Compartment: Manure

James M. Tiedje, Center for Microbial Ecology
Departments of Microbiology and Molecular Genetics
and of Plant, Soil & Microbial Sciences

Michigan State University
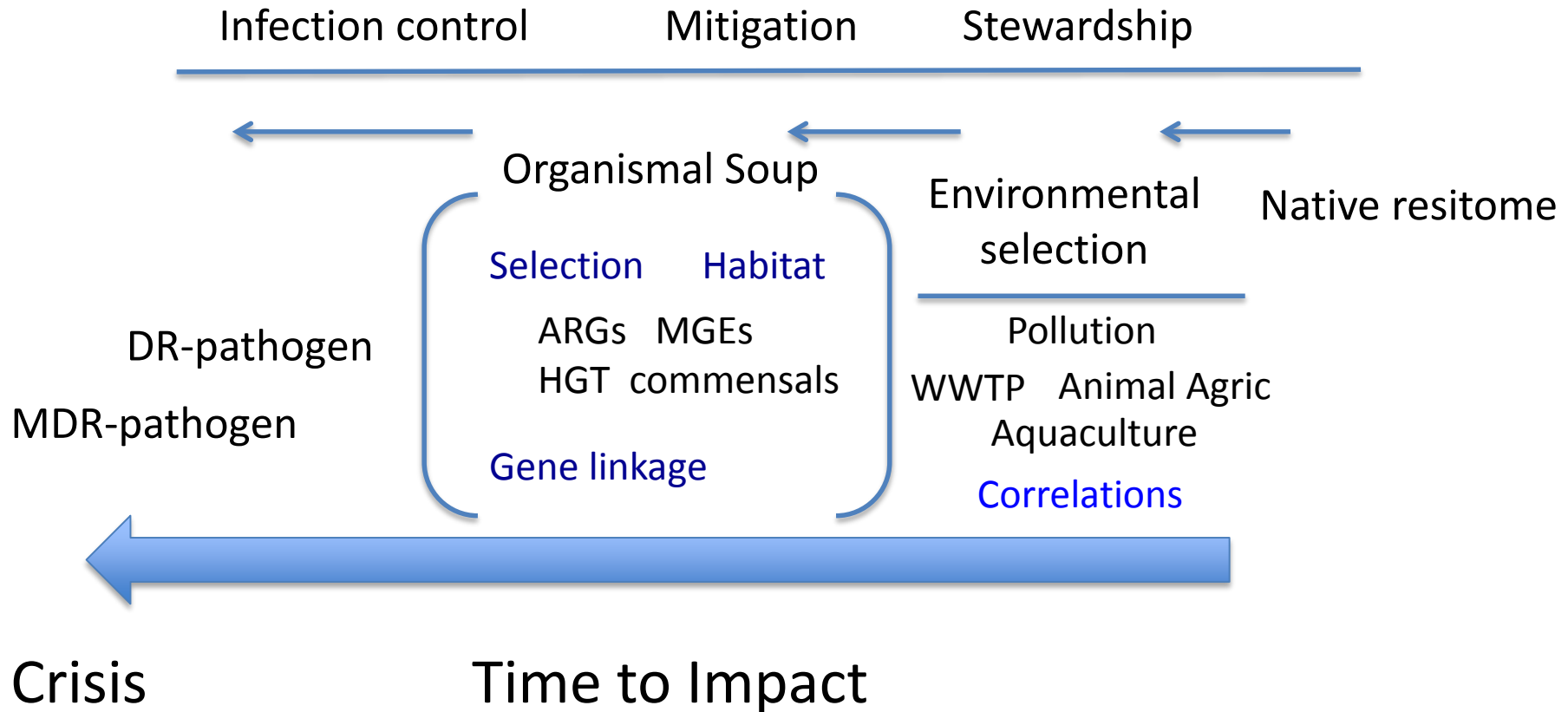
PACCARB Meeting
June 22, 2016

