Can Citizen Scientist Camera Trappers Redefine Mammal Monitoring Across the UK?

Phil Stephens

Mammal Web

Durham University

- Need
- Network
- Knowledge
- Narrative
- Next

Why monitor mammals in the UK?

- Ecology
  - monitoring, explaining and predicting responses to environmental change
- Management and conservation
  - cultural value
  - endangered species
  - control of pest species
  - invasive species
  - disease contingency

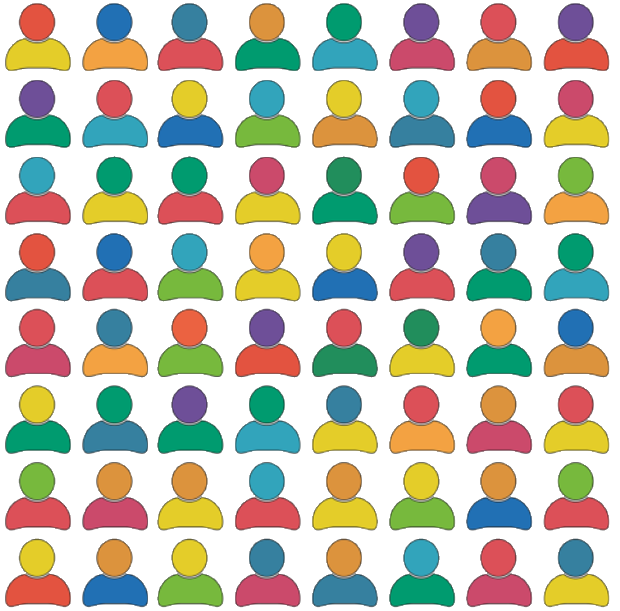
Why would new approaches help?

Could we meet this need with camera traps?

- Solution to problem of low detectability
  - monitor 24/7
  - more than just presence/absence
    - demography
    - behaviour
    - timing of events and activity
    - abundance … ?
- But, new problems
  - widespread use
    - servicing / maintenance
  - high volumes of data
    - data handling demands

Could we meet this need with camera traps?

- Citizen scientists
  - increasingly enlisted to aid with image classification
  - seldom engaged in long-term, large-scale camera trapping



ZOONIVERSE
REAL SCIENCE ONLINE

eMAMMAL

A citizen-science Network for camera trapping

- Local people
  - deploy cameras
  - upload images
  - classify image contents
  - low expertise required
    - but high value contribution
- Dual benefits
  - engagement
    - seldom-seen biodiversity
  - human resource
    - enables monitoring

MammalWeb

- Begun in 2014
- Initial funding from HLF
- (Deliberately) slow growth
  - focused in North East England …

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Mammal Web

Understanding wild mammals, one photo at a time

What is it all about?

We collate data from motion sensing "camera traps", set up to photograph and monitor wild mammals. These cameras don't *trap* animals - but they take pictures of animals that pass in front of them. To gain good coverage, we need lots of people like you to contribute by deploying camera traps in their area. Since there may be many thousands of photos, we also need *your* help to identify what's in them!

