The role of muscid flies in bovine pathogen dissemination

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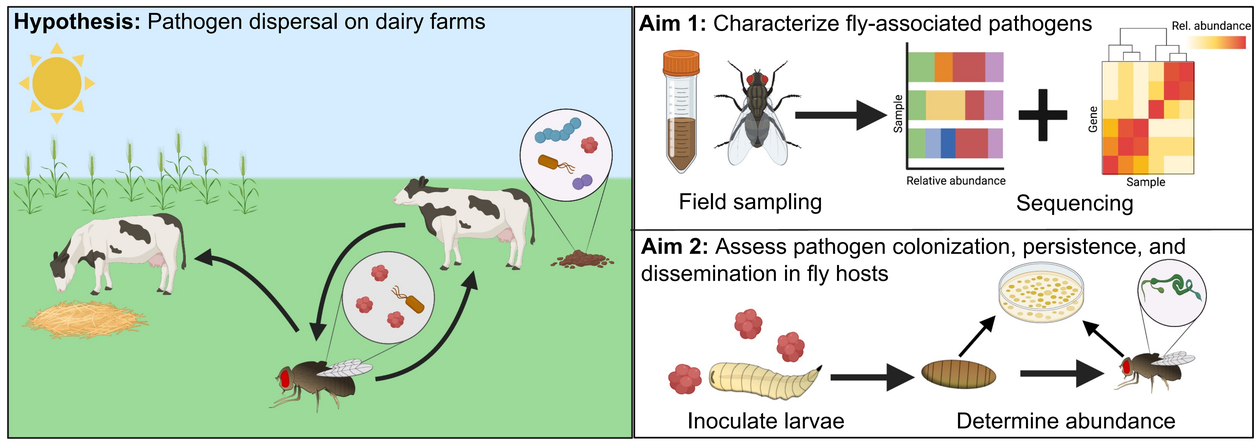
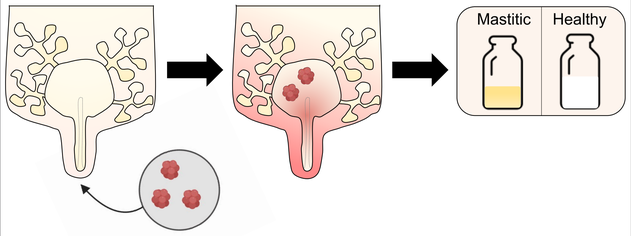
Project overview



We hypothesize that muscid flies have the capacity to acquire and disseminate pathogenic bacteria within and between dairy barn environments.

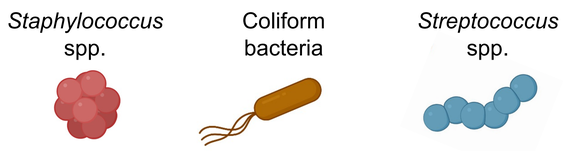
Bovine mastitis

Bovine mastitis is an infection characterized by the inflammation of the mammary gland tissues.[1]

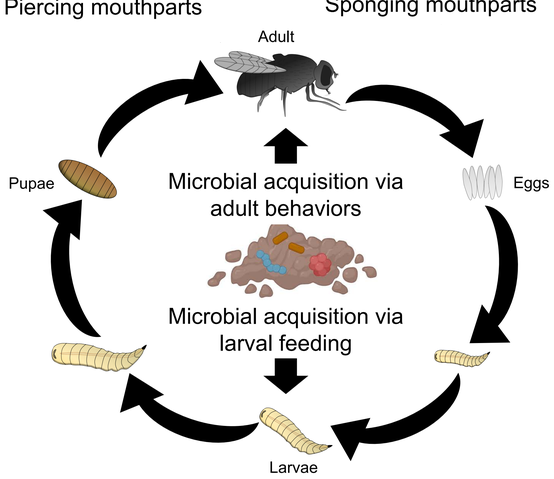


Research has historically focused on control of contagious pathogens; however, environmental pathogens are of growing concern.

