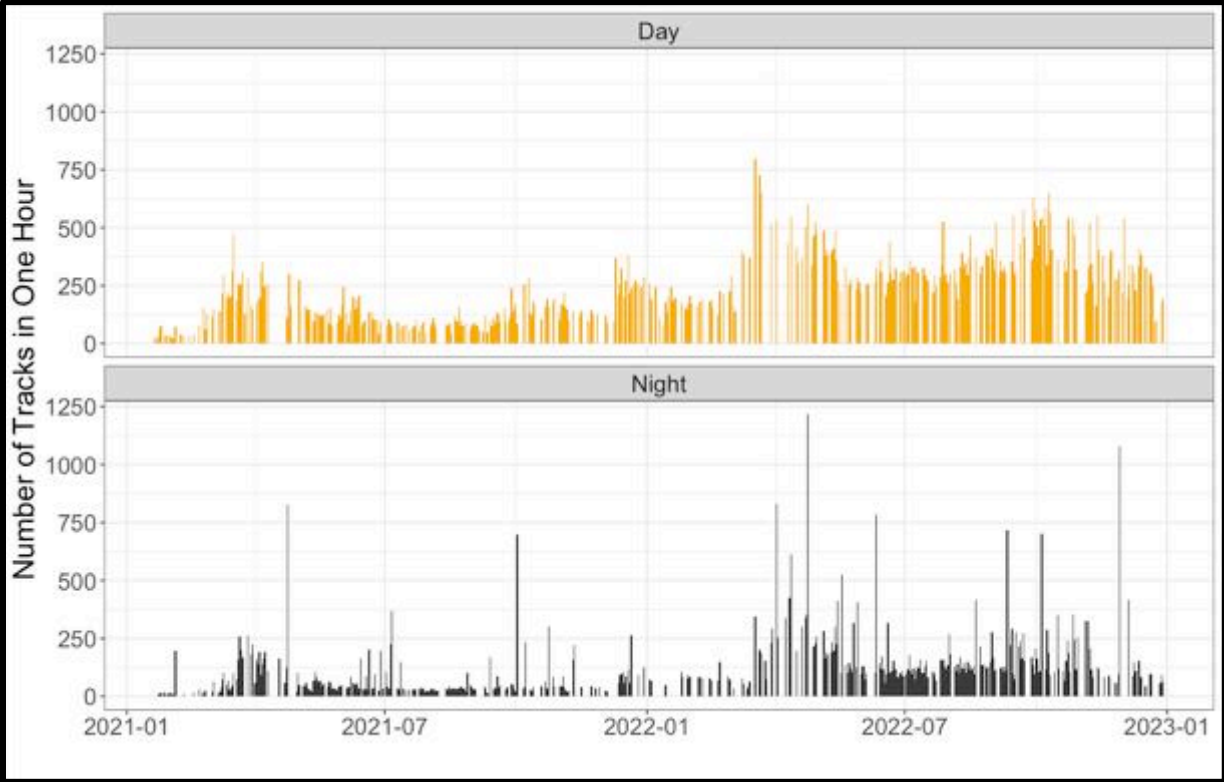
Seasonal changes



What Do Radars Provide?



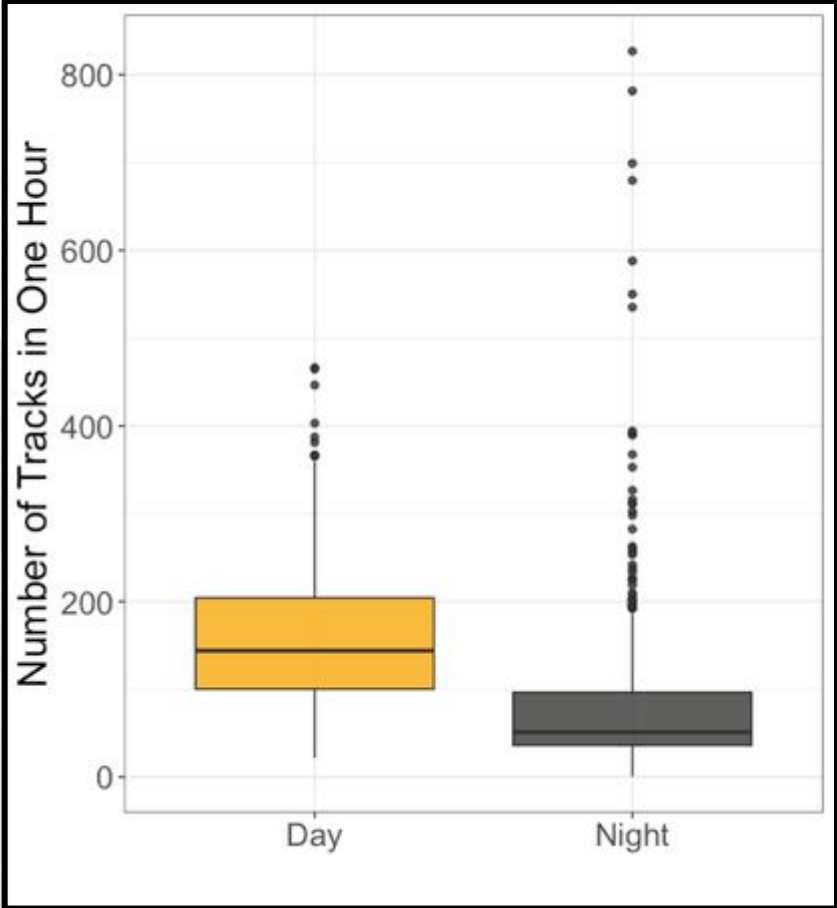
Daily changes



What Do Radars Provide?



Daily changes



Daily Changes

Would it be possible to forecast
the number of tracks TODAY
based on LAST NIGHT?



