Use of entomology surveillance data for *Culicoides* abundance modeling in mainland France

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InnovSur 2018
'INNOVATION in Health Surveillance' International Forum
16 to 18 May 2018

1- Introduction

Culicoides (Fig. 1) are biting midges (family Ceratopogonidae, order Diptera) which are vectors of several human and animal diseases [1]: Oropouche virus, Schmallenberg virus and Bluetongue virus (BTV).

Culicoides surveillance system was implemented in France since 2002 in specific areas (Corsica and Mediterranean coastal mainland) and in metropolitan France from 2009 to 2012 and then since 2015 to monitor vectors activity during BTV outbreaks (203 traps). The surveillance system was simplified since 2016 with 24 eco-climatic zones for continental France, each including one capture site.

Fig. 1: *Culicoides imicola* (JC Delécolle)

2- Material and methods

Catch data
- Weekly numbers of *Culicoides* trapped at 203 sites in metropolitan France from 2009 to 2012

Temperature data
- Minimum and maximum air temperature obtained from ALADIN-Climate [2]

Model
- Log-linear, semiparametric Poisson regression for each eco-climatic zone
- Fixed effects: spline on the week number to model the seasonality, minimum and maximum air temperatures
- Random effects: year and catch sites

3- Results

- Marked variations in the seasonal abundance of *Culicoides* among eco-climatic zones with one of two abundance peaks (Fig. 2)
- Onset of activity periods (early January to mid-April)
- End of activity period (end of October to mid-December)
- Maximum abundance at peak (250 to 4,600 *Culicoides*)

4- Discussion

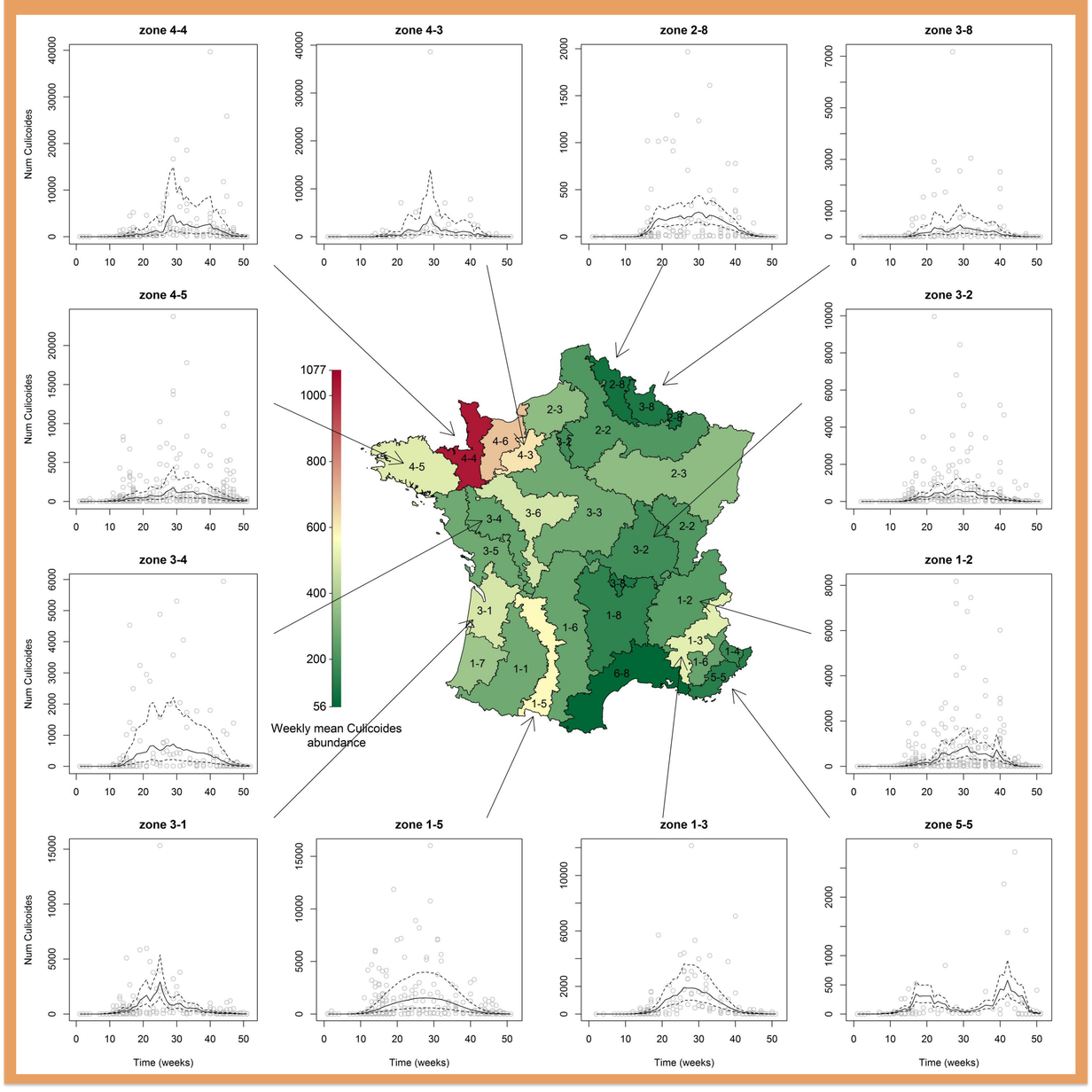
***Culicoides* data**
- *Culicoides* abundance likely underestimated due to zero counts during activity period (due to adverse climatic conditions or problems with the trapping)
- Absence of distinction of *Culicoides* species which means that the abundance of vectors for a specific disease may be overestimated
- Vector activity period may be overestimated if the proportion of pares females among *Culicoides* trapped during the year is not taken into account

Temperature data
- Air temperature, which is a critical factor of *Culicoides* abundance, was considered directly by including weekly minimum and maximum temperature data in the model and indirectly through eco-climatic zones

Results implication
- Improved knowledge about onset and end of activity period within each eco-climatic zone, and identification of at-risk period(s) for *Culicoides*-borne diseases emergence and transmission
- Implementation of risk-based surveillance of diseases in host species (for example, cattle sampling and *Culicoides* monitoring for identification of seasonally BTV-free zones)
- Use *Culicoides* abundance estimation as input for diseases modelling [3, 4]

Fig. 2: Observed (dots) and predicted (solid line) *Culicoides* abundance for some eco-climatic zones

Y-axis values vary among plots. Dotted lines indicate 95% confidence interval. Color within each eco-climatic zone characterizes the overall abundance of *Culicoides* over one year.



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