Important environmental pathogens include:

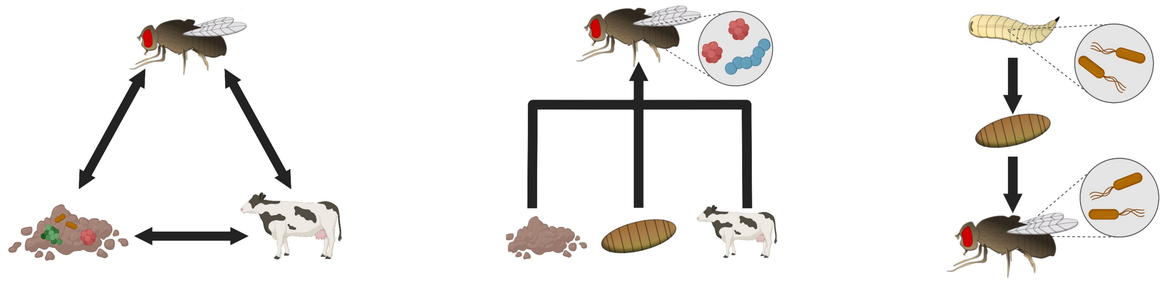


Muscid flies



House and stable flies closely associate with manure throughout their lifecycle.[2]

Research implications



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References: [1]Klaas, I.C. & Zadoks, R.N. (2018) An update on environmental mastitis: Challenging perceptions. *Transbound. Emerg. Dis.* 65, 166–185; [2]Meyer, J.A. and Petersen, J.J. (1983) Characterization and seasonal distribution of breeding sites of stable flies and house flies (Diptera: Muscidae) on eastern Nebraska feedlots and dairies. *J. Econ. Entomol.* 76, 103–108; [3]Nielsen, B. O. *et al.* (1987) The fly fauna of heifers and the transmission of summer mastitis in Denmark. *Summer Mastitis,* 116-120; [4]Lysyk, T. J. (1993) Seasonal abundance of stable flies and house flies (Diptera: Muscidae) in dairies in Alberta, Canada. *J. Med. Entomol.* 30, 888-895; [5]Zehner, M.M. *et al.* (1986) Growth of environmental mastitis pathogens in various bedding materials. *J. Dairy Sci.* 69, 1932–1941; [6]Toth, J. D. et al. (2013) Survey of animal-borne pathogens in the farm environment of 13 dairy operations. *J. Dairy Sci.* 96, 5756-5761; [7]Ahmad, A. *et al.* (2011) Insects in confined swine operations carry a large antibiotic resistant and potentially virulent enterococcal community. *BMC Microbiol.* 11, 1–13; [8]Wang, H. *et al.* (2017) The antibiotic resistome of swine manure is significantly altered by association with the *Musca domestica* larvae gut microbiome. *ISME J.* 11, 100–111; [9]Sasaki, T. *et al.* (2000) Epidemiological potential of excretion and regurgitation by *Musca domestica* (Diptera: Muscidae) in the dissemination of *Escherichia coli* O157: H7 to food. *J. Med. Entomol.* 37, 945–949; [10]Rochon, K. *et al.* (2005) Retention of *Escherichia coli* by house fly and stable fly (Diptera: Muscidae) during pupal metamorphosis and eclosion. *J. Med. Entomol.* 42, 397–403; [11]Butler, J.F. *et al.* (1977) Recontamination of food after feeding a 32P food source to biting muscidae. *J. Med. Entomol.* 13, 567–571.

