Case study: Detection of BTV-positive cattle
in Echuca Victoria, 2017

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Roadmap

- Detection of bluetongue exposure in Victoria, July 2017
- AADIS modelling

Bluetongue

- Twelve bluetongue serotypes have been recorded in Australia
  - serotypes BTV-1 and BTV-21 extend throughout the endemically affected areas of Queensland, New South Wales and Western Australia
  - BTV-2, BTV-3, BTV-5, BTV-7, BTV-9, BTV-12, BTV-15, BTV-16, BTV-20 and BTV-23 have been isolated only in the Northern Territory

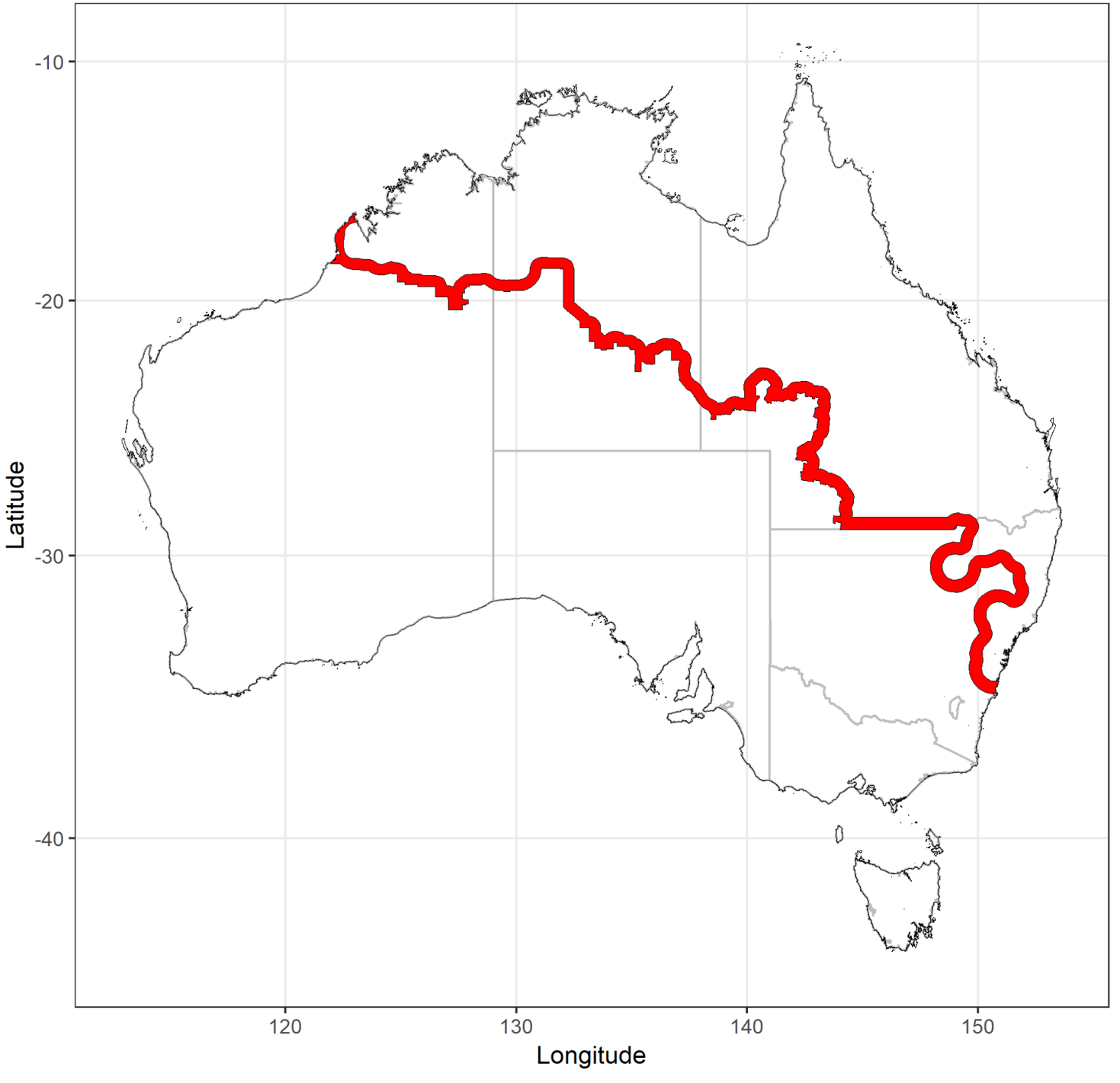
- The highly pathogenic strains (BTV-8) encountered in some overseas countries are exotic to Australia

Bluetongue

- No evidence of clinical disease associated with bluetongue infection in any livestock species in the field in Australia except for
  - disease in a sentinel sheep flock on a research station near Darwin in 1989
  - outbreak in a non-commercial sheep flock near Darwin in 2001

- The Northern Territory has regulated the import of susceptible species into the known bluetongue zone

Map of the states of Australia showing the boundaries of the October 2019 bluetongue zone (source: https://namp.animalhealthaustralia.com.au/public.php?page=namp_public&)



Bluetongue

- June 2017: dairy heifers from northern Victoria sold to China undergo routine pre-export testing

- July 2017: several heifers in the sale group show ‘evidence of past exposure to bluetongue virus’

- Victoria is well outside of NAMP’s BTV zone

Signs of Bluetonuge virus exposure in Victorian dairy cattle, 100km transmission buffer set up around Echuca

Alex Druce
@AlexDruuuce

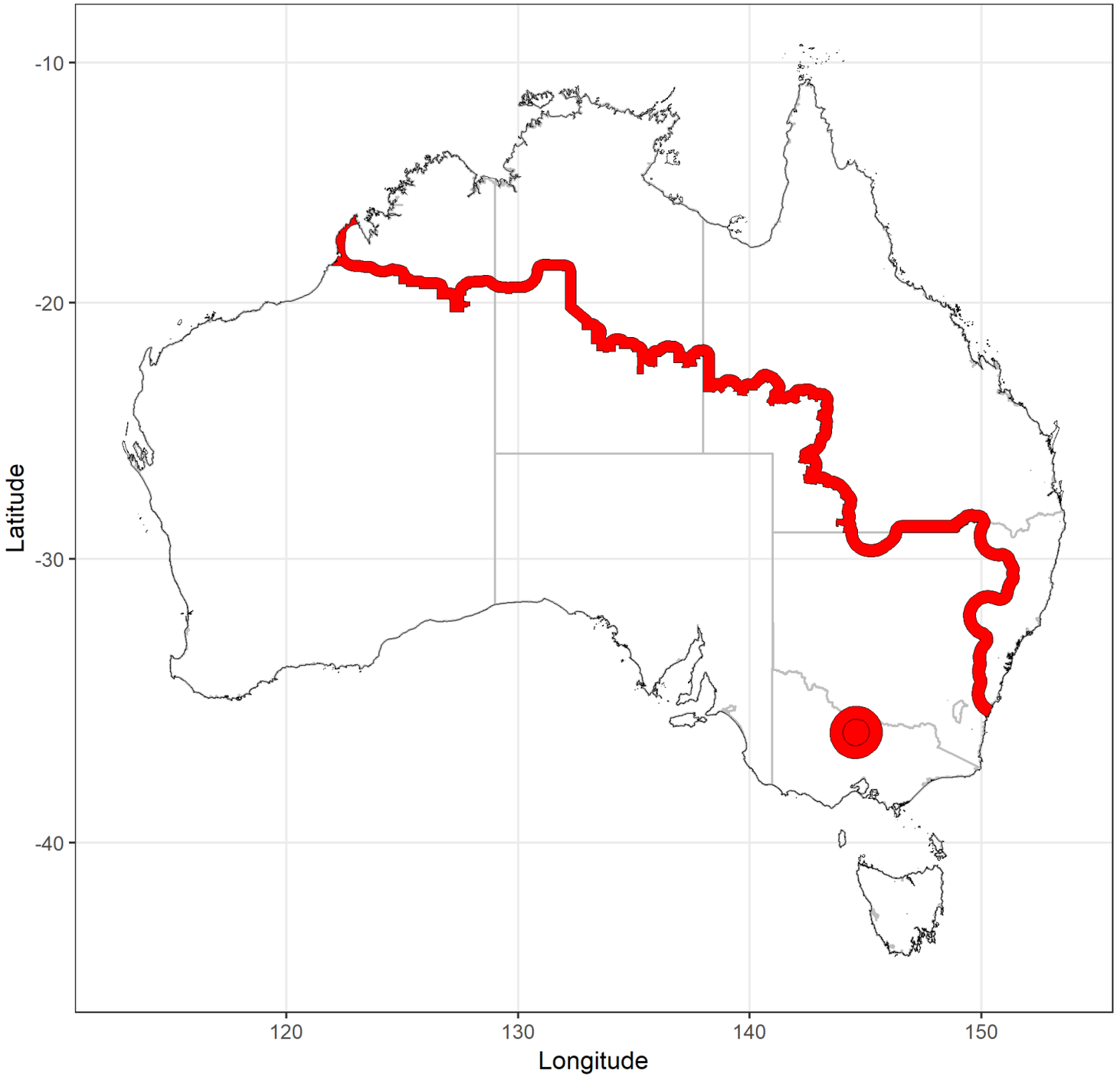
16 Oct 2017, 3:08 p.m. News

News

Signs of bluetongue vir...
3 weeks, 1 day ago

Integrating

Map of Australia showing the boundaries of the October 2017 bluetongue zone (source: https://namp.animalhealthaustralia.com.au/public.php?page=namp_public&)



Bluetongue

- Possible explanations …

  (1) Test-positive animals were non-Victorian born heifers

  or

  (2) Weather conditions in northern Victoria over the past 12 months were suitable for the bluetongue vector, *Culicoides brevitarsis* with

  - BTV being present in Victoria for some time

  and/or

  - 'local spread' arising from viraemic animals recently transported into Victoria from BTV zones

