

Carbapenemase-producing
Enterobacteriaceae from wastewater
disseminated in the environment

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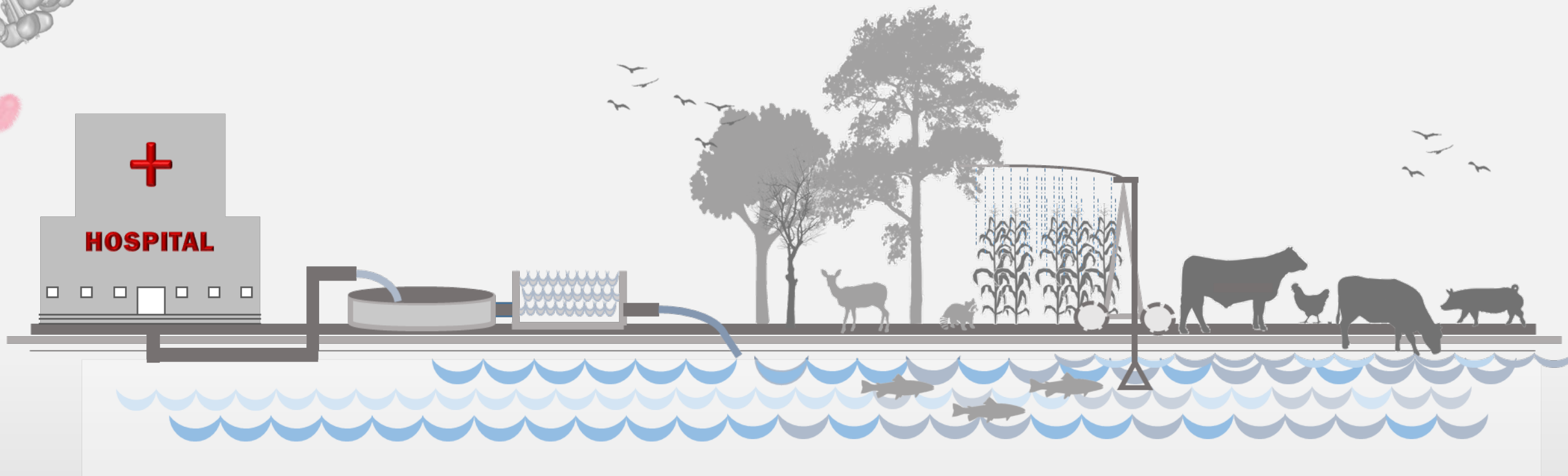


THE OHIO STATE UNIVERSITY

COLLEGE OF VETERINARY MEDICINE

Hypothesis:

Hospital CPE \rightleftarrows Wastewater \rightleftarrows Environment \rightleftarrows Animal Agriculture

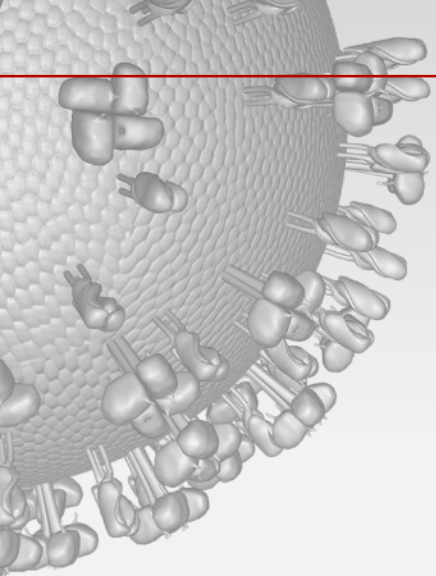


Objective:

