Association of *Cryptosporidium parvum* with Sedimentary Biofilms: Implications for Natural Attenuation during Transport in Watersheds

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Justification:
Animal operations have been implicated as a primary source of the human pathogen *Cryptosporidium parvum*, which is a particular concern because it can persist for long periods of time in natural waters. Improved understanding of *C. parvum* dynamics in natural waters is needed to assess the risks posed by animal agriculture and design management practices to reduce transmission of viable *C. parvum* to drinking water supplies.

Objectives:
The primary objective of this project is to evaluate how association with sediments and surface-attached microbial communities (biofilms) mediates the waterborne transmission of *C. parvum*. Laboratory experiments will elucidate mechanisms of *C. parvum* capture, retention, and release by biofilm communities, and models will be developed to predict the migration of infectious *C. parvum oocysts* in agricultural watersheds.

Progress to date:
We assessed the capture and retention of *C. parvum* oocysts in *Pseudomonas aeruginosa* biofilms using laboratory flow cell systems, sand columns, and recirculating flume systems. Flow cell experiments clearly showed that biofilms increase oocyst deposition, and that the extent of oocyst capture is influenced by biofilm structure. Flume experiments showed that benthic biofilms, overlying flow conditions, and particle size all play significant roles in regulating the removal of pathogens and other fine organic particles from surface waters. Additional experiments performed collaboratively with New Zealand's National Institute of Water and Atmospheric Research showed that fine particles and pathogens are also readily resuspended from gravel streambeds. Current experimental activity focuses on evaluating the extent to which *C. parvum* transport and association with bacterial biofilms affects oocyst viability. Data reduction, synthesis, and modeling of *C. parvum* transport and association with biofilms is also being completed now.

Impacts:
Our work has demonstrated that association with influences the capture and retention of *C. parvum* oocysts in sediments and should be expected to significantly alter the environmental transmission of *C. parvum* in a variety of aquatic systems. Project results were communicated to policy, management, and farming communities through a congressional brief on migration of zoonotic pathogens in aquatic systems, and a workshop on disease outbreaks associated with fecal pathogens in fresh produce. Example publication: Searcy, K.E., Packman, A.I., Atwill, E.R., and Harter, T., 2006, Capture and retention of *Cryptosporidium parvum* oocysts by *Pseudomonas aeruginosa* biofilms, *Applied and Environmental Microbiology*, 72(9), doi:10.1128/AEM.00344-06, 6242-6247 [Cover article].