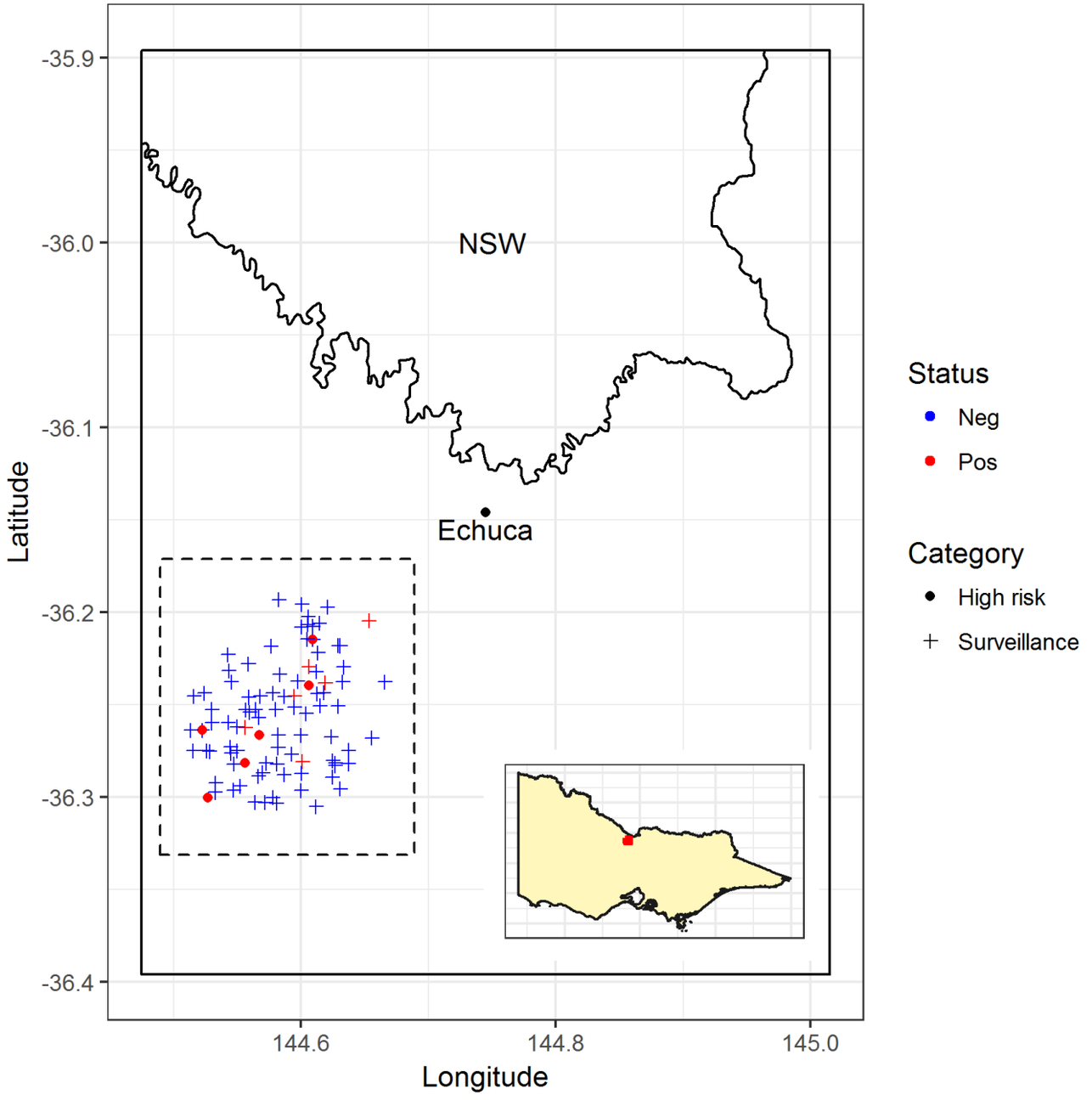
Bluetongue

- State Department of Agriculture response

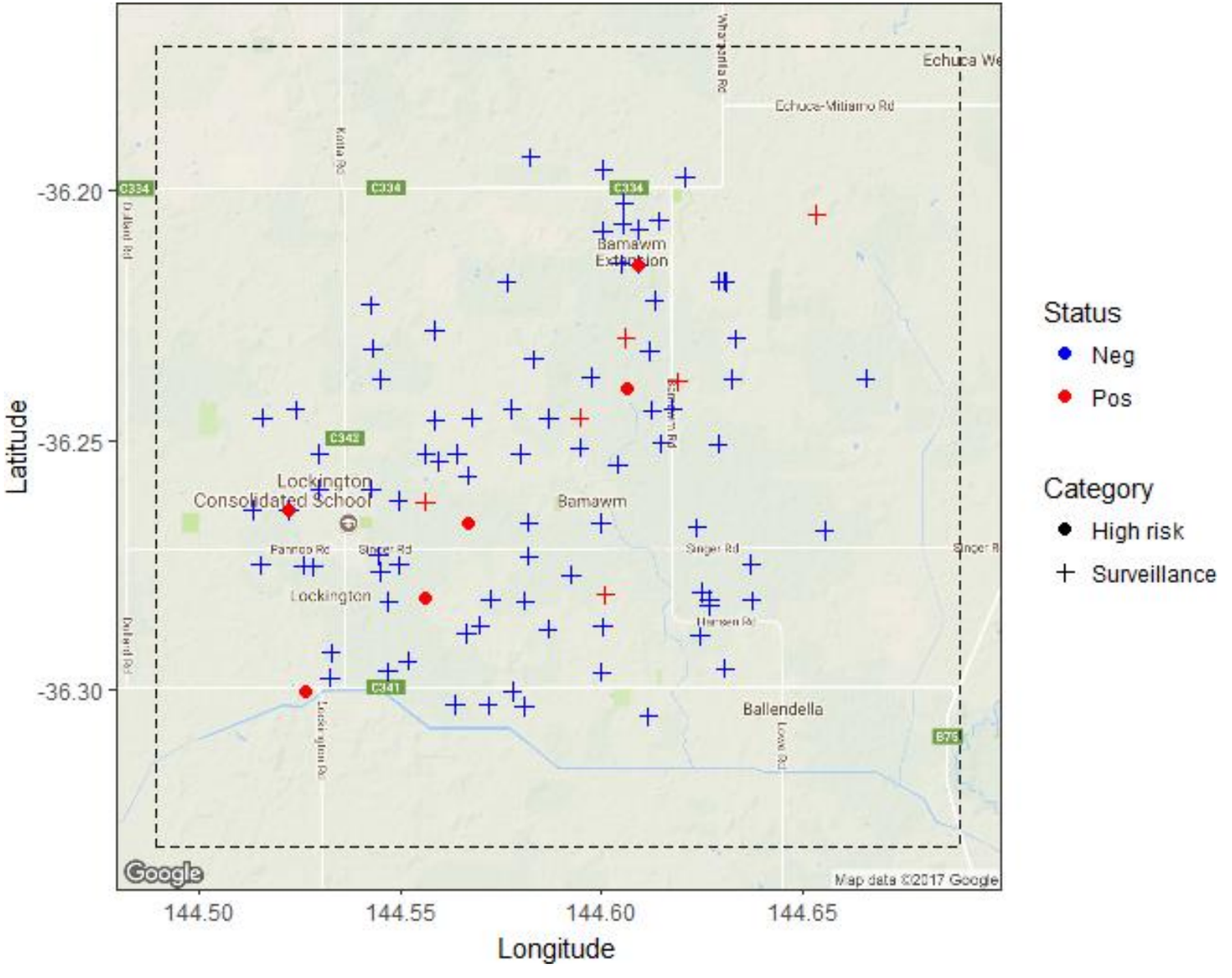
  (1) Conduct a delimiting survey

  (2) Trace all on-farm movements on identified BTV exposure-positive properties (22 Feb 2017, 30 Mar 2017 and 2 May2017)

Map of northern Victoria showing the location of the study area. ‘High risk’ are those properties that had received cattle from BTV zones during the previous 12 months.



Map of study area showing the centroid of farm premises identified as positive and negative based on testing carried out in October 2017. Locations marked as ‘high’ risk are those that had on-farm movements of cattle from BTV zones in the previous 12 months.



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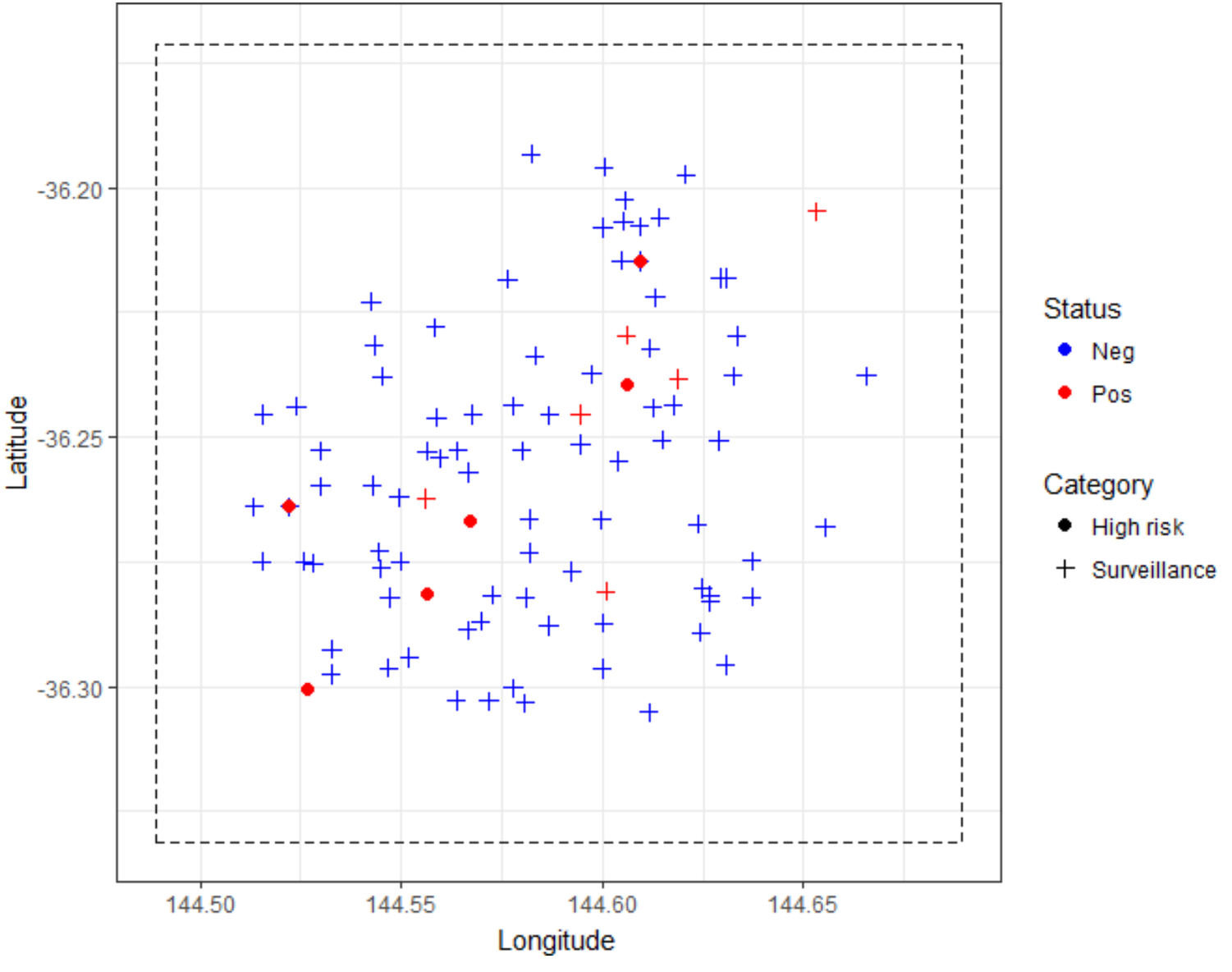
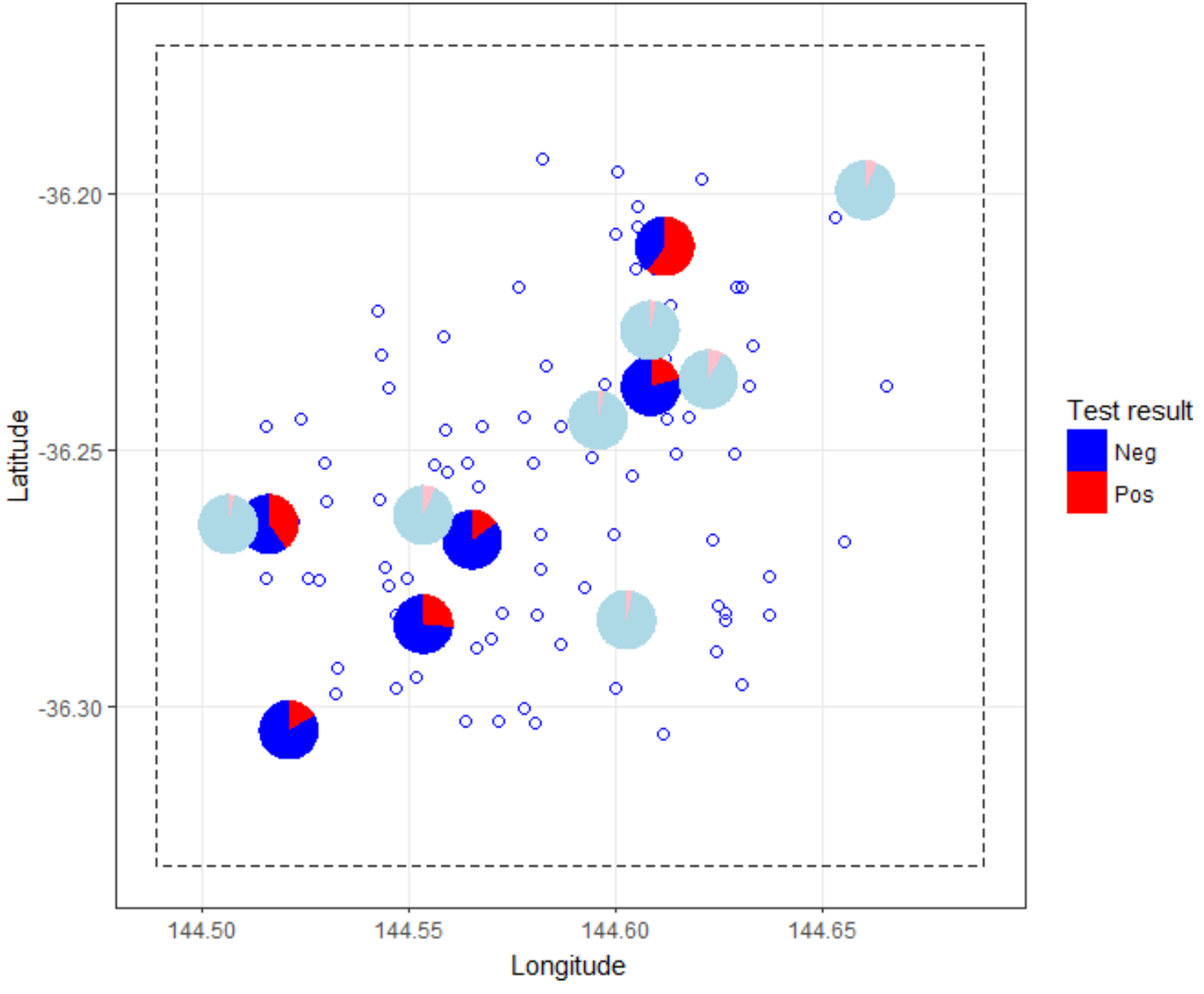


Proportional symbol map showing the proportion of animals on each property testing positive. Dark colour combinations [red-blue] represent high risk properties (those that received stock from BTV zones over the last 12 months); light colour combinations [pink-light blue] represent ‘surveillance’ properties (those with no history of receiving non-Victorian stock).