MICHIGAN STATE
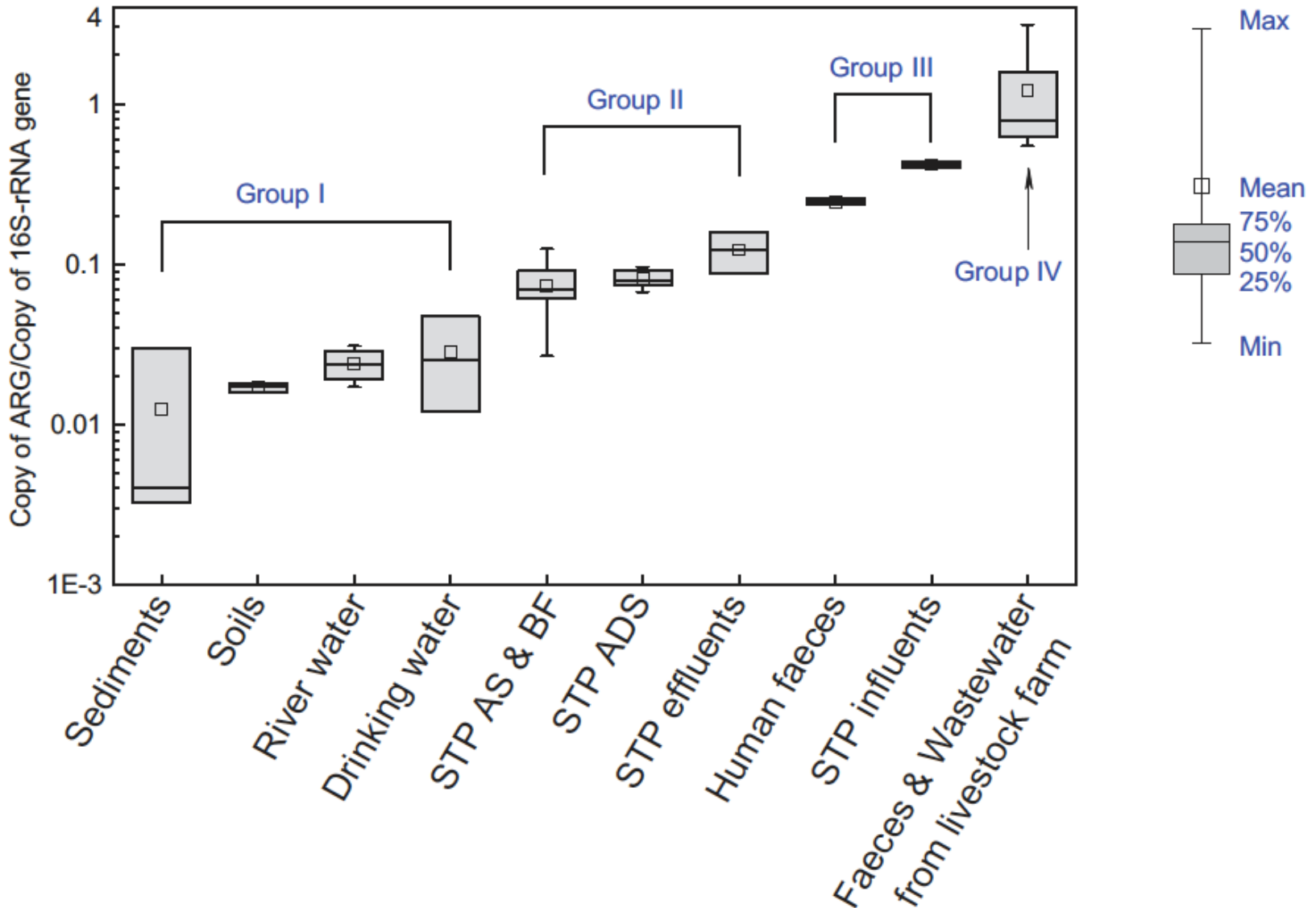U N I V E R S I T Y

Focal Questions

1. How should this topic be addressed be CARB/NAP in the future?
   - Quantitative risk assessment model
2. What is the connection to potential human health impacts?
   - High concentration point source
   - Favorable environment for HGT
   - Potential selective growth
3. Prioritize the gaps that need to be addressed to establish the connection to human health?
   - See last slide

