Bat Conservation Trust

New technologies for bat surveys, their applications and what guidance/training is available

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This table was put together following the UK Bat Steering Group meeting in 2019, with contributions from Kayleigh Fawcett (thermal imaging), Katherine Boughey (affordable passive acoustic sensors), David Wallis (acoustic directional sensors), Ewan Parsons (MOTUS) and David Lowe (ecological spatial modelling). Many thanks to our contributors.

Technology	Application	Pros	Cons	Approx cost	Guidance available	Training available	Where in technology adoption life cycle?*
Thermal Imaging	To aid or to carry out bat emergence/re-entry and activity surveys.	Avoids visibility bias (when too dark to see bats) Many devices can record data to verify later Many devices user friendly High level of accuracy Non invasive Health and safety	Can miss bats when scribing if not recording If not recording, can't verify data More expensive to record Not all devices are suitable for this application (due to limited field of view, resolution and frame rate)	Hire: £125-500/day Purchase: £3,000-£40,000	Thermal imaging bat survey guidelines (2019): https://www.bats.org.uk/resources/guidance-for-professionals/thermal-imaging-bat-survey-guidelines	BCT runs a one day course on thermal-**aided** bat surveys: https://www.bats.org.uk/our-work/training-and-conferences/training-for-ecologists/thermal-aided-bat-surveys To use thermal imaging as a **method**, more specialist training is required. A good starting point is: https://www.wildlifetek.com/wildlifetek-	Crossing the chasm. Semi-automated analysis software (in development) expected to make this method more affordable by reducing cost implications of manual analysis.

		benefits Cost savings for large/ complex/ multiple structures	Relative cost of data analysis (compared to say acoustic files)			thermal	
Affordable passive acoustic sensors (e.g. Audiomoth)	Remote acoustic bat surveying	Many models are open source Cheap Can achieve much greater survey effort with minimal surveyor effort, in comparison to active acoustic surveys. Can cover larger areas for longer periods of time. Allows rarer species to be monitored. Some models are easy to deploy. Can be used successfully by novice surveyors	Limited manufacturers. Currently available models still require regular human input, e.g. to change batteries, swap memory cards etc. Reduced recording quality in comparison to more expensive models. Firmware options limited or still in beta testing (e.g. programmable options, triggers, filters). Susceptible to microphone degradation, and approach to	AudioMoth – c. £50 per unit, plus SD card c. £13, batteries c. £1.20, waterproof case c. £5-20. Peersonic remote model £? RaspberryPi based model – c. £400 parts plus labour.	Bat Surveys for Professional Ecologists Good Practice Guidelines 3rd edition provides guidance on automated/static bat surveys and on automated sound analysis: https://www.bats.org.uk/resources/guidance-for-professionals/bat-surveys-for-professional-ecologists-good-practice-guidelines-3rd-edition. Guidance on automated analysis here: https://cdn.bats.org.uk/pdf/AutomaticID_Recommendations_Version_date_210416.pdf?mtime=20181109121746&focal=none	BCT runs one day courses on automated sound analysis: https://www.bats.org.uk/our-work/training-and-conferences/training-for-ecologists/automatic-species-identification and on the use of Kaleidoscope Pro for automated sound analysis: https://www.bats.org.uk/our-work/training-and-conferences/training-for-ecologists/wildlife-acoustics-kaleidoscope-pro	Early Adopters – past the chasm (about 10,000 devices by the end of the year).

		Can be deployed during daylight so night visits to site not required. Makes it easier to survey isolated sites or sites with difficult terrain. Automated sound analysis available to analyse data generated. Some models can carry out onboard processing of recordings, in theory enabling realtime monitoring.	testing/calibration not standardised. Limited user support from manufacturers due to open source nature of many models. Limited durability due to affordable nature, units have a short lifespan. May require additional weatherproofing. Generates a large amount of data Different automated analysis systems have pros and cons – only as good as reference library of calls used to develop them				
Acoustic directional analysis	To aid or carry out bat emergence/re-entry and activity surveys	Better data on behaviour and numbers of bats. May be able to provide a more representative	The only planned commercial option at the moment is the £7k Elekon Batlogger RS X8, therefore expensive	Elekon BATLOGGER RS X8 system is £7k	Not yet	Not yet	Moving from innovators to early adopters. Commercial hookup with Elekon and a product lined up for next year will help to bridge the chasm.

