Approaches for mapping the spread of endemic bovine TB in Great Britain

Nicholson, R.[1], Ashton, A.[1], Goodchild, A.[1], Alexander, N.[2], Wint, W.[2], Broughan, J.[1] and **Brunton, L. A.**[1]*
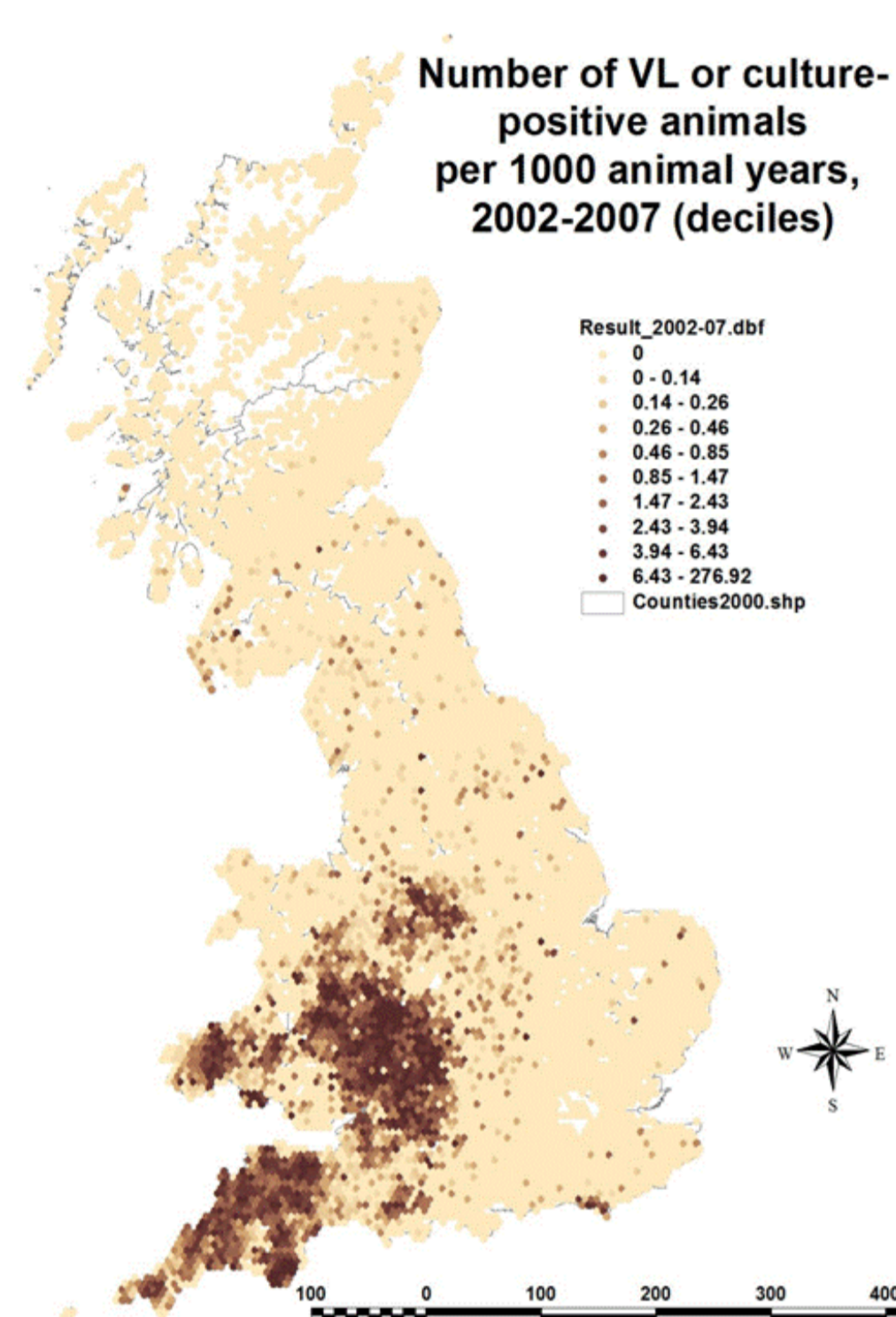
[1] Animal Health and Veterinary Laboratories Agency, United Kingdom, [2]Environmental Research Group Oxford (ERGO), United Kingdom
*lucy.brunton@ahvla.gsi.gov.uk

AHVLA
Animal Health and Veterinary Laboratories Agency

1. Introduction

Pre-movement testing for bovine tuberculosis (bTB) has had a significant impact on the long distance spread of the disease, especially on transmission to areas with relatively low incidence. However, the dynamics of local spread in the expansion of bTB-affected areas is not well understood. This work is part of a project which aims to combine GIS, epidemiological and social science expertise to characterise the spread of endemic areas of bTB in GB and explore the factors that facilitate or ameliorate this spread at a local environment and farm level.

