Antibiotic resistance genes and residues in water and soils in close proximity to swine production facilities

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Acknowledgements

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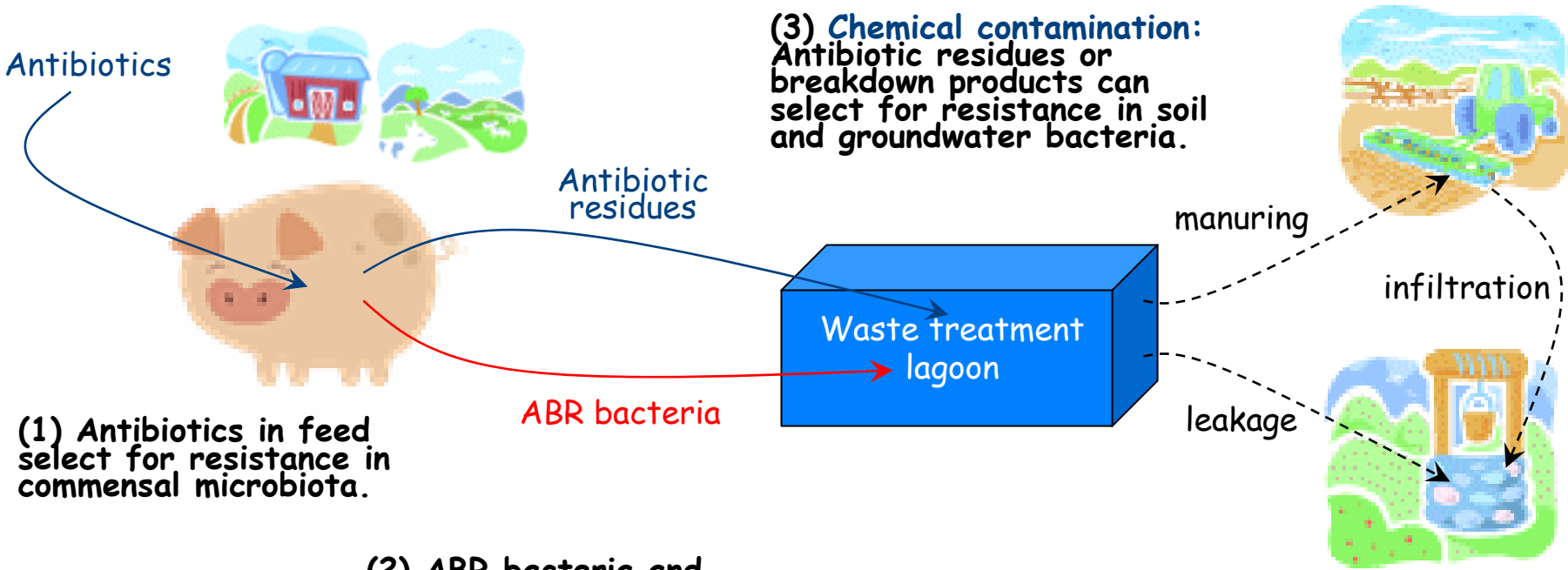
Overview