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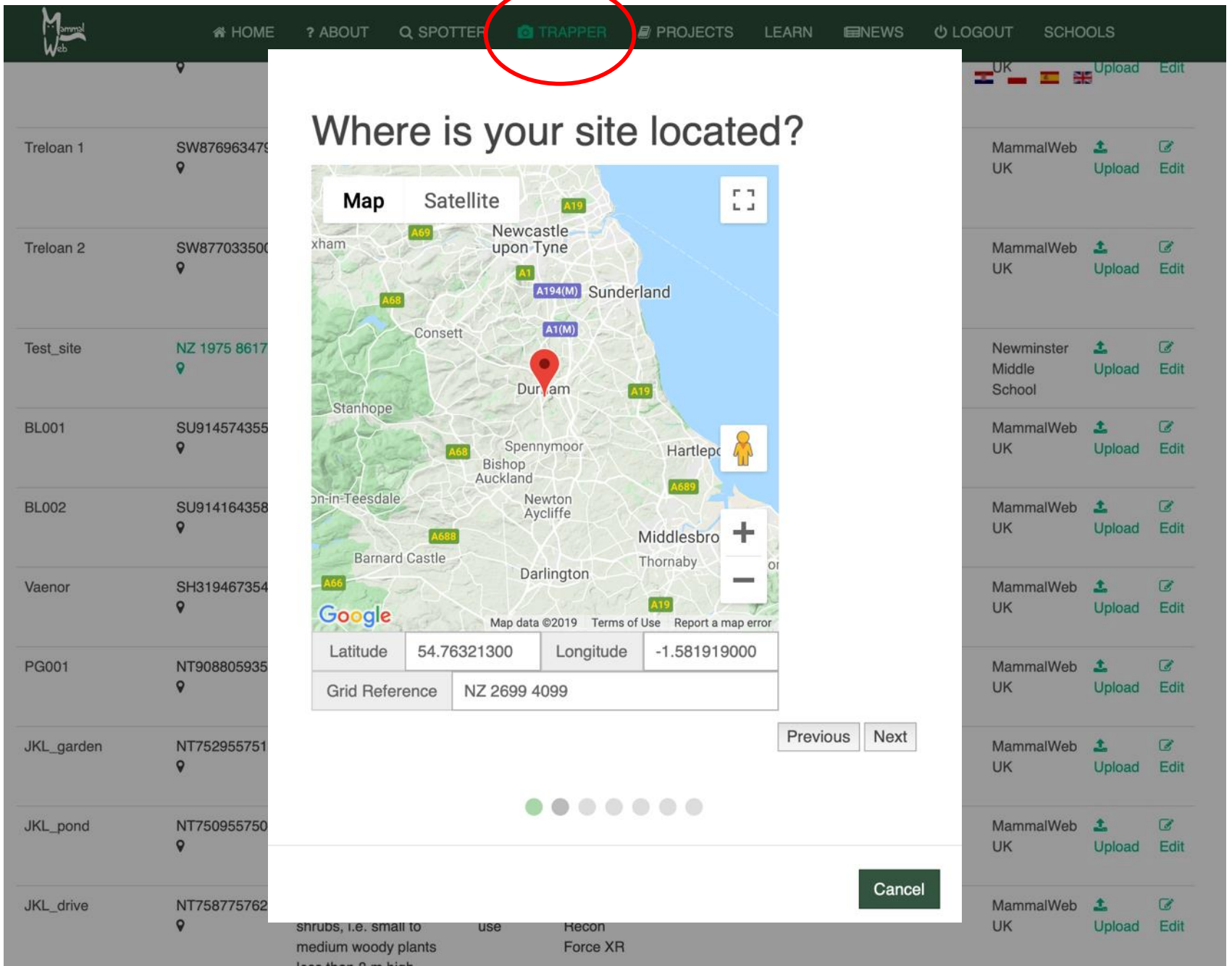
What do you see in this sequence?

Nothing ⊘ Human

Location Next Sequence

Common Species	Mammals	Birds
American mink	Roe deer	
Badger	Small rodent (unknown speci	
Brown (European) hare	Stoat	
Brown rat	Vole (unknown species)	
Domestic cat	Wood mouse	
Domestic dog	Blackbird	
Fallow deer	Carrion crow	
Grey squirrel	Dunnock	
Hedgehog (Western)	Great tit	
Horse	Jackdaw	
Livestock	Jay	
Muntjac	Magpie	
Otter	Pheasant	
Pine marten	Redwing	
Rabbit	Robin	
Red deer	Song thrush	
Red fox	Unidentified bird	
Red squirrel	Woodpigeon	
Don't Know	Other	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Treloan 2
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BL001
BL002
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PG001
JKL_garden
JKL_pond
JKL_drive
MammalWeb UK
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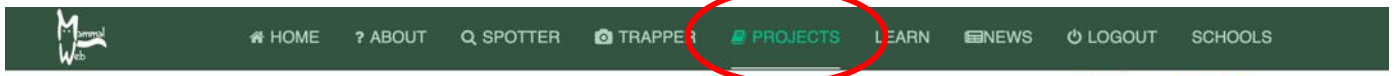
Newminster Middle School



Ingleborough NNR

Please keep spotting *

Camera trapping on the Ingleborough National Nature Reserve.

NatureSpy North York Moors Photos

Please keep spotting *

NatureSpy is a social enterprise specialising in camera trap projects. This project contains photographs collected by our camera traps on the North York Moors, as part of the Pine Marten Support Programme in partnership with the Forestry Commission.

NatureSpy North York Moors Videos

42% Classified *

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North Pennines NNRs

Please keep spotting *

The North Pennines National Nature Reserves are located across County Durham, Cumbria and Northumberland, and incorporate a wide variety of rare habitat types. Help us to document the mammals that are found in these unique areas.

The River Rother Project

98% Classified *

Project run by the Don Catchment Rivers Trust to document wildlife along the river Rother.