2. Objectives

- Identify and validate an appropriate, meaningful and generally-applicable mathematical method for defining and projecting the endemic status of bTB in cattle for given places and times

- Map the expansion of the area affected by endemic bTB through time using data from bTB testing and calculate rate of spread.

3. Approaches

A. Classical measures of incidence

Number of VL or culture-positive animals per 1000 animal years, 2002-2007 (deciles)

Result_2002-07.dbf
0
0 - 0.14
0.14 - 0.26
0.26 - 0.46
0.46 - 0.65
0.65 - 1.47
1.47 - 2.43
2.43 - 3.94
3.94 - 6.43
6.43 - 276.92
Counties2000.shp

Various holding / animal level measures of endemicity at the spatial resolution of a 6.25 km² hexagonal grid were investigated.

Incidence measures such as reactors with visible lesions or *M. bovis* per 1,000 cattle were used (left).

Non-normalised measures such as the number of officially TB free withdrawn (OTFW) breakdowns per grid cell or OTFW breakdowns per herd tested were also used (below).
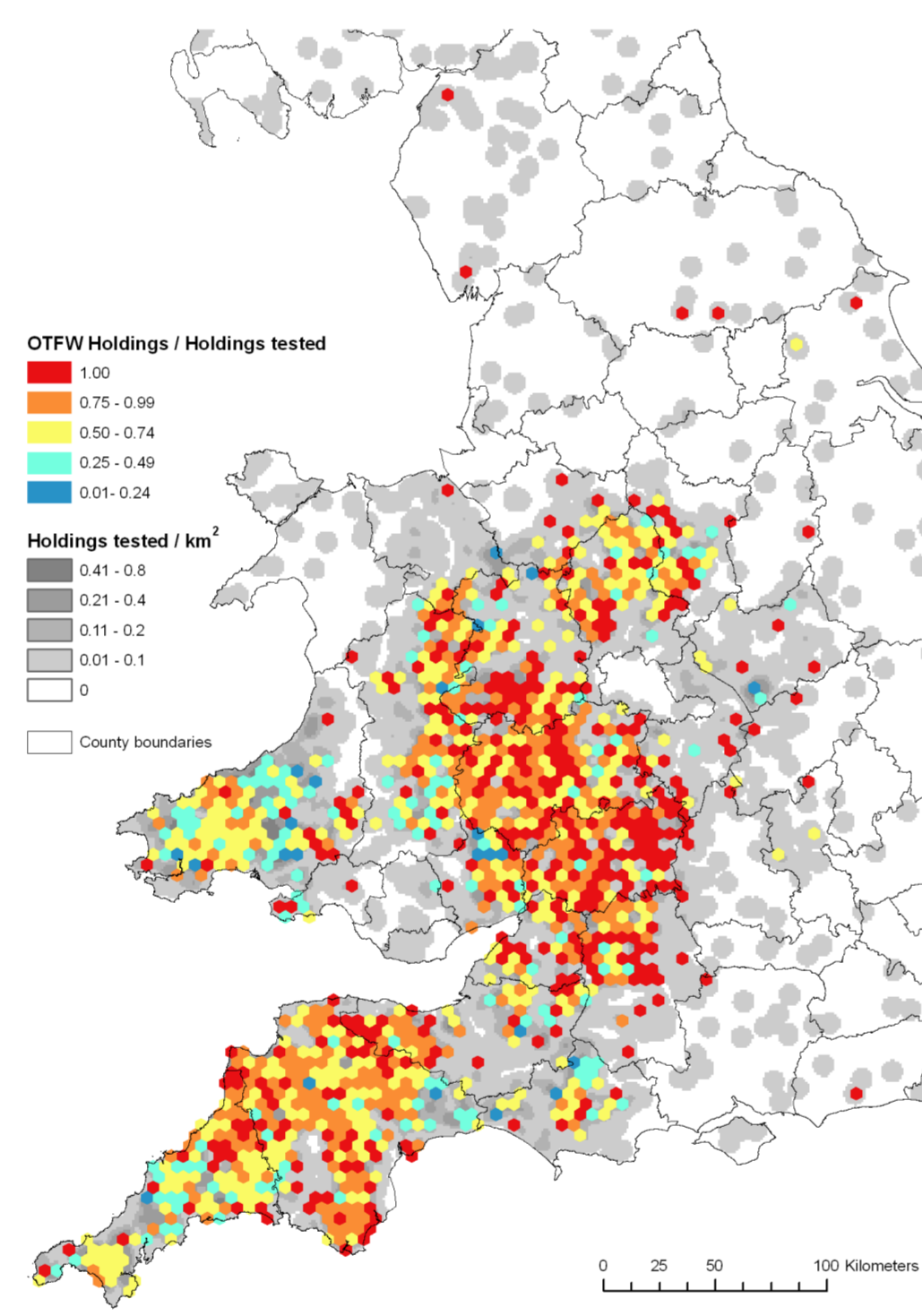
> Measures taken over a 2 year period combined with a requirement for recurrence of bTB in the 2 years prior to the time period of interest excluded sporadic occurrences.
>
> Core areas were not continuous in space or consistent over time because of low number of holdings per cell.
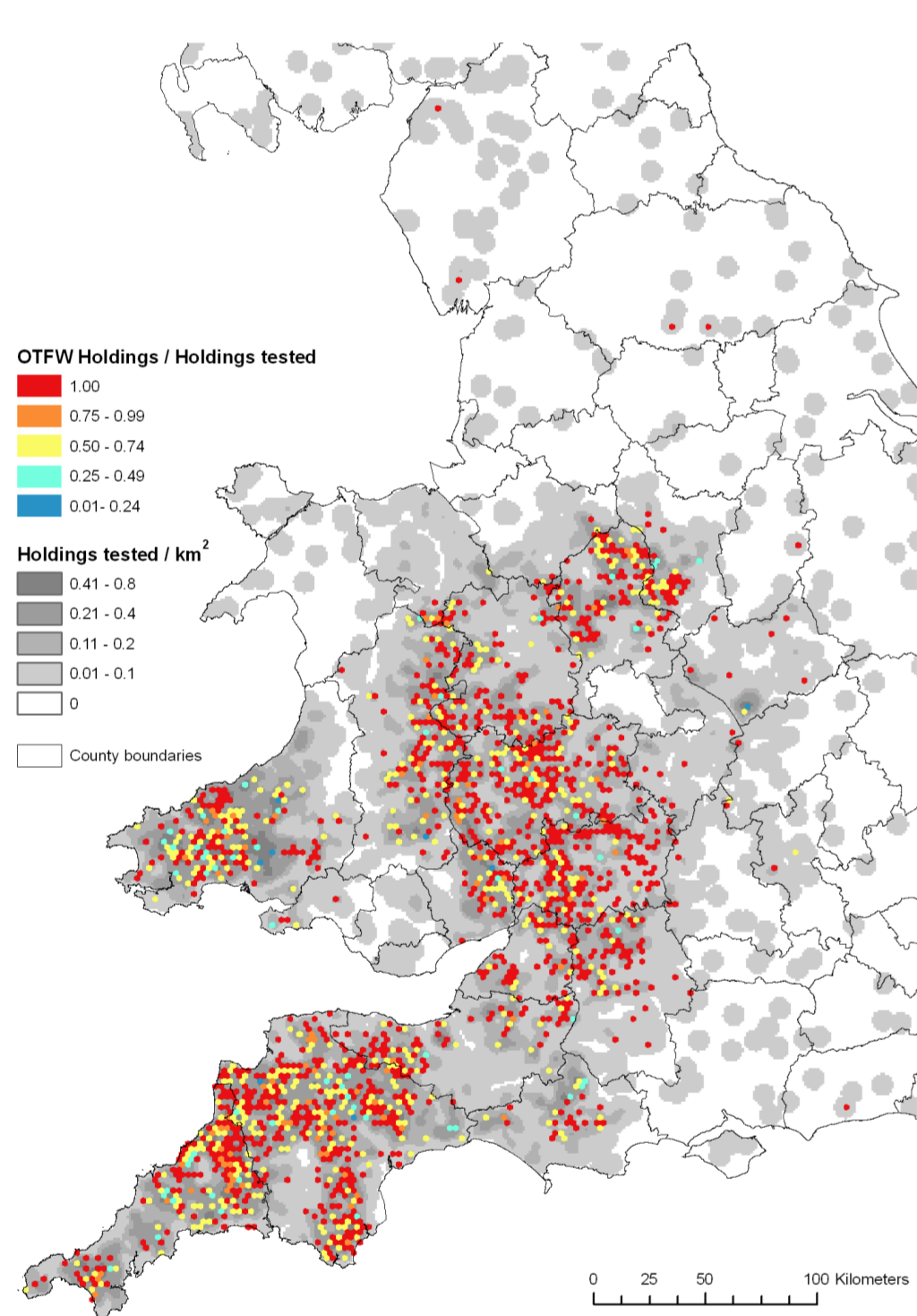
2007-2009 - 6.25 km²