Antibiotic use in animal production



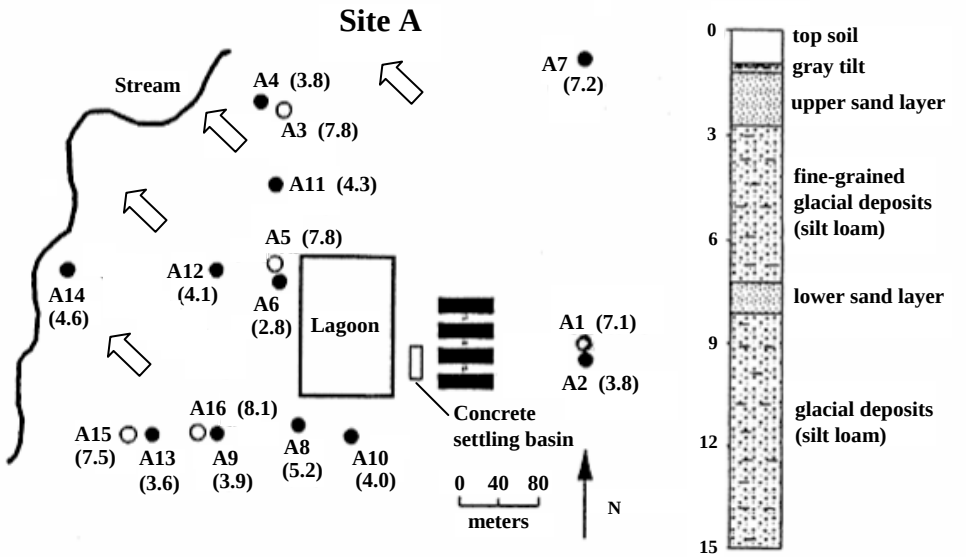
(1) Antibiotics in feed select for resistance in commensal microbiota.

(2) ABR bacteria and unabsorbed antibiotics enter the waste treatment system.

(3) Chemical contamination: Antibiotic residues or breakdown products can select for resistance in soil and groundwater bacteria.

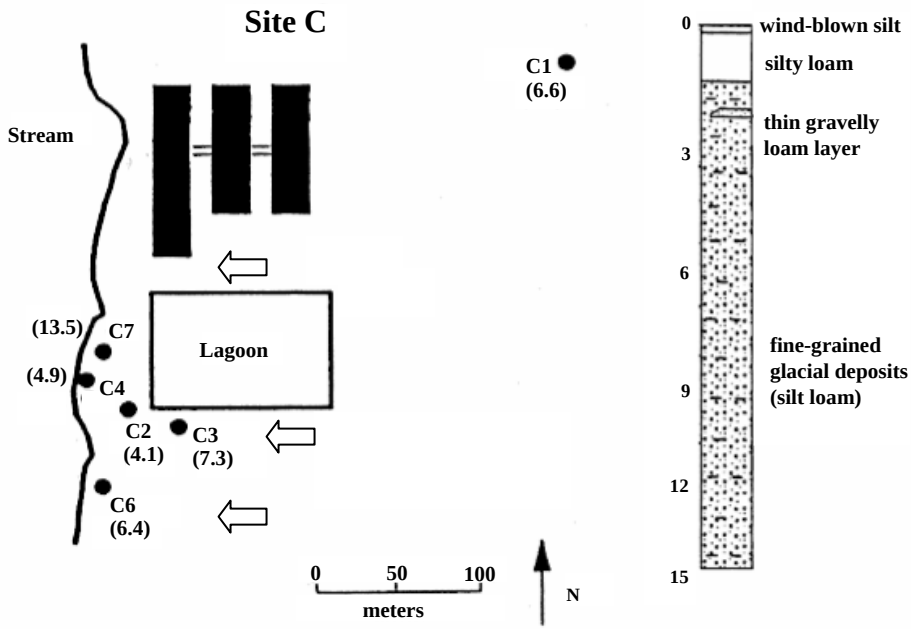
(4) Microbiological contamination: ABR bacteria may persist in soil or groundwater. Alternately, they can pass their ABR genes to native soil and groundwater bacteria via horizontal gene transfer.