Stages on the continuum to crisis

Infection control   Mitigation   Stewardship

Organismal Soup   Environmental selection   Native resitome

Selection   Habitat

ARGs   MGEs

HGT   commensals

Gene linkage

Pollution

WWTP   Animal Agric

Aquaculture

Correlations

DR-pathogen
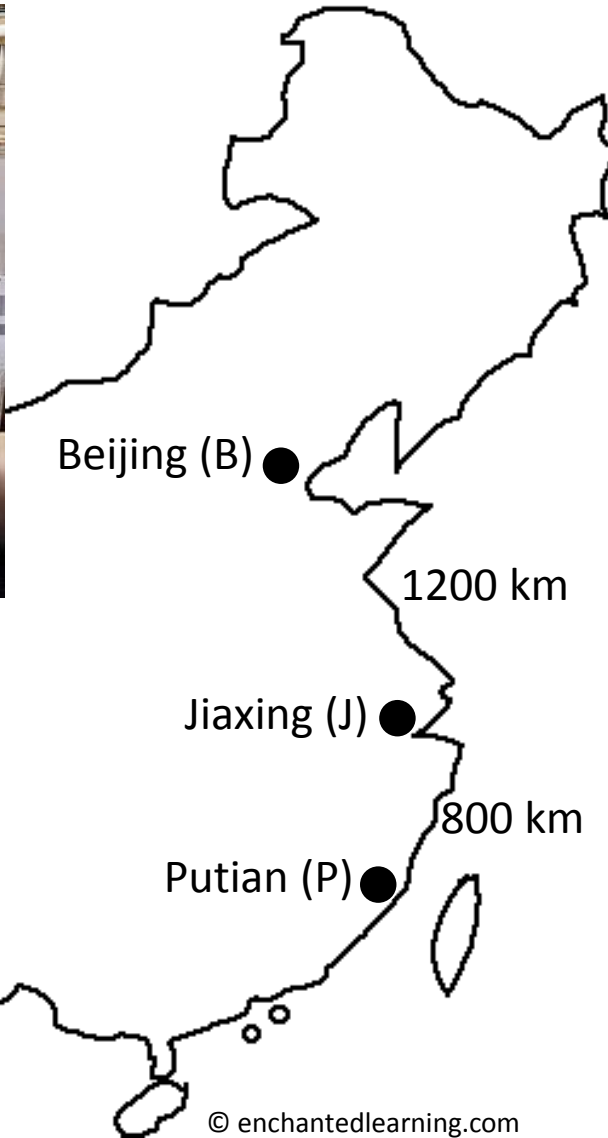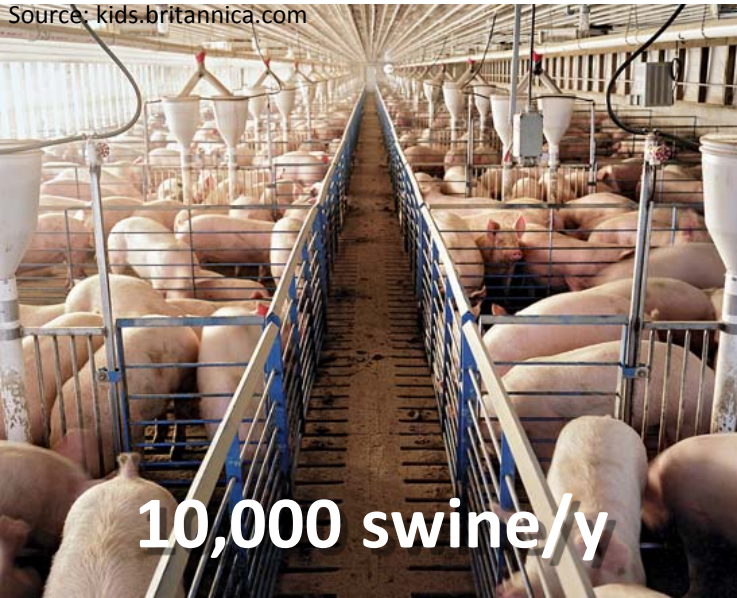
MDR-pathogen

Crisis   Time to Impact

ARG Abundances in MetaGs of Different Environments

Bing Li, Ying Yang...Tiedje, Tong Zhang, ISMEJ (2015)