Cotswold Canals Connected

19%

Cotswold Canals Connected is a restoration project that aims to link up the Stroudwater canal from Stonehouse to Saul Junction in Gloucestershire.

FSC Dale Fort

Camera trap records on site and around the grounds of FSC Dale Fort.

BES summer schools

Please keep spotting *

The British Ecological Society's summer schools for students across the British Isles.

Information and resources for teachers (Primary)

Curriculum links

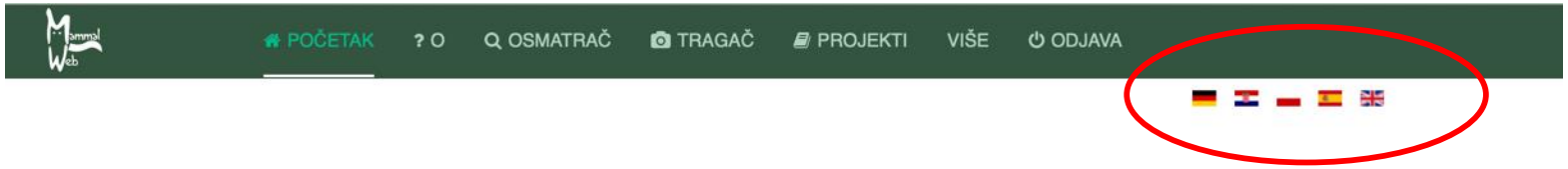
The MammalWeb project could help support learning across a number of areas of the national curriculum. Below are examples of some of these areas.

- KS1 Yr 1: 'identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals.'
- KS1 Yr 1: 'identify and name a variety of common animals that are carnivores, herbivores and omnivores.'
- KS1 Yr 1: 'describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals, including pets)'
- KS1 Yr 2: 'identify and name a variety of plants and animals in their habitats, including micro-habitats.'
- KS1 Yr 2: 'identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants, and how they depend on each other.'
- KS2 Yr 4: 'recognise that living things can be grouped in a variety of ways.'
- KS2 Yr 4: 'explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment.'
- KS2 Yr 6: 'describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals.'
- KS2 Yr 6: 'give reasons for classifying plants and animals based on specific characteristics.'
- KS2 Yr 6: 'identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution.'

Activity ideas

Below are some ideas for class activities relating to camera trapping and/or learning about UK mammals. Resources for some of these activities can be found at the bottom of the list. We aim to continue to update this list, so if you have previously designed your own activities, or have ideas for new activities relating to these topics, then please get in touch by emailing: info@mammalweb.org.

- Setting up the camera trap - get the children to think about where they would put the camera trap in order to get the best photos of animals. They could



Mammal Web

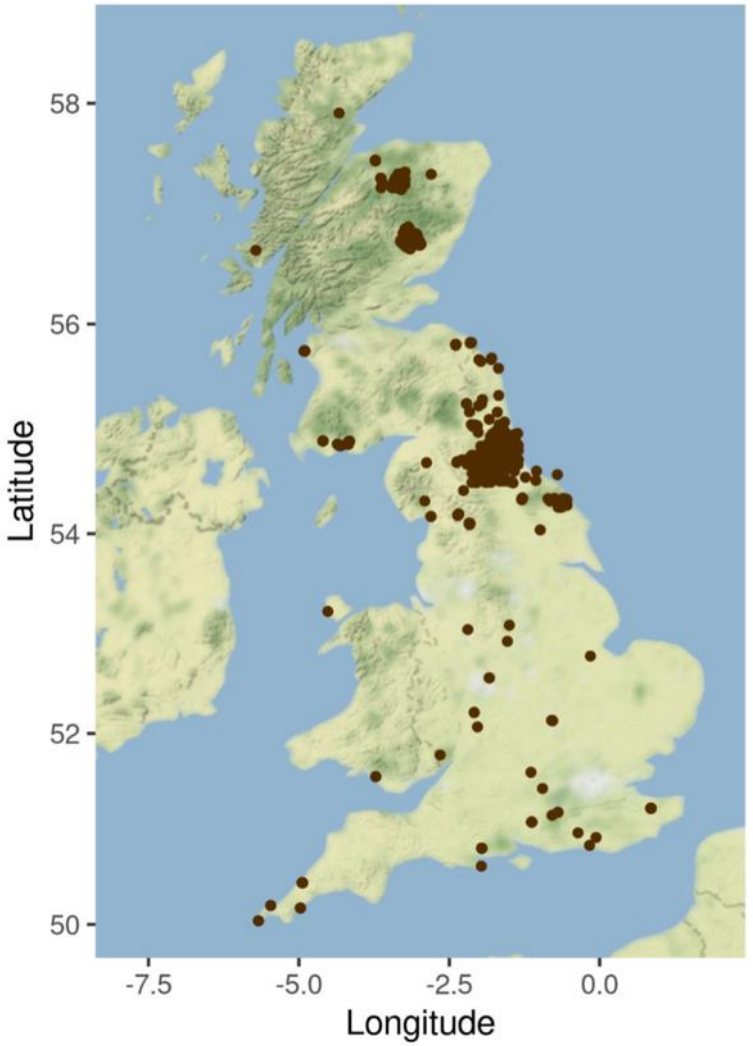
Razumijevanje života divljih sisavaca Europe, fotografiju po fotografiju

