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Ecoacoustic Bird Surveys: Comparison with traditional survey methods

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Carlos Abrahams, James Longley, Oliver Metcalf

Bird surveys for EIA and habitat management

Understanding the populations and distribution of bird species is essential for assessing their conservation status and making informed habitat management decisions. Accurate survey data is therefore vital for environmental impact assessments (EIA) 1 and management planning, enabling mitigation measures and adaptive management practices to be implemented.

There are several methods currently used in the UK to undertake bird surveys. Traditional bird survey (**TBS**) methods involve an experienced ornithologist conducting fieldwork in person, using a combination of aural and visual detections, following predetermined methodologies such as point counts, line transects, and breeding bird surveys, e.g. Bird Survey Guidelines 2.

These methods produce accurate, targeted, data but are often difficult to conduct at night or in remote locations, survey duration is restricted by human capacity, birds can be impacted by surveyor presence, and there is often no verifiable evidence for the species seen or heard in the field.

In recent years, these deficits have been addressed using a range of technological solutions – with ecoacoustic survey techniques leading the way 3. Ecoacoustic bird surveys (**EBS**) involve the use of specialised equipment to record bird sounds (Figure 1). The advantages of this approach are that there is a digital documentary record of all bird detections, disturbance caused by surveyor presence is minimised, and that automated surveys can be conducted over larger areas and for longer periods of time, allowing for more comprehensive data to be collected. Additionally, detection rates aren't impacted by visibility, so they can be as effective at night, and with secretive species.

Scientific studies have demonstrated that automated EBS methods can outperform point count methods 4. However, there have been no studies that compare the results of EBS with transect surveys as normally used for EIA in the UK. Baker Consultants has been using a combination of traditional and ecoacoustic bird surveys on consultancy projects for a number of years, and we have compiled a number of recent case studies below to compare the results from these two approaches.

1 CIEEM 2018: https://cieem.net/resource/guidelines-for-ecological-impact-assessment-ecia/
2 Bird Survey Guidelines: https://birdsurveyguidelines.org/methods/survey-method/
3 Metcalf et al., 2023. https://www.britishecologicalsociety.org/applied-ecology-resources/document/20230136742/
4 Darras et al. 2019. Autonomous sound recording outperforms human observation…. Ecological Applications 29(6):e01954. 10.1002/eap.1954

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Case Studies

We present below nine case-studies where we have used a combination of both traditional bird survey methods and ecoacoustic approaches (Table 1). These are not from a single coordinated study, but have all developed individually out of real-world consultancy projects over the last few years. The methods used in each case study therefore differ widely, depending upon the needs of each development project, but together build up into a collective story that demonstrates the potential value of ecoacoustic survey methods.

The ecoacoustic survey effort varies from quite intensive: nine recorders deployed for two months on a 171 ha site, at Derbyshire 1; to very low: only two recorders for 14 days on a 395 ha site in Neath.

The ecoacoustic surveys either recorded at dusk and dawn or through the full 24 hr diel cycle, and often used a time sampling approach (e.g. recording 1 minute in 5, or 1 minute in 10) to reduce data volumes. Ecoacoustic data was generally processed using BirdNET [5], using a high confidence threshold for classifications, and with a manual check of species classifications undertaken after this automated processing.

Each case study below presents some details on the site context, and the survey effort for traditional and ecoacoustic survey methods. We use the species richness of the detected bird assemblage as the key metric to compare the two survey approaches, as this is a feature commonly used for evaluation within Environmental Impact Assessments.

Figure 1. An automated sound recorder deployed in moorland habitat.

[5] Kahl S, Wood CM, Eibl M, Klinck H. (2021) BirdNET: A deep learning solution for avian diversity monitoring. Eco Inform. 61:101236.

Table 1. Case study sites. Traditional and ecoacoustic bird survey methods and species richness derived from each approach.