ARGs on Chinese swine farms
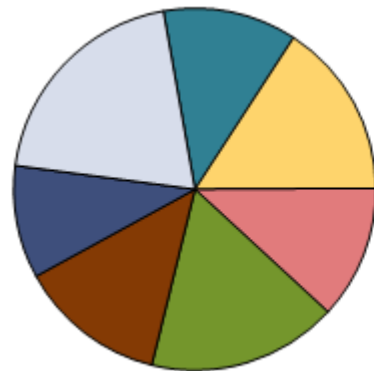

Source: kids.britannica.com

10,000 swine/y

Beijing (B) ●

1200 km

Jiaxing (J) ●

800 km

Putian (P) ●

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Zhu, Johnson, Tiedje et al. PNAS, 2013

Manure (M)
Source: beehavenacres.blogspot.com

Compost (C)
Source: mountainharvestorganic.com

Soil + Compost (S)
SCIENCEphoto

Nearly 100 resistance genes detected
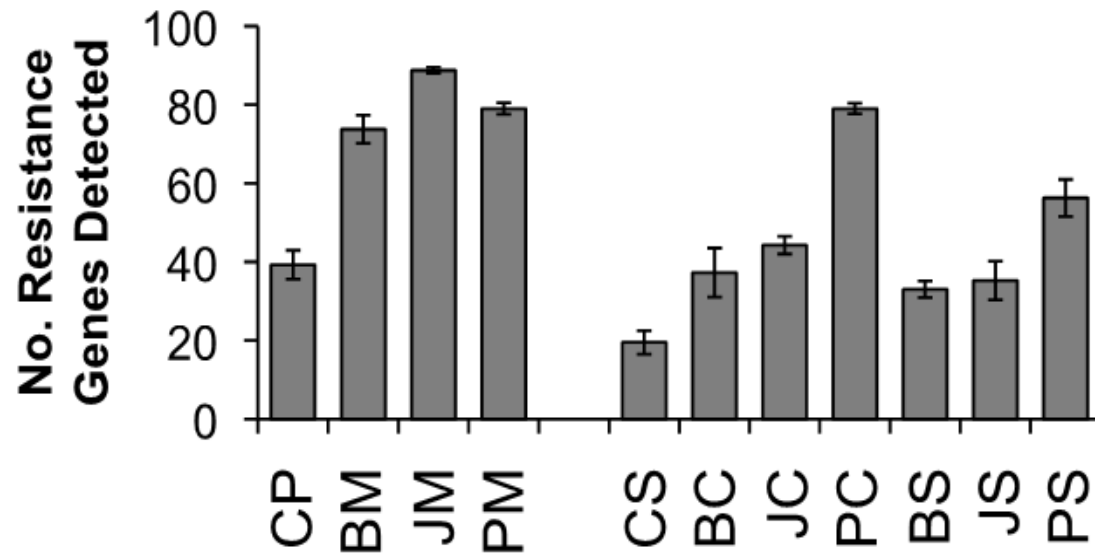
Zhu, Johnson, Tiedje et al. PNAS, 2013