Activity Ratio



Activity Ratio = *Previous Night
Tracks/Following Day Tracks*

Activity Ratio = 131/242
= 0.54

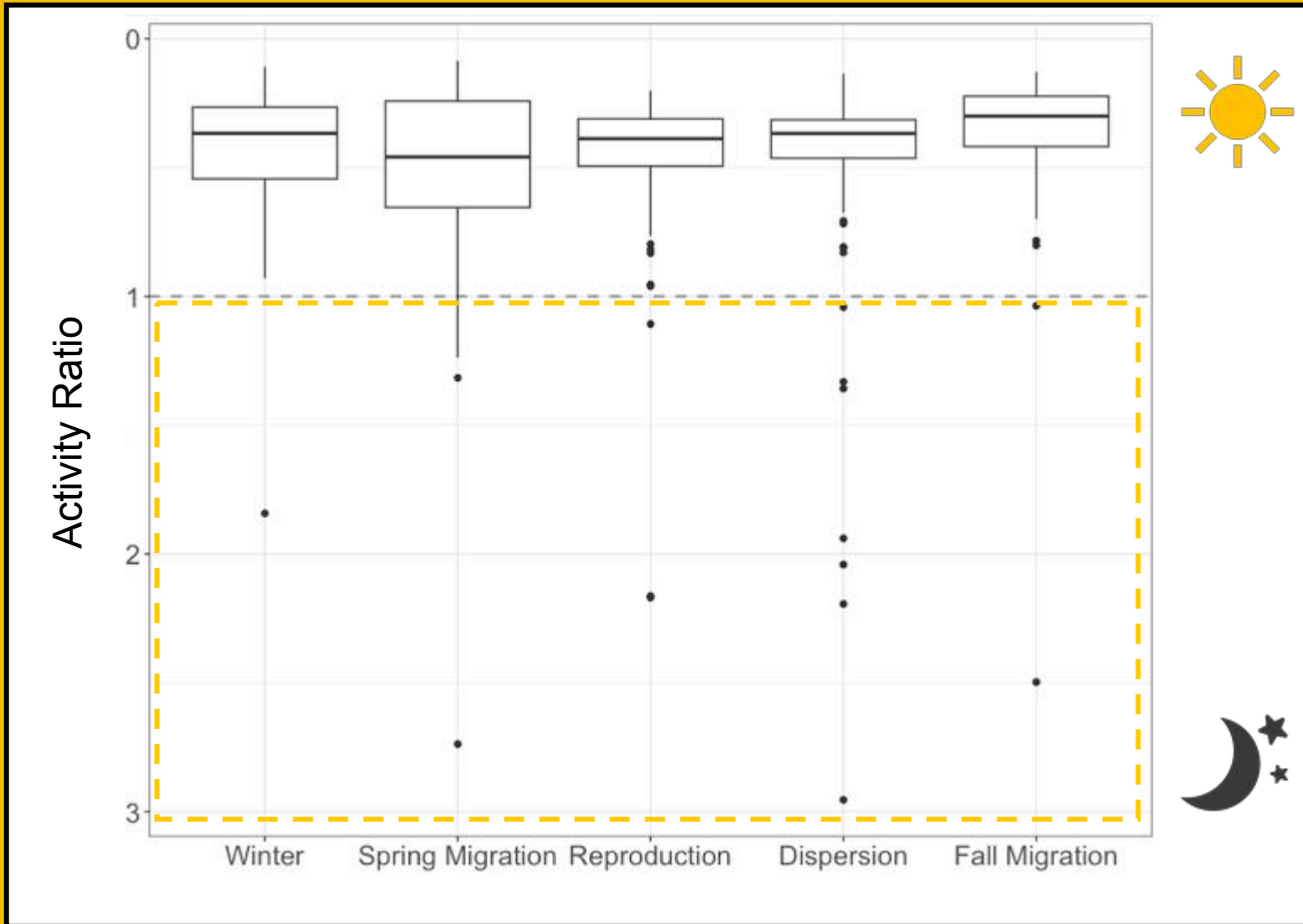


LAST NIGHT
131 Tracks

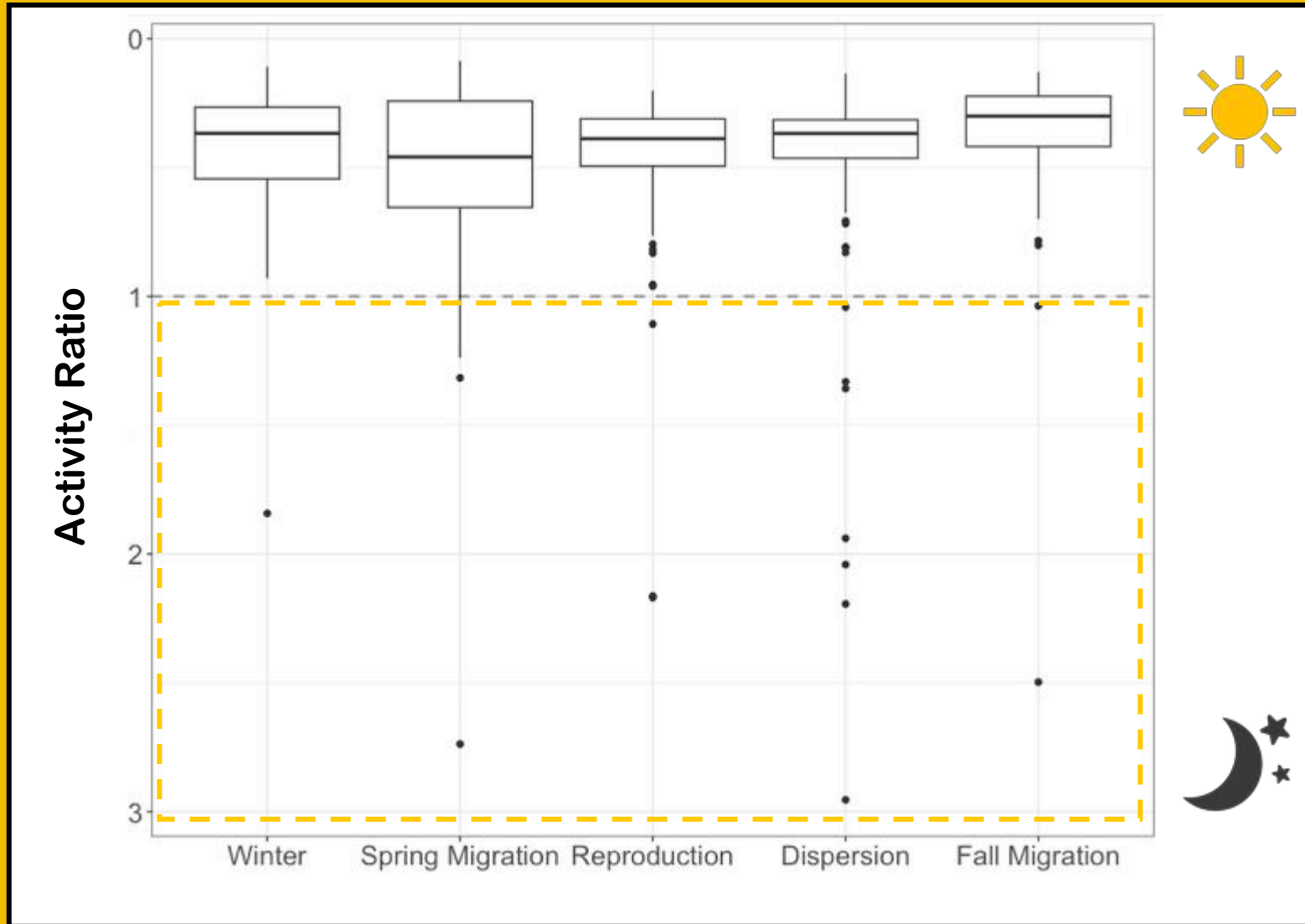
TODAY
242 Tracks



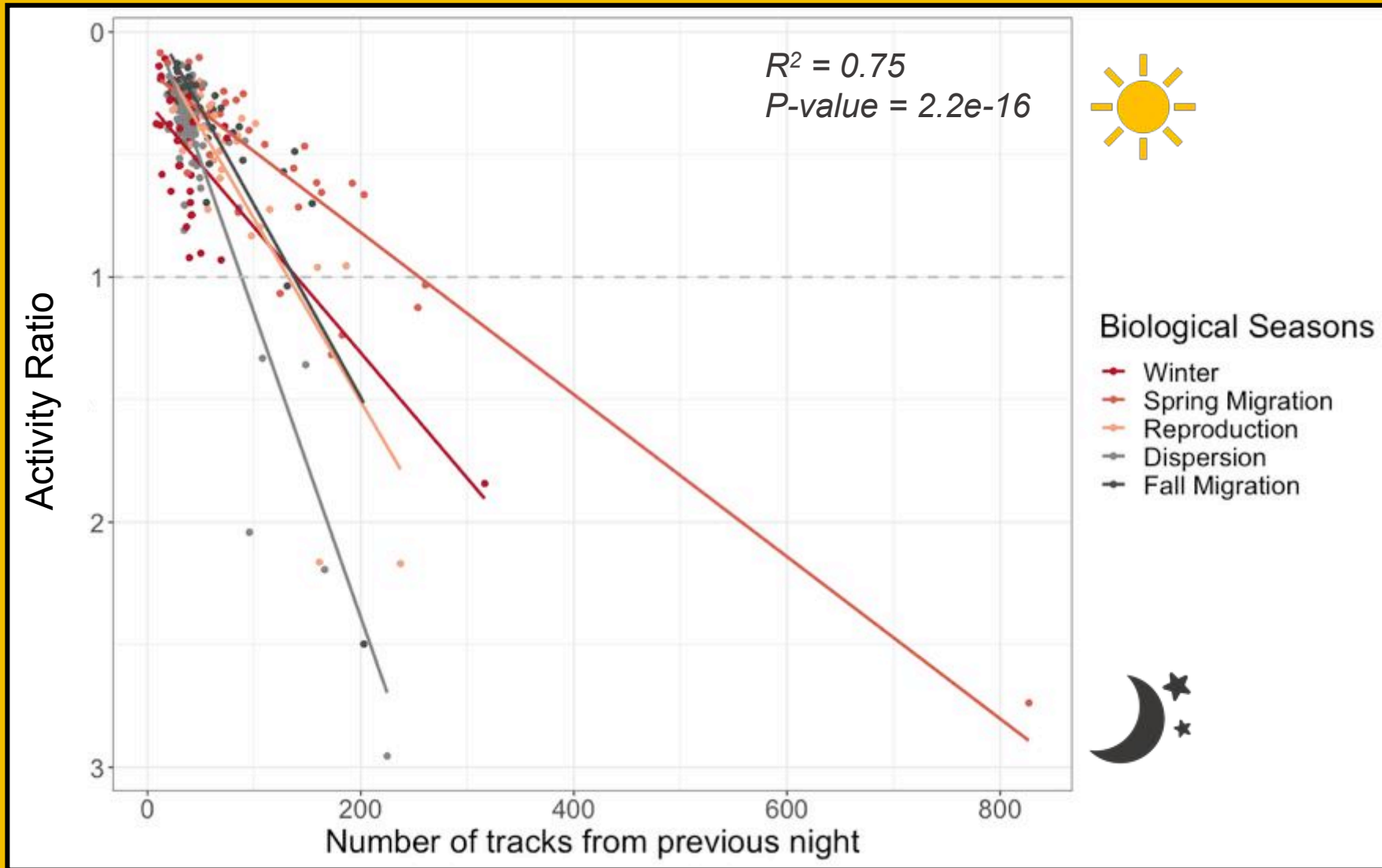
