

Spatial clustering of antimicrobial resistant organisms among dairy cattle relative to European starling night roosts

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Introduction

- European starlings (*Sturnus vulgaris*), one of the most abundant wild bird species in North America, contaminate livestock feed with their excreta potentially disseminating animal and zoonotic pathogens to dairy cattle (Fig.1). However, their role in disseminating antimicrobial resistant organisms has not been explored.
- Antimicrobial resistant *Escherichia coli* (*E. coli*), *Salmonella* and *Campylobacter jejuni* have been isolated from starlings (2).
- Daily, starlings leave their night roosts to search for feed in livestock facilities. On their return flight to roost sites, they visit different farms before they congregate to roost (1). Based on this behavior and previous studies implicating them in the dispersal of zoonotic enteric pathogens, we hypothesized that starling roost sites could be centers for spreading antimicrobial resistant organisms.
- In a previous study, starling night roosts were identified as potential foci for the dissemination of *E. coli* O157:H7 among dairy farms (3).



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Fig.1. European starlings on cattle feeding sites.

Objective

- To determine whether starling night roosts could be centers for spreading antimicrobial resistant organisms among livestock operations.

Materials and Methods

- Bovine fecal samples were collected from 150 dairy farms in Ohio.
- Each farm was visited twice (in summer and fall) between 2007 and 2009.
- A total of 1490 bovine fecal samples (10 samples/farm over two visits) were tested for ciprofloxacin and cefotaxime resistant *E. coli*.
- Using the spatial scan statistic with a Bernoulli model, focal scans were conducted to determine if clusters of resistant organisms from bovine fecal pats were centered around the four starling night roosts identified in the study area (Fig.2.)

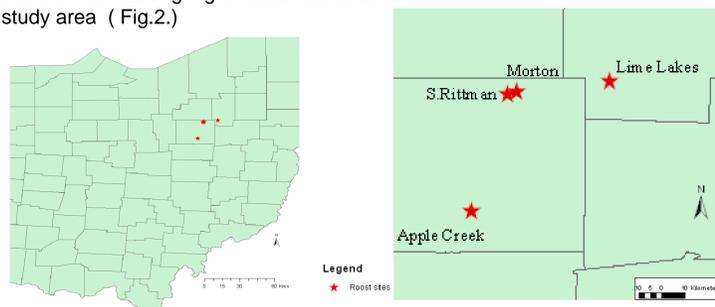


Fig.2. Starling night roost locations in the study area

Results

- Statistically significant ($\alpha = 0.05$) cefotaxime and ciprofloxacin resistant *E. coli* clusters were identified around the starling night roosts (Table 1&2; Fig. 3&4).
- Statistically significant spatial clusters were identified around the night roosts after adjusting for season and on farm starling density (Table 3).

Table 1. Significant spatial clusters of cefotaxime resistant *E. coli* among dairy cattle around starling night roost sites in Ohio (2007-2009).

Roost sites	O/E cases	Relative risk	No. of farms	Radius (km)	P-value
Apple Creek	1.33	1.99	75	37.67	<0.001
Lime Lakes	1.24	1.63	75	52.32	0.001
Morton	1.38	2.14	73	45.14	<0.001
South Rittman	1.40	2.20	72	43.99	<0.001

O/E = observed/expected

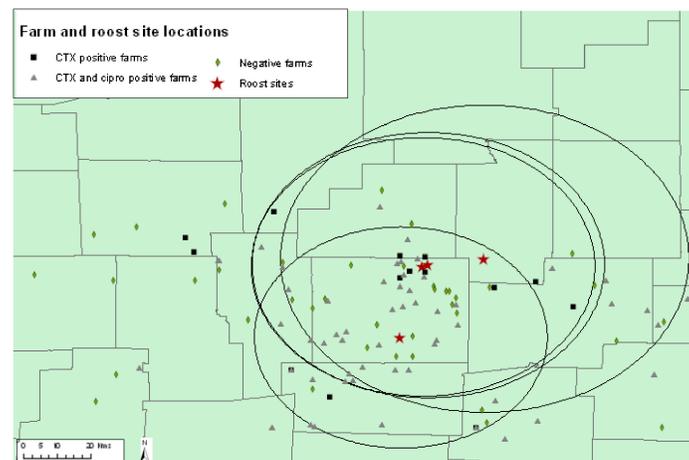


Fig. 3. Statistically significant cefotaxime resistant *E. coli* clusters among dairy farms around starling night roost sites in Ohio (2007-2009).

Table 2. Significant spatial clusters of ciprofloxacin resistant *E. coli* among dairy cattle around starling night roost sites in Ohio (2007-2009).

Roost site	O/E cases	Relative risk	No. of farms	Radius (km)	P- value
Apple Creek	1.43	2.48	75	37.67	<0.001
Lime Lakes	1.23	1.55	72	51.64	0.003
Morton	1.35	2.07	75	45.95	<0.001
South Rittman	1.38	2.21	75	47.90	<0.001

O/E = observed/expected

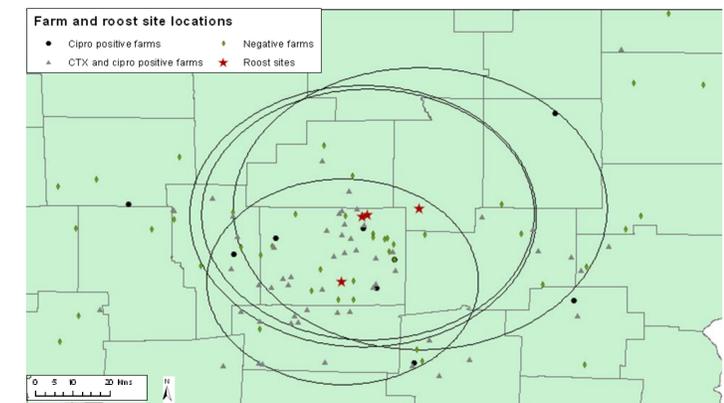


Fig. 4. Statistically significant ciprofloxacin resistant *E. coli* clusters among dairy farms around starling night roost sites in Ohio (2007-2009).

Table 3. Spatial clusters of ciprofloxacin or cefotaxime resistant *E. coli* around starling night roosts in Ohio dairy cattle farms 2007-2009. Clusters were adjusted for season and on farm starling density.

Roost sites	AMR	No. of farms	Radius (Km)	P-value
Apple Creek	CTX	69	33.32	0.004
Apple Creek	Cipro	52	26.99	<0.001
Lime Lakes	CTX	67	50.25	0.006
Lime Lakes	Cipro	72	51.64	0.004
Morton	CTX	74	45.95	<0.001
Morton	Cipro	74	45.95	<0.001
South Rittman	CTX	72	43.99	<0.001
South Rittman	Cipro	74	47.23	<0.001

CTX= Cefotaxime

Cipro= Ciprofloxacin

Summary and Conclusions

- The risk of carriage of antimicrobial resistant organisms in cattle closest to starling night roosts was higher compared to cattle located on farms further from these sites.
- Starlings might have an important role in spreading antimicrobial resistant *E. coli* to livestock environments, posing a threat to animal and public health.

Acknowledgements

This research was funded by the United States Department of Agriculture through their National Research Initiative (USDA-NRI), Epidemiological Approaches to Food Safety Grant # 2006-01227. Computational infrastructure was attained through a grant to D.L.Pearl from the Canada Foundation for Innovation and the Ontario Ministry of Research and Innovation.

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