Clusters of identical sequences

intl1-IS6100 cluster

IS1216-tet

Chinese Pigs, all 3 farms

A

NADL (no AB exposure) Pigs

B

blaTEM-sul2

Degree
- 20
- 10
- 1

- ARG
- MGE
- E. coli marker
- *Firmicutes*
- *Proteobacteria*
- Other phyla

Johnson et.al. *mBio,* 2016
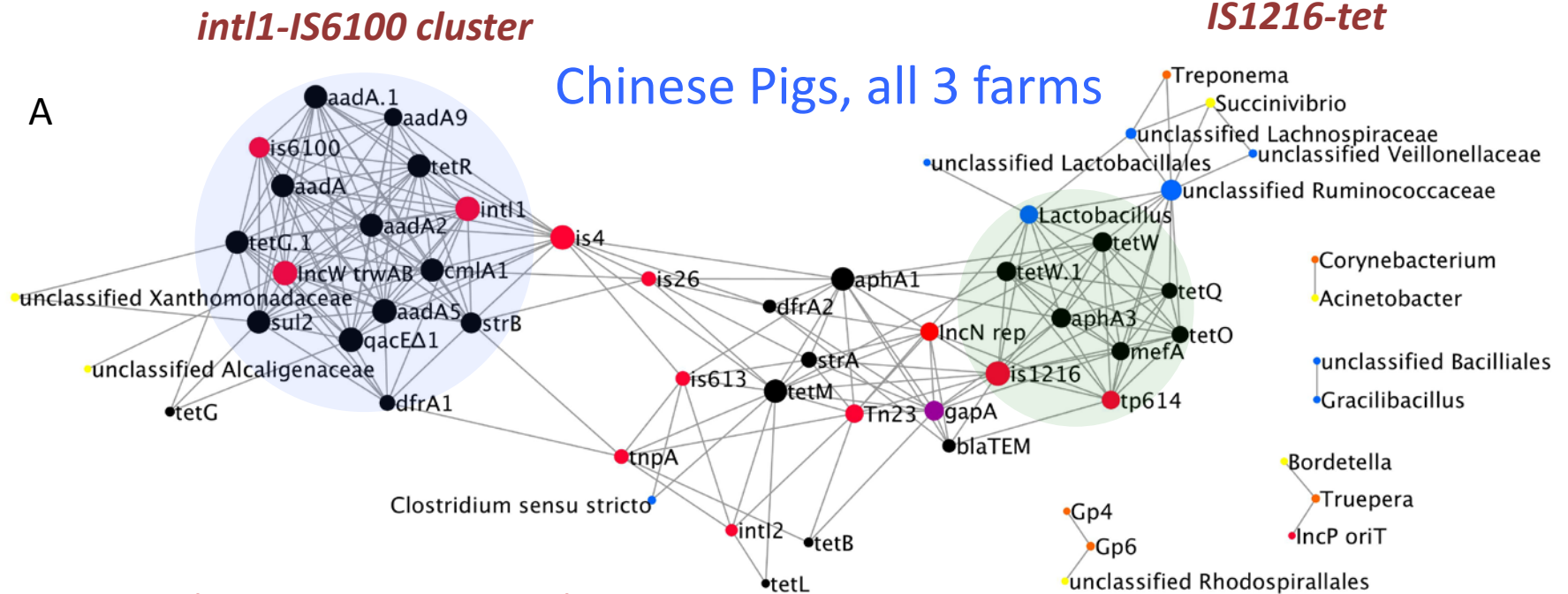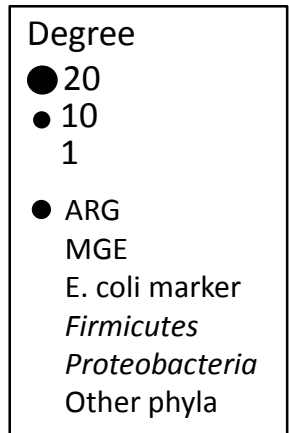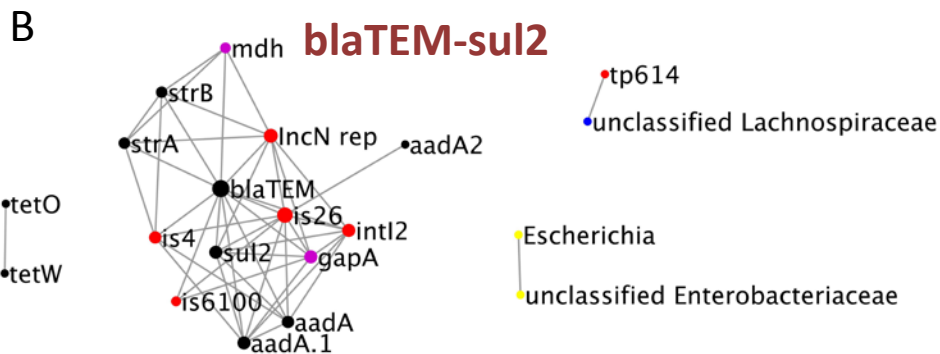
"Growth" of one cluster in compost in one Chinese farm