O čemu se radi?

Prikupljamo podatke sa "foto - kamera" , postavljenih u prirodi diljem zemlje za monitoring i nadziranje divljih životinja/ sisavaca. Kamere zabilježe fotografije životinja koje se kreću ispred njih, i s obzirom da možemo prikupiti na tisuće fotografija, trebamo tvoju pomoć za njihovu identifikaciju!

For UK (@ end-August)

- > 160 Trappers
  - > 880 sites
  - ~ 175,000 image sequences / videos
  - 60,000 camera trap days (~ 167 years)
- > 670 Spotters
  - 90% of sequences classified ≥ 1 time
  - ~ 150 species (birds and mammals) spotted

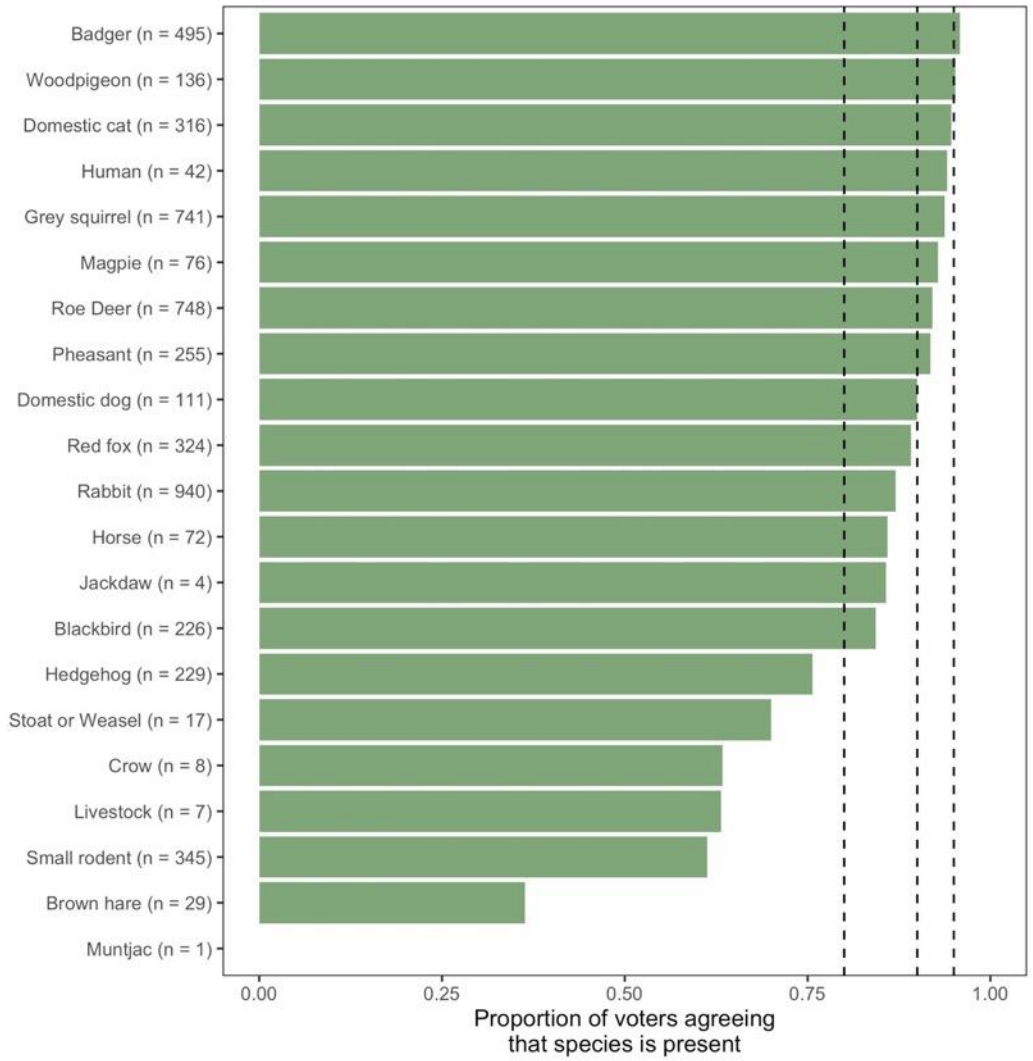


Can this network tell us what we want to know?

- What do we want to know from mammal monitoring?
  - where do animals occur (and what drives that)?
  - how abundant are they (and what drives that)?
  - how do they behave (and what drives that)?