Site	Description	TBS	EBS	TBS/EBS spp. no.
Derbyshire 1	Moorland and mixed plantation forestry site. 171 ha.	Three breeding bird surveys in 2022.	Nine recorders deployed from 20 May to 15 July 2022 - a period of 56 days. Recording for one minute in every five, at dawn and dusk.	34/57
Derbyshire 2	A small urban greenspace consisting of rank grassland, scrub and trees surrounded on all sides by housing. 2ha	Two transect surveys, in April and May 2022.	A single recorder deployed between 11 April and 10 July 2022 for a total of 44 days, with the recorder at three different locations during this period. Recording 1 minute in 10 through the 24 hr cycle.	18/20
Hertfordshire	A former golf course with modified grassland, a small river, scattered pockets of woodland and veteran trees. 40 ha	Three breeding bird surveys between April and July, in 2018, 2020 and 2022.	Two recorders deployed for 64 days between 7 April and 12 July in 2022, with their location moved each month to provide representative coverage the habitats present onsite. Recordings were made through the 24 hr cycle.	48/53
Neath	Upland post-industrial extraction site, undergoing habitat restoration. 395 ha.	Five breeding bird surveys between 1 April and 8 July 2021.	Two recorders deployed for 14 days between 30 April and 14 May 2021. Recordings were made through the 24 hr cycle.	51/44
Norfolk	A coastal caravan site extension, with amenity managed grassland and some areas of scrub and plantation woodland. 20 ha.	Six breeding bird surveys between 29 March and 21 June 2022.	A single recorder deployed for 81 days between Mid-April and Mid-July 2022, with the location moved each month. Recordings took place at dawn and dusk.	38/72
Oxfordshire	A small-scale housing project, consisting of two small arable fields with native hedgerows and woodland on the boundary. 6 ha.	Three breeding bird surveys between 30 April and 17 June 2015.	Two recorders deployed for 67 days between 31 March and 5 July in 2022. Recordings were made through the 24 hr cycle.	34/54
Warwickshire	Two arable fields with native hedgerows and a young linear section of plantation woodland bounding the site. 28 ha.	Four breeding bird surveys between 25 March and 8 June 2022.	A single recorder at a single central location, for 97 days between March and July 2022. Recording 1 minute in 10 through the 24 hr cycle.	26/37
West Yorkshire 1	South Pennines moorland habitat, 562 ha with areas intended for woodland creation. 562 ha	Six breeding bird surveys between 4 April and 7 July 2022.	Two recorders deployed twice, between 26 April to 11 May and 23 June to 7 July, for a total of 31 days. Recording 1 minute in 5 at dawn and dusk.	59/48
West Yorkshire 2	South Pennines moorland habitat, with areas intended for woodland creation. 222 ha	Six breeding bird surveys between 4 April and 20 July 2022.	Two recorders deployed twice, between 4-25 April and 12 May to 13 June, for a total of 55 days. Recording 1 minute in 5 at dawn and dusk.	56/55

Comparing standard bird survey methods with ecoacoustic bird surveys

In two-thirds of the case studies, ecoacoustic surveys recorded more species than traditional methods (Figure 1A). In two cases, Oxfordshire and Warwickshire, EBS recorded 50-59% more species than traditional surveys. However, TBS always recorded at least one species, and a mean of 9.33 species, that were not recorded using EBS (Figure 1B), although again in most cases EBS recorded far more unique species than TBS, and in all cases the majority of recorded species were detected by both methods.