Bluetongue

- Were weather conditions in northern Victoria over the past 12 months suitable for the bluetongue vector, *Culicoides brevitarsis*?

Kelso J, Milne G (2014) A spatial simulation model for the dispersal of the bluetongue vector Culicoides brevitarsis in Australia. PLoS One 9, DOI: 10.1371/journal.pone.0104646.

OPEN ACCESS Freely available online

PLOS | ONE

A Spatial Simulation Model for the Dispersal of the Bluetongue Vector *Culicoides brevitarsis* in Australia

Joel K. Kelso, George J. Milne*

School of Computer Science and Software Engineering, University of Western Australia, Crawley, Western Australia, Australia

Abstract

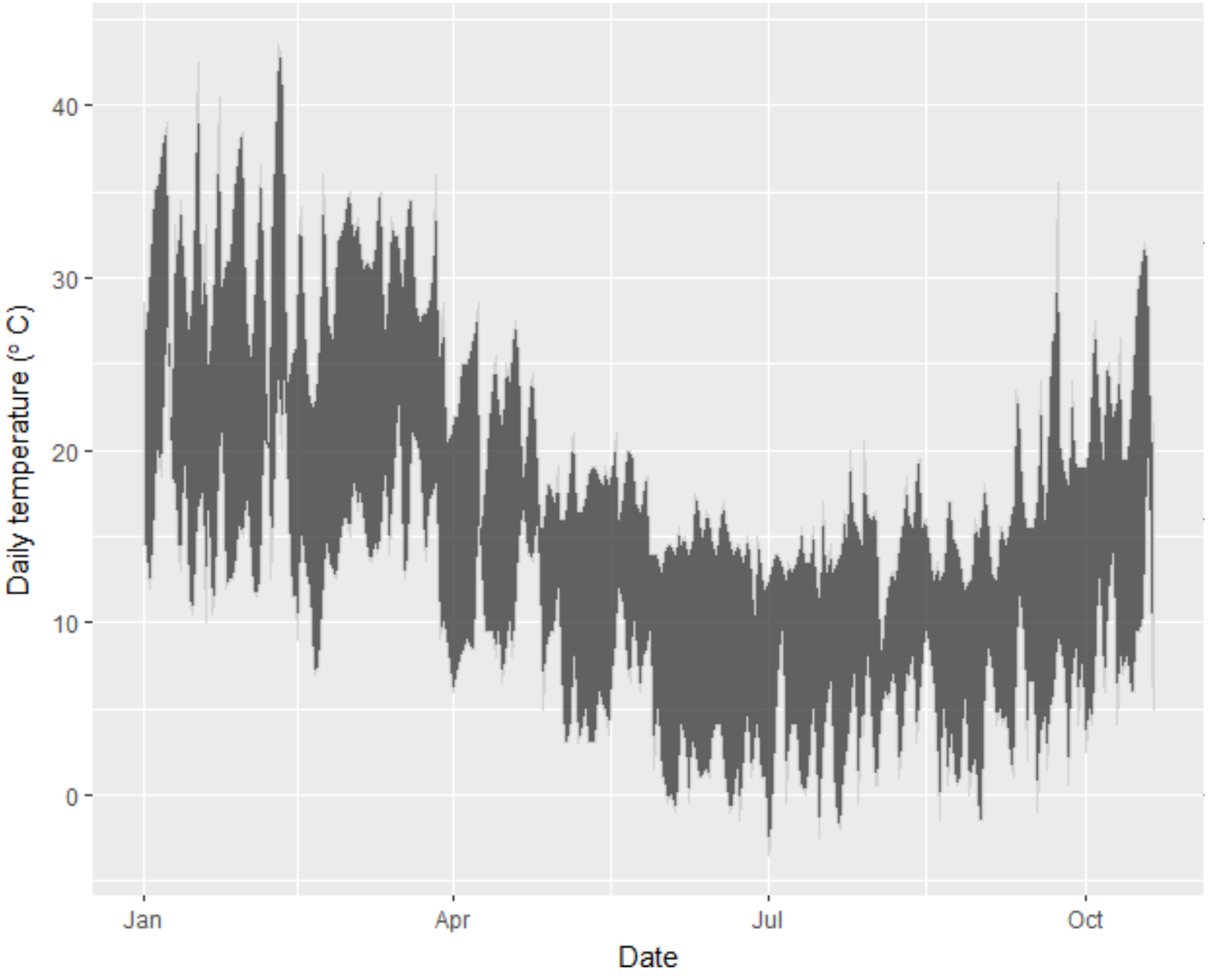
Background: The spread of Bluetongue virus (BTV) among ruminants is caused by movement of infected host animals or by movement of infected *Culicoides* midges, the vector of BTV. Biologically plausible models of *Culicoides* dispersal are necessary for predicting the spread of BTV and are important for planning control and eradication strategies.

Methods: A spatially-explicit simulation model which captures the two underlying population mechanisms, population dynamics and movement, was developed using extensive data from a trapping program for *C. brevitarsis* on the east coast of Australia. A realistic midge flight sub-model was developed and the annual incursion and population establishment of *C. brevitarsis* was simulated. Data from the literature was used to parameterise the model.

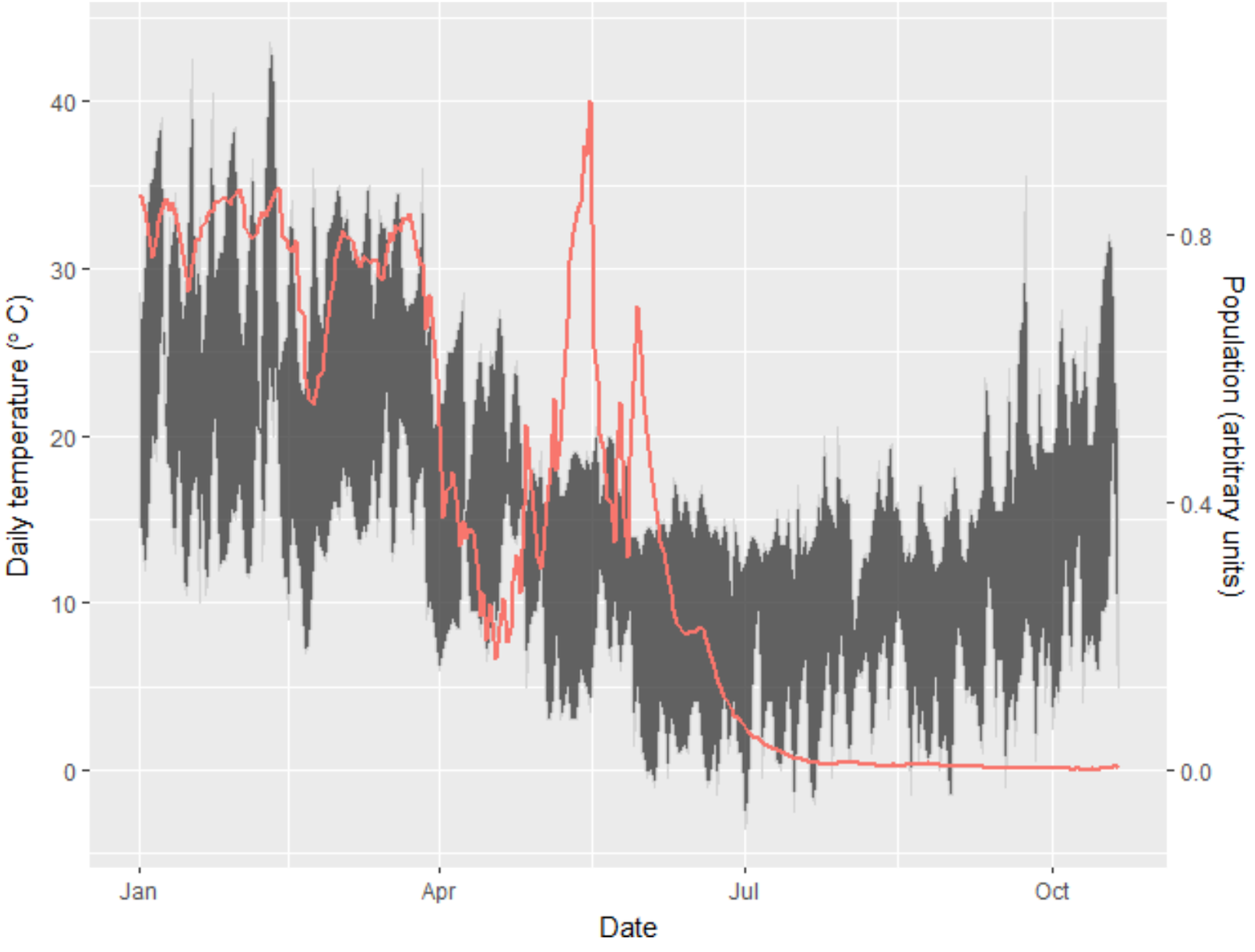
Results: The model was shown to reproduce the spread of *C. brevitarsis* southwards along the east Australian coastline in spring, from an endemic population to the north. Such incursions were shown to be reliant on wind-dispersal; *Culicoides* midge active flight on its own was not capable of achieving known rates of southern spread, nor was re-emergence of southern populations due to overwintering larvae. Data from midge trapping programmes were used to qualitatively validate the resulting simulation model.

Conclusions: The model described in this paper is intended to form the vector component of an extended model that will also include BTV transmission. A model of midge movement and population dynamics has been developed in sufficient detail such that the extended model may be used to evaluate the timing and extent of BTV outbreaks. This extended model could then be used as a platform for addressing the effectiveness of spatially targeted vaccination strategies or animal movement bans as BTV spread mitigation measures, or the impact of climate change on the risk and extent of outbreaks. These questions involving incursive *Culicoides* spread cannot be simply addressed with non-spatial models.

Line plot showing, for the centre of the surveillance study area (longitude 144.5891; latitude -36.25109) daily minimum and maximum temperature (grey shaded area) as a function of calendar date, 1 January 2017 to 21 October 2017.



Line plot showing, for the centre of the surveillance study area (longitude 144.5891; latitude -36.25109) daily minimum and maximum temperature (grey shaded area) as a function of calendar date, 1 January 2017 to 21 October 2017. Superimposed on this plot (as a red line) are the simulated adult Culicoides densities expressed in relative population units (minimum 0, maximum 1) based on Kelso and Milne (2014).



