

Institution: University of Leeds		
Unit of Assessment: UOA5 Biological Sciences		
Title of case study: Development and implementation of guidance to protect wildlife during major transport infrastructure projects.		
Period when the underpinning research was undertaken: 2008 - 2015		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Professor John Altringham	Lecturer, Senior Lecturer, Reader Professor Emeritus Prof	01.10.1989 – 31.07.1998 01.08.1998 to 31.07.2016 01.08.2016 to present
Dr Anna Berthinussen	Research Fellow Visiting research fellow	01.01.2010 – 08.02.2017 09.02.2017 - present
Period when the claimed impact occurred: 01/08/2013 - 31/12/2020		
Is this case study continued from a case study submitted in 2014? N		
1. Summary of the impact (indicative maximum 100 words) European law protects all bat species, and infrastructural development must not have a negative effect on bat populations. Altringham and Berthinussen conducted research to develop effective monitoring and mitigation strategies to enable roads and railways to be built without significantly affecting the ability of bats to move freely and safely through landscapes severed by new infrastructure. This research informed guidance developed for Defra. The guidance has been widely disseminated and the mitigation recommendations have been incorporated into official guidance in the UK, New Zealand and the EU. These guidelines have been used in six road schemes and two rail schemes that have been constructed/are being constructed in the UK and incorporated into proposals for four other road and two other rail schemes (including HS2) in the UK, plus additional schemes in Austria and Croatia.		
2. Underpinning research (indicative maximum 500 words) Altringham and Berthinussen (R1) demonstrated for the first time that major roads significantly reduce bat numbers, foraging activity and diversity. The negative impact of a major road was shown to stretch a considerable distance beyond the actual road, with bat activity three times lower at the roadside than 1.6 km away. Mitigation prior to this work should in principle have made roads more permeable and safe for bats to cross, and improved adjacent habitat. However, existing mitigation measures were shown to be ineffective or of unknown effectiveness, indicating the need for evidence-based designs for mitigation and monitoring of effectiveness. The effectiveness of two commonly used mitigation measures for bats was assessed by Altringham and Berthinussen (R2). Three underpasses and four bat gantries were investigated in northern England. They found that underpasses could be an effective means of mitigation if located on pre-construction commuting routes, but were ineffective if placed in a location away from the bats' established commuting routes. They found that bat gantries (elevated wire 'guides') were ineffective. Most bats near gantries crossed roads along severed, pre-construction commuting routes at heights that put them in the path of vehicles. They recommended that green bridges (wide and planted with trees and shrubs) should be explored as an alternative form of mitigation. The research clearly demonstrated that robust monitoring is essential to assess objectively the case for mitigation and to ensure effective mitigation. They have also developed multiscale habitat suitability models (HSMs) for bats in the Lake District, (R3). Acoustic surveys were used to gather presence data for eight bat species from 30 sites, and to develop and assess a number of multiscale models. The best models were used to predict habitat suitability across the landscape and provide insights into the potential impacts of land-use and environmental change. HSMs identify areas of conservation concern that may be affected by new transport infrastructure, and are thus useful for ecological impact assessment (EIAs) of proposed developments. Defra contract, research, report and guidance: Following their research (R1 , R2) JA and AB were commissioned by the Department for the Environment, Food & Rural Affairs (Defra) in 2013 to conduct further research, to develop standardised and cost-effective methods for assessing the effects of linear transport infrastructure on bats, and to test the effectiveness of mitigation, such as crossing structures (R4). They developed and tested these methods (2013-2014) while also		

assessing the effects of multiple road and rail schemes in the UK on bats, and the effectiveness of some currently used mitigation measures. The research enabled methods to be developed which are quantitative, robust, replicable, and produce data suitable for statistical analysis – all of which were absent from existing common practice prior to 2013. Importantly, these methods also allow for comparisons to be made before, during and after construction. The research carried out through this contract, together with the previous research (**R1-3**), enabled JA and AB to develop research-informed guidelines for road and rail developers, which have been widely used (see section 4).

