Meetings

Ecology and evolution on the banks of the St Lawrence

5th Annual Meeting of the Canadian Society for Ecology and Evolution (CSEE), Université Laval, Quebec City, Canada, May, 2010

The population biologist John Harper (1967) wrote that 'the theory of evolution by natural selection is an ecological theory, founded on ecological observation by perhaps the greatest of all ecologists'. More than 40 yr since this observation, it is surprising that the professional societies devoted to the study of ecology and evolution still remain largely distinct (for example, consider the Society for the Study of Evolution and European Society for Evolutionary Biology vis à vis the Ecological Society for America and European Ecological Federation), notwithstanding the American Society of Naturalists. While still relatively young, the Canadian Society for Ecology and Evolution (CSEE) is as a prominent exception, with a diverse membership and an emerging tradition of intellectually rich meetings that integrate ecology and evolutionary biology. The annual meeting of the society, recently held at Université Laval, illustrated the potential synergy available from a meeting covering diverse topics such as theoretical ecology, comparative biology, ecological genomics, molecular population genetics, population biology, and ecosystem ecology.

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One feature of CSEE meetings is the diverse plenary lectures and symposia, and this year was no exception: symposia topics ranged from *Impacts of a Changing Climate on Northern Terrestrial Ecoystems*, through *Biodiversity: a Molecular Perspective*, to *Marine Ecosystems in a Changing World*. Each symposium featured five speakers, headlined by plenary addresses from distinguished scientists: Douglas Morris (Lakehead University, ON, Canada), Belinda Chang (University of Toronto, Canada), and Paul Falkowski (Rutgers University, NJ, USA), respectively. These symposia reflect regular themes at CSEE meetings: influences of global climate change on ecological and evolutionary processes, connections between conservation biology and basic research in ecology and evolution, and the emergence of ecological and evolutionary genomics as a field that cuts across molecular biology, population and quantitative genetics, and evolutionary ecology (see Landry & Aubin-Horth, 2007; Barrett & Vamosi, 2008; Starzomski & Brown, 2009).

The Canadian Institute for Ecology and Evolution

One exciting component of the meeting was hearing about recent progress of the Canadian Institute for Ecology and Evolution (CIEE) from its director, Art Weis (University of Toronto). The CIEE, which is based at the Koffler Scientific Reserve at Jokers Hill (http://ksr.utoronto.ca), is a consortium of Canadian universities that sponsors thematic research programs and advanced training in ecology and evolution. The CIEE's goals are to address significant questions in ecology and evolution through synthesis of existing data or development of novel theory, and to make policy recommendations based on scientific data. At this year's meetings, the results of two successful thematic programs were described. First, the CIEE co-hosted with the Fields Institute a symposium on the 'Adaptive Movement of Interacting Species' organized by Peter Abrams (University of Toronto) and Yuan Lou (Ohio State University, USA). The symposium attracted > 50 international participants spanning ecology, evolution and applied mathematics. Second, a past program on the use of science in implementing the Species at Risk Act led to program organizer Arne Mooers (Simon Fraser University, BC, Canada) and participant Jeannette Whitton (University of British Columbia, Canada) testifying before parliamentary committees on the Act's renewal.

One exciting prospect described in Laval was the potential for graduate mini-courses hosted at the CIEE: short, non-credit courses providing advanced training in ecology and evolution in a format not typically found in academic departments. A call for proposals from potential course leaders will be made in summer 2010. The CIEE seeks

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applications for mini-courses that focus on hands-on application of techniques or methods, or that take an interdisciplinary approach by mixing students and instructors from several fields of study. Further details on the CIEE and graduate mini-courses can be found at http://www.ecoevo.ca/CIEE.

Plant and animal evolutionary ecology in alpine and arctic ecosystems

Arctic and alpine ecosystems are likely to experience rapid change in the next century, and characterizing the ecological and evolutionary dynamics of these systems in response to global change is an ongoing challenge. Several talks stood out this year; for example, David Hik (University of Alberta, Canada) outlined the results of long-term demographic analyses of collared pikas (*Ochotona collaris)* and hoary marmots (*Marmota caligata*) near Kluane Lake, Yukon, Canada. In a series of detailed studies of population density, age structure, and behavior, Hik and colleagues have investigated the contribution of climatic variation to vital rates (Karels & Hik, 2003; Morrison & Hik, 2007). The Pacific Decal Oscillation (PDO) determines snow-melt timing, which, in turn, affects vital rates. These observations implicate the onset of spring and plant phenology as potential forces affecting population growth (Morrison & Hik, 2007). Forecasting the effects of global climate change on demography is challenging, as current predictions call for both earlier snow melt (a positive) coupled with increasing freeze–thaw events in late winter and early spring (a negative). Teasing apart the direct effects of climate change on vital rates and the indirect effects via plant phenology is likely to be an ongoing challenge for many species and ecosystems.