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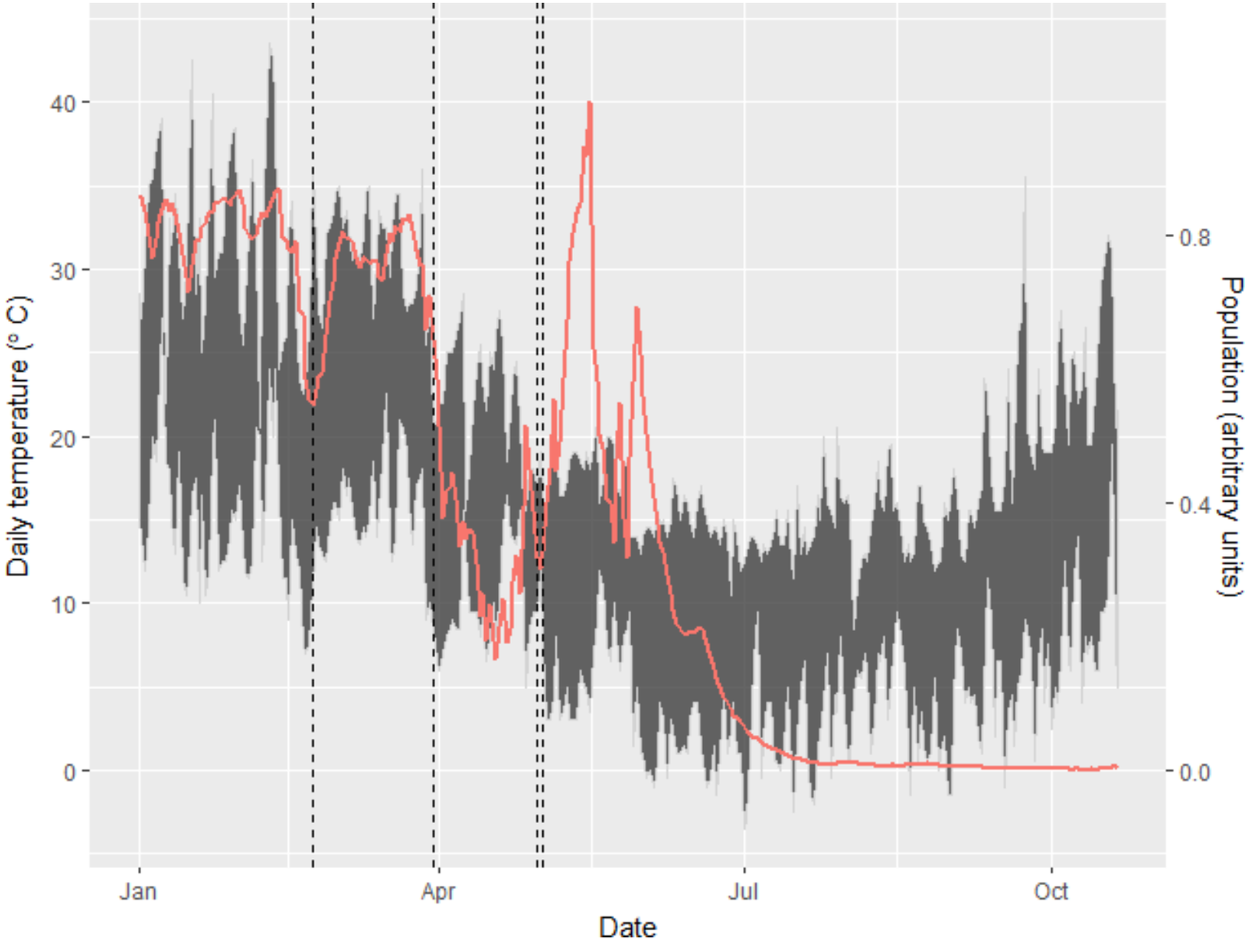
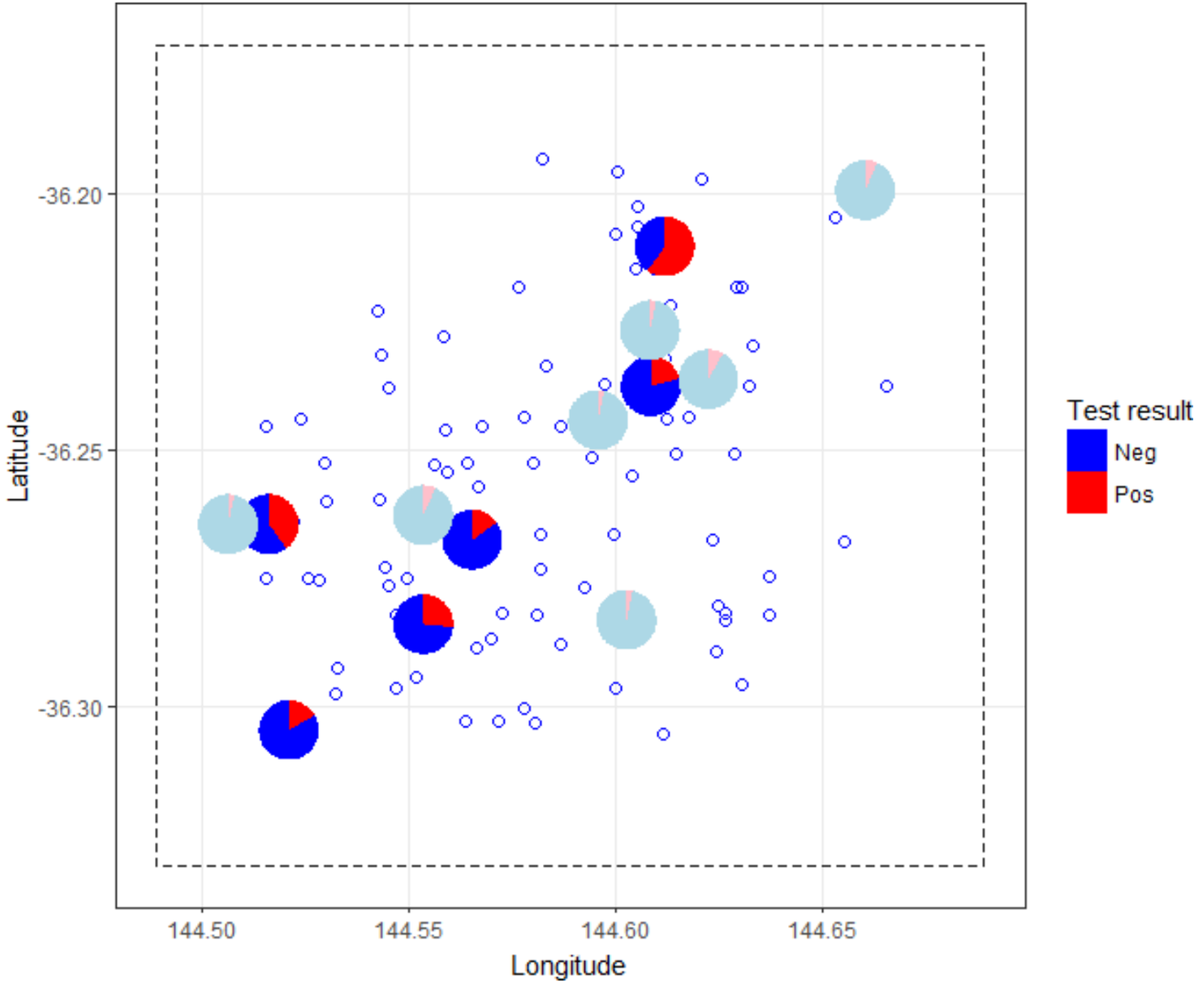


Bluetongue

- Inference

  (1) Relatively high prevalence of BTV exposure on ‘high risk’ properties (those that received stock from BTV zones over the last 12 months); low prevalence of BTV on ‘surveillance’ properties (those those with no history of receiving non-Victorian stock over the past 12 months)

Proportional symbol map showing the proportion of animals on each property testing positive. Dark colour combinations [red-blue] represent high risk properties (those that received stock from BTV zones over the last 12 months); light colour combinations [pink-light blue] represent ‘surveillance’ properties (those with no history of receiving non-Victorian stock).



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  (2) Weather conditions in northern Victoria Jan-Oct 2017 suitable for *Culicoides brevitarsis*

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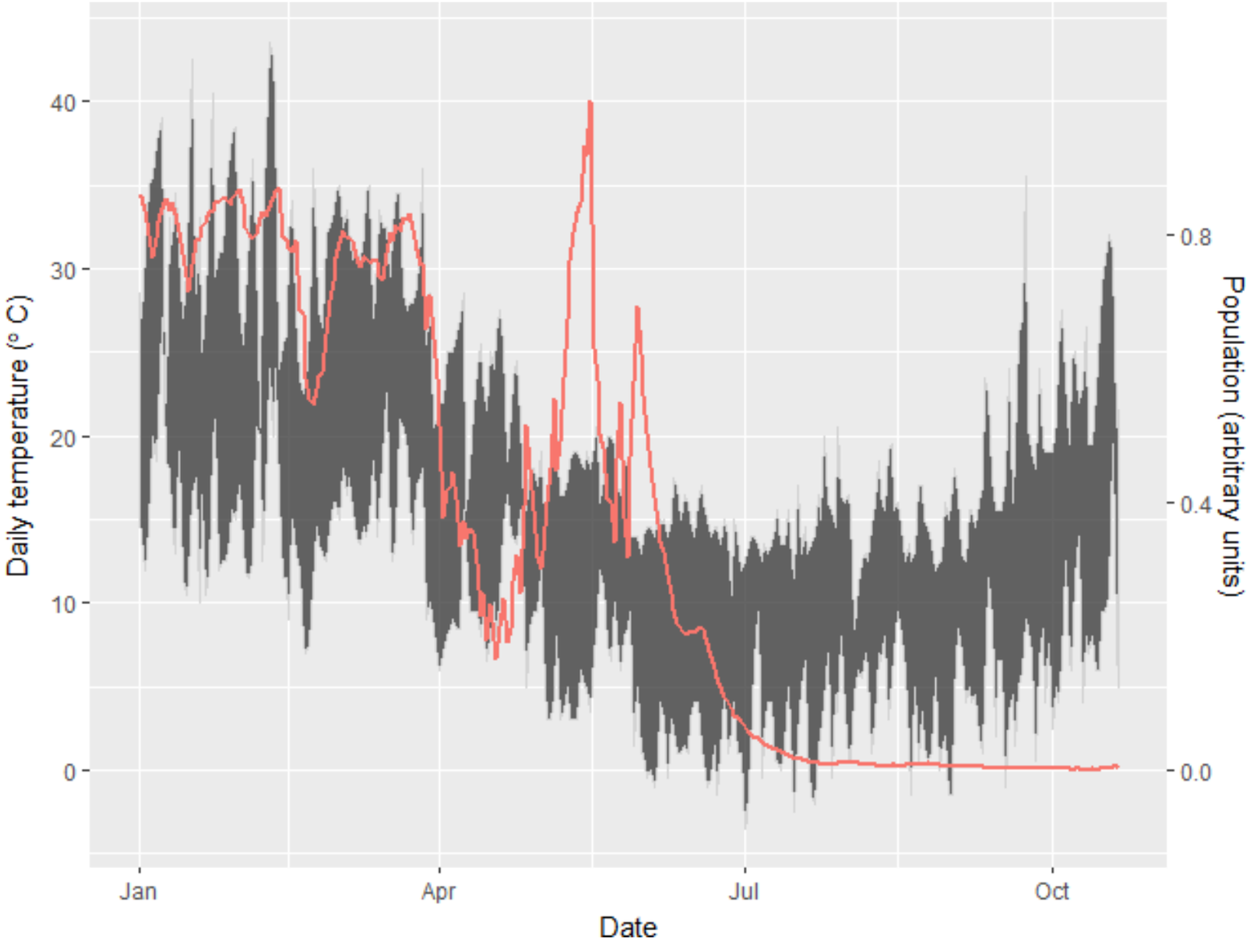

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  (2) Weather conditions in northern Victoria Jan-Oct 2017 suitable for Culicoides brevitarsis

  (3) Results support the hypothesis of a recent incursion of BTV into Victoria with [limited] local spread

