

Farmland Biodiversity Monitoring Using Bird Song



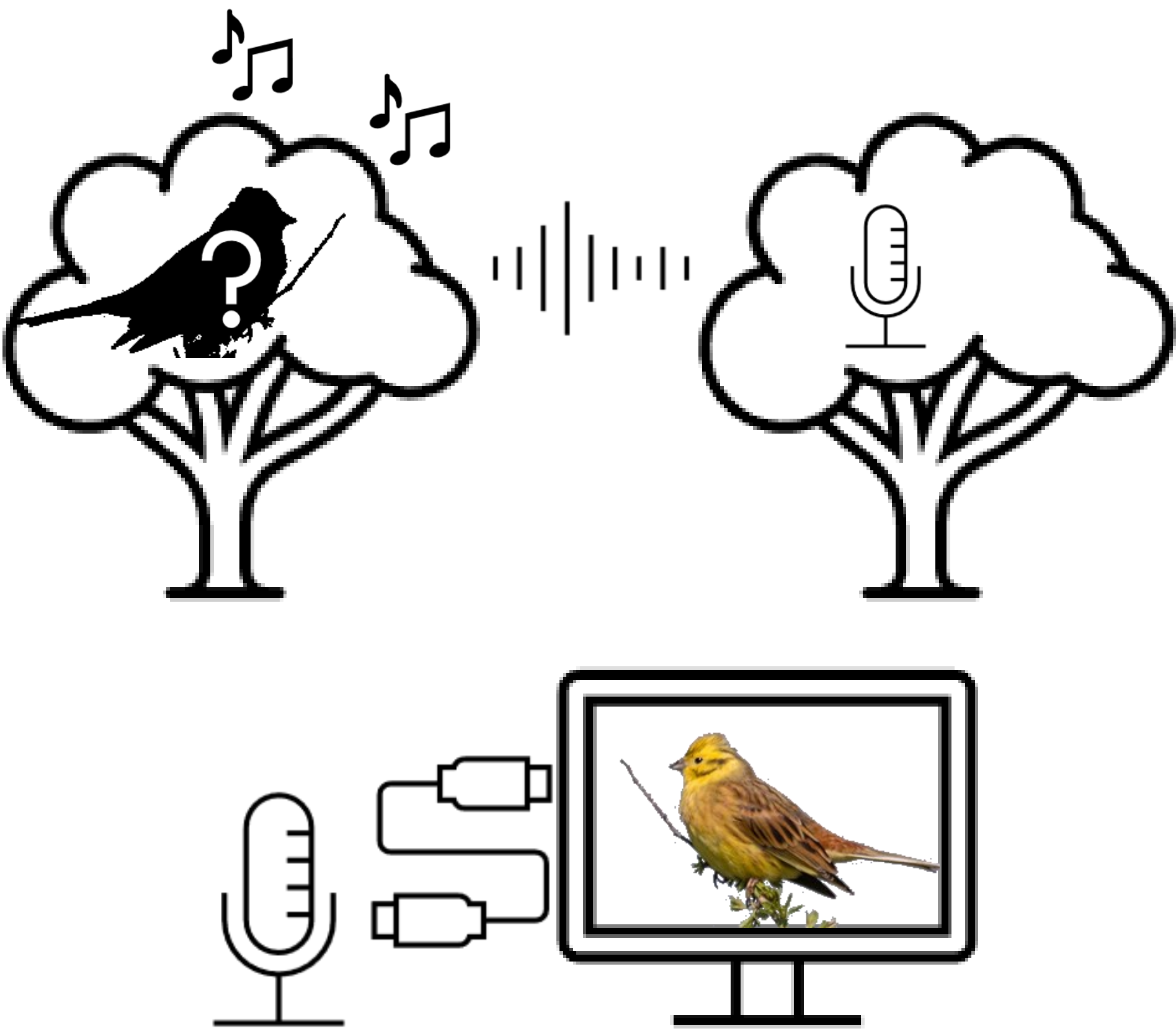
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Introduction

- DEFRA set out a fund that farmers could apply for if they were following the suggested biodiversity measures and could quantify their success
- Birds are a key indicator group and can be surveyed with ease to prove biodiversity increase (Benchaiiba et al., 2025)
- Surveying birds by their song allows for remote and auto-nomic surveying, allowing samples to be collected more easily at dawn and dusk, when birds are most vocal, and without needing any training (Hoefer et al., 2025)
- However existing tools such as merlin bird ID and bird net are unreliable, based on citizen science with large portions of data that is incorrectly labelled and a disproportionate sampling size across different countries leading to many false Ids, particularly in regards to falsely suggesting American birds in lesser sampled countries.