Johnson et. al, mBio
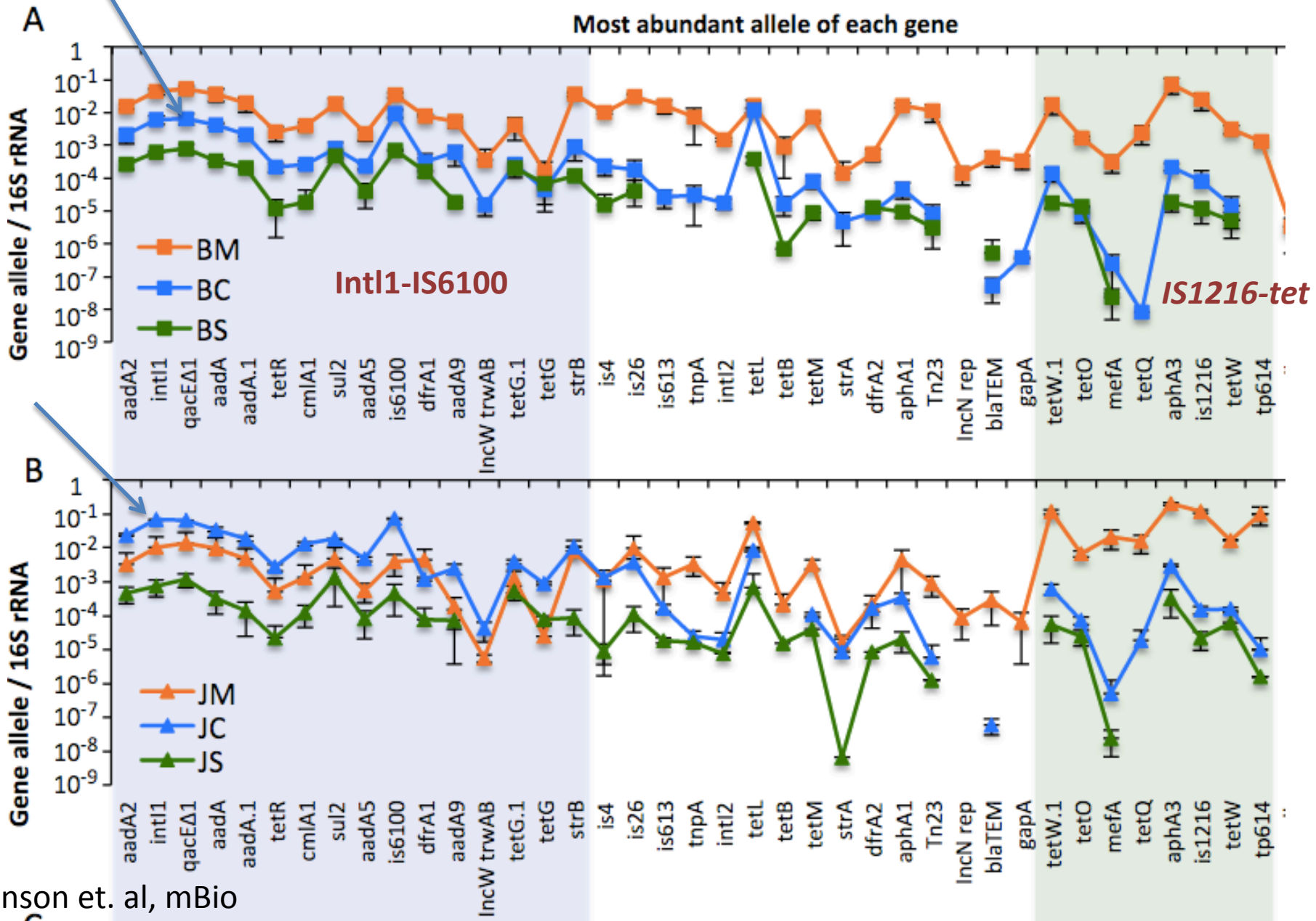
Need for integration of data from environments to the clinic

Gathers and geospatially maps ARGs and ARB from environments & clinic

Stedtfeld et.al. 2016 Antimicrobial resistance (AR) dashboard... FEMS Microbiol Ecol

Resistance Type
- Aminoglycoside
- Amphenicol
- Beta Lactamase
- Fluoroquinolone
- MDR
- MSLB
- Other
- Sulfonamide
- Tetracycline
- Transposase
- Vancomycin