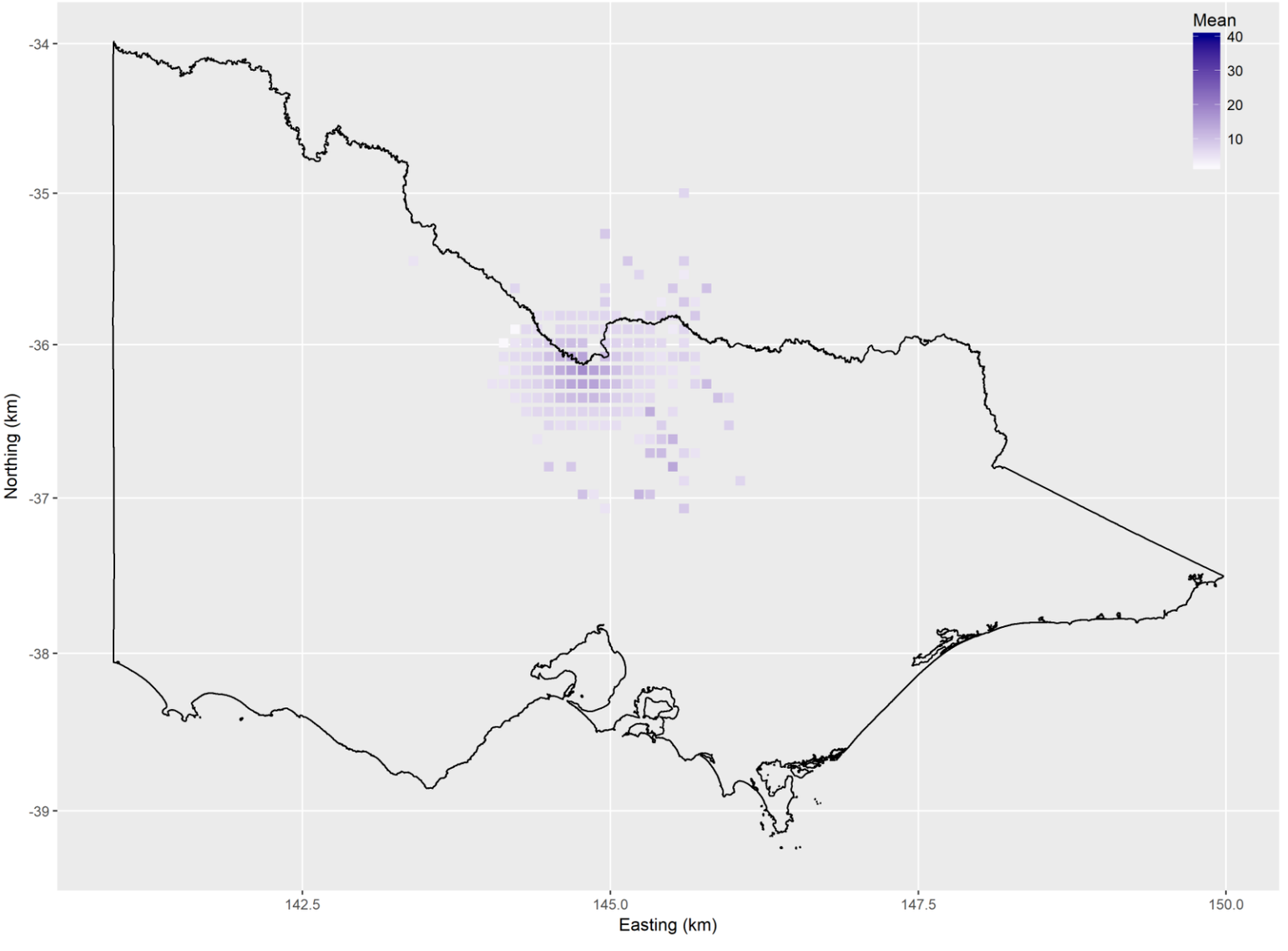
Roadmap

- Detection of bluetongue exposure in Victoria, July 2017
- AADIS modelling

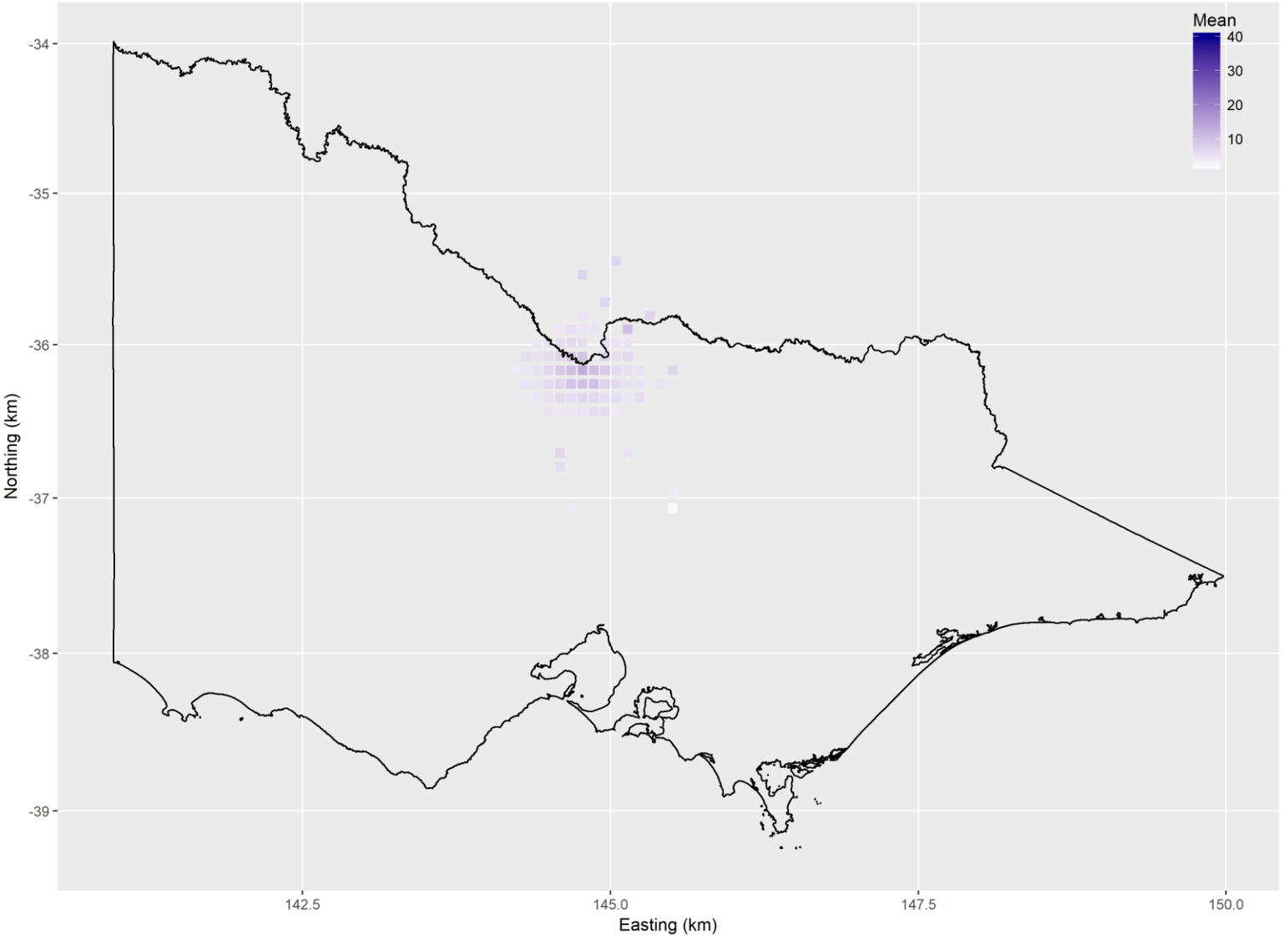
AADIS modelling

- AADIS's use to inform decision making
  - seed Culicoides midges into the study area on the 15th of each month for the period January 2017 to December 2017
  - on which incursion month(s) did Victorian grid cells remain 'Culicoides active' for a sustained period?

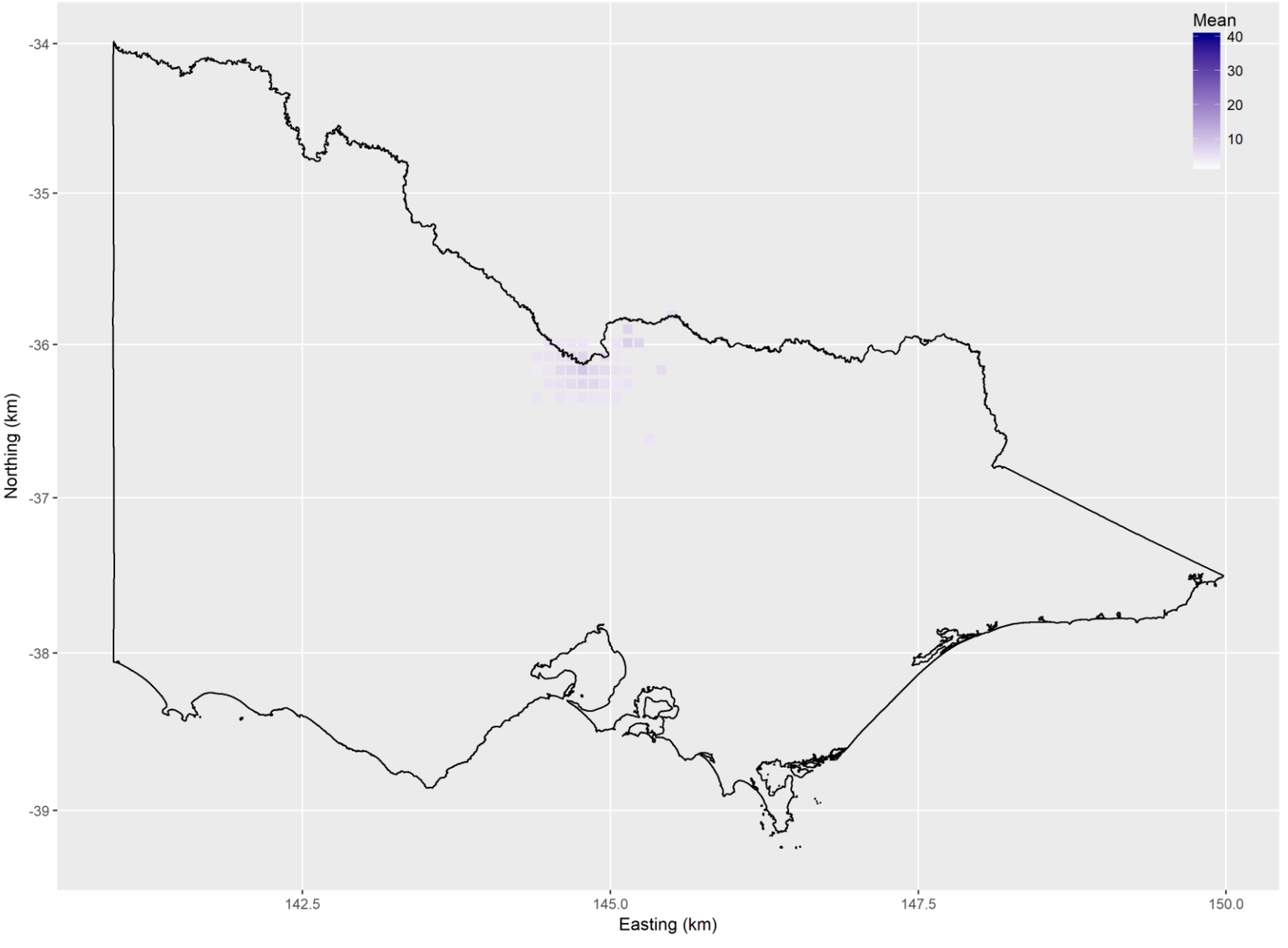
Average number of days a cell remained vector active following Echuca vector incursion occurring in January.
Simulation period: 365 days. Number of runs: 100. Cattle dependency.