Spatial and temporal continuity was improved by increasing cell size

Smaller cell size will still be required for regression analysis (see next steps)
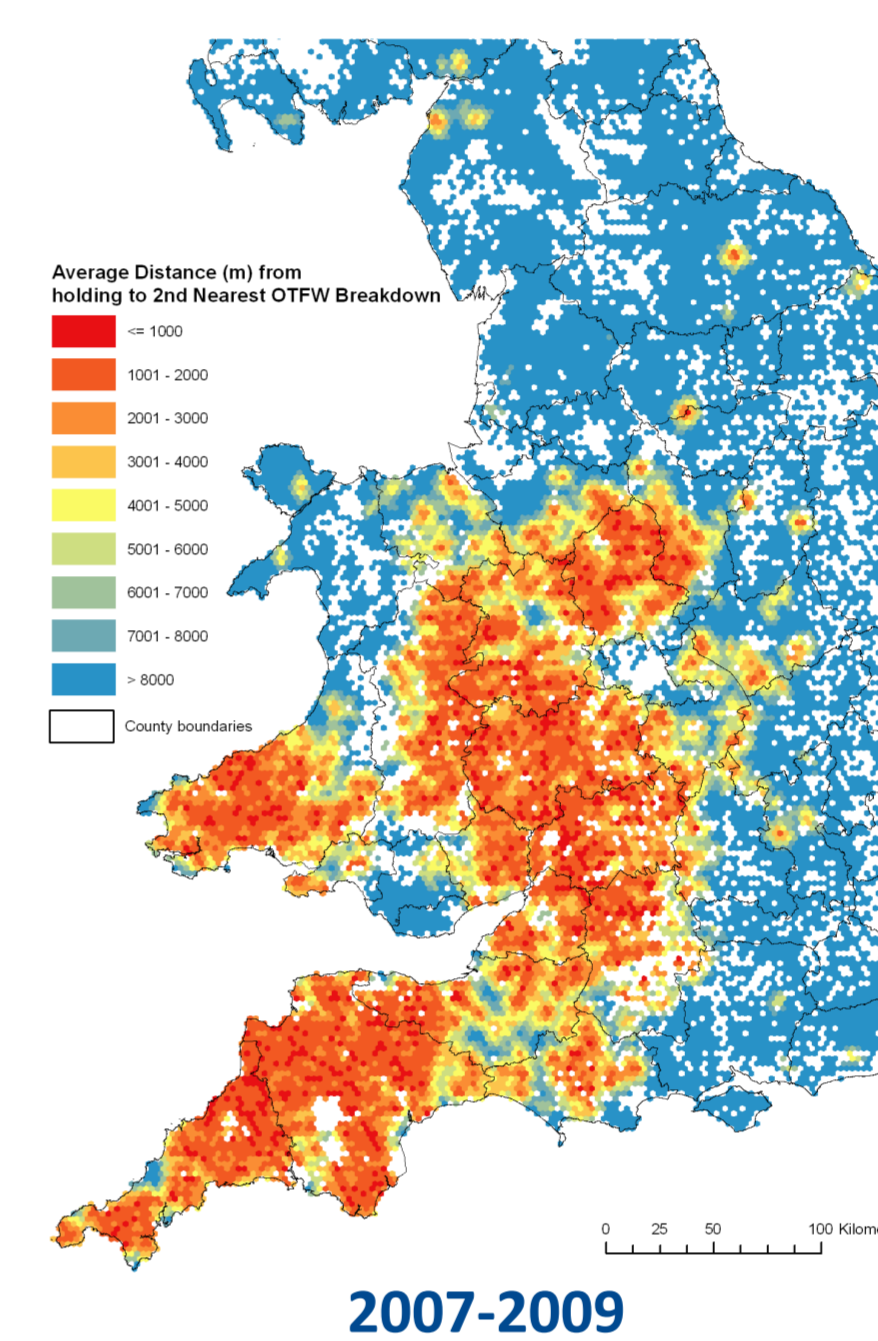