  - all rely on knowing what is in photos …

Consensus on image sequence contents

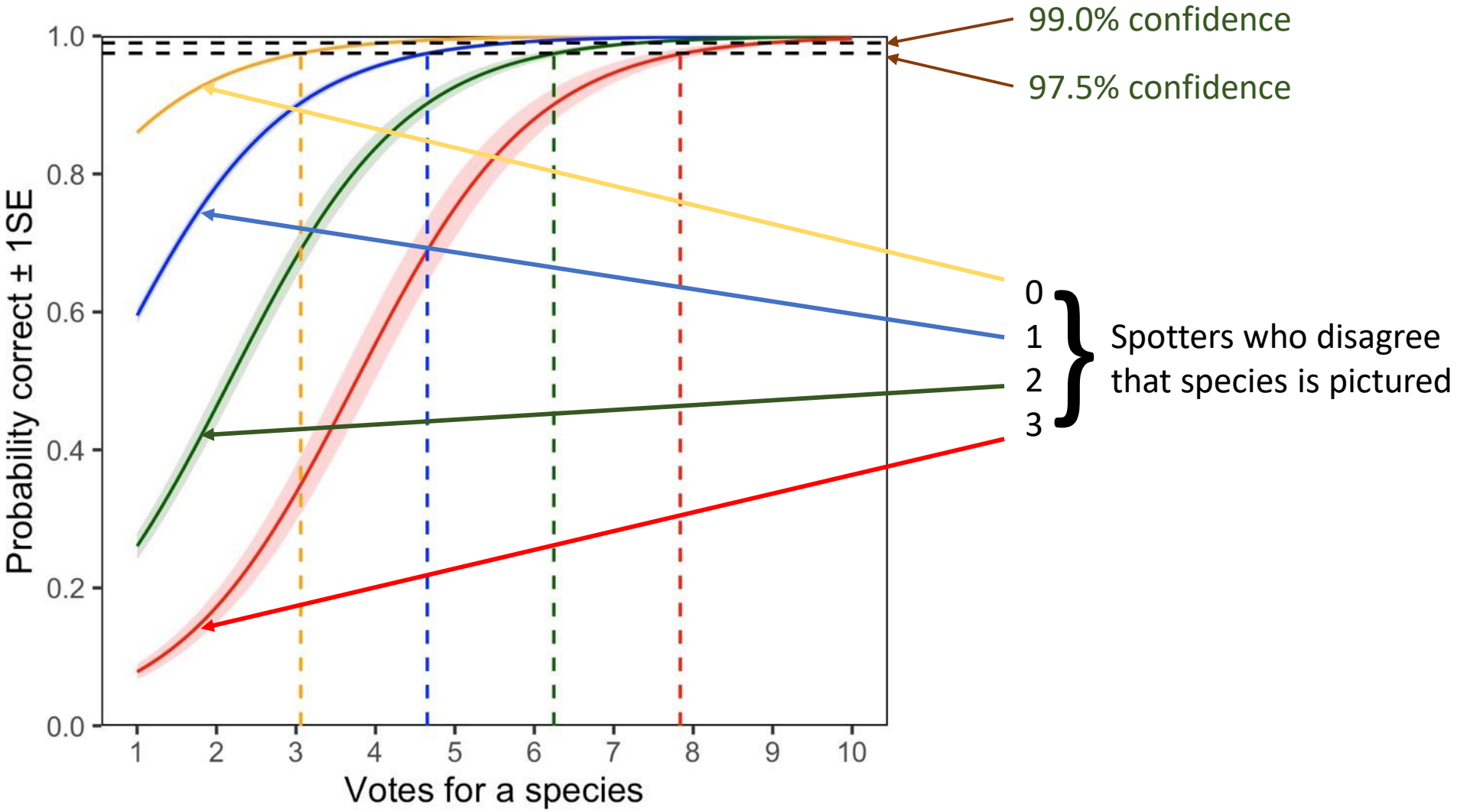


- Some species (e.g., badger) highly recognisable

- Others (e.g., hedgehog) less striking

- Most species ≥ 80% agreement

Consensus on image sequence contents



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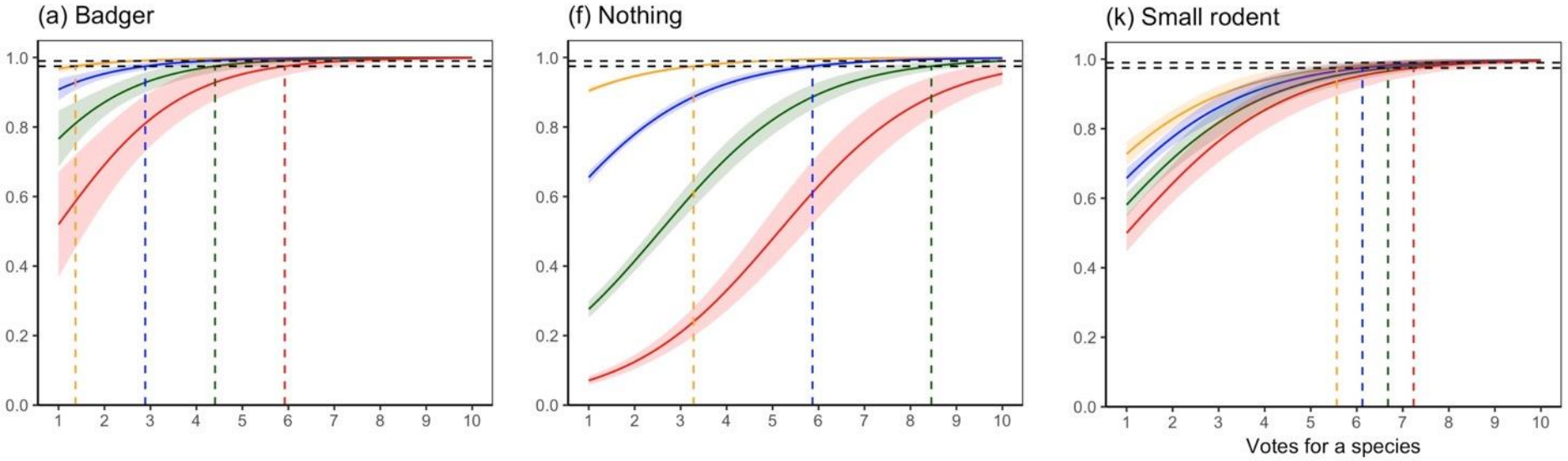

- Species-specific algorithms
  - more rapid confidence