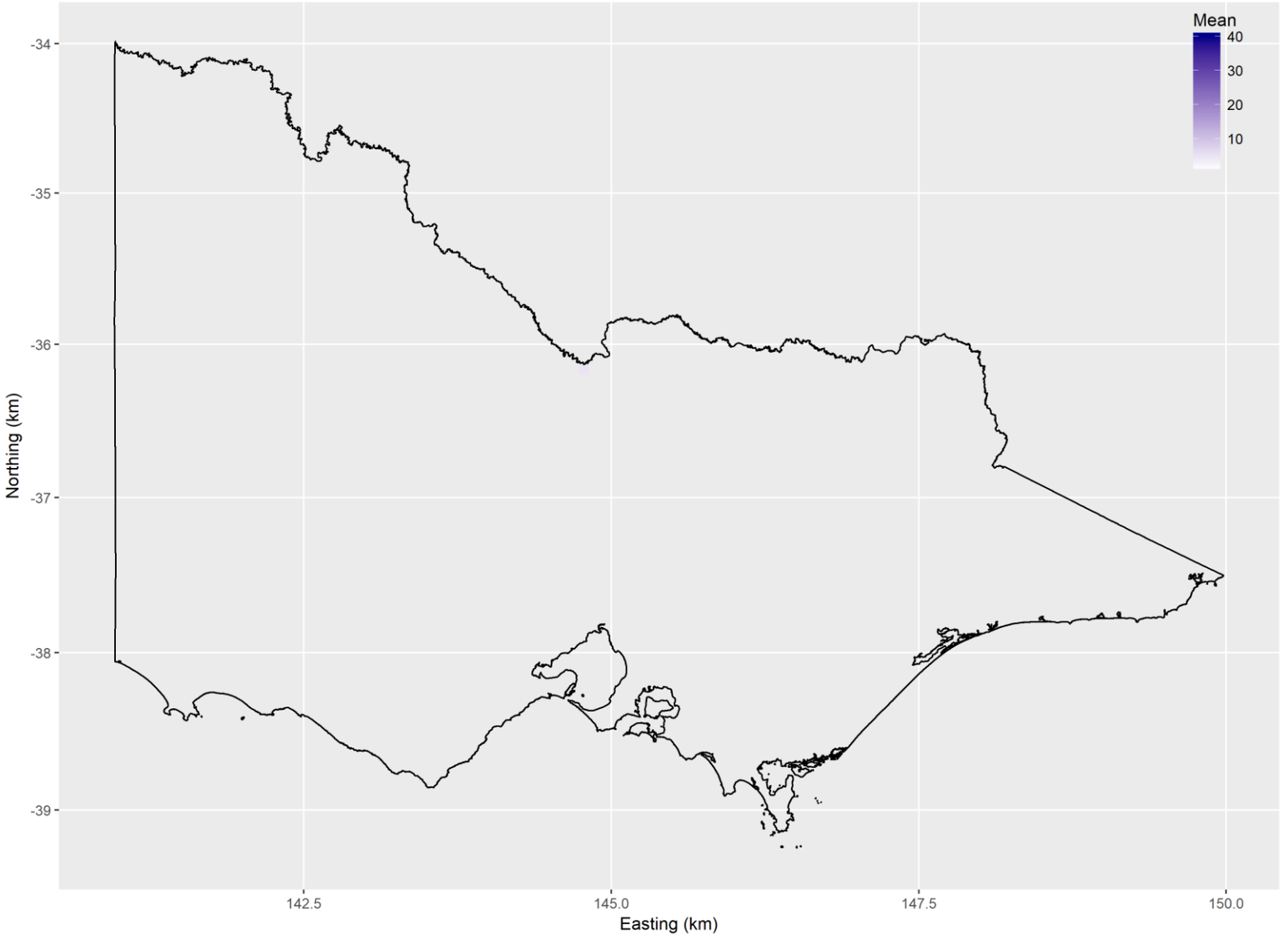
Average number of days a cell remained vector active following Echuca vector incursion occurring in February.
Simulation period: 365 days. Number of runs: 100. Cattle dependency.



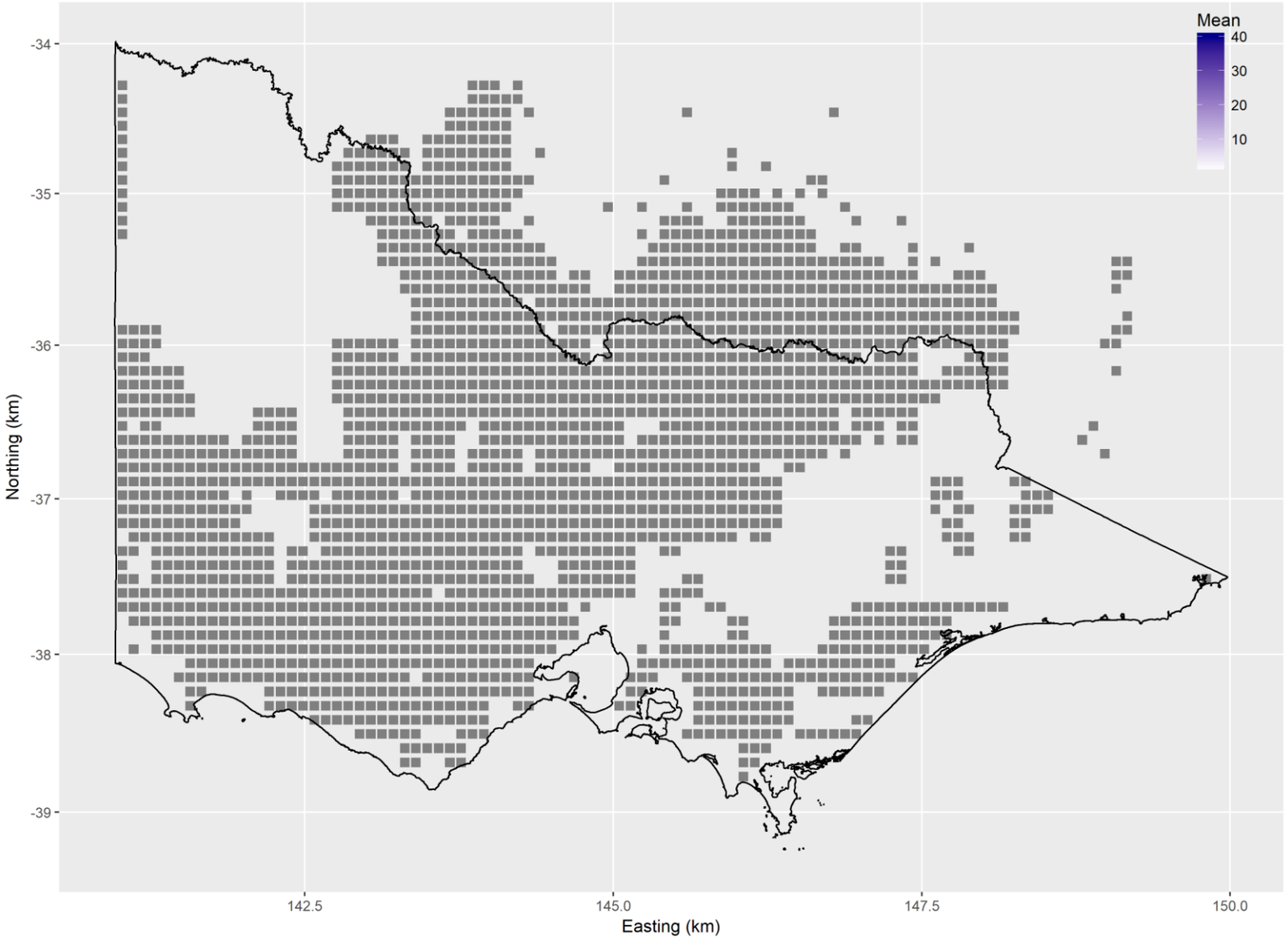
Average number of days a cell remained vector active following Echuca vector incursion occurring in March.
Simulation period: 365 days. Number of runs: 100. Cattle dependency.



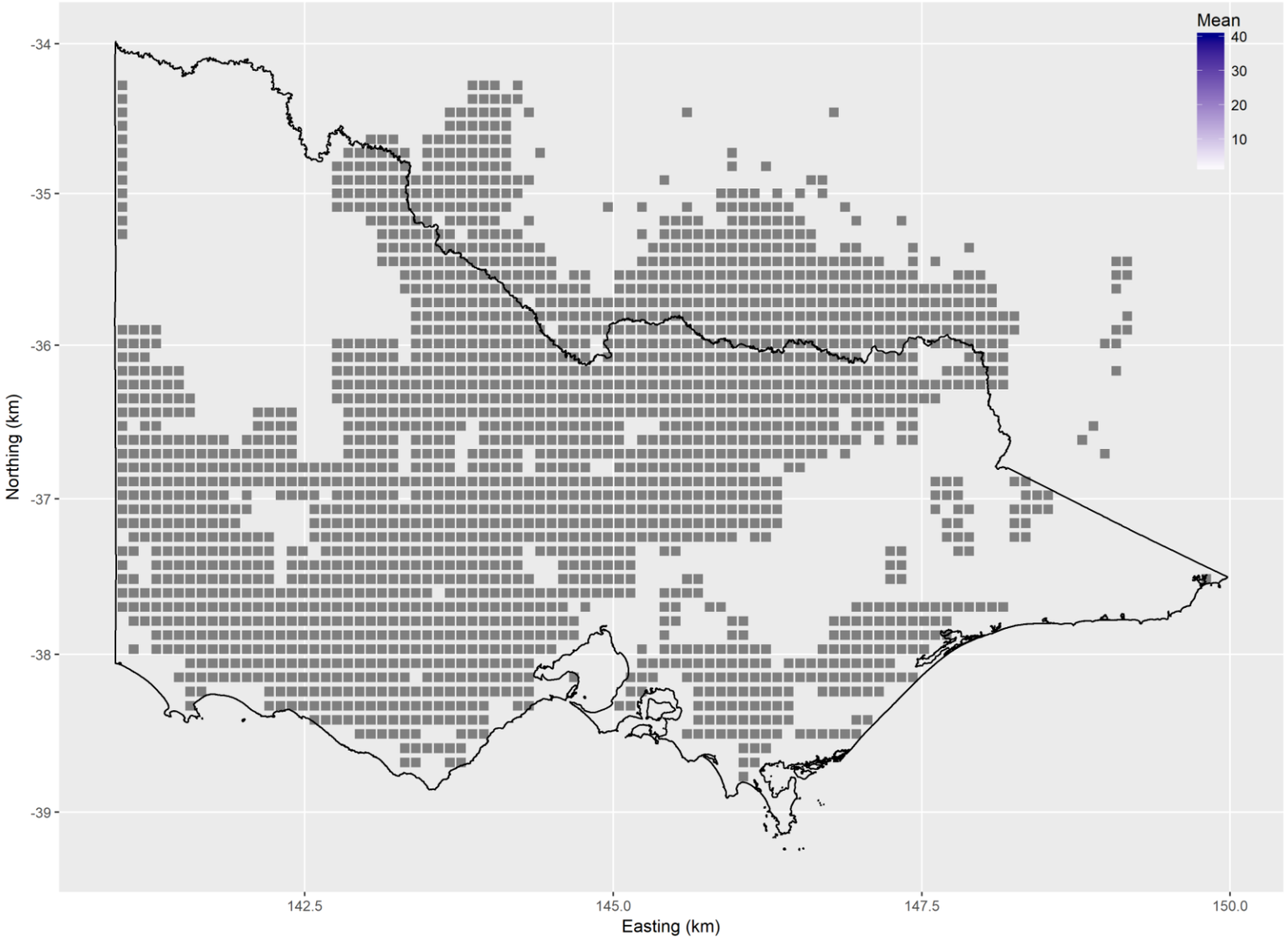
Average number of days a cell remained vector active following Echuca vector incursion occurring in April.
Simulation period: 365 days. Number of runs: 100. Cattle dependency.