Activity Ratio



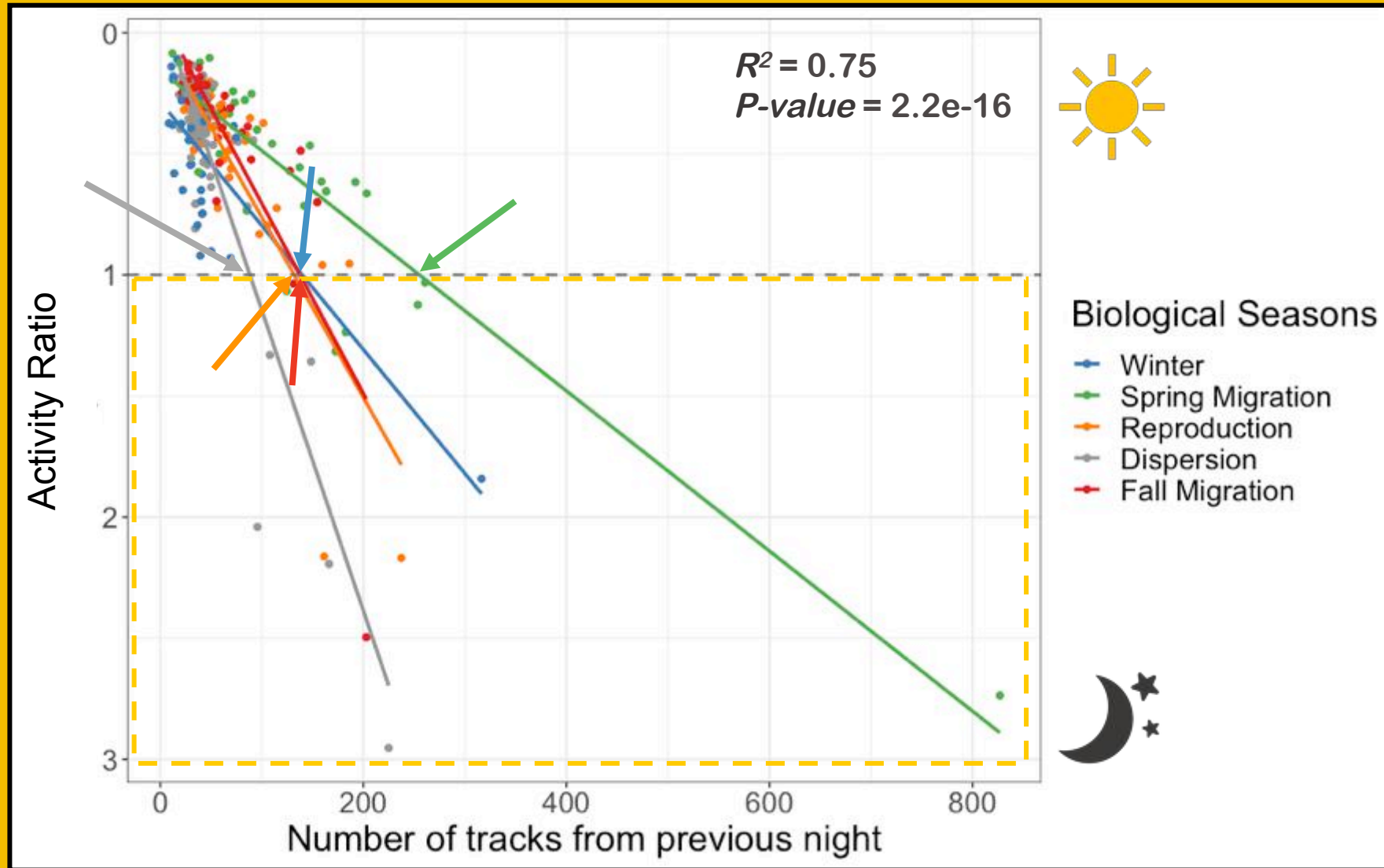
Activity Ratio



Forecasting



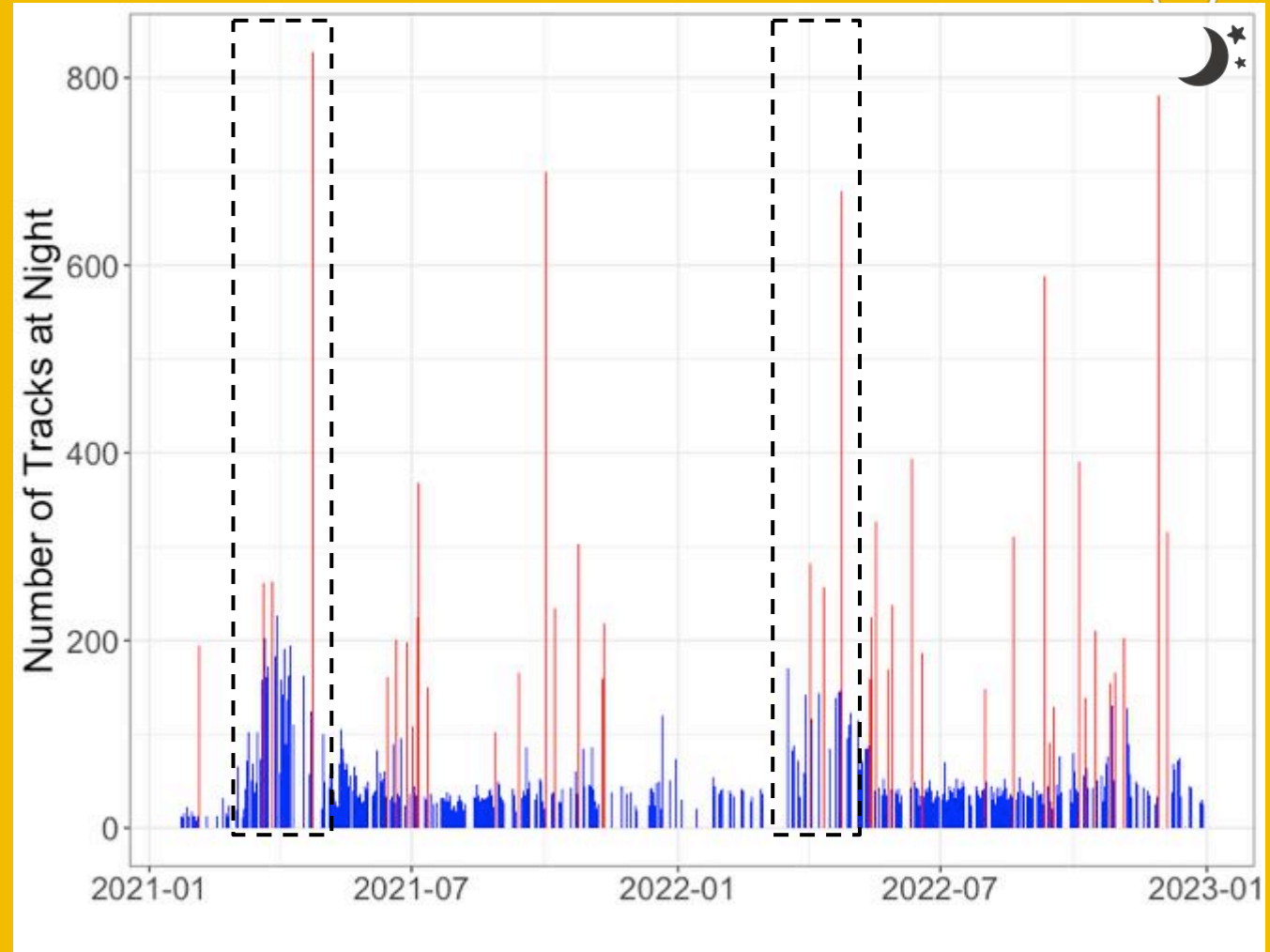
Forecasting



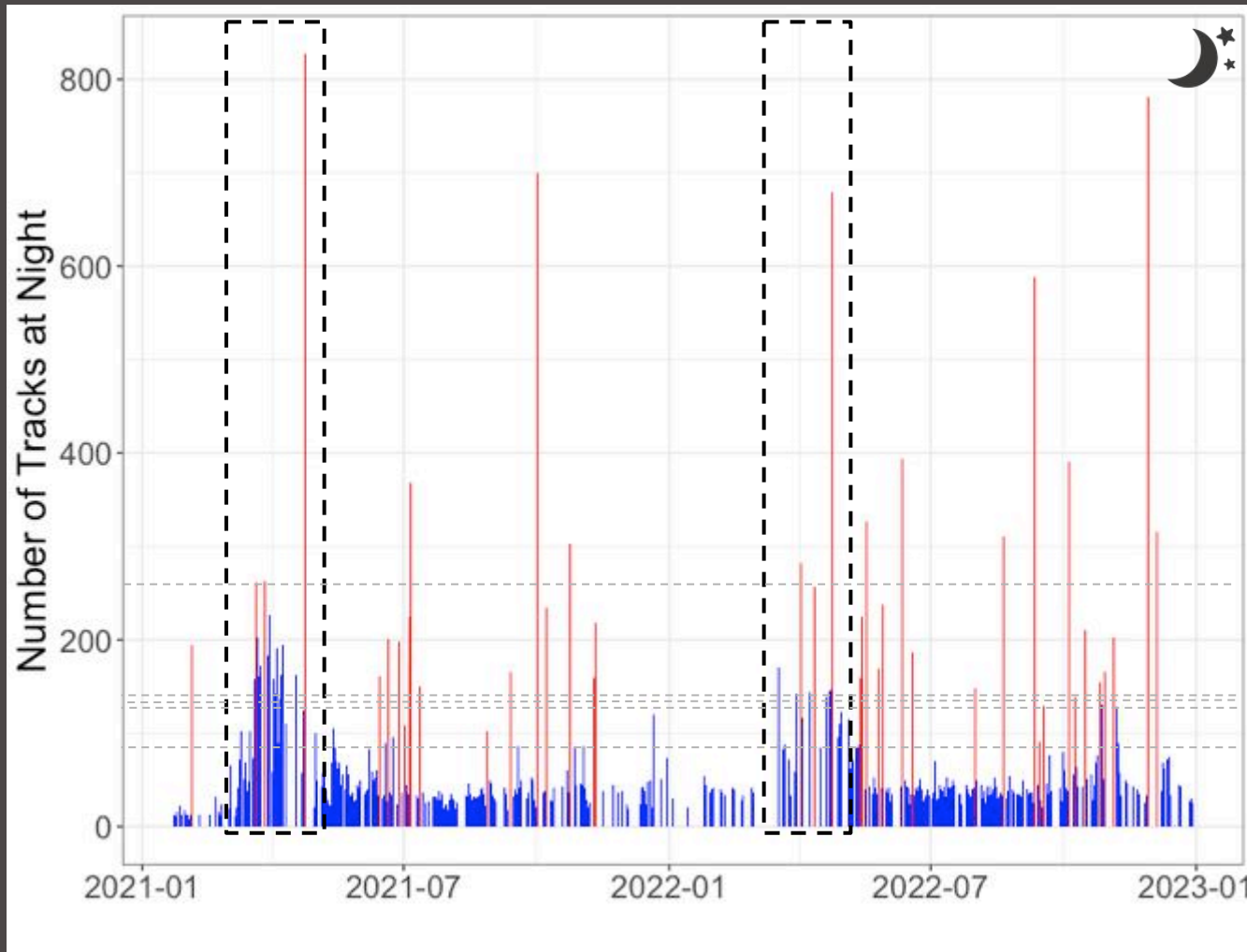
Activity Shift

Spring Migration:

- Less than 255 tracks last night = **more birds the following day**