  - more rapid withdrawal of sequences
  - more efficient use of a small classifier pool
- → probability of what's in an image

Knowledge from the network?

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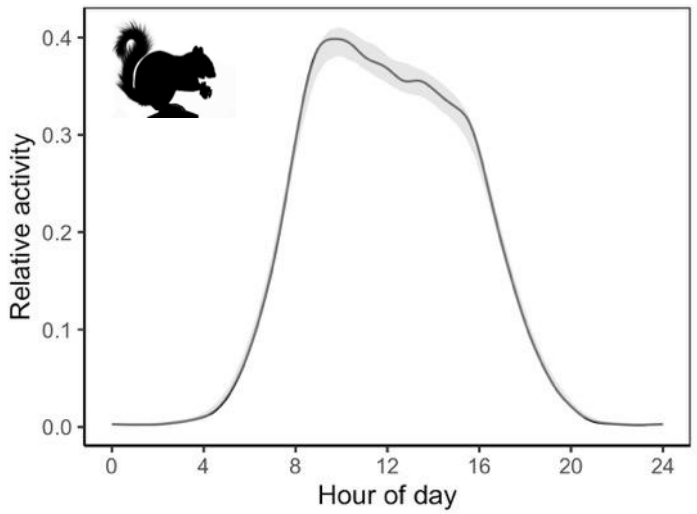
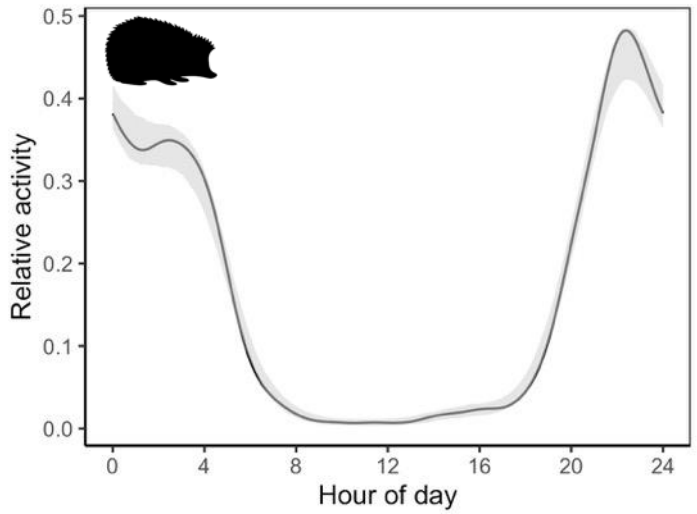
    - proportion of sites occupied, probability of occurrence at a site
    - answers question of where animals occur
  - → determination of behaviours (such as temporal activity)





