

## Biodiversity: past, present and future

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## Meeting report

**Biodiversity: past, present and future**Emily M. Rubidge<sup>1,†</sup>, A. Cole Burton<sup>2,\*</sup>† and Steven M. Vamosi<sup>3</sup><sup>1</sup>Museum of Vertebrate Zoology, University of California, 3101 Valley Life Sciences Building, Berkeley, CA 94720-3160, USA<sup>2</sup>Alberta Biodiversity Monitoring Institute, University of Alberta, CW 405 Biological Sciences Building, Edmonton, Alberta, Canada T6G 2E9<sup>3</sup>Department of Biological Sciences, University of Calgary, 2500 University Drive North West, Calgary, Alberta, Canada T2N 1N4\*Author for correspondence ([acburton@ualberta.ca](mailto:acburton@ualberta.ca)).

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**On 12–15 May 2011, a diverse group of students, researchers and practitioners from across Canada and around the world met in Banff, Alberta, to discuss the many facets of biodiversity science at the 6th Annual Meeting of the Canadian Society for Ecology and Evolution.****Keywords:** Canadian Society for Ecology and Evolution; biodiversity; conservation; interdisciplinary; taxonomy; ecological monitoring**1. INTRODUCTION**

Conservation of biological diversity is among society's most daunting challenges, and one that can only be met through interdisciplinary effort [1]. Strong science will underpin sustainable policies, yet scientific uncertainty abounds in our understanding of complex ecological dynamics operating across multiple spatial and temporal scales—from sub-cellular to landscape, seasonal to epochal. Such uncertainty reaches beyond boundaries of traditional disciplinary thinking, necessitating shared insight from ecologists, evolutionary biologists, taxonomists and conservation biologists (among many others). How will species and communities respond to a changing climate? What effect will biodiversity loss have on the functioning of ecosystems and delivery of critical ecosystem services? Which species are most vulnerable to extinction, and how can damaged ecosystems be restored? Tackling these and other pressing questions will undoubtedly require a thriving and interdisciplinary community of biodiversity scientists.

Within such a context, and in the first year of the United Nations' Decade of Biodiversity (<http://www.cbd.int/2011-2020>), a diverse group of scientists gathered in Canada's beautiful Banff National Park from 12–15 May 2011, for the 6th annual meeting of the Canadian Society for Ecology and Evolution (CSEE). Four hundred and sixty students and professional scientists discussed and debated a wide range of topics within a meeting theme of 'Canada's biodiversity: past, present, and future'. The theme encompassed an array of approaches to biodiversity study that were on display: the long view of palaeoecology and its lessons from the

past; insight on contemporary patterns and processes from field and laboratory experiments; and predictions of future scenarios from theoretical and empirical models. It also showcased a diversity of participant perspectives: wisdom garnered over long careers of senior scientists; cutting-edge contributions from acclaimed mid-career faculty; and fresh ideas from graduate theses and student works-in-progress. Overall, the programme included three keynote addresses, seven symposia, 254 contributed talks and 135 posters covering diverse subdisciplines, from ecological and evolutionary applications to mathematical and statistical modelling to palaeobiodiversity. While comprehensive coverage of the breadth of the meeting is beyond the scope of this report, in the following sections, we summarize some of the highlights and themes that emerged from the conference.

**2. LESSONS FROM THE PAST AND THE REBIRTH OF NATURAL HISTORY**

Any assessment of the current status of biodiversity is incomplete without an understanding of the loss and gain of species over geological time. The field of palaeoecology looks deep into the past to provide this perspective and to inform our outlook of current biodiversity dynamics under global change [2]. The meeting's Plenary Lecture, by Philip Currie, opened a window into the ancient biodiversity of Alberta's Dinosaur Provincial Park, a United Nations World Heritage Site, and highlighted modern lessons learned from changes that occurred over 70 million years ago. He also relayed that new species continue to be described 125 years after the discovery of *Albertosaurus*. A symposium on Palaeobiodiversity further explored the origins of modern biodiversity through presentations on species assemblages and dynamics across diverse taxa and time spans in addition to talks detailing advances in methods for reconstructing the past from the fossil record.

A look into the more recent past reminds us that the fields of ecology and evolution were born from the study of natural history; that is, the careful description of species and their distributions and inter-relationships. These roots are often forgotten in fields now rich with advanced technologies, yet we continue to rely on this basic foundation. A symposium on systematics and biodiversity provided a timely reminder that the study of biodiversity is hindered by major holes in documentation of the underlying components of biological diversity. Sally Otto began the symposium by summarizing results of a recent review of the status of taxonomy in Canada [3]. Key concerns included a growing gap in taxonomic expertise in Canada, lack of a national strategy for museum natural history collections, and decreasing availability of jobs in taxonomy and systematics (despite interest from young scientists). Canada has over 50 million specimens in museums across the country yet lags behind in making data more accessible through digitization of collections. Once digitized, specimen data can be more readily used in many applications, ranging from the integration of distribution records with phylogenetic hypotheses to predictive models of species responses to climate change [4].

Canada's taxonomists must also be better prepared to meet a growing demand driven by the need for more

biodiversity monitoring. In another of the symposium's talks, Tyler Cobb described the 'taxonomic impediment' in relation to the Alberta Biodiversity Monitoring Institute (ABMI, [www.abmi.ca](http://www.abmi.ca)), an ambitious programme tracking populations of diverse taxa across the province. Cobb outlined many challenges and opportunities presented by such large-scale monitoring programmes, including an abundance of new specimens to be accurately identified (e.g. since 2007 the programme has processed 15 660 oribatid mite specimens, resulting in 27 species confirmed new to science). The taxonomic work is a prerequisite for answering other important ecological and evolutionary questions, and it creates training and employment opportunities for a new generation of systematic biologists. Other presentations in this symposium highlighted cutting-edge applications of systematics to biodiversity science, from exploring species diversification to defining conservation priorities.

### 3. TOWARDS A MODERN SYNTHESIS

In addition to uncertainties in our basic accounting of biodiversity past and present, there remain wide gaps in our understanding of eco-evolutionary dynamics within and among extant species. A wide range of presentations at the meeting examined patterns and processes across scales from genes to ecosystems.

In his classic book *The ecological theater and the evolutionary play*, Hutchinson [5] emphasized that evolution occurs within the context of the environment. At few other society meetings is this inseparability of ecology and evolution so fruitfully acknowledged, including considerations of eco-evolutionary dynamics of competition, impacts of resource heterogeneity on speciation, and effects of regional biodiversity on local community resilience. Another common theme in many talks and posters was the application of modern molecular and genetic techniques to advancing understanding of key questions in ecology, evolution and conservation.

Fundamental questions underlying the origin of species were addressed in a symposium on the genetics of evolution and species isolation. Dolph Schluter started the symposium by reviewing recent findings from long-term studies of sticklebacks and previewing what promises to be an exciting long-term pond experiment on ecological speciation. Louis Bernatchez and Loren Rieseberg presented recent results on genomic divergence from whitefish and sunflowers, respectively, among many other insightful talks. The symposium wrapped up with a presentation by Jerry Coyne on the 'genetical biogeography' of speciation, including a thought-provoking discussion of the utility of continuing to invoke a geographical component to speciation.

The quest to characterize complex patterns and processes within ecological communities has long been a centrepiece of ecological inquiry, and the meeting did not disappoint in this respect. Many presentations examined plant–insect interactions, including a symposium on Canada's pollinator biodiversity and pollination services, which covered themes such as mapping Canada's pollinator biodiversity, ecosystem services provided by pollinators, and projections of future pollinator diversity with global change. Bringing

together such diverse themes and subdisciplines in one meeting provided fertile ground for synthesis and advancement in biodiversity science.

### 4. WHAT FUTURE FOR BIODIVERSITY?

Ecologists increasingly accept that an understanding of eco-evolutionary patterns and processes is in itself not sufficient to address concerns about biodiversity loss [6]. Accordingly, several talks and posters at the meeting were devoted to applications of ecological and evolutionary science for addressing environmental problems. David Schindler brought the theme of environmental impacts to the forefront in his President's Award Address on the impacts of oil sands industrial activity in Alberta's Athabasca River ecosystem. Schindler—recognized with CSEE's highest honour for outstanding contributions to ecology in Canada—detailed the potential pitfalls of unmitigated industrial expansion and highlighted the need for high quality, independent and transparent environmental monitoring [7].

