1. MOTIVATION

In the UK, many wildlife species are currently in decline. An example is the Starling, *Sturnus vulgaris*, a species on the UK Red List – of highest conservation priority (Figure 1).

Such declines can be explained by changes in vital rates, such as annual survival probability and productivity (breeding success).

Integrated Population Models (IPMs) combine different types of data into one analysis and provide the only reliable means for estimating these vital rates for a species across a population.\(^2\)

Our aim is to provide a mechanistic explanation of the observed population declines at finer geographical scales than is currently possible.

2. DATA

Data provided by the British Trust for Ornithology:
- Ring-recovery data: information on survival,
- Census data: information on abundance.

By combining these data in a spatially-explicit IPM we can:
- estimate productivity rates (impossible otherwise),
- can better manage sparse spatial data,
- obtain more accurate results.

3. MODEL

**Spatially-explicit Integrated Population Model**

\[ \phi_{1,s}, \text{Spatially-explicit first-year survival probability} \]

\[ \phi_{a,s}, \text{Spatially-explicit adult survival probability} \]

\[ \lambda, \text{Probability a dead ringed bird is reported} \]

\[ \rho, \text{Productivity rate} \]

\[ Y_t, \text{Number of birds observed at time } t \text{ and location } s \]

\[ N_t, \text{Number of birds in the population at time } t \text{ and location } s \]

**NOVEL APPROACH**

- Fast
- Flexible
- No productivity estimates
- Fast
- Gaussian approx.
- Requires large counts
- Flexible
- Small counts
- Large counts
- Can be slow

4. RESULTS

- Adult survival for starlings is strongly affected by latitude.
- First-year birds have a lower probability of survival.
- First-year and adult survival is much lower in the centre of Great Britain, where there are more urban areas.

5. IMPACT & FUTURE WORK

- Makes possible finer analyses within a country.
- Other geographical and meteorological data can be easily incorporated into our model.
- Applicable to many species of birds and other animals.
- Developing open access computer software.

Our models can help experts to better identify areas where species have low survival in Great Britain, Europe, and North America, where such data exist. Prioritizing interventions in these areas, such as habitat protection or restoration, will allow a more efficient allocation of governmental and NGO resources and the improvement of species conservation and biodiversity management.

References: