Integrative Studies of Ecological Genomics and the Environment

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Research idea – We live at a time of unprecedented advances in DNA sequencing technologies, yet integrating these advances into studies of ecology, evolution and behavior can be challenging. ***The objective of this research theme is to integrate advances in next-generation DNA sequencing (NGS) technology with cutting edge environmental research here at Rice University.*** The long-term goal is to advance this capacity here at Rice, catalyze interdepartmental research, and move Rice University to the forefront of the application of genomics to environmental problem solving. Four specific research goals form the core of the proposal and involve applying NGS to new environmental challenges: (1.) to investigate the adaptive genetic basis of populations invading new habitats (host range expansion and speciation) and quantify genomic responses to human induced environmental change including pesticide use, urbanization and climate; (2.) investigate the evolutionary relationships among species in communities using phylogenomics; (3.) to assess the threat posed by new invaders and hybridization for conservation genetics and pest control; (4.) to discriminate rare species (invasive or endangered) from common taxa for pest management or conservation. Additionally, a fifth goal will be to develop an instructional "how to" website to allow other Rice University researchers, including undergraduate, graduate, post-doctoral scholars, and faculty, access to the tools for generation and analysis of NGS data. These goals all relate to Rice University's mission of improving human well-being, increasing our knowledge of the natural world, and protecting biodiversity.

Current strengths that Rice has in this area – The Department of BioSciences has a core strength in integrative studies in evolutionary ecology and behavior. Integrating NGS approaches to current questions would be a natural progression of current faculty research and offer a strong foundation from which we can grow. Moreover, we have a strong record of collaboration among disciplines across Rice, especially with the Department of Computer Science in the School of Engineering. Moreover, there is a strong computing infrastructure here at Rice, such as the Shared Computing Resources and Research Computing Support Group that would provide support for such an initiative.

Required investment – Short-term investments might include funding for post-docs and graduate students tasked with linking NGS with environmental research here on campus. These personnel could be co-advised by multiple lab PIs. Additional short term funding could target NGS data collection that would serves as preliminary data for external grant proposals, memory space and computing time on Rice University's Shared Computing Resources, funds to support conference attendance or funds to host a small targeted conference here at Rice, and open access charges for publications. Intermediate funding might include a staff bioinformatician and/or computer programmer that would also be tasked with linking labs between genomics and environmental research, as well as to fund computer time on the Rice. This person could be housed in a new 'named' Core Facility for NGS data and environmental research. Long-term investments might include targeted senior and junior faculty hires in this area and/or cluster hires across departments that would benefit from a genomics perspective. Along these lines, a graduate program in ecological genomics could emerge from this growth. Lastly, we hope that this theme can attract new investments from administrators and fundraisers here at Rice for targeted investment in the future.

Potential impact of that investment at Rice – The generation of NGS data will position each system for external funding from NSF and/or the USDA, as well as from other conservation and environmentally oriented sources. The methods and the analytical toolbox developed will be fully transferable and 'open sourced' to Rice University communities through a Genomics & Bioinformatics Core Facility and a dedicated Website, enabling application to all future studies and interested individuals on campus. Many of the study systems are in hand and Rice researchers are ready to make immediate progress, translate results into high-profile journals, presentations at national meetings, and grant applications to increase the profile of BioSciences at Rice University. Lastly, this theme is synergistic with other new collaborations, including the research field station (Miller) and the cell signaling/community structure themes (Silberg).