In kicking off a symposium on population ecology, Charley Krebs reinforced the importance of sound, long-term ecological monitoring to inform natural resource management. Krebs argued that decades of research in population ecology provide a strong foundation for addressing applied problems, but he stressed the incomplete nature of our ecological understanding (e.g. of the driving forces behind population declines) while decrying the 'politics of ignorance' that renders what we do know largely ineffective at influencing policy. He also lamented the difficulty of obtaining support for long-term monitoring in Canada. Symposium talks from other veteran and emerging population ecologists spanned a range of taxa and ecosystems—from reef sharks to alpine butterflies—while echoing the importance of combining long-term monitoring with novel datasets and analyses in addressing management concerns.

One concern featuring prominently in many presentations was that of the ecological effects of climate change. From the expansion of white-tailed deer in the boreal forest to vegetation shifts in Arctic and alpine environments, evidence of climate-related impacts was widely noted. Ecological impacts in protected areas were another important management theme receiving attention, particularly in the symposium on ecological integrity in Canada's national parks. Pertinent to the meeting's setting, presentations on the challenges of ecologically effective management in Banff and Jasper national parks covered complex themes including trophic cascades, wildlife corridors and the restoration of altered terrestrial and aquatic systems. This symposium was organized by Parks Canada and facilitated vital interaction among academics and practitioners, driving home the importance of involving a variety of stakeholders in the development of effective conservation solutions.

Multi-stakeholder collaboration was also highlighted in a public lecture by Robert Barclay on threats to bat biodiversity. Barclay's talk—attended by conference participants and local residents—provided examples of how scientists can successfully work with

government and industry to tackle conservation problems, such as the risks to bats posed by emerging diseases and wind farms. Scientists must continuously strive to make their research results accessible to decision makers, while also demanding that sound science be given appropriate weight in the policy arena.

## 5. CONCLUDING THOUGHTS

The broad range of participants and presentations at the CSEE's 6th annual meeting underscored the energy and enthusiasm of this rapidly maturing society. The gathering provided ample opportunity for learning and exchange among students, professors and practitioners, including successful workshops on networking, grant writing (hosted by the Natural Sciences and Engineering Research Council of Canada), statistical methodologies (sponsored by the new Canadian Institute for Ecology and Evolution <http://ciece-icee.com>), and women in academia (the popular 'SWEEET'; [www.ecoevo.ca/banff2011/SWEEET](http://www.ecoevo.ca/banff2011/SWEEET)). In addition, an outreach event for children and three field trips introduced participants to local biodiversity in the Canadian Rockies. Raising public awareness of the importance of ecology and evolution to Canadian society is one of CSEE's main objectives (see [www.ecoevo.ca](http://www.ecoevo.ca)), and the progress exemplified by this meeting bodes well for the future of the study and application of these sciences in Canada (see also e.g. [8]).

That being said, many challenges remain. Despite its international reputation for pristine wilderness, Canada has a poor environmental record [9], with high *per capita* consumption rates, questionable commitment to international environmental agreements, and limited implementation of endangered species recovery plans. Economic demands will continue to grow, as will the associated strains on biodiversity and ecosystem services. Add in the uncertain arena of a changing climate, and it is clear that Canadians face great challenges in meeting their desire to protect the country's natural heritage. For a young and relatively uncrowded country, these challenges also represent an opportunity for bold leadership in biodiversity science and conservation, and such leadership will need the support of a strong and multi-disciplinary scientific society.

In closing, we look ahead with anticipation to future reporting of advancements in ecology and evolution at the 2012 CSEE meeting in Ottawa. Next year's meeting is bound to be an exciting and stimulating

gathering as it will be the first joint meeting of several scientific societies, including the American Society of Naturalists, Society for the Study of Evolution, Society of Systematic Biologists and European Society for Evolutionary Biology. This year's meeting demonstrates that CSEE is ready to showcase itself to these well-established societies and will do so for the mutual benefit of all participants.

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