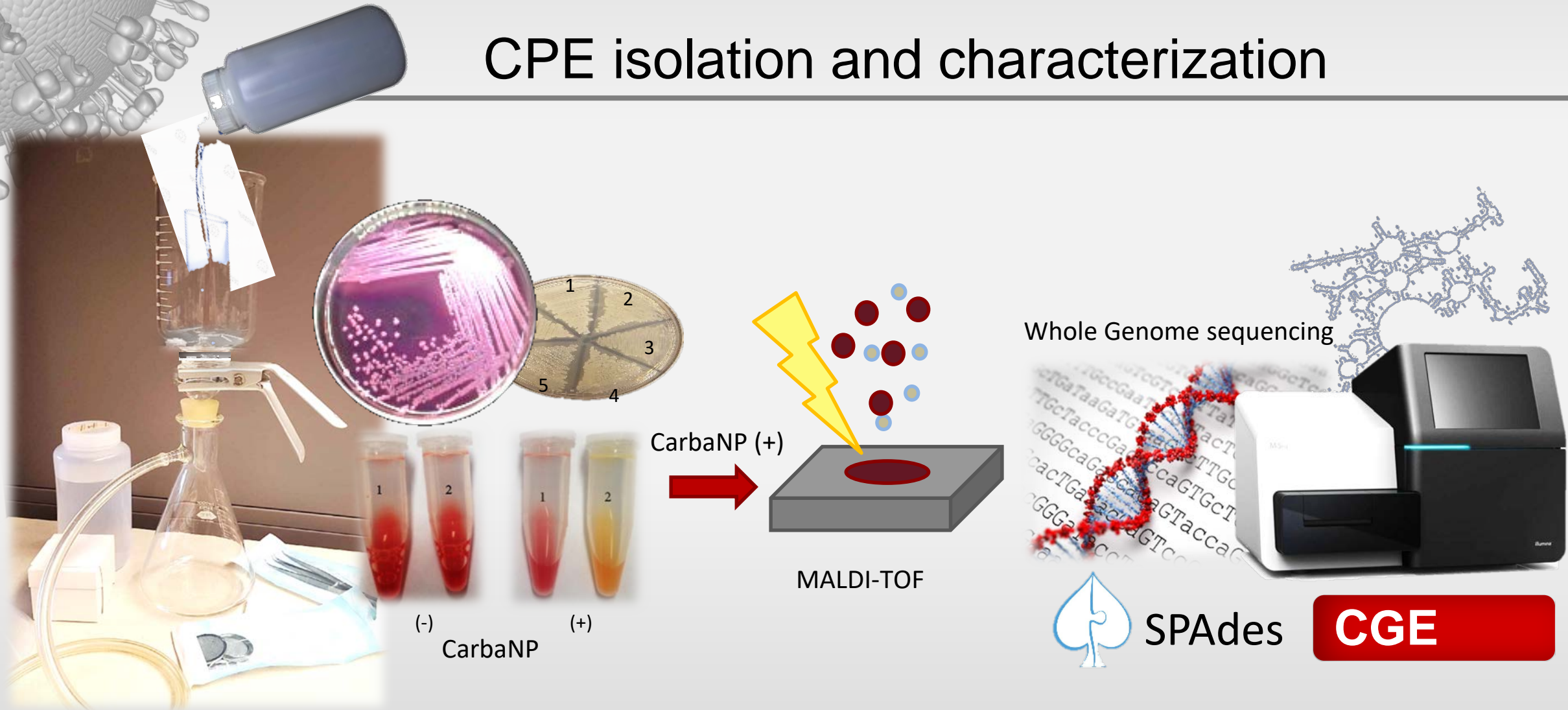
Describe the dissemination of CPE from waste into the environment, and the risk to animal agriculture

National survey of US WWTPs

- Contacted 96 WWTP in 48 continental US states
 - One metropolitan, one rural in each state
- 1L samples
 - Effluent
 - Upstream
 - Downstream
- Vacuum filtered, selective culture



CPE isolation and characterization



National survey of US WWTPs

- 50 WWTPs provided samples
 - 26 metropolitan
 - 24 rural
- Effluent
- Upstream
- Downstream

CRE recovered

15 (30%)

13 (50%)

2 (8%)

9 (18%)

4 (8%)

10 (20%)

