

BIOGRAPHICAL SKETCH

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NAME: Cressler, Clayton Edward

eRA COMMONS USER NAME (credential, e.g., agency login): NA

POSITION TITLE: Assistant Professor, School of Biological Sciences, University of Nebraska

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Hope College	BS	05/2003	Mathematics
University of Michigan	PhD	04/2011	Ecology & Evolutionary Biology
Queen's University	Postdoc	07/2015	Biology and Mathematics

A. Personal Statement

My training and expertise makes me well-suited to collaborate on the proposed research. I have broad training in mathematics and statistics, with particular emphasis on (i) the development and analysis of mathematical models for ecological and evolutionary systems and (ii) application of statistical techniques for fitting complex nonlinear dynamical models to empirical data. I also have training in experimental disease ecology, combining mathematical modeling with experimental data to distinguish among competing mechanistic hypotheses for patterns in disease data. I will contribute expertise in each of these areas as part of my collaboration on this project. My research interests also strongly complement those of this project. In particular, my recent research has focused on developing and testing a theoretical framework for studying the interactions between host nutrition, immune function, and parasitism in microparasitic infections. Publications in this area helped to define the scope of this project during its early development. More recently, through the NSF's Research Coordination Network program, I have been directly involved in helping Dr. Budischak extend this framework to study macroparasitic infections, a key component of this research program. My interest in how host nutrition affects disease processes has grown out of my dissertation research, which involved studying how the evolution of organismal traits, like body size and behavior, is shaped by the need to acquire nutrition from the environment (resource acquisition) and by competing physiological demands on nutrients (resource allocation trade-offs).

1. Cressler, C. E., A. A. King, and E. E. Werner. 2010. Interactions between behavioral and life-history trade-offs in the evolution of integrated predator-defense plasticity. *American Naturalist* 176: 276-288.
2. Cressler, C. E., W. A. Nelson, T. Day, and E. McCauley. 2014. Disentangling the interaction among host resources, the immune system, and pathogens. *Ecology Letters* 17: 284-293.
3. Cressler, C. E., W. A. Nelson, T. Day and E. McCauley. 2014. Starvation reveals the cause of castration and gigantism. *Proceedings of the Royal Society B*. 281: 20141087.
4. Cressler, C. E., A. L. Graham, and T. Day. Host evolution under manifold costs of defense. *Proceedings of the Royal Society B*. 282: 20150065.

B. Positions and Honors

Positions and Employment

2011-2015 Postdoctoral Research Fellow, Queen's University, Kingston, ON
2015- Assistant Professor, School of Biological Sciences, University of Nebraska, Lincoln, NE

Other Experience and Professional Memberships

2003- Member, Society for Mathematical Biology
2006- Member, Ecological Society of America
2009- Member, American Society of Naturalists
2011-2015 Member, Canadian Society for Ecology and Evolution

Honors

2006 Lotka Prize, Theoretical Ecology section of Ecology Society of America
2011 Queen's University Senate Advisory Research Council Postdoctoral Fellowship
2012-2013 National Science Foundation Postdoctoral Research Fellowship in Biology (Intersections of Biology and Mathematical and Physical Sciences)
2014-2015 Coleman Postdoctoral Fellowship in Mathematics