Overview



Groundwater monitoring well networks

Soil samples from manure-amended fields



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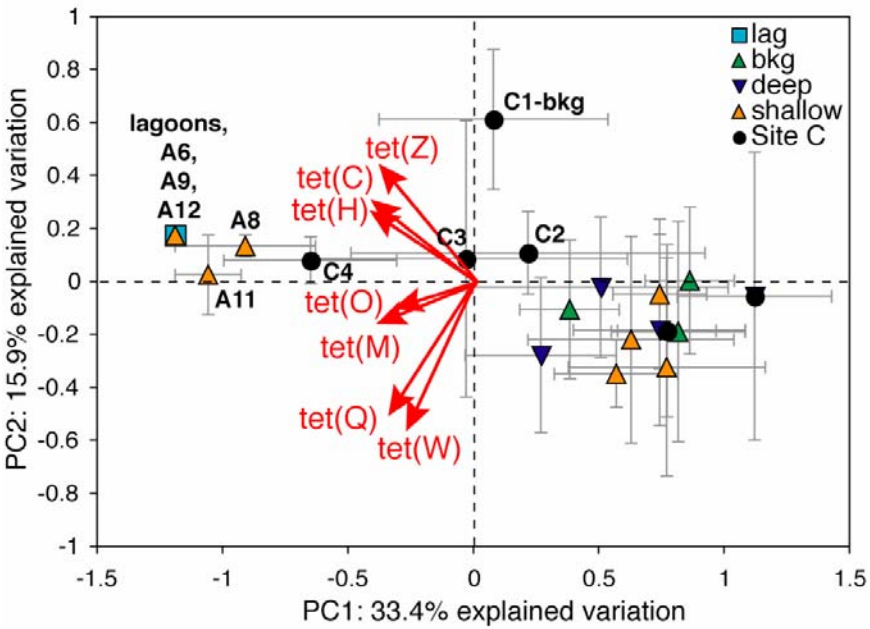
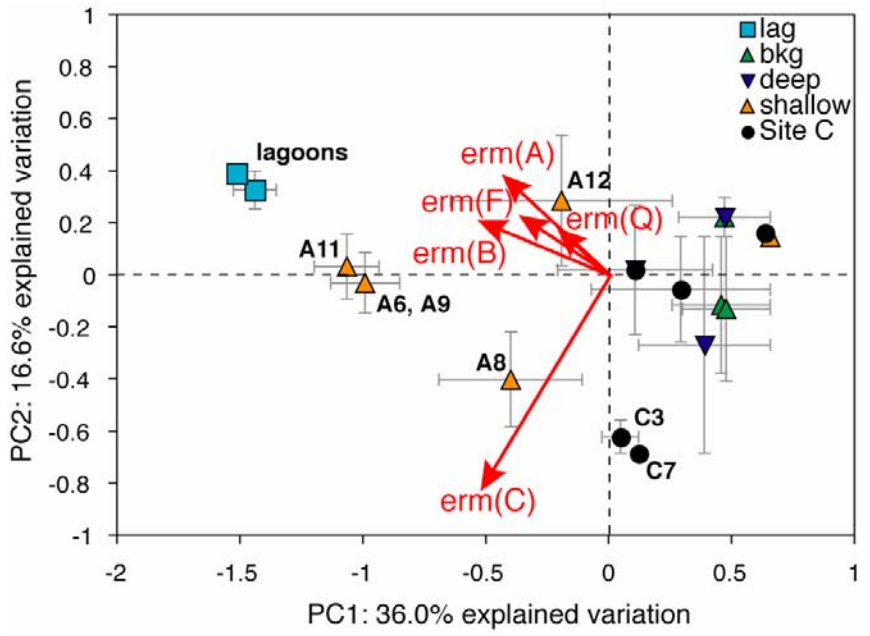
Objectives

In surface waters, groundwater, and soils:

1. Monitor chemical quality and antibiotic residue concentrations
2. Determine the diversity of antibiotic resistance genes
    1. *Tetracycline (tet)*
    2. *Erythromycin and tylosin (erm and tlr)*
3. Numerical modeling of groundwater flow and particle transport

Impacts: lagoon leakage





Numerical modeling: bacteria-sized particle from lagoon could reach Site A stream in 14 days