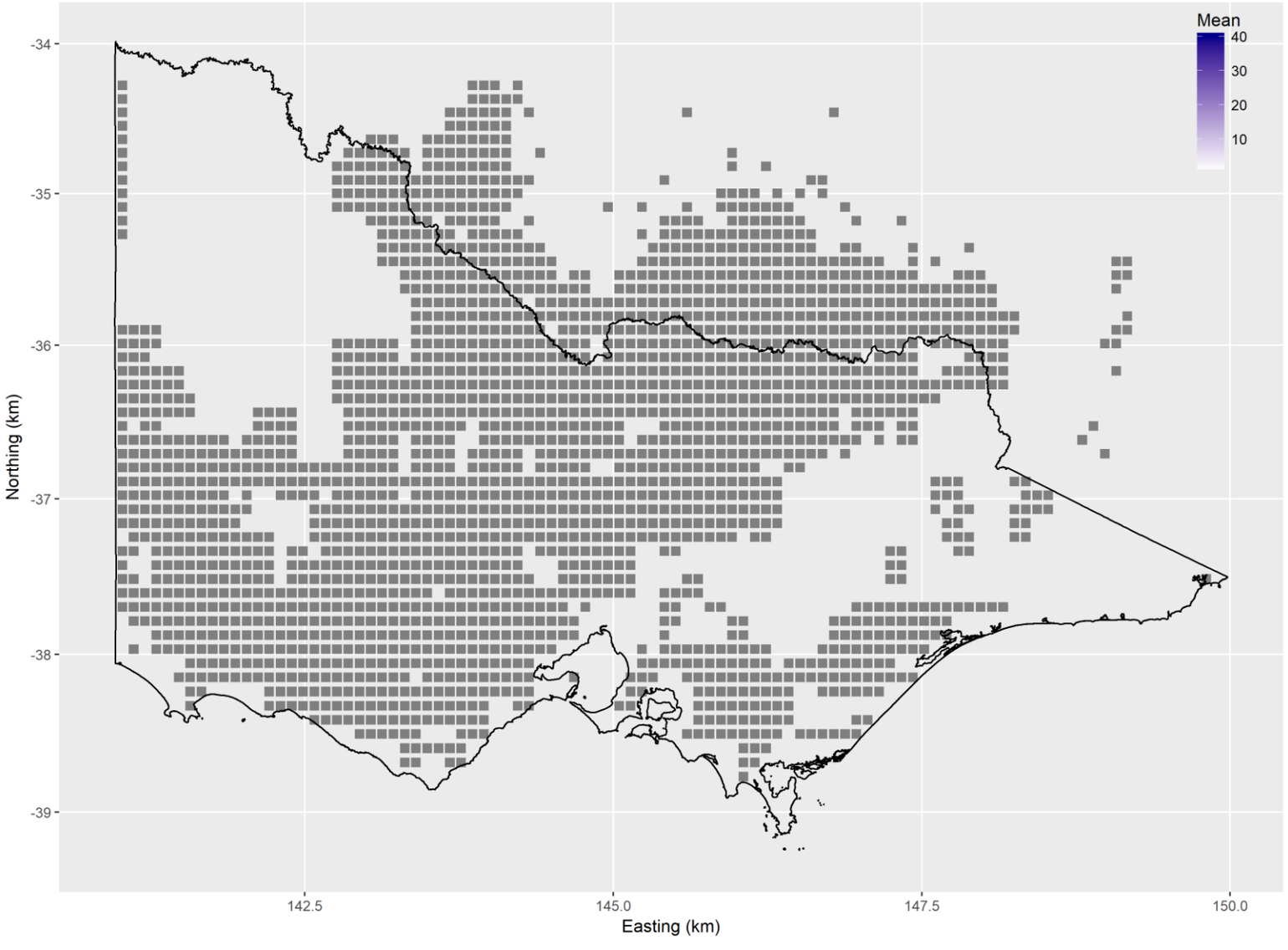
Average number of days a cell remained vector active following Echuca vector incursion occurring in May.
Simulation period: 365 days. Number of runs: 100. Cattle dependency.



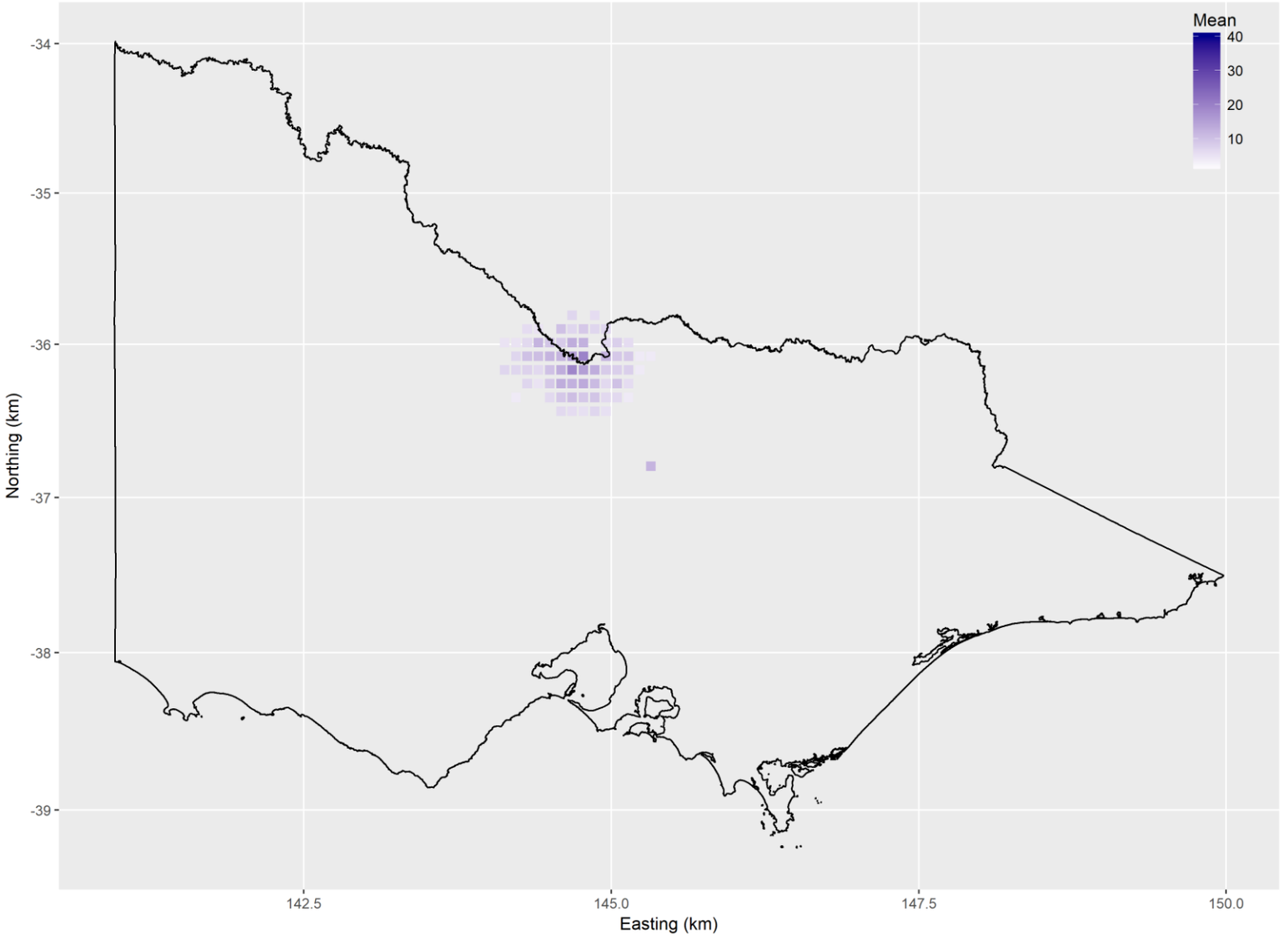
Average number of days a cell remained vector active following Echuca vector incursion occurring in June.
Simulation period: 365 days. Number of runs: 100. Cattle dependency.



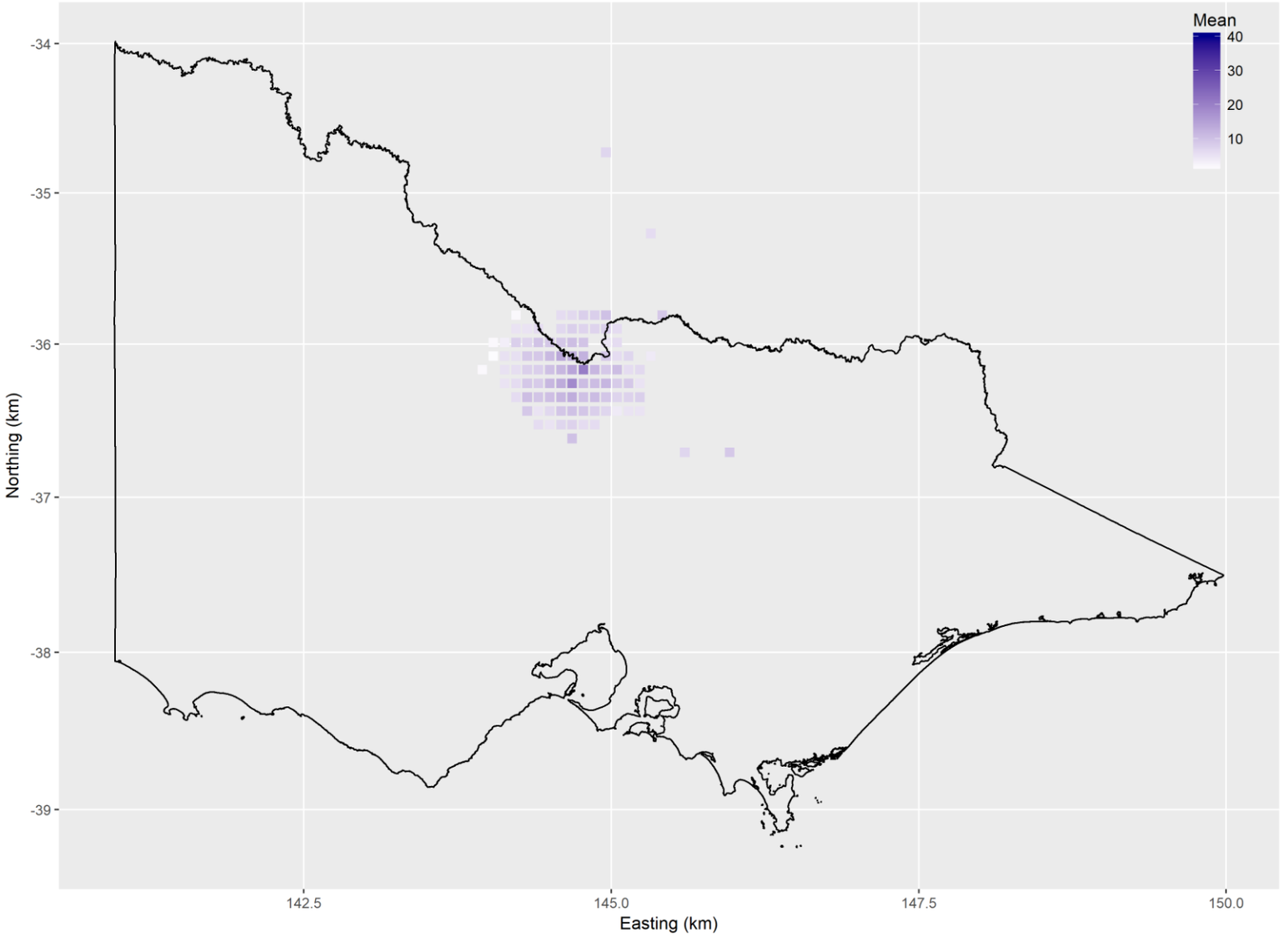
Average number of days a cell remained vector active following Echuca vector incursion occurring in July.
Simulation period: 365 days. Number of runs: 100. Cattle dependency.