		measure of population status that measures based solely on occupancy or activity.	Cannot work yet with horeshoes because of the high frequency. Only works when calls are audible. E.g. long-eared bats can be quiet and therefore undetectable.				
MOTUS	Tracking over long and short distances of tagged bats, e.g. during migration	Single detector station provides data on presence / absence and direction of movement. Networked detector stations enable flight time/ speed to be assessed together with residence times. Detector network is multi-national allowing movements to be monitored over extended distances. Centralised data storage and	Significant fixed costs for receiver stations, so expensive for localised studies. Permanent detector stations likely to require planning permission when fixed to buildings. Uncertainty over licencing of tags in the UK (under investigation). Invasive method involving tagging bats.	£4,000 - £5,000 installation of mast and receiver at detector station. £400 pa power, telecoms, maintenance £180 per MOTUS tag c.f £120 -£150 for conventional beeper tag	Some from: https://motus.org/ and https://groups.google.com/forum/#!forum/motus-wts https://archived.sensorgnome.org/	Not yet Potential European Conference later in 2020	Late majority in US/ Canada & Western Europe. Early adopters for UK & Ireland.

		access. Multi-taxa capability, so costs can be shared between projects. Tags are generally lighter than long distance radio/ satellite/ GPS tags allowing smaller species to be monitored, albeit for shorter periods.					
Ecological Spatial Modelling	Predictive mapping to show where species are likely to exist, and/or how they could move through a landscape, define their ecological niche, and explore drivers of population change.	Good way to target conservation effort Good way to design surveying programmes Good way to monitor the 'health' and 'functioning' of a landscape Good way to translate large amounts of data into a presentable	Can be technical and data hungry. Most consultancy projects will not generate sufficient data for a modelling approach. Can be mis-interpreted A model is only as good as the data it uses. Care is needed to ensure all model assumptions are understood and	Many models are open source but may need technical learning or the acquisition of data that could be expensive.	Online guidance is generally very good with support.	Good online training and more face-to-face available from specialist groups. Online training: https://events.cieem.net/Events/Event-Listing.aspx and http://wordpress.condatis.org.uk/about-the-software/training-resources and https://biodiversityinformatics.amnh.org/open_source/maxent/Maxent_tutorial2017.pdf	For non-bat applications: Widely employed by Government Agencies such as FC and EA – early majority. Used by Government Agencies in developing new licencing approaches – use is growing so late majority. Local Government and NGOs are exploring how to use differing models in creating Nature Recovery Maps and Natural Capital Assessments – early majority.

		format.	met. Models require careful variable selection, including proper consideration of scale, and assessment of goodness of fit to both training and testing data.' Care is needed when extrapolating beyond the modelled range.			and http://spatial-ecology.net/ Specialist groups: https://www.envsys.co.uk/ and https://www.ceh.ac.uk/training/introduction-gis-environmental-scientists	Very widely adopted in academic fields.

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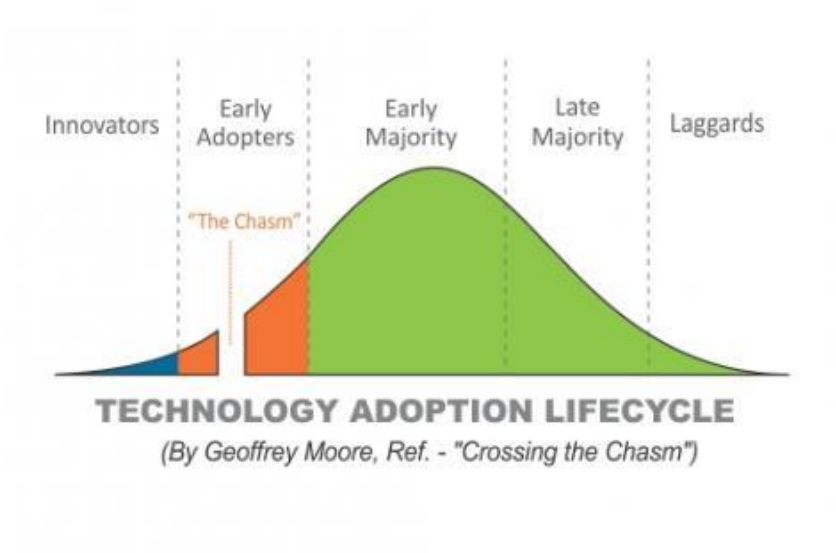
Innovators
Early Adopters
Early Majority
Late Majority
Laggards
"The Chasm"
TECHNOLOGY ADOPTION LIFECYCLE
(By Geoffrey Moore, Ref. - "Crossing the Chasm")