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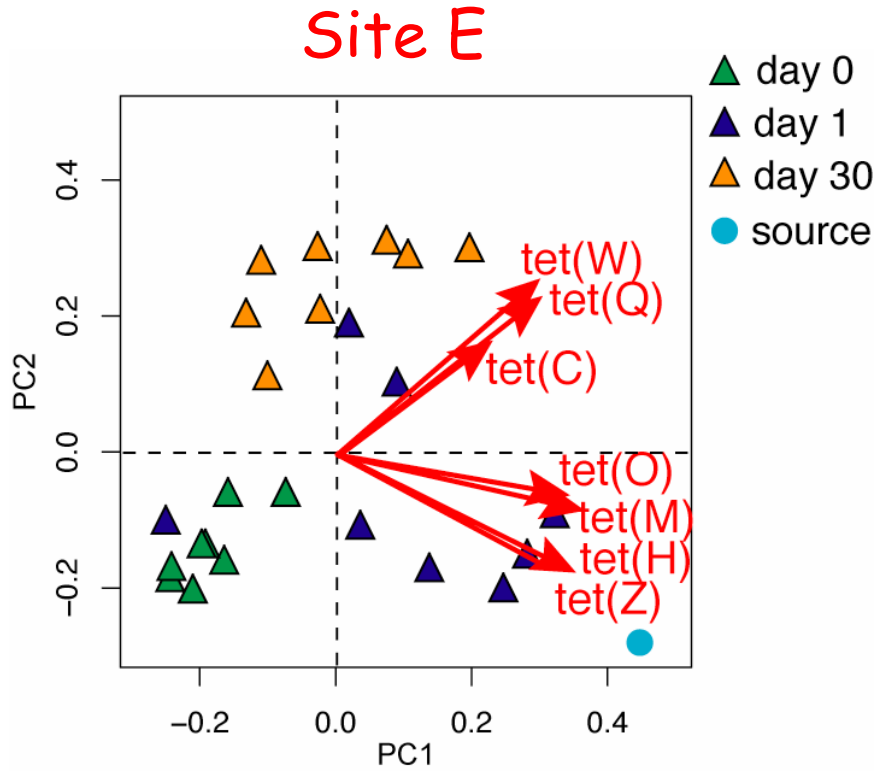
Impacts: ABR in soils



Development of high-throughput assay for 14 *tet* genes

Outputs: publications

Aminov, R. I., N. Garrigues-Jeanjean, and R. I. Mackie. 2001. Molecular ecology of tetracycline resistance: Development and validation of primers for detection of tetracycline resistance genes encoding ribosomal protection proteins. Appl. Environ. Microbiol. ***67****:22-32.*

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Aminov, R. I., J. C. Chee-Sanford, N. Garrigues, B. Teferedegne, I. J. Krapac, B. A. White, and R. I. Mackie. 2002. Development, validation, and application of PCR primers for detection of tetracycline efflux genes of gram-negative bacteria. Appl. Environ. Microbiol. ***68****:1786-1793.*

Krapac, I. G., W. S. Dey, W. R. Roy, C. A. Smyth, E. Storment, S. L. Sargent, and J. D. Steele. 2002. Impacts of swine manure pits on groundwater quality. Environmental Pollution ***120****:475-492.*

Jindal, A., Kocherginskaya, S., Mehboob, A., Robert, M., Mackie, R.I., Raskin, L. and Zilles, J.l. 2006. Antimicrobial use and resistance in swine waste treatment systems. Appl. Environ. Microbiol. ***72****:7813-7820.*

Mackie, R. I., S. Koike, I. Krapac, J. Chee-Sanford, S. Maxwell, and R. I. Aminov. 2006. Tetracycline residues and tetracycline resistance genes in groundwater impacted by swine production facilities. Animal Biotechnology ***17****:157-176.*

Aminov, R.I. and Mackie, R.I. 2007. Evolution and ecology of antibiotic resistance genes. FEMS Microbiol. Lett. ***271****:147-161.*

Koike, S., I. G. Krapac, H. D. Oliver, A. C. Yannarell, J. C. Chee-Sanford, R. I. Aminov, and R. I. Mackie. 2007. Monitoring and source tracking of tetracycline resistance genes in lagoons and groundwater adjacent to swine production facilities. Appl. Environ. Microbiol. ***73****:4813-4823.*

Future directions

Horizontal gene transfer at the interface of agricultural environments