Aims

- To develop a tool for easy bird surveying for farmers to use in order to quantify the success of their biodiversity measures
- To identify 10 species which indicate a successfully bio-diverse farmland (Listed in Figure 1.)
- To collate a database of bird song samples for each of these species, supplemented with field recordings to provide more realistic samples
- Using this data to then train an AI to identify these birds from sound files, with the data split into training and testing in order to provide an accurate and reliable model



Methods

- 250 individual songs for each of species listed in Figure. 1 were isolated in 5 second segments using recordings from Xeno Canto
- These song databases were supplemented by field recordings, taken using Audio Moths set to record for an hour at dawn and dusk for 2 weeks over June/July
- These 2500 samples were split in an 80:20, training:testing ratio in Edge Impulse
- Using Edge Impulse this data was used to train an AI model which can be used to recognise if any of the species are present in provided .wav (sound) files

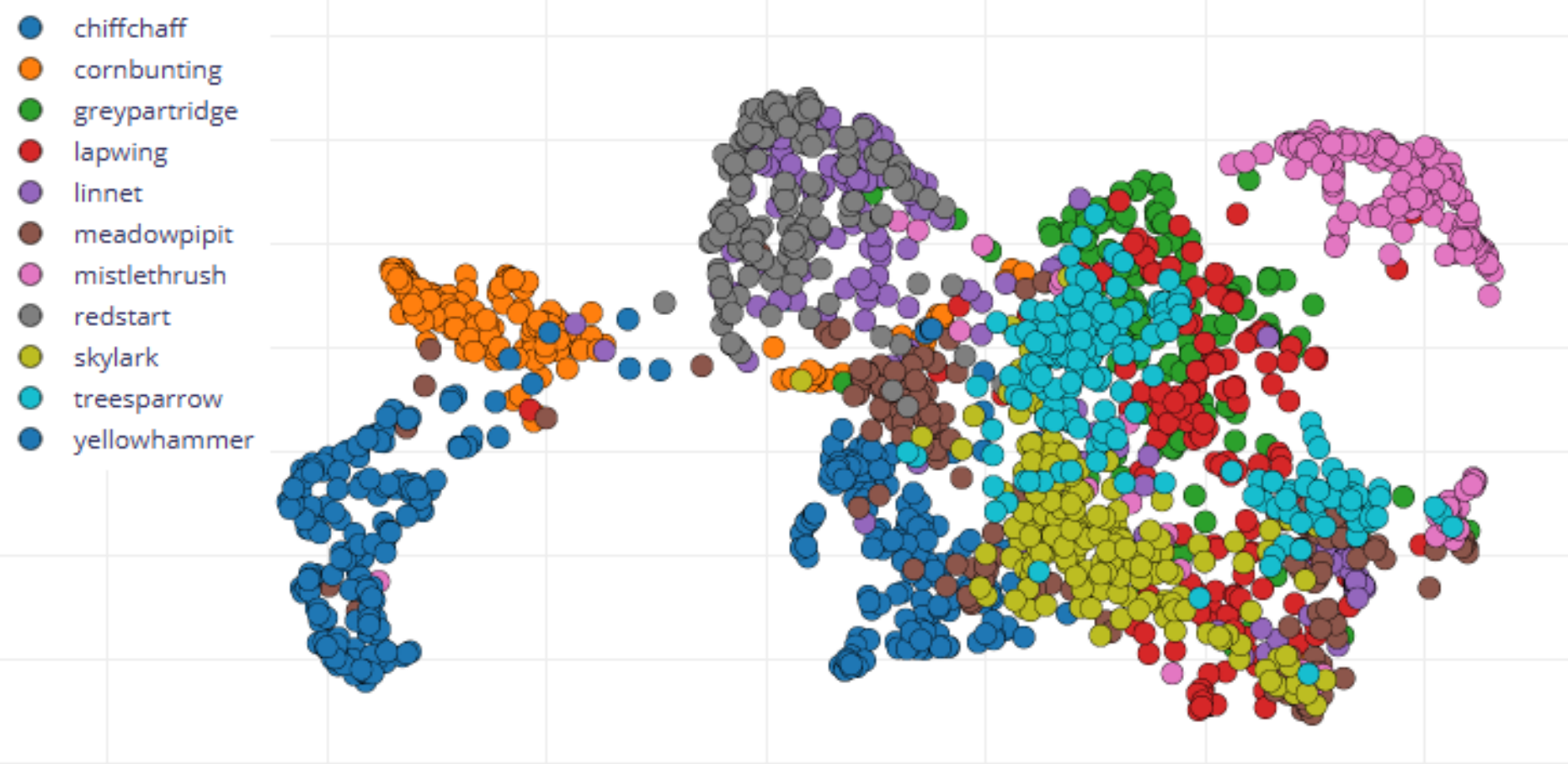


Fig.1 UMAP display of spectrograms derived from bird calls

	CHIFFC	CORNB	GREYPA	LAPWIN	LINNET	MEADO	MISTLE	REDSTA	SKYLAR	TREESP	YELLOW	UNCERT
CHIFFCHAFF	94.3%	0%	0%	0%	0%	0%	0%	0%	0%	1.9%	0%	3.8%
CORNBUNTING	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
GREYPARTRIDGE	0%	0%	98.0%	0%	0%	0%	0%	0%	0%	0%	0%	2.0%
LAPWING	0%	0%	0%	90.2%	0%	0%	0%	0%	0%	2.0%	0%	7.8%
LINNET	0%	0%	0%	0%	88.5%	0%	0%	5.8%	0%	0%	0%	5.8%
MEADOWPIBIT	0%	0%	0%	0%	0%	91.5%	0%	0%	2.1%	0%	0%	6.4%
MISTLETHRUSH	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%
REDSTART	0%	0%	1.7%	0%	1.7%	0%	0%	91.5%	0%	0%	0%	5.1%
SKYLARK	0%	0%	0%	0%	0%	1.9%	0%	0%	92.3%	0%	0%	5.8%