2007-2009 – 25 km²

B. Distance

Distance from each holding to the nearest OTFW breakdown was strongly influenced by sporadic, isolated cases probably introduced through trade but did not persist.
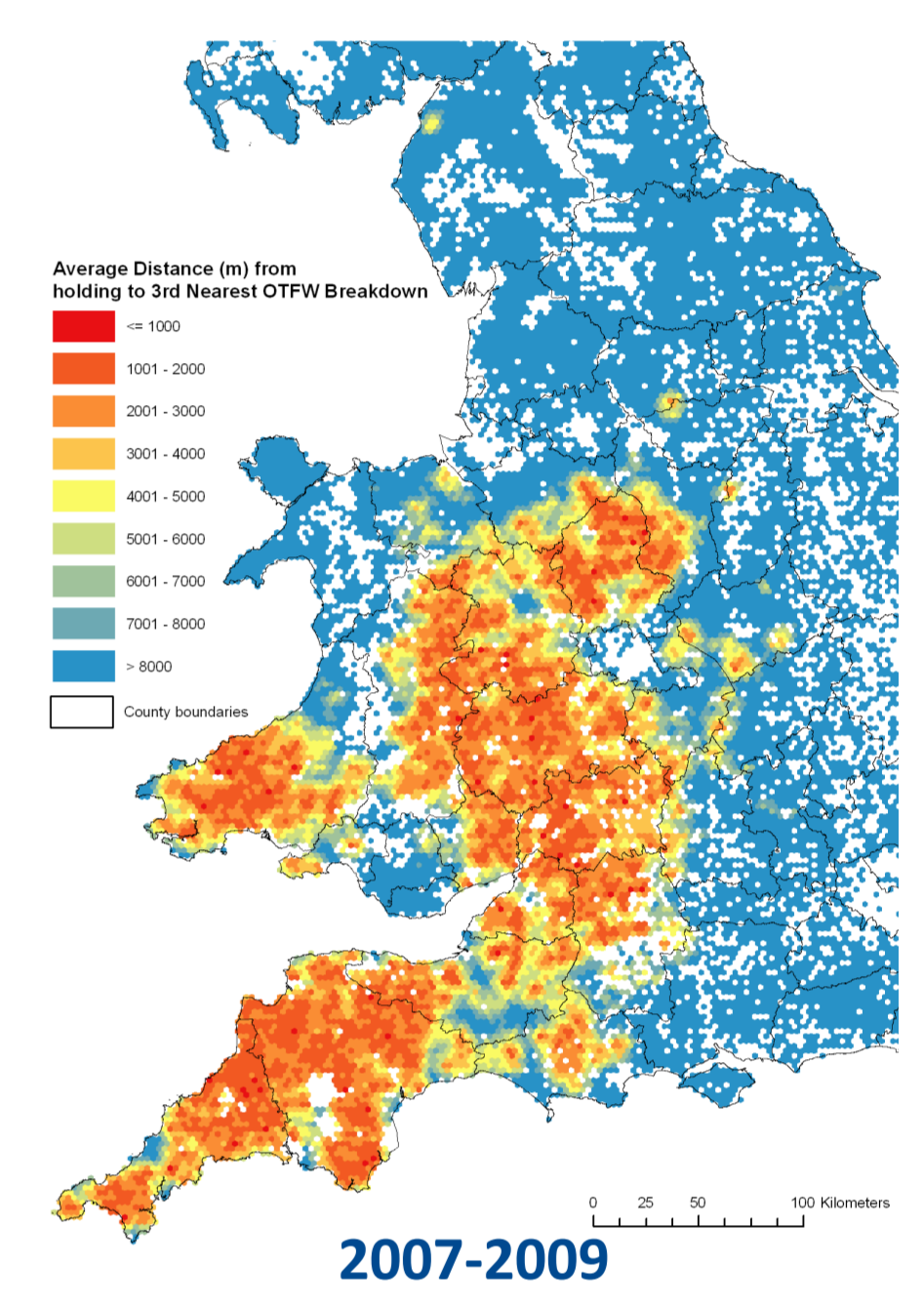