C. Contributions to Science

1. During my postdoctoral fellowships, I began developing and testing a theoretical framework for studying the interaction between host nutrition, immune function, and microparasitic infection. This research was motivated by my recognition of an important gap in our understanding of within-host disease processes: while the influence of host diet on immune function has been an important area of biomedical research for decades and all parasites depend on their hosts for resources to fuel their own development and reproduction, very few scientists had given any thought to the potential for resource-dependent interactions *between* the immune system and parasites. For example, if both the immune system and parasites require a similar resource (e.g., protein), then parasites might compete directly with host immunity for access to that resource. Moreover, even among authors who had considered the question, the complexity of potential interactions made verbal prediction nearly impossible. Using simple resource budget-based mathematical models, I developed a simple theoretical framework for studying these interactions. These models suggested a simple, but profound, mechanism for predicting how resources will impact the immune-parasite interaction: *priority*. If the immune system (or parasites) has priority in accessing resources, then improving host nutrition will always improve (or reduce) host health and reduce (or improve) parasite fitness. A survey of empirical datasets suggested that the framework could help explain previously unrecognized patterns in the response of parasites to changes in host diet. Subsequent work used the framework to explain infection-induced host life history changes in the *Daphnia magna-Pasteuria ramosa* host-parasite system. By comparing experimental data against alternative resource budget models, we were able to demonstrate conclusively that infection-induced castration and gigantism benefit only the parasite, settling a long-standing debate in the disease literature. Ongoing work is using this framework to ask why *Pasteuria* has evolved different life history manipulation strategies across *Daphnia* species by fitting resource budget models to empirical data using cutting-edge statistical inference techniques.
 - a. Cressler, C. E., W. A. Nelson, T. Day, and E. McCauley. 2014. Disentangling the interaction among host resources, the immune system, and pathogens. *Ecology Letters* 17: 284-293.
 - b. Cressler, C. E., W. A. Nelson, T. Day and E. McCauley. 2014. Starvation reveals the cause of castration and gigantism. *Proceedings of the Royal Society B*. 281: 20141087.
2. My dissertation research integrated insights from behavioral ecology and life history theory to understand how the evolution of organismal traits is shaped by trade-offs. Behavioral ecology often studies how behavior is influenced by trade-offs between, in particular, foraging and predation risk: organisms must acquire resources through foraging to grow, develop, and reproduce, but increased resource acquisition typically increases the risk of predation. Life history theory studies how schedules

of growth, development, reproduction and mortality are shaped by resource allocation trade-offs, such as growth versus reproduction or egg size versus egg number. Despite the central role that resources, in particular resource acquisition, play in both behavioral and life history trade-offs, and the rich bodies of theory and experiment in each field, no one had considered how these trade-offs might interact with one another. My work showed how predation shaped the evolution of behavior and body size by developing and analyzing mathematical models of resource acquisition and allocation. In particular, I showed how trait evolution is shaped by the interaction between behavioral and life history trade-offs in ways that are not predicted by studying either trade-off in isolation. These predictions provide an explanation for the complex, multivariate, plastic responses of organisms to their predators. More recently, I have used similar theoretical techniques to study the evolution of host defense against parasites. This work studied how immunopathology that generates trade-offs between immune defense and host reproduction or mortality can lead hosts to evolve away from resistance strategies and can break down widely assumed trade-offs between reproduction and immune defense.

- a. Cressler, C. E., A. A. King, and E. E. Werner. 2010. Interactions between behavioral and life-history trade-offs in the evolution of integrated predator-defense plasticity. *American Naturalist* 176: 276-288.
- b. Peacor, S. D. and C. E. Cressler. 2012. The implications of adaptive prey behavior for ecological communities: a review of current theory. In: *Evolution and Ecology of Trait-Mediated Indirect Interactions: Linking Evolution, Community, and Ecosystem* (eds. T. Ohgushi, O. Schmitz, and R. D. Holt). Cambridge University Press.
- c. Cressler, C. E., A. L. Graham, and T. Day. Host evolution under manifold costs of defense. *Proceedings of the Royal Society B*. 282: 20150065.

Complete List of Published Works in Google Scholar:

https://scholar.google.com/citations?hl=en&user=S10_OzUAAAAJ&view_op=list_works&gmla=AJsN-F4KCgM5HuJU4Bjh35owpAdq-VIL7Wm0-L2yd_fRWTx30xHEFxPYD7dau2e7UMi1a_IVRWkMkCf-K8nu7mk95hxmAq84TMcRHgEnuPNuuz3wwA34zQwIpbDEjRaKFiwAl3cuYued

D. Research Support

Not applicable.