Joint modelling of data from multiples sources

An application to abundance indexes of woodcock wintering in France

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Population monitoring

Assessing changes in ...

Species distribution  Demographic parameters  Population size

help to define ...

Species status  Hunting pressure

Sustainable management
Monitoring programs

**Introduction**

- Scientific institutions
- Non-profit organizations
- Citizen sciences
- multiple monitoring programs

**Materials & Methods**

**Results**

**Limitations**

**What next?**

p. 2/12
Woodcock abundance indexes

- Wintering abundance of woodcock in France
  - Counts methods for this species:
    - With pointing dogs during the day (HAI)
    - With a light at night (NAI)

Introduction

Materials & Methods

Results

Limitations

What next?

Relative abundance indexes
Woodcock abundance indexes

Introduction

Materials & Methods

Results

Limitations

What next?

- NAI data

- Limitation:
  Heterogeneous observation effort in time

p. 4/12
Introduction

Materials & Methods

Results

Limitations

What next?

- Limitation:
  Heterogeneous observation effort in space
Joint modelling of both indexes

- **NAI & HAI**

  - **Advantages:**
    - Both type of habitat used by woodcock are sampled
    - Maximise the number and the coverage of the data in space and time

  - **Limitation:**
    - No sampling strategy
## Modelling step

- **Specify data distribution**
  - **Count data**
    - Poisson
    - Negative Binomial (overdispersion)
      - NAI: 1.79 (se: 0.06) → >>10
      - HAI: 2.26 (se: 0.05) → >>100
• Specify data distribution

- Poisson
- Negative Binomial (theta = 10)
Modelling step

• Specify data distribution
  – Count data
    • Poisson
    • Negative Binomial (overdispersion)
      – NAI: 1.79 (se: 0.06) \(\rightarrow\) \(>>10\)
      – HAI: 2.26 (se: 0.05) \(\rightarrow\) \(>>100\)
Modelling step

- Specify data distribution
  - Count data
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      - NAI: 1.79 (se: 0.06) $\rightarrow$ $>>10$
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- Quantify spatial autocorrelation

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Introduction
Materials & Methods
Results
Limitations
What next?
p. 7/12
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Modelling step

- Specify data distribution
  - Count data
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      - NAI: 1.79 (se: 0.06) \( \rightarrow \) >>10
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- Quantify spatial autocorrelation

- Define a spatial index (random effect)
Modelling step

- Specify data distribution
  - Count data
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- Quantify spatial autocorrelation

- Define a spatial index (random effect)

- Identify which variables best explain observed variation in NAI & HAI.
Candidate Variables

Climatic data

Introduction

Materials & Methods

Results

Limitations

What next?

Temperature - December 2015

- 0.2
- 3.5
- 7.0
- 10.5
- 14.0

0 100 km
Prediction step

- Use the model to predict (interpolate) at unsampled locations: 10 x 10 km grid
- Estimate the index at the country scale
- Evaluate prediction errors
An application for 2015-2016 winter

- NAI & HAI : WAI (wintering abundance index)

WAI October 2015 : 0.96 (0.86 – 1.07)

Predicted WAI October 1st 2015

log scale

WAI October 2015 : 0.96 (0.86 – 1.07)
An application for 2015-2016 winter

- NAI & HAI : WAI (wintering abundance index)

WAI November 2015 : 1.16 (1.07 – 1.25)

Predicted WAI November 1st 2015

WAI November 2015 : 1.16 (1.07 – 1.25)
An application for 2015-2016 winter

- NAI & HAI : WAI (wintering abundance index)

WAI December 2015 : 1.31 (1.23 – 1.40)
An application for 2015-2016 winter

- NAI & HAI : WAI (wintering abundance index)

WAI January 1st 2016 : 1.42 (1.34 – 1.50)

Results

Predicted WAI January 1st 2016

p. 10/12
An application for 2015-2016 winter

- NAI & HAI : WAI (wintering abundance index)

WAI February 1st 2016 : 1.44 (1.36 – 1.52)
An application for 2015-2016 winter

- NAI & HAI : WAI (wintering abundance index)

WAI March 1st 2016 : 1.40 (1.32 – 1.49)
Limitations

- Covariates only explain few percents of the variation in the indexes
  - Investigating the effect of others covariates
    e.g. the number of days with T° < 0°C over the last 15 days
  - Collecting more information about the indexes
    e.g. the number of hunters and dogs used for HAI
    e.g. the observer detection for NAI
Next steps

- Validate the approach for others hunting seasons
  - 2010-2011: normal winter
  - 2011-2012: harsh coldspell: February 2012
  - 2016-2017: small coldspell: January 2017

- Long term changes
  - Estimate winter abundance since 10 years (2008-2017)
  - Draw distribution maps for each year
  - Show changes on woodcock wintering distribution
  - Investigate the causes of these changes
Thank you!

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