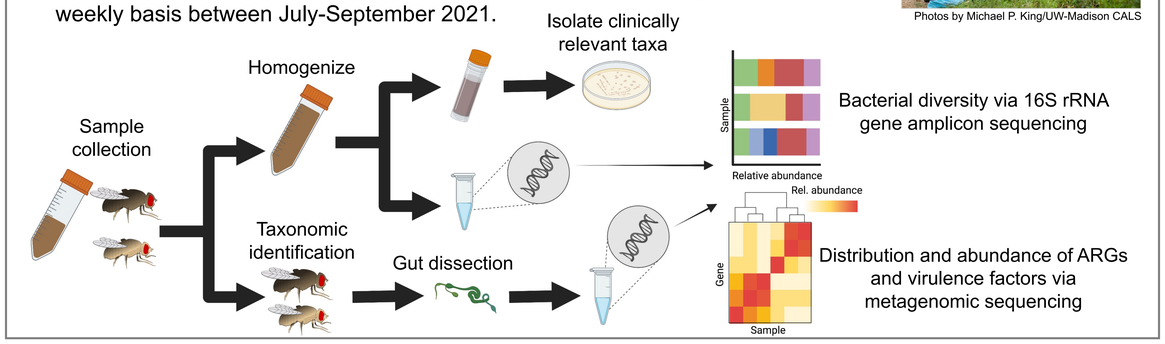
Aim 1: Characterize fly-associated pathogens

Background:
- Dairy barns are home to large populations of biting and nonbiting flies, with fly abundance positively correlating with mastitis incidence.[2,3,4,]
- Cow manure is likely to harbor an array of bovine pathogens.[5,6]
- Flies have previously been shown to spread and modulate antimicrobial resistance gene (ARG) profiles on swine farms.[7,8]

Knowledge gaps:
- Current knowledge is highly biased towards culture-dependent methods.
- Past research has focused near exclusively on house flies.

Progress:
- Fly and environmental samples were collected from the Dairy Cattle Center (Madison, WI) and Emmons Blaine Dairy Research Center (Arlington, WI) on a weekly basis between July-September 2021.

Photos by Michael P. King/UW-Madison CALS



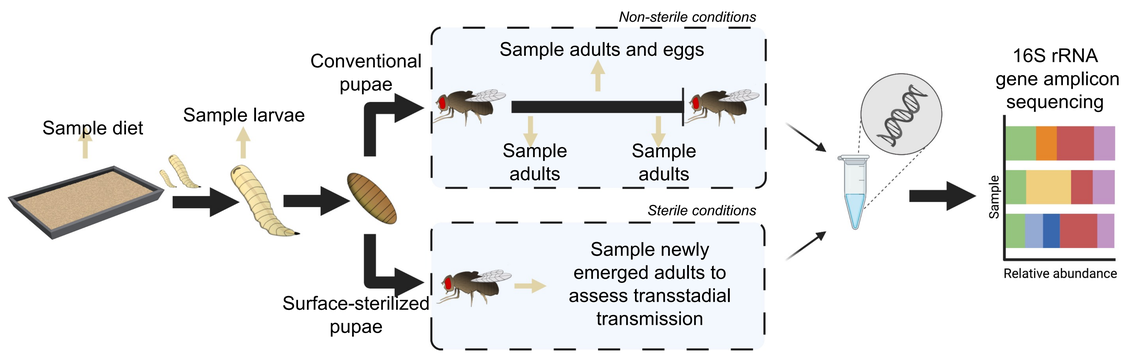
Aim 2: Assess pathogen colonization, persistence, and dissemination in fly hosts

Background:
- Adult flies can acquire microbes via feeding or transstadial transmission from larvae.[9,10]
- Bacteria colonizing the digestive tract can then be spread via regurgitation or defecation.[9,11]

Knowledge gaps:
- A suitable model in which to study the mechanisms underlying fly-microbe interactions is currently lacking.
- There is little research on colonization dynamics of dairy barn pathogens.

Progress:
- A house fly colony has been established to perform laboratory experiments.
- We have optimized methods for extracting and amplifying DNA from field-collected and lab-reared flies.
- Methods have also been developed for the generation of axenic (microbe-free) and gnotobiotic flies (colonized by known microbes).

Aim 2.1: Characterize microbiota acquisition and persistence across fly life history



Aim 2.2: Assess the ability of pathogens to colonize, persist, and be disseminated by fly hosts with different microbial backgrounds