Distance to 2nd, 3rd or 4th nearest OTFW breakdown appeared to have the potential to identify continuous core endemic areas, areas of spread and areas vulnerable to endemic spread.
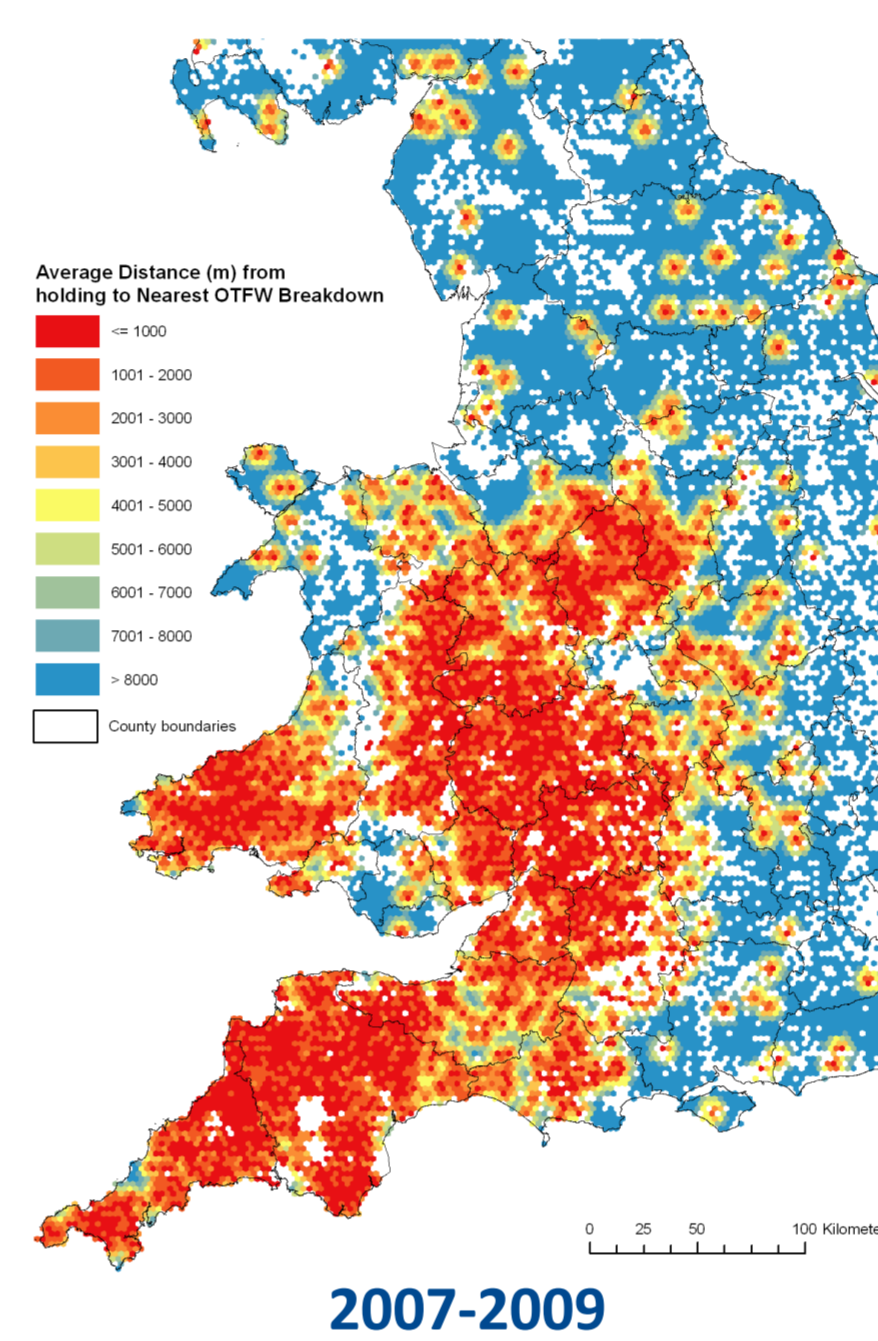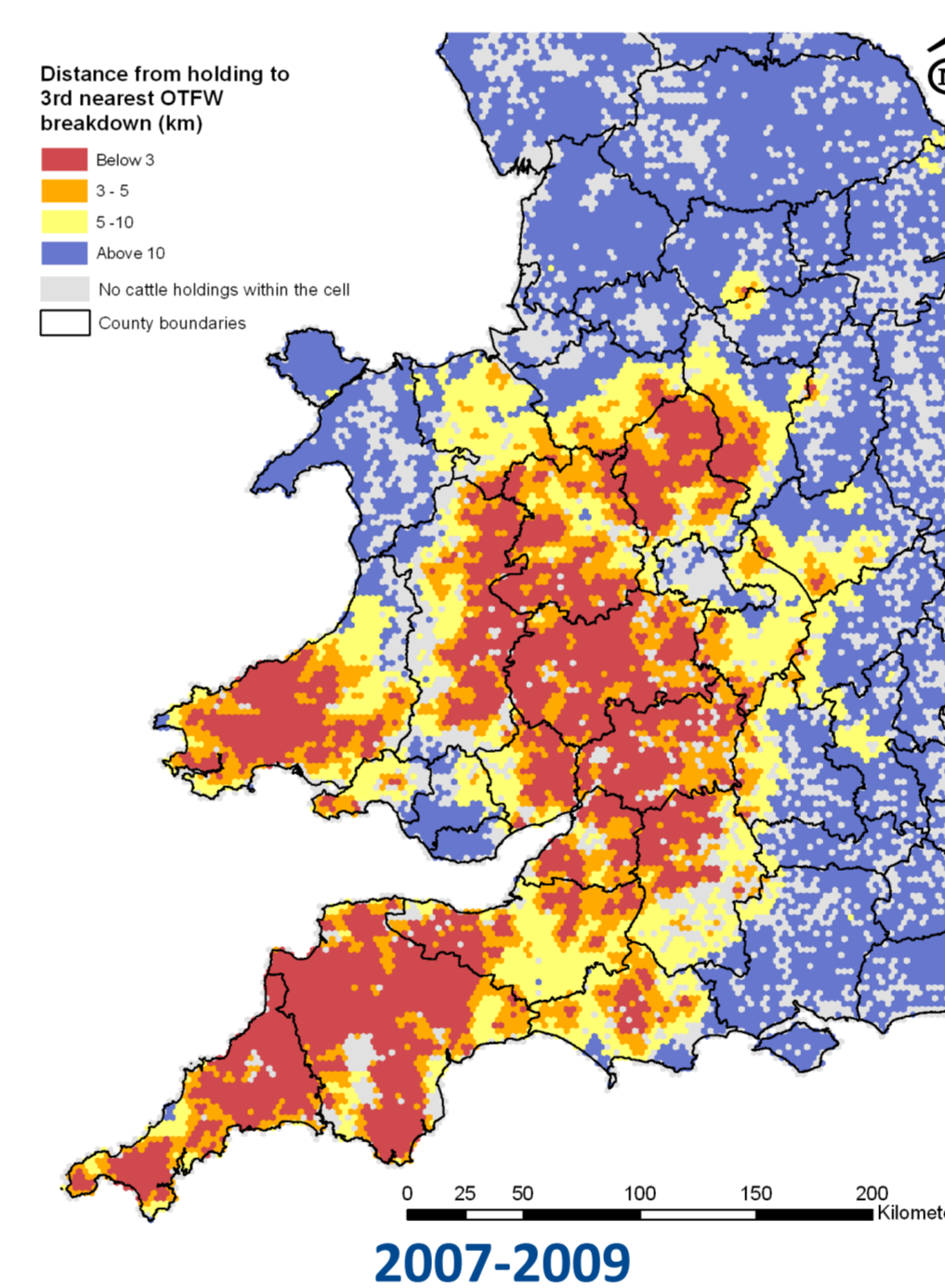