- More than 255 tracks last night = **less birds the following day**



Activity Shift



Seasonal Thresholds:

Spring Migration: 255

Winter: 140

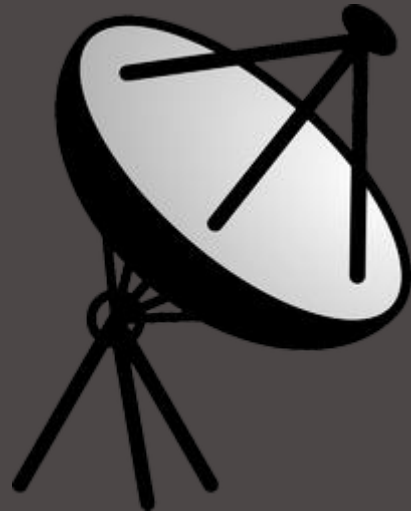
Fall Migration: 138

Reproduction: 132

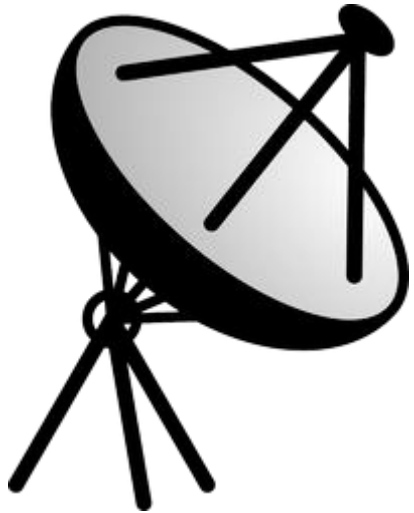
Dispersion: 88

Radars Limitations

- Difficult to identify species
- Geographical coverage not uniform
- Biased towards certain bird behaviour
- Counts are not real counts
- Precipitation



What if We Integrate Field Data?



Redundancy Analysis (RDA)