3. References to the research (indicative maximum of six references)

1. Berthinussen, A. & Altringham, J. (2012a) The effect of a major road on bat activity and diversity. *Journal of Applied Ecology* **49**: 82-89. DOI: <https://doi.org/10.1111/j.1365-2664.2011.02068.x> [WOS 77 (06/01/2021)]
2. Berthinussen, A. & Altringham, J. (2012b) Do bat gantries and underpasses help bats cross roads safely? *PLoS ONE*, **7**, e38775. DOI: <https://doi.org/10.1371/journal.pone.0038775> [WOS 29 (06/01/2021)]
3. Bellamy C; Scott C; Altringham J. (2013) Multiscale, presence-only habitat suitability models: fine-resolution maps for eight bat species. *Journal of Applied Ecology* **50**: 892-901 DOI: <https://doi.org/10.1111/1365-2664.12117> [WOS 67 (06/01/2021)]
4. Defra final report - Berthinussen, A. & Altringham J. (2015) WC1060: Development of a cost-effective method for monitoring the effectiveness of mitigation for bats crossing linear transport infrastructure. <http://sciencesearch.Defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=18518>

Grants:

1. Mapping migration patterns of bats using stable isotopes and genetics. Investigators: John Altringham (PI). Funder: Leverhulme Trust. Awarded Value (100%): GBP111,628 Start date: 04/02/2008, and following grant Awarded Value (100%): GBP335,675 Start date: 04/02/2009
2. Developing an effective method for the systematic surveillance of bats in woodland habitats in the UK. Investigators: John Altringham (PI). Funder: Defra Awarded Value (100%): GBP263,188 Start date: 01/12/2011
3. Bat Conservation Intervention Systems. Investigators: John Altringham (PI). Funder: Natural England. Awarded Value (100%): GBP24,814 Start date: 04/12/2012
4. Monitoring mitigation for bats on road and rail developments. Investigators: John Altringham (PI). Funder: Defra. Awarded Value (100%): GBP127,945 Start date: 06/05/2013.

4. Details of the impact (indicative maximum 750 words)

Introduction/context – what is the problem that needs solving? Improvement of transport infrastructure through the building of roads and railways is a priority of many countries, to support economic development. However, such structures frequently have deleterious effects on wildlife, including bats, which have to cross them when moving through their habitat. UK and European law protects all species of bats, which means that all construction work must not have a negative effect on bat populations. Builders/road developers must provide effective mitigation to enable bats to move freely and safely through the altered landscapes. Bats make up ~30% of UK/European terrestrial mammal species and are amongst the most threatened. There was a need for robust evidence to assess the effectiveness of mitigation approaches in use before 2012 (**R1, R2**), which included overhead gantries and underpasses. An understanding of the potential impacts of land-use and environmental change on habitat suitability for bats (**R3**) was also required, together with clear guidelines for the developers of road and rail schemes, to enable them to construct and test effective mitigation structures and fulfil their legal obligations (**R4**).

Defra contract - research into guidance: Clear survey and data analysis protocols were created for use by conservation practitioners and the consultancy industry and recommendations were made for best practice mitigation solutions for future linear transport infrastructure schemes. Importantly, the guidelines also allow for comparisons to be made before, during and after construction. The final report to Defra containing the research and the guidelines (**R4**) has been disseminated at numerous national and international conferences. The recommendations made in the Defra report were disseminated through three workshops (September 2016 – September 2017) commissioned by the professional body CIEEM (Chartered Institute for Ecology and Environmental Management). The course provided an overview of the research (**R1-4**) and detailed instructions for following the methods and recommendations. Attendees (61) included

ecologists (graduate level through to company directors) from independent consultancies as well as County Councils, Network Rail and Wildlife Trusts.

Incorporation of guidelines into linear infrastructure proposals:

In the UK, the UK Guidance note for UK Statutory Nature Conservation agencies (published on Natural Resources Wales website – **[Source A]**) is based on the Defra report. This Guidance note and the Defra report have been used (to date) to inform and/or change fourteen plans and proposals for road and rail schemes throughout the UK, eight of which have been/are being constructed. The guidelines have also been used in a number of other countries, being incorporated into recommendations, and also have been used to inform the development of several overseas linear infrastructure proposals.

