

Meeting report

Meshing molecules and management: a new era for natural resource conservation

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A symposium entitled ‘Applied Ecological Genetics: Molecular Approaches in Natural Resource Conservation’ was held at Purdue University, West Lafayette, Indiana from 5 to 8 October 2008. The purpose of the symposium was to bring together researchers from disparate fields of molecular ecology, evolutionary biology and genomics to address ways to apply research in ecological genetics to relevant questions in conservation and management. Symposium speakers presented ongoing research in characterizing the wealth of biodiversity on the planet, understanding the fundamental evolutionary processes influencing species over time and space, and predicting responses of species and entire ecosystems to environmental change. Recent advances in these areas have had a profound impact on conservation and management, and have helped to secure the future of our natural resources.

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1. SYMPOSIUM INTRODUCTION

At the interface of ecology, evolution and genetics lies the field of ecological genetics. The interdisciplinary nature of the discipline necessitates collaborative research that brings together disparate specialties to answer questions that are difficult or impossible to otherwise address. For example, geneticists can use molecular data to characterize reproductive success when individuals exhibit cryptic breeding behaviours, and this information can subsequently be used by behavioural ecologists to investigate questions related to mate choice and fitness. Once fitness traits have been identified, the research focus can be passed back to geneticists so that the genes underlying those fitness traits can be described. Population geneticists can use the same information to characterize the distribution of these traits over time and space. Although it is now quite common for genetic data to be used to answer ecological questions about a species in an academic context, it is still relatively rare for molecular data to be directly applied towards natural resource conservation and management. The Department of Forestry and

Natural Resources at Purdue University recently hosted a symposium that brought together a number of the discipline’s leaders to showcase their work. In addition to highlighting recent research, the symposium cultivated a shared interest in seeking ways to apply that research to relevant questions in conservation and management. As pointed out in the welcoming remarks, ‘...along with compasses and rubber boots, molecular tools are an integral part of wildlife conservation and management’.

2. UNTOLD WEALTH

A number of themes were evident at the symposium. One such theme articulated by David Hillis was that, in order to conserve our natural resources, we first need to take stock of our biodiversity and evaluate its viability in a systematic and objective way. Although our world is often thought to be generally well described, biodiversity is still being discovered at a remarkable rate. Because that rate of discovery shows no signs of slowing down, it is apparent that much work remains. We heard about an automated Tree of Life approach to cataloguing biodiversity that emphasizes a comprehensive framework for characterizing new species. By taking advantage of new DNA sequencing technologies, and combining them with the phylogenetic information available in the Tree of Life, we can characterize new organisms fully and more efficiently. This framework shows tremendous promise for the once daunting task of describing all of the biodiversity on Earth. Once biodiversity has been described, it is also critical to define a system for the designation of evolutionarily significant units (ESUs) for the monitoring and management of that biodiversity. Empirical and theoretical work was presented by Robin Waples who effectively demonstrated the application of the ESU concept to the complex (and often controversial) Pacific salmon system, with promising results for the conservation of this valuable resource.

3. FROM PATTERN TO PROCESS

A second theme of the symposium was that an understanding of the fundamental processes underlying the evolution of populations and species could provide the tools necessary to conserve our natural resources. Processes governing the maintenance of diversity within species can, for example, be harnessed to propagate species, either in captivity or in the wild, while minimizing loss of diversity. Jamie Ivy synthesized work done within the zoo community to advance our understanding of pedigree-based management, and highlighted the importance of molecular data for the successful implementation of these programmes when pedigree-based management is not possible. Interactions among populations and species were also discussed, and two different talks highlighted the importance of hybridization. Kelly Zamudio discussed the importance of hybrids in shaping the evolutionary trajectory of species, drawing from her own research in the field as well as reviewing the existing literature on the topic. Tom Whitham synthesized some of his work on the role of hybrids in shaping the evolution of whole communities and ecosystems. Interestingly, both noted that specific parameters influencing hybridization are probably species (or population) specific, making the

prediction of hybridization processes challenging. However, the fundamental role of hybridization in the evolution of species, communities and entire ecosystems necessitates interdisciplinary research in ecological genetics to secure the future of our natural resources.

4. A CHANGING WORLD

One of the prevailing issues addressed at the symposium was how species respond to change. We heard theoretical developments and cutting-edge research in both pure and applied science describing the response of species to climate change, habitat loss and fragmentation, reintroductions and supplementations, and environmental pollution. For example, Jim Hamrick's presentation on pollen flow illustrated the importance of isolated remnant trees in maintaining connectivity between habitat fragments, challenging the notion that these remnant trees may be a 'lost cause'. Another talk (by Gene Rhodes) focused on the increasing use of reintroductions as a management tool, and, using examples from wildlife management, emphasized the importance of careful planning before, during and after a translocation event to maximize retention of genetic variability. A major theme to come out of this series of talks was the idea that while the details of a response might be unique to a species or habitat, contemporary research is leading us towards a better understanding of the underlying processes that govern a species' response to change.

Unprecedented advances in genomics and analytical tools have led to exciting research to uncover the underlying genetic basis of important behavioural, morphological, physiological and life-history traits in plant and animal species, and identifying those genes that have been shaped by natural selection. These advances herald a new era of natural resource genomics, where we can look at both the ecological causes and evolutionary consequences of environmental change. This information can be used in the conservation, management and restoration of native

plants and animals. Symposium presenters discussed some of their exciting work using candidate gene approaches to understanding association genetics, the search for genes associated with phenotypes of interest. Antoine Kremer's work with retrospective monitoring of forest tree populations sheds light on past and future evolutionary trajectories of populations at previously intractable scales. In addition, particularly exciting research by Tom Whitham and colleagues on adaptive variation in foundation species challenged our understanding of how ecosystems might respond to climate change, and how we might be able to incorporate this information when designing restoration or conservation programmes. Challenges remain in the application of these tools to non-model organisms, but much progress has been made in overcoming these challenges.

5. A BRIGHT FUTURE FOR CONSERVATION AND MANAGEMENT

Student posters rounded off the symposium, showing theory in action. Diverse research projects used molecules in new and interesting ways to address problems surrounding the conservation and management of our natural resources. The symposium was marked by a sense of excitement at the potential for future research and collaboration. By integrating ongoing genetics research from different disciplines including wildlife, forestry and fisheries, we are developing a comprehensive framework for effective conservation and management of our natural resources. The symposium was attended by contributors to the forthcoming book *Molecular insights into natural resource conservation and management*, scheduled for release by Cambridge University Press in 2009. Those interested in learning more about the meeting and the upcoming book should visit <http://www.fnr.purdue.edu/research/aoe/egconference/ecologicalgeneticsofnr.shtml>, where abstracts of presentations given at the symposium, book chapter titles and case study authors are provided.