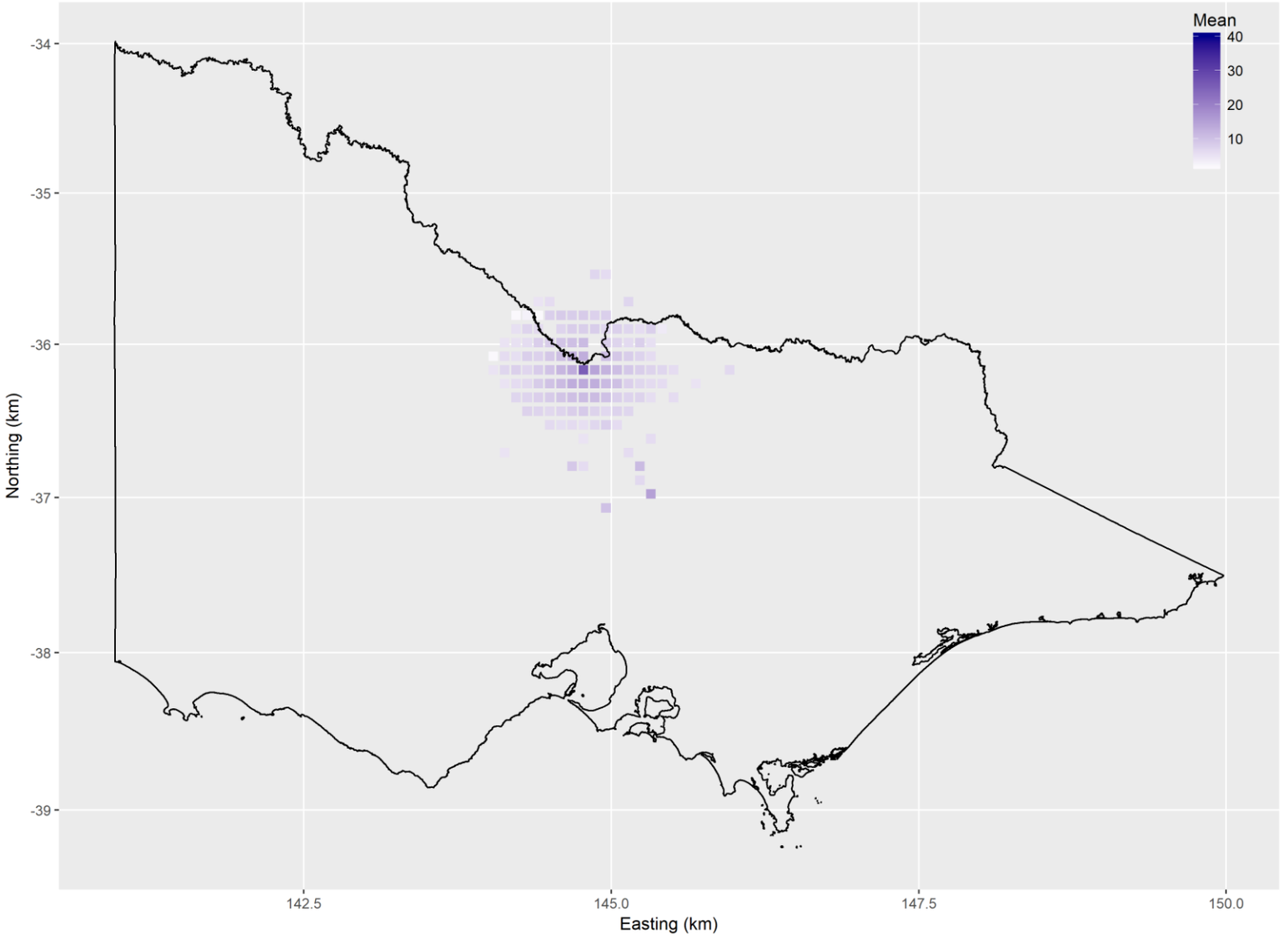
Average number of days a cell remained vector active following Echuca vector incursion occurring in August.
Simulation period: 365 days. Number of runs: 100. Cattle dependency.



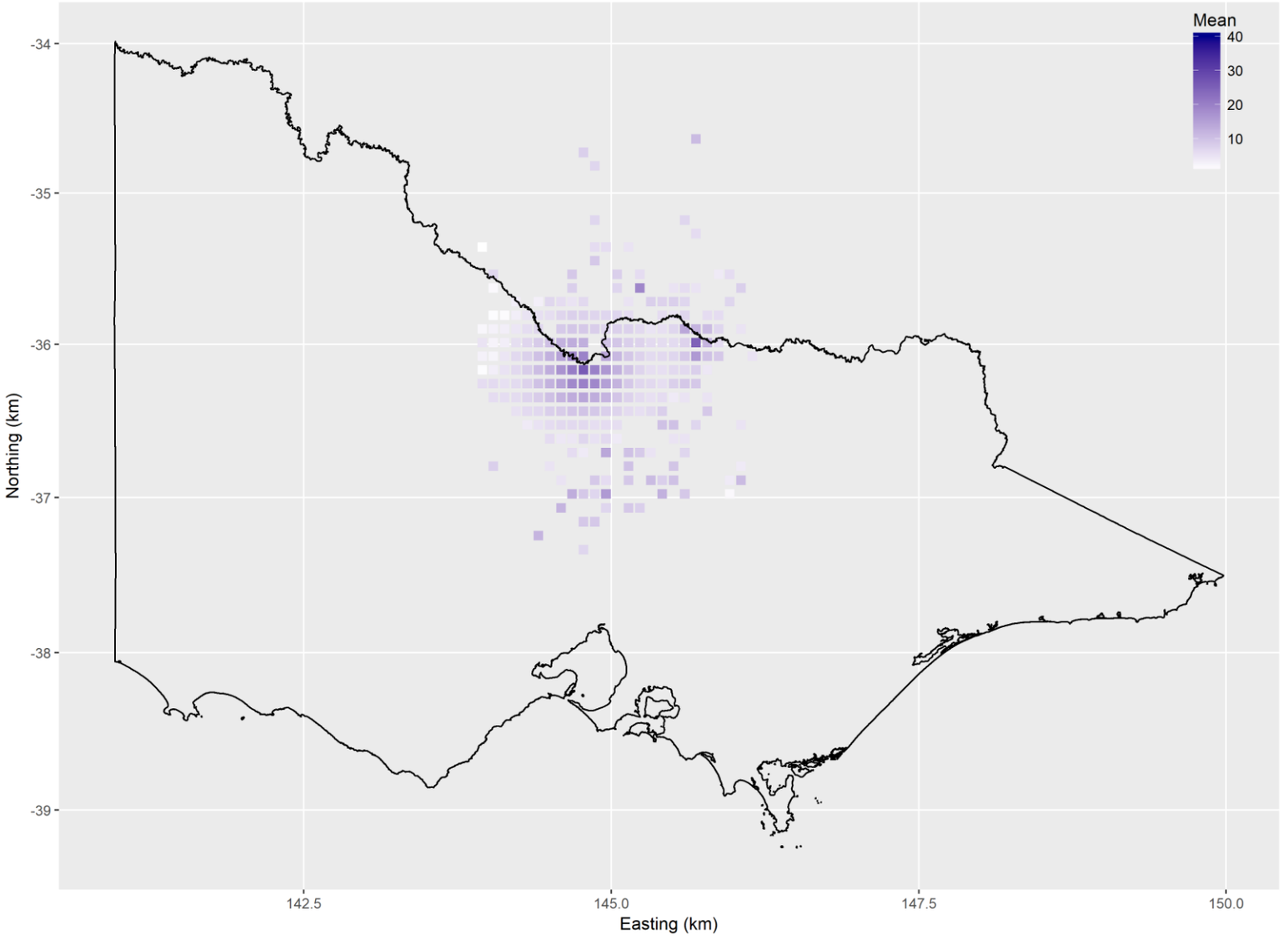
Average number of days a cell remained vector active following Echuca vector incursion occurring in September. Simulation period: 365 days. Number of runs: 100. Cattle dependency.



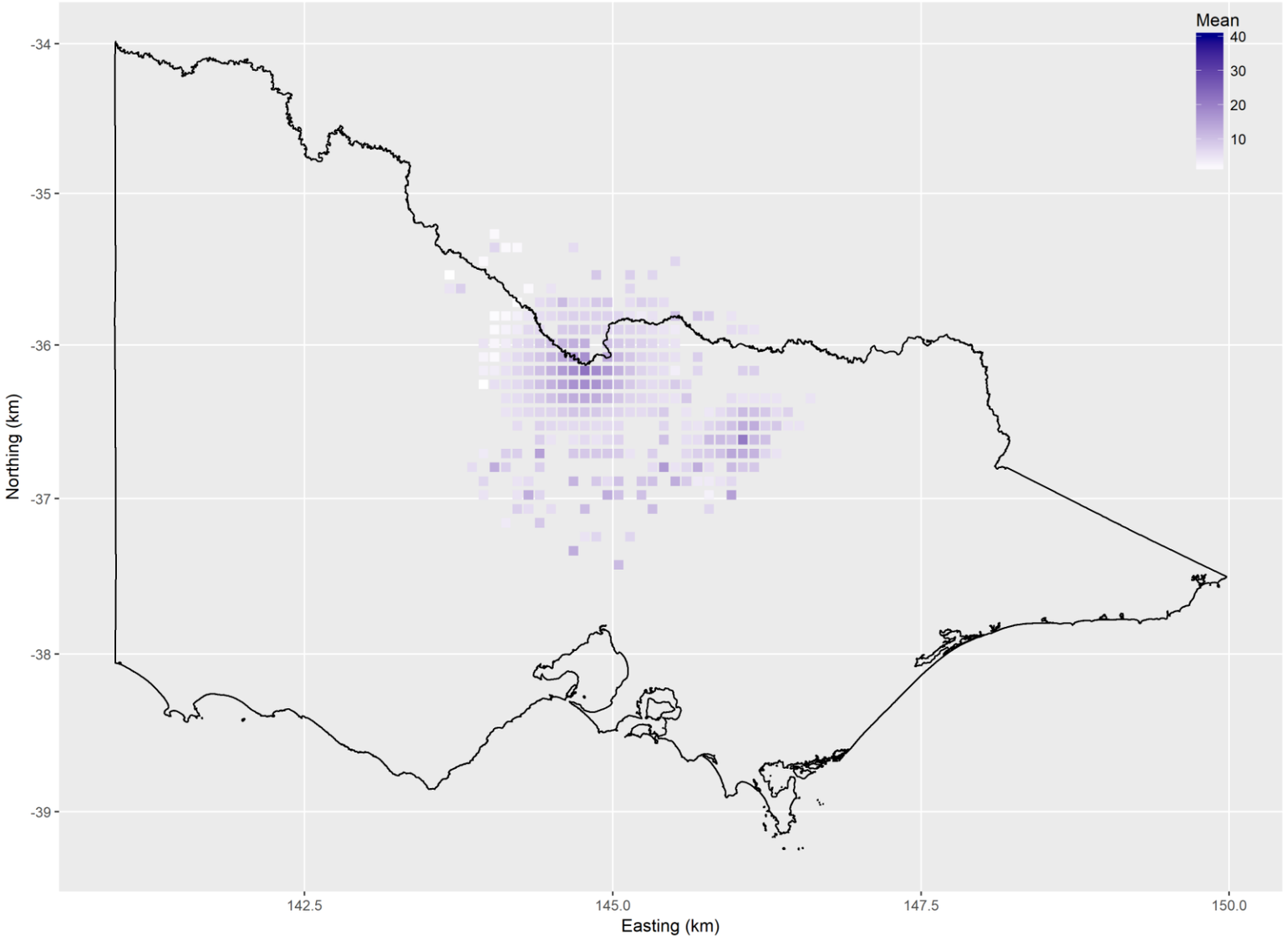
Average number of days a cell remained vector active following Echuca vector incursion occurring in October.
Simulation period: 365 days. Number of runs: 100. Cattle dependency.



Average number of days a cell remained vector active following Echuca vector incursion occurring in November. Simulation period: 365 days. Number of runs: 100. Cattle dependency.



Average number of days a cell remained vector active following Echuca vector incursion occurring in December. Simulation period: 365 days. Number of runs: 100. Cattle dependency.



AADIS modelling

- Grid cells remained Culicoides active for a sustained period (i.e. up to 40 days) when incursions occurred Jan, Feb, Mar, Aug, Sep, Oct, Nov and Dec

- Provides support for the hypothesis that the BTV viraemic animals were transported into Victoria on either 22 Feb 2017 or 30 Mar 2017

- Forensic veterinary epidemiology ...

Bluetongue disease zone lifted but China still shuns dairy heifer exports from northern Victoria

ABC Rural By Warwick Long

Posted 17 January 2018 at 10:08 am

The lucrative trade of exporting live dairy heifers to China continues to be on hold for some farmers despite authorities declaring northern Victoria free of bluetongue disease.

Agents say hundreds of cattle have been rejected from export to China, costing the industry hundreds of thousands of dollars.

Bluetongue is an endemic disease to northern Australia but is not found in southern regions.

Roadmap

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