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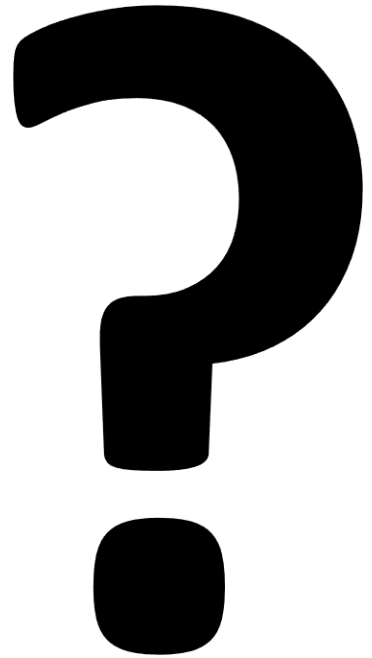
  - → invasive species identification and location, enabling trapping
  - → estimation of “occupancy”
    - proportion of sites occupied, probability of occurrence at a site
    - answers question of where animals occur
  - → determination of behaviours (such as temporal activity)
    - examples of answering questions about how animals behave
  - Currently, less well-suited to answering questions about abundance …

Less tangible outputs? Narrative …

- Highly-engaged individuals pioneering own projects
- Schools leveraging camera trapping to win environmental funding
- Pupils growing science capital and biodiversity awareness
- MammalWeb in the Great North Museum

Next steps … and future challenges

- Scientific challenges
  - sustaining quality of camera trap placement
  - reducing bias in camera placements
  - estimating abundance from camera trap data
- Engagement challenges
  - growing the network of Trappers
  - sustaining interest in online classifications
- Financial challenges
  - funding a monitoring / surveillance network
  - long-term curation and the costs of hosting
- Adding value
  - how to get the data on to the NBN …



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    - Pen-Yuan Hsing, Sammy Mason, Sian Green, Jonathan Rees
  - Newcastle University
    - Mark Whittingham
- Most importantly
  - All our contributors!

Thanks for listening

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Why would new approaches help?

- Impressive focus on other taxa
  - birds rigorously monitored since 1960s (CBC, etc.)
  - butterflies rigorously monitored since 1970s (UKBMS)
  - mammals?
- Dominant sources of data for most mammals:
  - NBN
    - effort hard to evaluate
    - low reporting of common species
    - limited reporting in some areas
    - → difficulties in abundance estimation (Croft et al. 2017, *PLoS One*)

Species	Abundance range
Hedgehog	730K – 12M
Rabbit	2M – 255M
Water vole	540K – 8M
Weasel	1M – 25M
Badger	80K – 970K