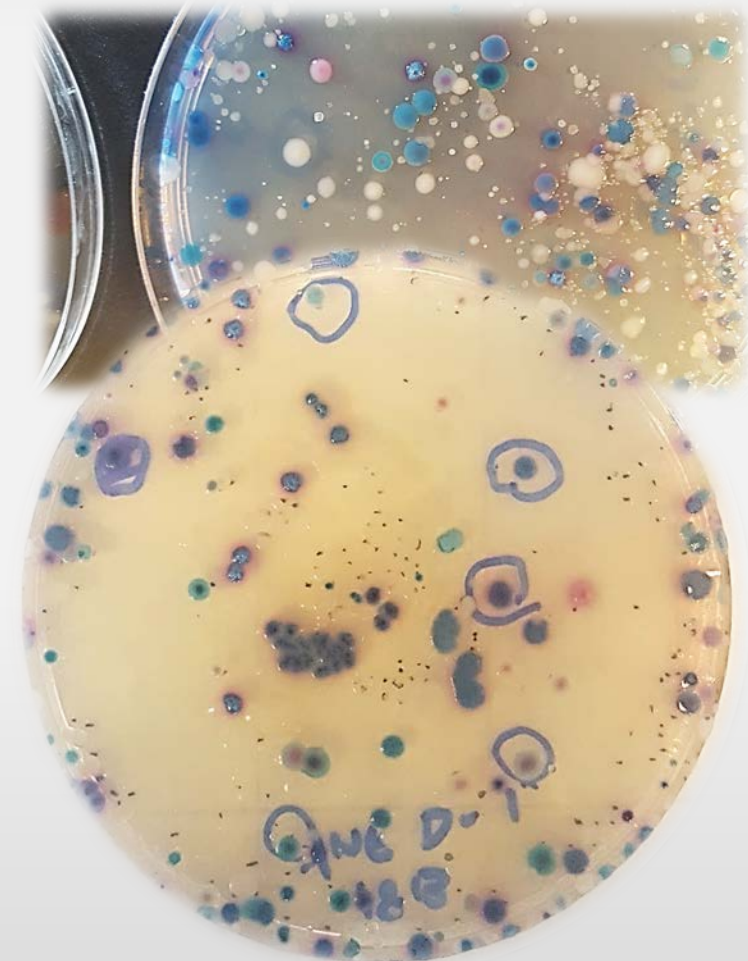
National survey of US WWTPs

30 total CRE isolates

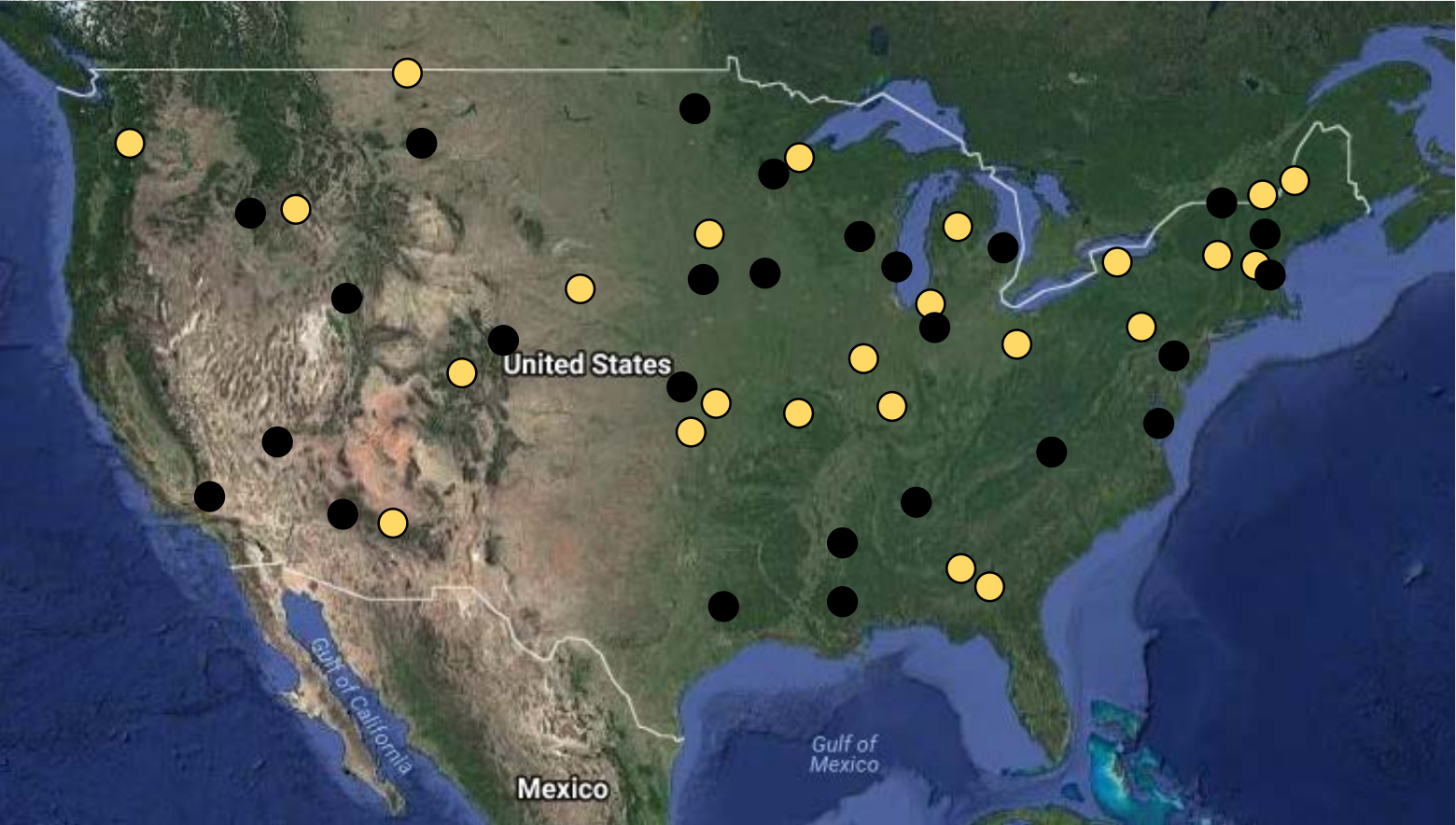
- 9 *Enterobacter* spp.
- 7 *Klebsiella* spp.
- 5 *Aeromonas* spp.
- 3 *Citrobacter freundii*
- 3 *Escherichia coli*
- 3 *Raoultella* spp.