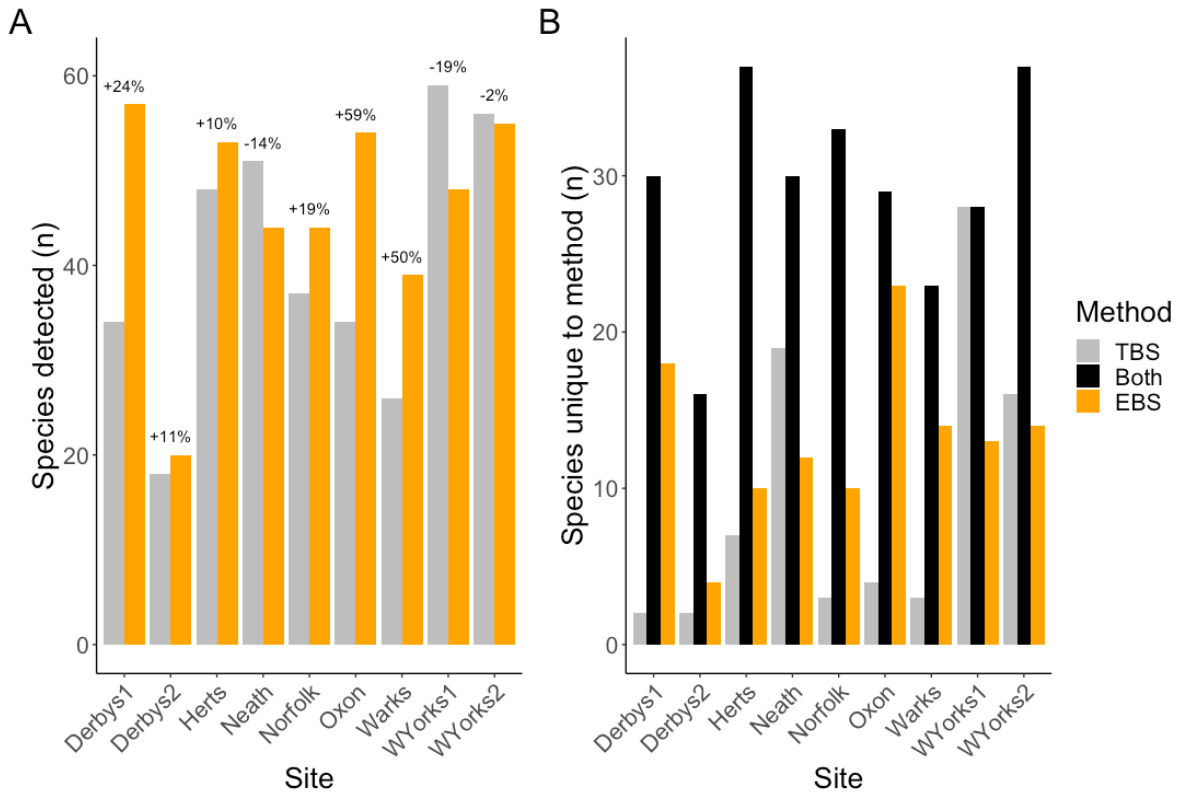


Figure 2. A comparison of bird species detected using traditional bird survey methods (TBS) and ecoacoustic bird survey methods (EBS).

Critically, some of the species detected only by EBS were rare and/or of high conservation concern, i.e. UK Birds of Conservation Concern [6] red or amber listed, or on Schedule 1 of the Wildlife and Countryside Act 1981 [7] (Table 2). It is worth noting that some of these species are either diminutive (e.g. Firecrest, Lesser Spotted Woodpecker) or highly secretive (e.g. Hawfinch), the results therefore demonstrating a real benefit of using automated recorders.

6 Stanbury et al., 2021 https://britishbirds.co.uk/sites/default/files/BB_Dec21-BoCC5-IUCN2.pdf
7 https://www.rspb.org.uk/birds-and-wildlife/advice/wildlife-and-the-law/wildlife-and-countryside-act/schedules/

Table 1. Priority bird species only detected by ecoacoustic bird surveys

Site	Species detected only by ecoacoustic bird surveys Red/amber=status in *Birds of Conservation Concern 5*, black=Schedule 1 of the Wildlife and Countryside Act 1981
Derbyshire 1	Barn Owl, Grey Wagtail, Hawfinch, Lapwing, Lesser Redpoll, Linnet, Mallard, Mistle Thrush, Oystercatcher, Stock Dove, Teal, Whitethroat
Derbyshire 2	None
Herts	Firecrest, Hawfinch, House Sparrow, Lesser Spotted Woodpecker, Meadow Pipit, Mistle Thrush, Redwing, Tree Pipit,
Neath	Barn Owl, Great Black-backed Gull, Lapwing, Lesser Redpoll, Oystercatcher, Snipe, Teal
Norfolk	Black-headed Gull, Common Sandpiper, Curlew, House Martin, House Sparrow, Meadow Pipit, Oystercatcher
Oxon	Bullfinch, Herring Gull, Kestrel, Meadow Pipit, Mistle Thrush, Moorhen, Reed Bunting, Spotted Flycatcher
Warks	Greenfinch, Herring Gull, Linnet, Swift
West Yorkshire 1	Barn Owl, Great Black-backed Gull, Grey Wagtail, Moorhen, Teal, Tree Pipit
West Yorkshire 2	Common Sandpiper, Greenfinch, Grey Wagtail, Lapwing, Moorhen, Redwing, Starling, Stock Dove, Tree Pipit, Whitethroat