1. For road developments, the Defra guidance has been used to inform proposals for **six schemes which have been/are being constructed [Source B]:**

a. M20 Junction 10a, Kent, UK. In July 2016, Highways England referred to the Defra research in their Protected Species Report on bats for the M20 Junction 10a road scheme in Kent using this to inform the proposed mitigation, which consisted of underpasses with tree planting on either side. Page 46: *“Recent studies (Berthinussen & Altringham 2015) have found no evidence to support the effective use of wire gantry structures (built for the purposes of providing an echolocation guide for bats over roads) in maintaining commuter routes. Overbridges were also found to not be utilised. Therefore more naturalised structures are recommended as these are more likely to be effective.”* The application was granted development consent by the Secretary of State for Transport in Dec 2017; work commenced in January 2018, and was completed in early 2020.

b. Arborfield Cross Relief Road, Wokingham, England: in the Environmental Statement for this scheme (2017), Wokingham Borough Council asked for the Defra guidelines to be referenced during consultation. The scheme is a new 2.3 km bypass that has the potential to have impacts on at least nine bat species. Page 4: *“the ecological submission should include discussion regarding the selection of bat survey methods with reference to guidelines for bat survey to inform linear infrastructure projects published in 2015 (Berthinussen & Altringham 2015).”* This scheme is now completed, with a green bridge crossing for wildlife, and opened 17th November 2020.

c. A30 Chiverton to Carland Cross, Cornwall, England. Highways England refer to the Defra report in both the Environmental Impact Assessment Scoping Report (2017) and Preliminary Environmental Information Report (2018) for this road. The A30 Chiverton to Carland Cross involves the construction of 12.7km of new dual carriageway and will affect multiple bat species (including several rare species, such as barbastelle, and lesser and greater horseshoe bats). A Development Consent Order (DCO) was granted on 6 February 2020 which allows the design as submitted to the planning inspectorate to be built. A contract for the work was awarded to Costain (31 March 2020), and preliminary works for the scheme have begun.

d. A120 Little Hadham Bypass, Hertfordshire, UK. The Herts and Middlesex Wildlife Trust (HMWT) referred to the Defra research in their Consultation Response to the A120 Little Hadham bypass in Hertfordshire on the 9th of December 2015. This is a 3.9km single carriageway bypass, which will disturb an important colony of barbastelle bats. Page 4: *“Guidance on appropriate survey, assessing impacts and appropriate mitigation for road schemes is provided the DEFRA research report WC1060. The ecological report submitted in support of this proposal should utilise this research to demonstrate that the scheme will not result in unacceptable levels of disturbance that would negatively impact this Annex II species.”* The objections raised by HMWT resulted in mitigation design changes and additional survey work being carried out prior to the planning application, submitted in October 2016. Construction started in July 2019 and is currently scheduled for completion in late summer 2021.

e. The Environmental Statement for the **A496 Llanbedr Access Improvement, Gwynedd, Wales** uses the Defra report to inform the mitigation plans for habitat connectivity, which affects eight bat species. This scheme was approved on 4th March 2020, including mitigation plans for bats.

f. Preston Western Distributor and East West Link Road, Lancashire, UK. Jacobs UK Ltd. referred to the Defra research in their Bat outline mitigation strategy prepared for Lancashire County Council in April 2016 as part of the Preston Western Distributor (PWD) and East West Link Road (EWLR) Environmental Impact Assessment (EIA). The Defra research was used to inform the proposed mitigation, which included underpasses and an environmental overbridge. Page 6:

“The latest academic research was...considered and includes.... “Berthinussen and Altringham (2015); and Natural England (2015).” This scheme is now under construction.