Model how radar tracks explain field data

Number of observation
for each species



Number of
radar tracks



Seasonal Change



Winter



Fall Migration



Reproduction



Dispersion



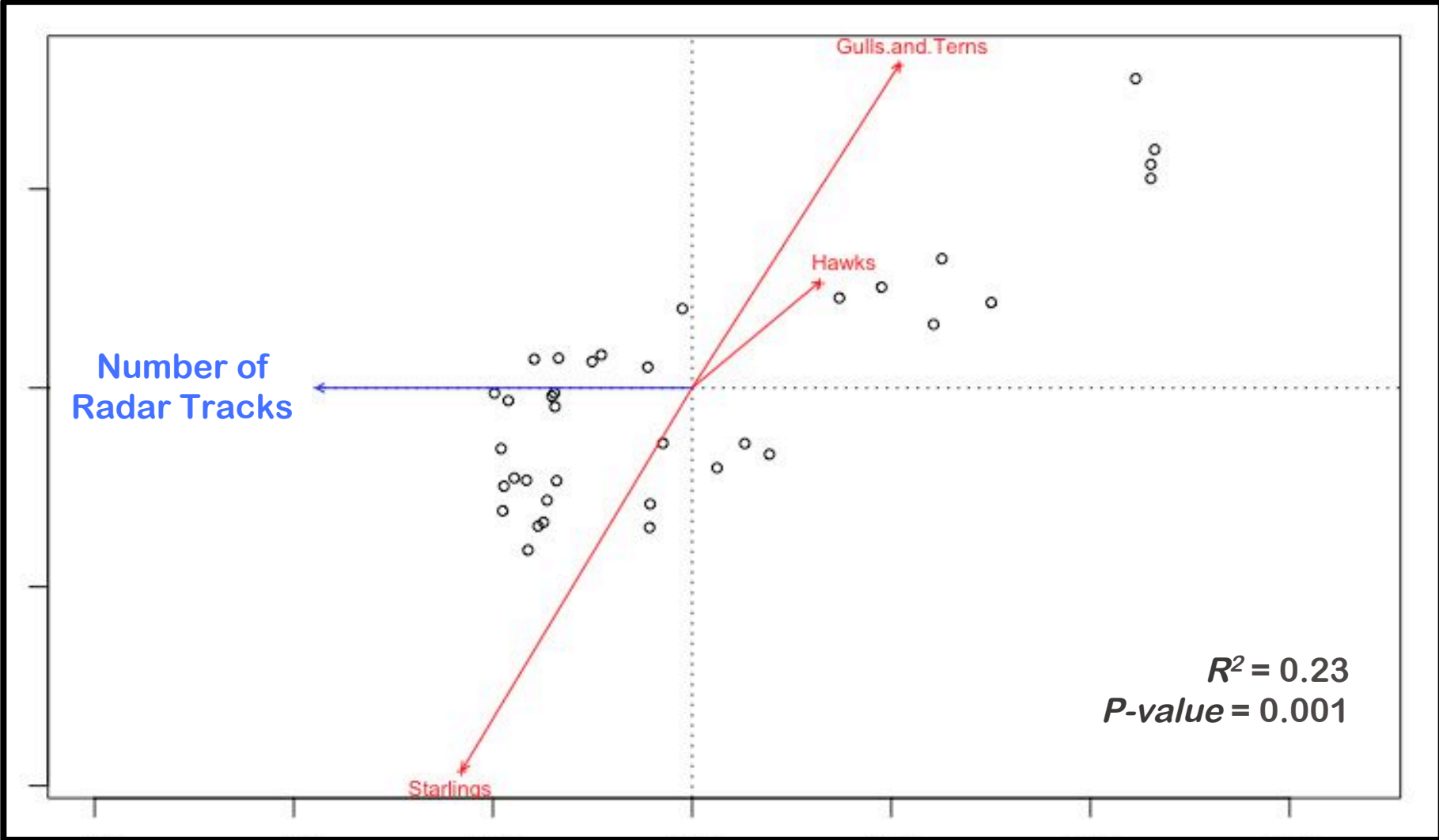
Spring Migration



All Seasons



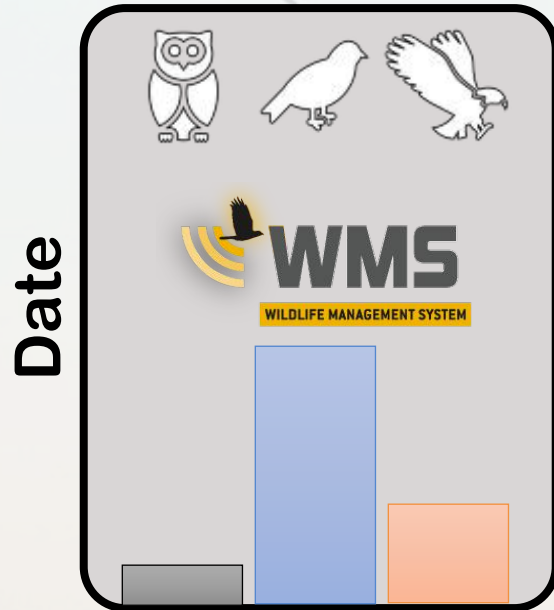
Fall Migration



Multivariate Regression Tree

Model partitions observation data using a threshold value

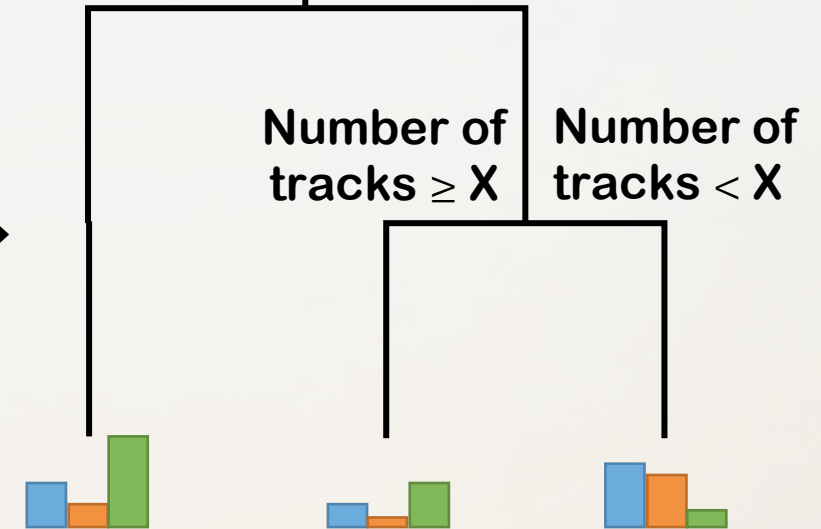
Number of observation
for each species



Number of
radar tracks



Number of tracks $\geq X$ | Number of tracks $< X$

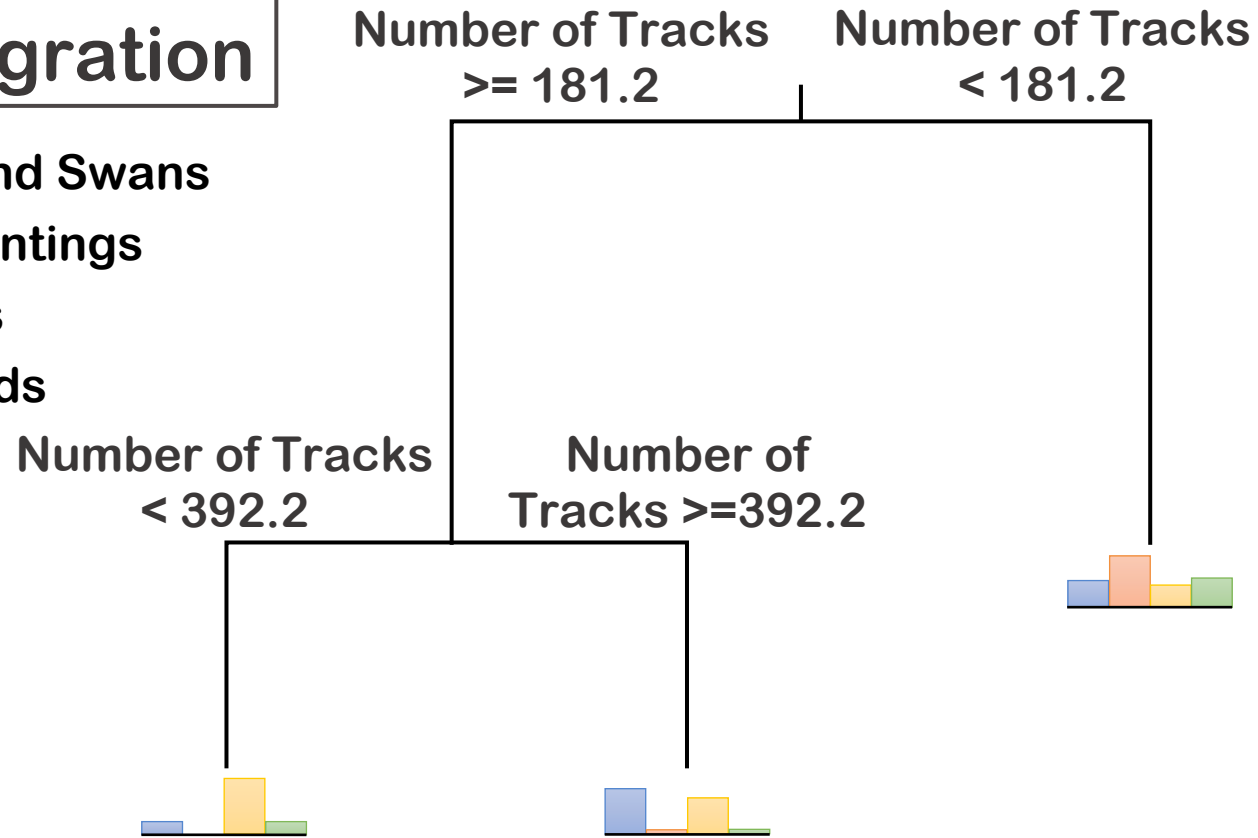


Multivariate Regression Tree



Spring Migration

- Geese and Swans
- Snow Buntings
- Starlings
- Blackbirds



$R^2 = 0.74$



Multivariate Regression Tree

Spring Migration

$$R^2 = 0.74$$

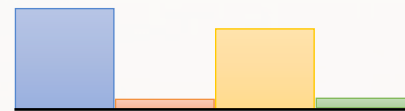
Less than 181 tracks:



Between 181 and 392 tracks:



More than 392 tracks:



Geese and Swans



Snow Buntings



Starlings



Blackbirds



How Is This Useful?

- Further operational use of radars at airports
- Can highlight patterns for specific species using radar and field data
