

## CATTLE TRADE NETWORK IN FRANCE: ANALYSIS AND PREDICTION TO INFORM EPIDEMIOLOGICAL RISK

Elisabeta Vergu<sup>1\*</sup>, Gaël Beaunée<sup>1,2</sup>, Patrick Hoscheit<sup>1</sup>, Mathieu  
Moslonka-Lefebvre<sup>1</sup>, and Pauline Ezanno<sup>2</sup>,

<sup>1</sup>MaIAGE, INRA, Université Paris-Saclay, 78350, Jouy-en-Josas, France

<sup>2</sup>BIOEPAR, INRA, Oniris, la Chantrerie, 44307, Nantes, France

elisabeta.vergu@inra.fr (\*corresponding author),  
gael.beaunee@inra.fr, patrick.hoscheit@inra.fr,  
mathieu.moslonka@gmail.com, pauline.ezanno@oniris-nantes.fr

Informing prevention and control of infectious diseases in livestock populations at regional level necessitates the investigation of spread underlying structure represented by animal trade network and the coupling of intra-herd infection dynamics. In this talk, I will first show some results from the analysis of the French cattle movement network over several years using tools from graph theory to investigate the temporal stability of its main descriptors and the fidelity over time of transaction partners. Proxies for pathogen spread, such as percolation and reachability ratio, accounting for network time-varying properties, were also computed to explore contrasting strategies for the prevention of epidemics [1]. I will also present a simple and efficient microeconomic model incorporating generic components for trade of cattle at the level of agricultural holdings [2]. If time permits, I will present the model of regional spread of *Mycobacterium avium subs. paratuberculosis*, responsible for bovine paratuberculosis. Intra-herd infection dynamics, described by stochastic models in discrete time were coupled through trade movement and the efficacy of control strategies was assessed by numerical explorations [3].

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## **References**

- [1] Moslonka-Lefebvre, M., Gilligan, C., Monod, H., Belloc, C., Ezanno, P., Filipe, J.A.N\*, Vergu, E.\* (2016) *Market analyses of livestock trade networks to inform the prevention of joint economic and epidemiological risk*, J. Roy. Soc. Interface, 13 (116), 20151099.
- [2] Hoscheit, P., Geeraert, S., Beaune, G., Monod, H., Gilligan, C.A.G, Filipe, J., Vergu, E.\*, Moslonka-Lefebvre, M. (to appear). *Dynamical Network Models for Cattle Trade: Towards Economy-Based Epidemic Risk Assessment*, J. Complex. Netw.
- [3] Beaune, G., Vergu, E., Ezanno, P. (submitted). *Controlling bovine paratuberculosis at a regional scale: towards a decision modelling tool*.