In a second example, Brian Kopach, (University of Calgary, Canada) described his work on how facilitation can affect natural selection and adaptation in plants. Positive interactions such as facilitation are predicted to occur in environments of high abiotic stress, such as alpine plant communities, where neighbors can buffer local environmental conditions. By manipulating the presence and absence of neighbors of the alpine perennial *Potentilla diversifolia* (Rosaceae) along an altitudinal gradient, Kopach was able to estimate how neighbor removal affected both reproductive success and natural selection on morphological traits. Early results show variable selection across altitudes and neighbor removal treatments, although more data will be needed for a perennial such as *P. diversifolia*. More generally, the work described by Hik and Kopach illustrates the need for – and potential benefit from – long-term, *in situ* studies of the ecological and evolutionary dynamics of plant and animal communities, especially in an era of global change.

New approaches to mating system evolution and phenology

The relationship between investment in sexual function and fitness return is a key factor shaping mating system evolution (Charnov, 1979). Current models assume that these so-called 'gain curves' differ for male and female function: male gain curves in plants should saturate (for example, because more pollen is produced in a population than there are ovules to fertilize), while female gain curves should be more linear, because female reproduction is more typically resource-limited. Marcel Dorken and Wendy Van Drunen, from Trent University, Ontario, Canada, presented novel theoretical work on how clonality alters the fitness returns on investment in male and female reproductive effort (Dorken & Van Drunen, 2010). If each clonal ramet reproduces independently (probably a simplifying assumption in animal-pollinated species), reproductive investment by each individual ramet is in the steepest part of the male gain curve. Their model suggests that male fitness is maximized by clonal expansion, and that fertility selection may be responsible for male-biased sex ratios in clonal, dioecious species, an alternative hypothesis to the traditional explanation involving the greater costs of female reproduction (Dorken & Van Drunen, 2010). Testing this model will require more characterization of male and female gain curves, a challenging empirical task, but one with major theoretical implications.

The ecological and evolutionary significance of variation in flowering phenology is well recognized (Elzinga *et al.*, 2007), but methods to quantitatively describe and compare phenologies still need further development. Emily Austen (University of Toronto) described a novel multivariate statistical approach to describe variation in flowering phenology among individuals. The approach yields biologically interpretable summaries of phenological variation, and should be widely applicable, as it frees the investigator from making *a priori* assumptions about the nature of phenological variation. Moreover, Austen's approach is also applicable to investigations involving population- or community-level phenological changes. For this work, Austen won the *Annals of Botany* prize for the student talk that made an outstanding contribution to plant biology.

Conclusions and prospects

What potential future prospects for plant ecology and evolution are apparent, given the talks at the CSEE meeting? Two, among many, stand out. First, while the role of large-scale climatic forces such El Niño/La Niña and the PDO in plant and animal ecological dynamics is becoming appreciated (see for example Holmgren *et al.*, 2001; Hallett *et al.*, 2004; see above), few studies have taken advantage of these climatic

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events to study short-term microevolutionary responses – an exception being Franks *et al.* (2007). Studies on the microevolutionary response to climatic oscillations with short-lived plants would seem especially feasible, as seeds can be stored, facilitating comparisons between ancestors and post-event descendants. Moreover, the rich background knowledge about life history and physiological trade-offs in plants should allow specific predictions about what suites of traits would be favored after a climatic event, along with what types of traits might evolve as correlated responses.

Second, the benefits of long-term monitoring of the microevolutionary dynamics of animal systems are now quite apparent, from several detailed studies of bird and large mammal populations (Grant & Grant, 2002; Coltman *et al.*, 2003; Sheldon *et al.*, 2003; Garant *et al.*, 2005; Postma & van Noordwijk, 2005; Wilson *et al.*, 2006; Charmantier *et al.*, 2008). Advanced methods now exist for decomposing long-term phenotypic trends in ecologically important traits into plastic responses caused by changing environmental conditions and evolutionary responses resulting from selection and evolution (Coulson & Tuljapurkar, 2008; Ozgul *et al.*, 2009). While the statistical methods used in many of these studies are not without their potential pitfalls (see Hadfield *et al.*, 2010; Wilson *et al.*, 2010), these studies have nonetheless improved our understanding of the evolutionary genetics of a variety of difficult-to-study animal populations. Given that they 'stand still and wait to be counted', to use Harper's (1977) phrase, it is regrettable that there are so few comparable long-term demographic and genetic studies in plant populations on means and distributions of ecologically important traits, or temporal trends in the strength and form of natural selection.

John R. Stinchcombe

Department of Ecology and Evolutionary Biology, Centre for the Analysis of Genome Evolution and Function, University of Toronto, Toronto, ON M5S 3B2, Canada (tel: +1 416-946-5986; email john.stinchcombe@utoronto.ca)

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