- Example: Starlings at Toronto Pearson
- Can create alerts using radar data for starlings
- Can be more useful for certain species and seasons



How Is This Useful?

- Radar data by itself can be useful for some airports
- Post-processing of data and comparing with field data enables its full potential



Things to consider

- At Toronto Pearson, there are a lot of different species present
- Hard to pull out specific movement patterns
- Limited by the amount of data
- We expect to be able to highlight larger patterns at airports with larger movement patterns



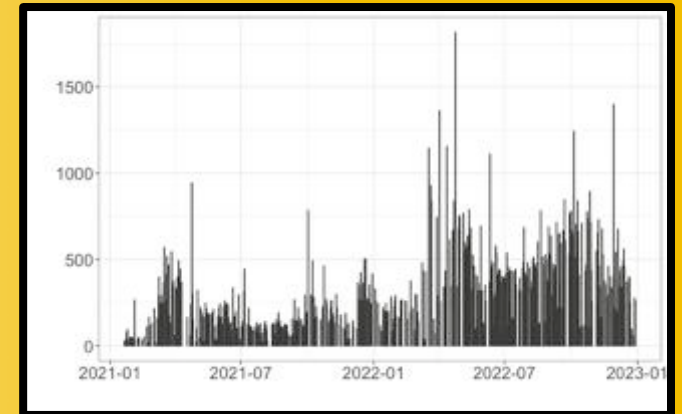
Our Next Steps

- Narrow down our sampling field
- Use data from other airports
- Take into account weather data
- More stats!



Conclusion

- Results change between radars
- Species composition changes with seasons, so should alert
- Need to understand biological behaviour behind radar data



Introduction

- Radars provide a lot of information but not all of it is relevant to each airport











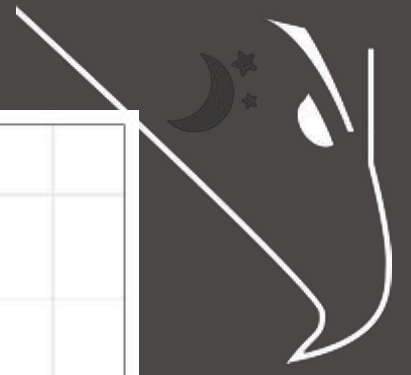
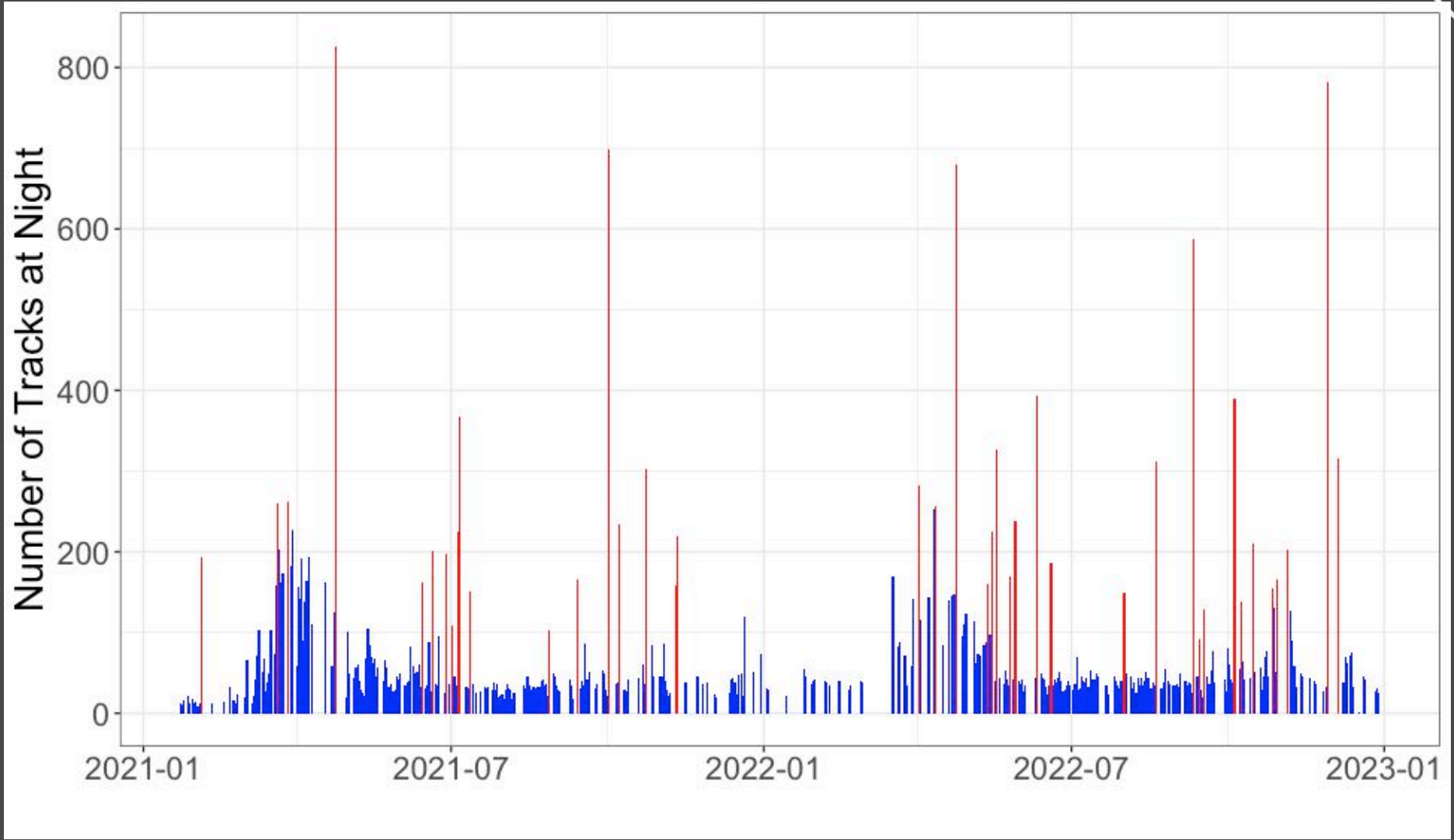
Activity Ratio

