

MMG 991 Prospectus

Graduate seminar title: Opportunistic Pathogens: Biology and Context

Instructor: Dr. Ned Walker

When: Fall 2019, time and day to be arranged at first class meeting

To register: MMG 991 Section 002

Credits: 1

Grading: Point scale

Target audience: Graduate students in MMG, Plant Pathology, CMIB, EEBB, etc.

Structure: One, two-hour session per week for class meeting time. First set of class sessions devoted to lecture and discussion, supported by readings. Remainder of class sessions devoted to student team projects, practicum with PathogenFinder and VirulenceFactorDataBase tools, and group presentations supported by discussion and topical readings. Faculty and postdoctorals are invited to participate.

Theme: In this one credit, graduate seminar, we will explore the concept of opportunistic pathogens from the point of view of ecology, evolution, genomics, and virulence. Departing from the traditional view that opportunistic pathogens are simply certain microorganisms that establish infection with disease in immunocompromised or weakened hosts, we will consider the idea of flexible life histories, open pan-genomes, and how traits having ecological functions (predator defense, allelopathy, alleviation of oxidative stress, biofilm formation) are co-adapted for living host association, infection, virulence, and pathogenesis. For example, is the ecological function of the phenazine pigment pyocyanin, functioning as a virulent exotoxin for certain *Pseudomonas aeruginosa* strains in human hosts, co-opted from its primary ecological function to generate reactive oxidation species that protect it from predators and allelopathically create space from competitors? For another example, do bacterial virulence toxin secretion systems originate from anti-predatory ameoboid defense mechanisms? Participants will work in teams and use tools such as PathogenFinder and VirulenceFactorDataBase to explore genomes of known or suspected opportunistic pathogens to ferret out genomic attributes that might be associated with “opportunism,” make inferences about the nature of these attributes, and generate predictions regarding the potential for virulence and opportunism in nature. They will present findings to the class and host discussion.

Textbook: Hurst, Christon (ed.). *The Rasputin Effect: When Commensals and Symbionts Become Parasitic*. *Advances in Environmental Microbiology* Vol. 3. Springer Nature, Switzerland. 347 pp.

Further reading

Martínez JL (2014) Short-sighted evolution of bacterial opportunistic pathogens with an environmental origin. *Front. Microbiol.* **5**:239. doi: 10.3389/fmicb.2014.00239

Brown SP, Cornforth DM, Mideo N (2012) Evolution of virulence in opportunistic pathogens: generalism, plasticity, and control. *Trends Microbiol.* **20**:336–342. doi: 10.1016/j.tim.2012.04.005

Casadevall A, Pirofski L (2014) Ditch the term pathogen. *Nature* **516**:164-166.

Anttila J, Kaitala V, Laakso J, Ruokolainen L (2015) Environmental variation generates environmental opportunist pathogen outbreaks. *PLoS ONE* **10**: e0145511.

<https://doi.org/10.1371/journal.pone.0145511>

Granato ET, Ziegenhain C, Marvig RL, Kümmerli R (2018) Low spatial structure and selection against secreted virulence factors attenuates pathogenicity in *Pseudomonas aeruginosa*. *ISME J* 12: 2907–2918. doi:10.1038/s41396-018-0231-9.