In the three case studies that TBS recorded more species than EBS surveys, EBS survey effort was particularly low (Figure 3). We calculated EBS survey effort as the number of recorder days (number of recorders x number of days each was recording) divided by recorder density (site area divided by the number of recorders deployed).

In all cases that recorder survey effort was above 1, EBS recorded more species than TBS – indicating that it is important to ensure sufficient recorder coverage to maximise EBS benefits. However, it is important to note that we did not control for variation in traditional bird survey effort, although it seems unlikely that the overall pattern would greatly change from this parameter.

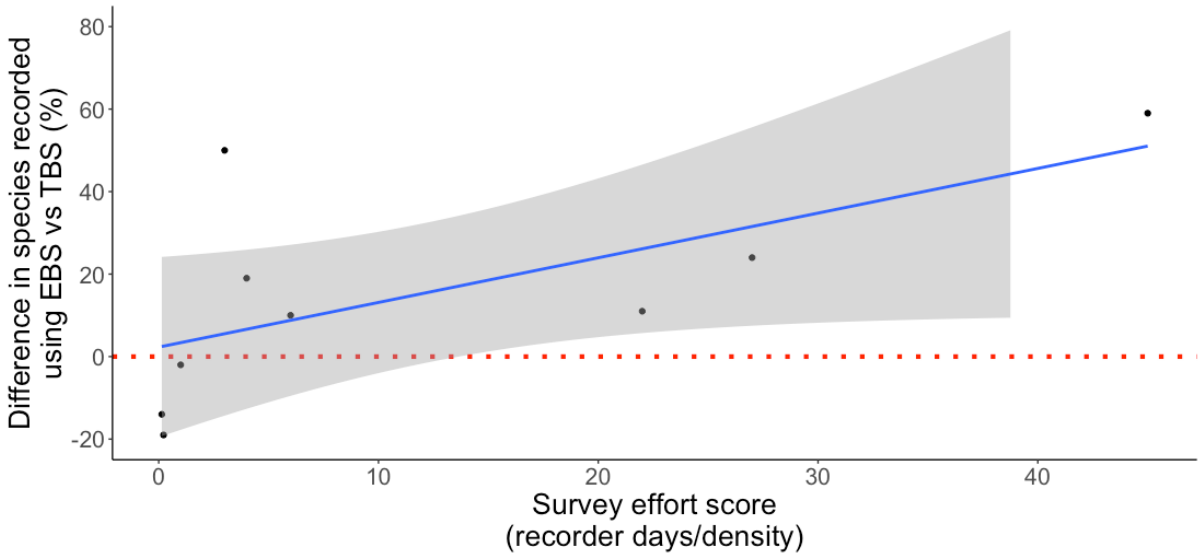
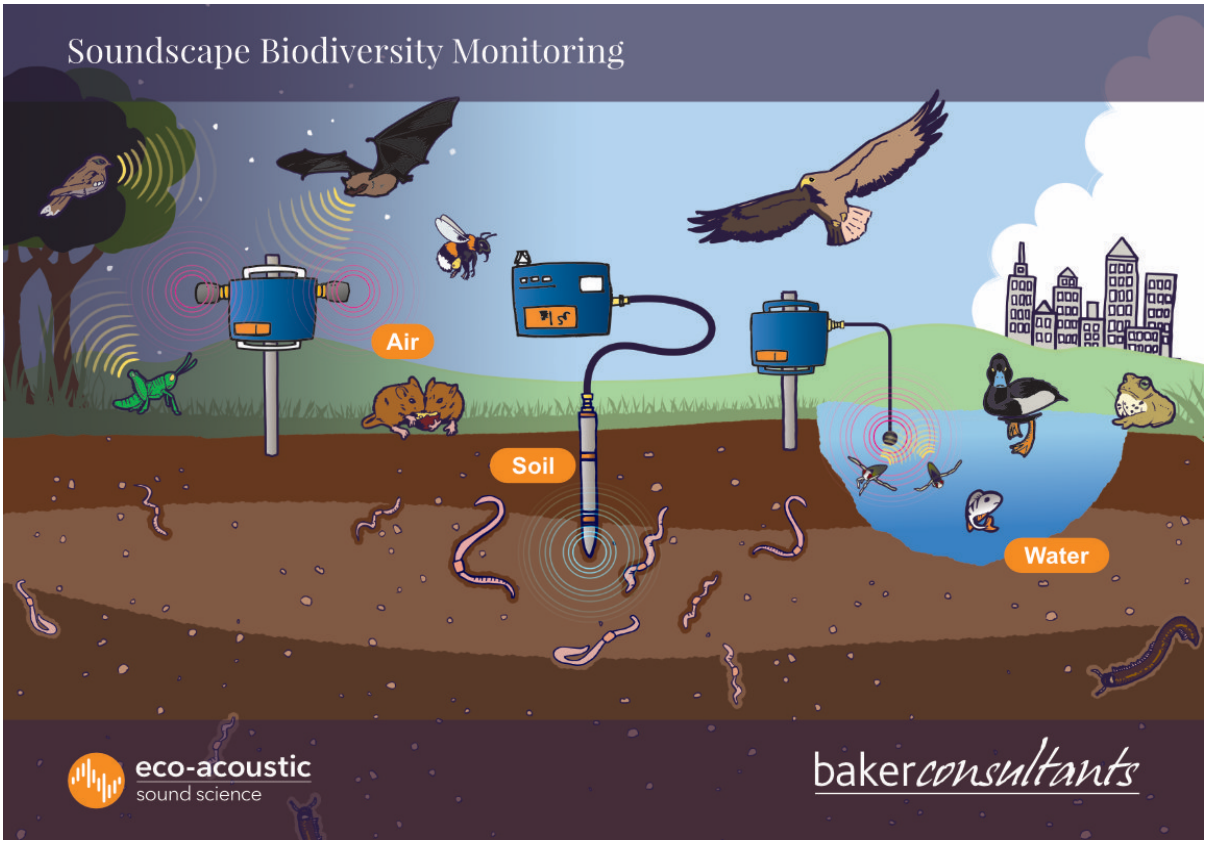