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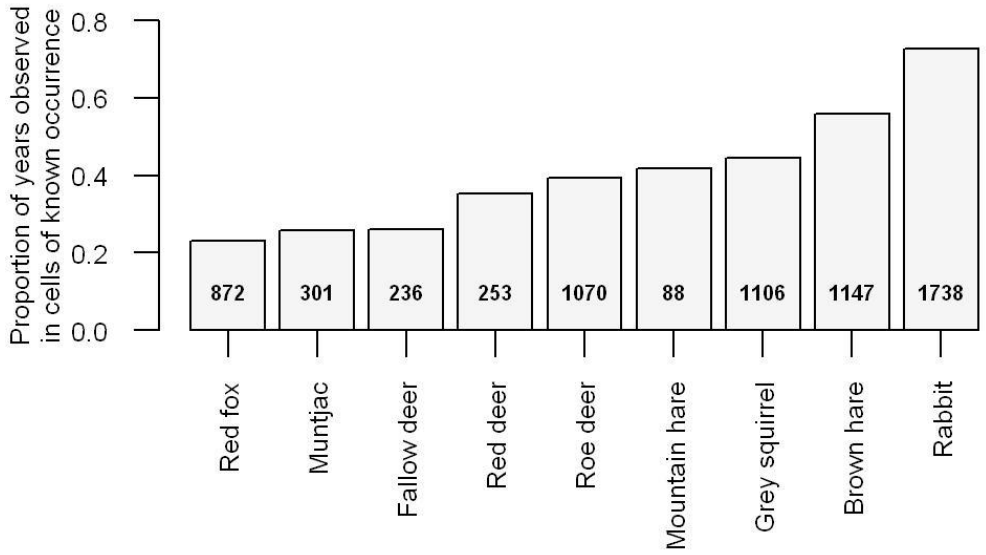
- Dominant sources of data for most mammals:
  - NBN
  - BTO (during breeding bird survey)
    - good for long-term trends
    - relatively brief daytime visits
    - poor for nocturnal / elusive species



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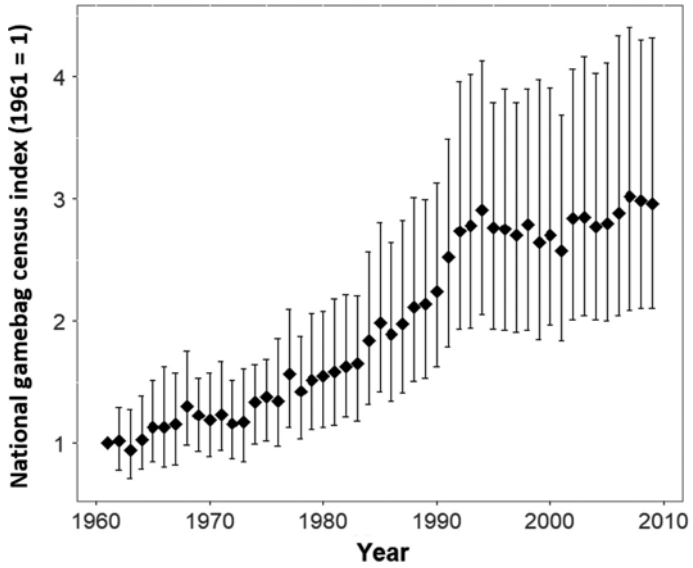
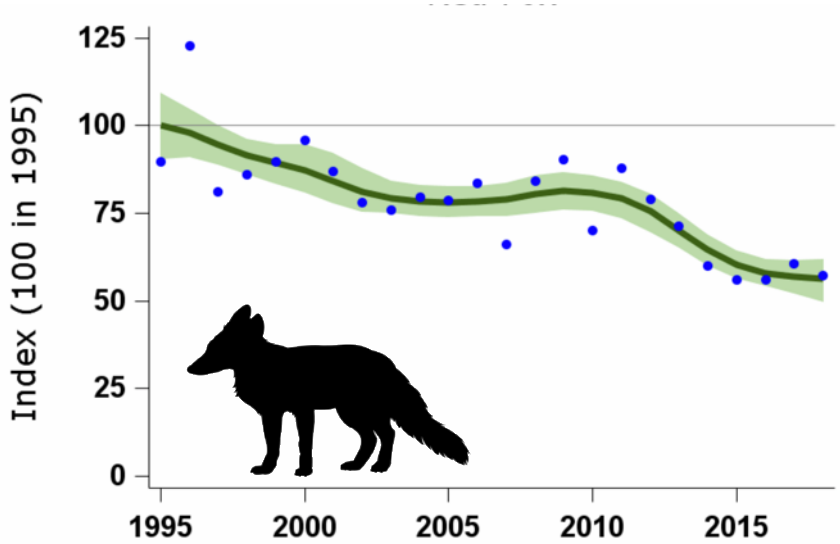
- Dominant sources of data for most mammals:
  - NBN
  - BTO
  - Gamebag census
    - variable effort
    - reporting rigour unclear
    - high uncertainty





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- Dominant sources of data for most mammals:
  - NBN
  - BTO
  - Gamebag census
  - Mammal Mapper
    - new approach
    - useful index of effort
    - still could be problematic for nocturnal species