2. Use of Defra guidance in road proposal developments: there are four schemes [Source C] that utilise the Defra guidance: A9/A96 upgrades, Scotland; M4 relief road, Gwent levels, Wales; Ashton park urban extension/relief road, Wiltshire; and A30 Honiton-Devonshire Inn, Devon.

3: Four rail scheme proposals use the DEFRA guidelines in the Impact Assessments and Environmental Statements [Source D]:

a. High Speed rail 2 (HS2, Phase 1), Bernwood Forest: JA and AB have provided ongoing advice to Berks, Bucks and Oxon Wildlife Trust (BBOWT) since 2014 about the potential impact of HS2 Phase 1 on rare Bechstein’s bats in the Bernwood Forest area of Buckinghamshire. The likely effectiveness of proposed mitigation has been assessed through reviewing and reporting on numerous Environmental Statements and appearing (JA) as an expert witness in front of a parliamentary select committee in November 2015. From BBOWT website: *“As a direct result of our campaigning with The Wildlife Trusts nationally, and with the help of experts Prof John Altringham and Dr Anna Berthinussen from the University of Leeds, we secured:*

- *“....A commitment for Green Bridges to be built where the line passes through the Bernwood Forest area. These will have 30m wide ‘green’ planting of grass and trees. The HS2 route through Bernwood Forest bisects a colony of Bechstein’s bats, one of the UK’s rarest mammals. BBOWT also secured extensive mitigation proposals for woodland creation in Bernwood Forest.*
- *Changes to the Bill to ensure that bats can use the planned underpasses....”*

Natural England also requested that monitoring plans for HS2 were informed by the Defra research. In April 2020 the government announced that Phase 1 of HS2 could proceed.

b. High Speed rail 2 (Phase 2a), West Midlands to Crewe, England: In the Technical Appendices of the Environmental Statement prepared for Phase 2a of High Speed rail 2 (HS2) in July 2017, the Defra report is referenced and used to inform survey methodologies. Phase 2a is the second stage of the HS2 line running between London and the north of England, *“Proposed survey methodologies are largely based on the Bat Workers Manual, Bat Mitigation Guidelines and Bat Surveys: Good Practice Guidelines 3rd Edition. Reference has also been made to the survey methods recommended within Design Manual for Roads and Bridges Volume 1050, and the Defra research report WC1060”.*

c. The East West Rail Phase 2, southern England. The Ecology Technical Appendix on Field Survey Standards (part of the EIA) for this scheme, published in April 2017, referenced the Defra report and based their proposals for surveys on the Defra methods. This is a significant scheme involving the introduction of direct rail passenger services between Oxford, Milton Keynes and Bedford, and between London and Milton Keynes, *“Proposed survey methodologies are largely based on best practice methodology contained within the following resources: Berthinussen A & Altringham J (2015) ...”* Phase two of this section (Bicester to Bedford) was approved by the Secretary of State for Transport on 4 February 2020 allowing main construction work to start.

d. South Wales Metro: In the Strategic Habitat Regulations Assessment screening report for the South Wales Metro (August 2017), the Defra report is referenced several times and its findings are used to assess the potential impact of this rail scheme on bats. This is a significant scheme involving the construction of a new ‘Metro’ network (including rail and bus routes) across ten local authorities which form the Cardiff Capital Region, *“A report by Berthinussen, A. and Altringham, J. (2015) reported that railways have a comparable impact on bats to roads,, we can use the same principals of the impacts of bats on roads to assess the impact of the plan”.* This scheme has been approved, construction work began on 3rd August 2020.

Incorporation of guidance into UK conservation organisation guidelines: In the Bat Conservation Trust’s (BCT) third and newest edition of ‘Good Practice Guidelines’ Bat Surveys for Professional Ecologists (2016, [Source E]), the reader is referred to the Defra research for guidance on monitoring road and rail schemes, *“Berthinussen and Altringham (2015) provide information on pre- and post-construction surveys of linear infrastructure schemes, designed specifically to assess the effectiveness of mitigation for bats crossing them.”*

Impact of this work beyond the UK: The **European** guidance document “Roads and Wildlife Manual” which makes use of the DEFRA report was published in May 2018 for the Conference of

European Directors of Roads [Source F]. Prior to this JA and AB were involved in the production of EU guidance documents on bats and linear transport infrastructure for CEDR as part of a transnational research programme, attending a workshop in Denmark in February 2016 to discuss and share knowledge on the current situation on bats, roads and mitigation. Twenty-two delegates from 10 different European countries attended the workshop.