Figure 3. Ecoacoustic survey methods detect more species than traditional survey methods as EBS survey effort increases

Conclusions

Ecoacoustic surveys provide a highly valuable bird survey approach that can expand the spatial and temporal coverage of data collection, increasing the detection of bird species – especially of rare, cryptic or nocturnal taxa that may be difficult to capture by surveyors in the field. They are therefore highly complementary to traditional bird surveys, which are better suited to detecting bird behaviour, movements through a site, and non-vocalizing individuals. Ecoacoustic surveys should not be used as *ad hoc* additions to traditional surveys where convenient – our case studies show they are their most effective when survey effort is appropriately robust. The additional effort to deploy automated recorders is minimal, and data processing tools have rapidly developed in recent years, allowing sound recordings to be efficiently converted to species registrations.

To ensure the reliability, consistency, and comparability of ecoacoustic surveys, it is important to adhere to published guidance wherever possible. Broad-ranging guidance is provided within the UKAN+ Good practice guidelines for long-term ecoacoustic monitoring in the UK [8]. In addition, the Bird Survey Guidelines have recently been updated to incorporate advice on how ecoacoustic bird surveys can be used within a professional consultancy context [9]. We recommend that the two survey approaches, traditional and ecoacoustic, should be used alongside each other within professional practice to provide a more comprehensive and robust assessment of sites for EIA or habitat management.



[8] Metcalf et al., 2023. https://www.britishecologicalsociety.org/applied-ecology-resources/document/20230136742/
[9] https://birdsurveyguidelines.org/acoustic-survey-methods/