Genotypes

- 22 bla_{KPC-2}
- 3 bla_{KPC-3}
- 2 bla_{GES-5}
- 1 bla_{NDM-1}
- 1 bla_{NDM-5}
- 1 bla_{NDM-7}
- 1 bla_{VIM-1}



Participating WWTPs



● Metropolitan

● Rural

CPE-positive WWTPs

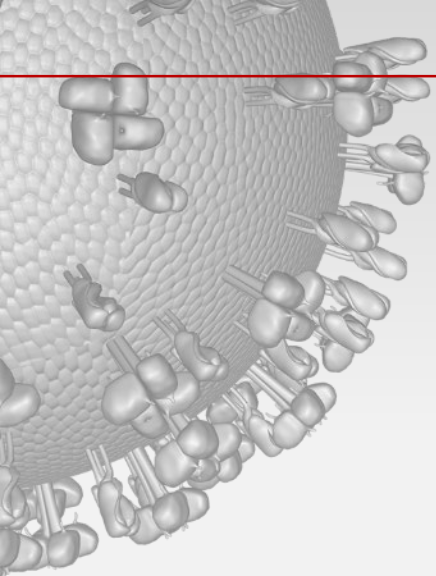


● Metropolitan

● Rural

Jackson Pike Wastewater Treatment Plant Columbus Ohio USA

Scioto River discharge



CPE in the Scioto River



**Upstream
river water**

**Influent
untreated**

**Effluent
treated**

**Downstream
river water**

**Way Downstream
river water**

Jackson Pike/Scioto River CPE

246 non-duplicate, “healthcare-associated”