Guidelines from Defra report have been referred to in documentation for **EU road schemes in Croatia and Austria (2015-2017) [Source G]**. In December 2016, the Republic of Croatia Ministry of Environmental Protection (MZOE) referred to the Defra research and guidelines in a response to a request to build a 12.2 km road development, from Saborsko – Rakovica, by Croatian Roads. The proposals were considered to have significant adverse impacts on barbastelle and lesser horseshoe bats. Page 4 (translated from Croatian): *“For research, possible mitigation measures and a monitoring program for target bats, we recommend using a methodological approach to best practice examples such as: Berthinussen and Altringham (2015).”* In May 2017, the Defra research was cited in a review of an EIA (Environmental Impact Assessment) for the L5181 Spange Wörth (Austria) road development by LANIUS, which raises objections about the survey work carried out and the lack of appropriate mitigation proposals. The research is referenced in relation to the effectiveness of green bridges, which are recommended as a mitigation measure.

The Defra methods were put forward as a template for adoption as a best practice framework by the **New Zealand Transport Agency (NZTA, 2017)**. The Defra report is being used to inform the work and the methods have been put forward as a template for adoption. The final report for this project is available on the NZTA website. The Defra research is described in detail and is cited frequently in relation to both survey methods and mitigation measures [Source H].

The research is referenced in the French manual “Bats and transport infrastructure guidelines”, **French Government, 2016**, in relation to the impact of large infrastructure schemes on bats (page 23) [Source I].

5. Sources to corroborate the impact (indicative maximum of 10 references)

Source A: “Bats and linear infrastructure” UK Guidance note (2017) for UK Statutory Nature Conservation agencies – hosted on Natural Resources Wales website

<https://cdn.naturalresources.wales/media/682728/bats-and-linear-infrastructure-report-final-240817.pdf>

Source B: Incorporation of Defra guidance into six UK road development schemes that have been completed/are currently being constructed (M20, J10a; Arborfield Cross; A30 Chiverton-Carland Cross; A120 Little Hadham bypass; A496; Preston Western Distributor).

Source C: Incorporation of Defra guidance into four UK road development proposals (A9/A96 upgrades, Scotland; M4 relief road, Gwent levels, Wales; Ashton park urban extension/relief road, Wiltshire; and A30 Honiton-Devonshire Inn, Devon).

Source D: Incorporation of guidance into four rail development proposals (HS2, Phases 1 and 2a; East-West rail, phase 2; South Wales Metro).

Source E: Bat Conservation Trust guidelines: Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London.

Source F: European guidance document for Conference of European Directors of Roads (CEDR, 2016). CEDR’s Roads and Wildlife Manual (May 2018); Defra research is referenced in the ‘Further reading’ section, p115. PDF available at: <https://www.cedr.eu/download/Publications/2018/CR-2018-3-Call-2013-Roads-and-Wildlife-Manual.pdf>

Source G: EU road schemes in Croatia (Saborsko – Rakovica, document in Croatian) and Austria (L5181 Spange Wörth, document in German) (2015-2017)

Source H: Smith, D., *et al.*, (2017) Effects of land transport activities on New Zealand’s endemic bat populations: reviews of ecological and regulatory literature. NZ Transport Agency research report 623. 249pp. <http://www.nzta.govt.nz/resources/research/reports/623>

Source I: French transport infrastructure guidelines. Full reference (in French): Nowicki, F., *et al.*, (2016) Guide méthodologique. Chiroptères et infrastructures de transport. Centre d’études et d’expertise sur les risques l’environnement la mobilité et l’aménagement (Cerema), France.