TREESPARROW	0%	0%	0%	2.0%	4.1%	0%	0%	0%	0%	85.7%	0%	8.2%
YELLOWHAMMER	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%
F1 SCORE	0.97	1.00	0.98	0.94	0.91	0.95	1.00	0.93	0.95	0.90	1.00	

Fig. 2. Confusion matrix of observed (rows) and columns (predictions) from test dataset

Conclusions

- This research resulted in the training of an AI model that detects the species listed from sound files within 93.82% accuracy.
- The field sampling method developed to record samples using audio moths creates a simple method that untrained land owners can use to collect samples.
- The methods and work flow developed for the collation of 5 second segments from Xeno Canto files allows for more samples to be easily added by any future researchers furthering the development and reliability of the model.
- Surveying biodiversity through the use of bird songs and vocalisation is an incredibly useful tool which takes expertise and time to develop but subsequently allows for easy, automatic and remote surveying, whilst still providing reliable and useful insights into the species present in an area
- To create a reliable AI for all uses of bird surveying is an impractical and inefficient aim, however development of AI tools to identify an isolated group of species which are interesting to survey for a particular project is very viable.

References:

Benchaiiba, L., Elafri, A. & Telailia, S. (2025) 'Birds as indicators of landscape changes: a lesson from southern Mediterranean semi-arid streams', *Landscape and Ecological Engineering*,
Hoefer, S., Allen-Ankins, S., McKnight, D.T., Nordberg, E.J. & Schwarzkopf, L. (2025) 'Sensors versus surveyors: Comparing passive acoustic monitoring, camera trapping and observer-based monitoring for terrestrial mammals', *Methods in Ecology and Evolution*,