2007-2009

2007-2009

2007-2009

2007-2009

Cell data are required for regression analysis but contour lines are more appropriate for calculating rate of spread.

Distance from each point location to the 3rd nearest OTFW breakdown was calculated for 2 year periods, and contours were fitted to a threshold value (e.g. 7km) of these distances.

The contours for each time period were converted to masks representing areas in which bTB was considered endemic at that time.
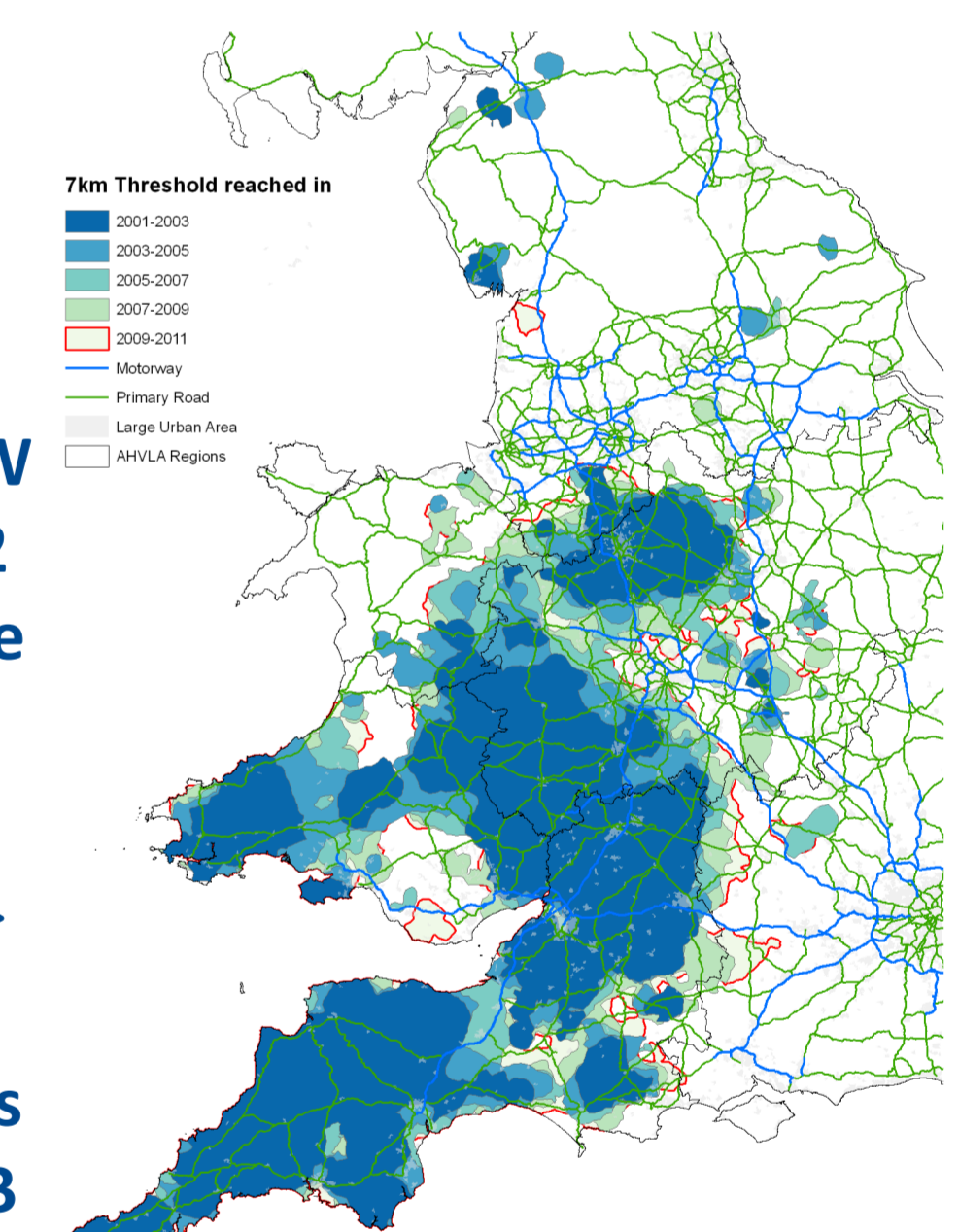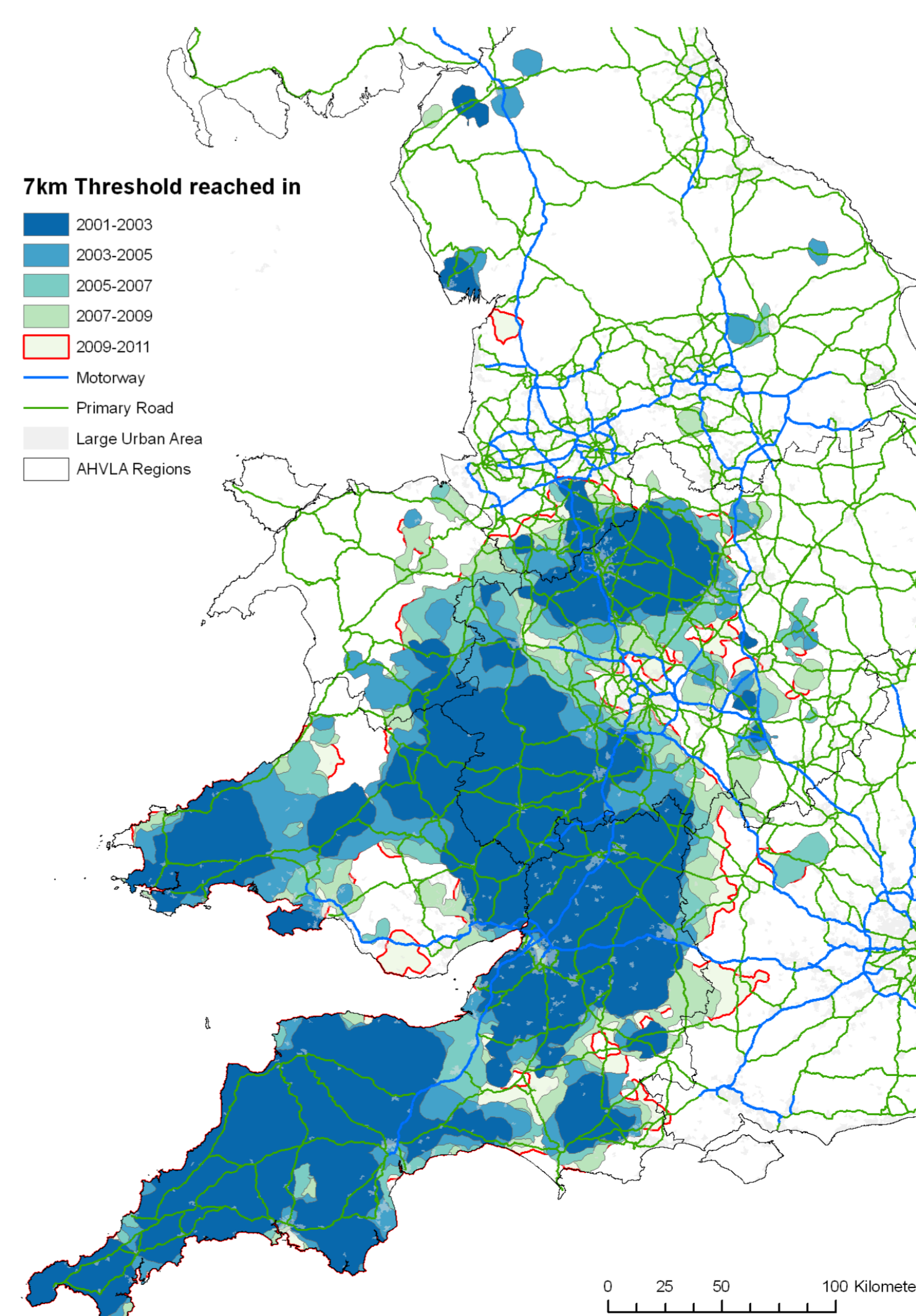