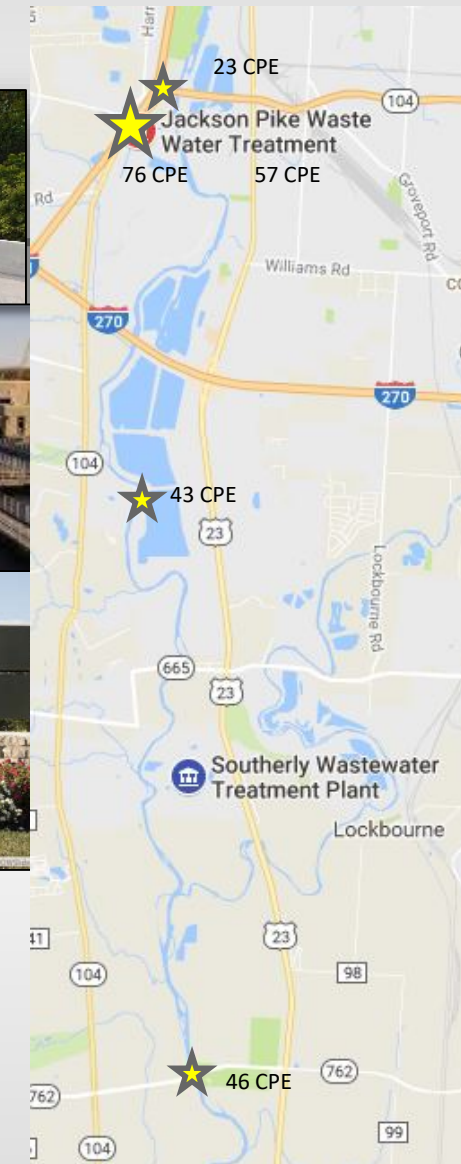
- 202 bla_{KPC} 57% *Enterobacter* 20% *Klebsiella*
 - 173 bla_{KPC-2}
 - 13 bla_{KPC-3}
 - 16 bla_{KPC}
- 42 bla_{NDM} 74% *E. coli* 19% *R. ornithinolytica*
 - 1 bla_{NDM-1}
 - 1 bla_{NDM-4}
 - 39 bla_{NDM-5} 49% *E. coli*
 - 1 bla_{NDM-7}
- 2 bla_{OXA}
 - 1 $bla_{OXA-181}$ *E. coli* ST-10
 - 1 $bla_{OXA-232}$ *K. pneumoniae*



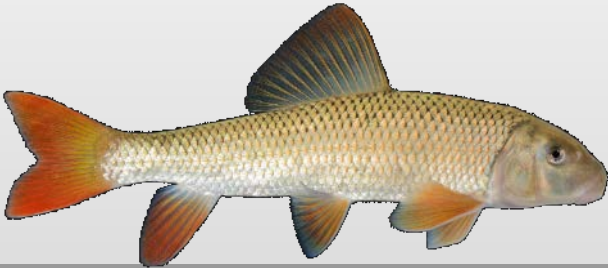
Jackson Pike/Scioto River CPE

Upstream	9%
Influent	31%
Effluent	23%
Downstream	18%
Way Downstream	19%

- CPE most common in untreated influent
- CPE least common upstream of discharge
- 45% of CPE were *Enterobacter* spp.
- 82% of CPE were KPC genotype
- Subset of NDM-5 *E. coli* ST-167



Electrofishing on the Scioto River



Electrofishing vent swab samples collected in the Scioto watershed

Location	Distance from JP	# Samples	Fish Species	Bacteria	Gene
Scioto Audubon MP	~ 8 km upstream	71	Smallmouth Buffalo	<i>Citrobacter freundii</i>	KPC-3
			Golden Redhorse	<i>Klebsiella pneumoniae</i>	KPC-3
Scioto Grove MP	~ 8 km downstream	79	River Carpsucker	<i>Klebsiella pneumoniae</i>	KPC-2
			River Carpsucker	<i>Pseudomonas sp.</i>	KPC-2
			Smallmouth Buffalo	<i>Klebsiella pneumoniae</i>	KPC-2
			Smallmouth Buffalo	<i>Raoultella ornithinolytica</i>	KPC-2
			Smallmouth Buffalo	<i>Pseudomonas sp.</i>	KPC-2
			Smallmouth Buffalo	<i>Klebsiella oxytoca</i>	KPC-2
			Quillback Carpsucker	<i>Citrobacter freundii</i>	KPC-2
Mackey Ford WA	~ 25 km downstream	74	River Carpsucker	<i>Raoultella ornithinolytica</i>	KPC-2
			Smallmouth Buffalo	<i>Enterobacter asburiae</i>	KPC-2
			Gizzard Shad	<i>Enterobacter sp.</i>	KPC-2
			Common Carp	<i>Klebsiella pneumoniae</i>	KPC-2
Circleville	~ 50 km downstream	75	0		
Chillicothe	~ 80 km downstream	68	0		
Portsmouth	~ 135 km downstream	83	0		