North Surface Waters

Waste Waters

10 clinical isolates

Southwest Surface Waters

Southeast Surface Waters
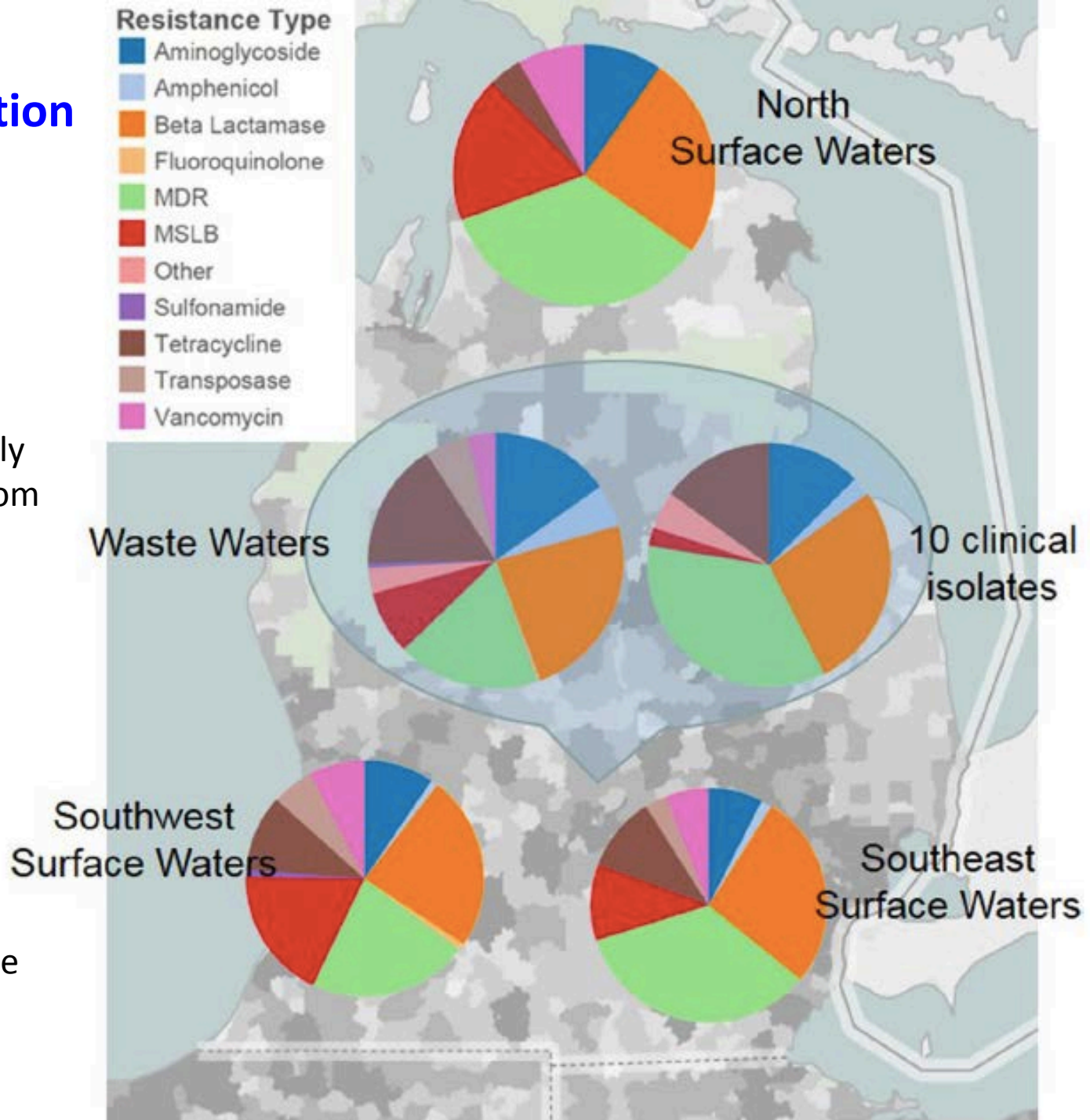
Prioritized Gaps - Manures

1. Fate and transport (ARGs, ARB as pollutants)
   - Survival rates, conditions, compost (heat), other treatments
   - <u>Growth:</u> substrates, conditions, selection, co-selection (board), concentrations below MIC; manure microbial ecology
   - Transport: water (surface, leaching), workers, produce, dust/air; regulatory tweaks?
2. HGT (GMO [microbes] experience)
   - Clusters: ARG, MGE, microbe; geographic range
   - ARG, MGE gene linkages, mechanisms, host range for HGT
   - Commensal host ecology
3. Data bases and nomenclature
   - Getting beyond the isolates
   - Efficient searching, communicating, recognizing the new
4. Data integration, mining, epidemiology
5. Quantitative risk assessment model