4. Validation

To validate the choice of distance threshold used to create the masks for each time period, a workshop was organised in February 2013 in collaboration with social scientists at Cardiff University in which veterinarians with local knowledge of bTB spread were consulted to obtain their view of how endemic bTB is spreading in their area.

They were shown four maps using thresholds of 3km, 5km, 7km and 10km.

The 7km threshold was found to be most accurate. However, there were concerns over data lag where it was felt that inconclusive reactors and animals without visible lesions in surrounding areas should be considered when identifying endemic and vulnerable areas.

5. Selected approach and next steps

7km Threshold reached in
2001-2003
2003-2005
2005-2007
2007-2009
2009-2011
Motorway
Primary Road
Large Urban Area
AHVLA Regions

Next steps:

- Calculate the rate of spread at cell level.

- Relate the rate of spread to local characteristics of the environment, cattle population, cattle husbandry and wildlife factors using a regression approach.

- Explore farm practices and risk factors on the edge of endemic areas using focus groups composed of vets and farmers.

- Conduct a telephone survey of farms in endemic areas and areas vulnerable to endemic bTB to collect data on farmer behaviour, practices, beliefs and attitudes in relation to bTB and risk factors identified in the project. This data will be incorporated in to the spatial datasets used in the statistical analysis.

E·R·G·O Environmental Research Group Oxford

defra Department for Environment, Food & Rural Affairs