Activity Ratio = *Previous Night Tracks/Following Day Tracks*

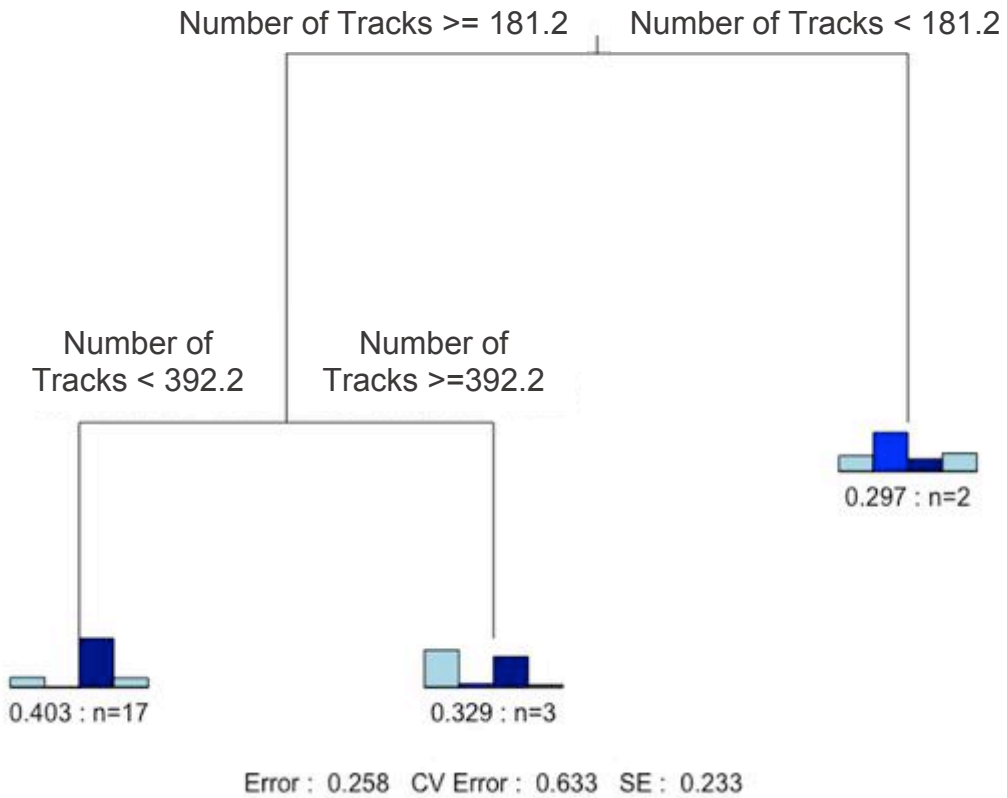
$$\text{Day 1} = 131/242 = 0.54$$



Day 1		Day 2	
 Number of tracks = 131	 Number of tracks = 242	 Number of tracks = 131	 Number of tracks = 242
			

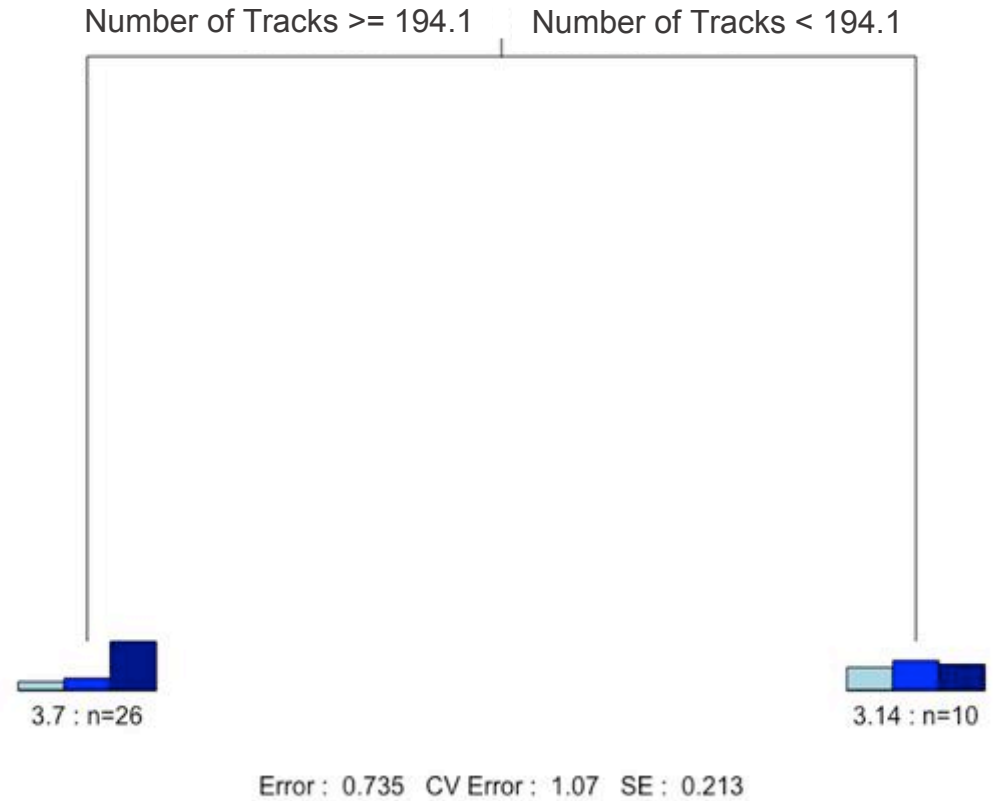


Spring Migration



- Geese and Swans
- Snow Buntings
- Starlings
- Blackbirds

Fall Migration



- Hawks
- Gulls and Terns
- Starlings

The floor is yours





FALCON

ENVIRONMENTAL