MILLER INSTITUTE NEWSLETTER

Fall 2010

Miller Fellow Focus: Dan Rabosky

Explaining the diversity of organisms in the natural world is a challenging problem that has vexed naturalists for centuries. From trees and frogs in tropical forests to backyard birds and garden beetles, the sheer variety of living things can be nearly incomprehensible. There are millions of insect species, hundreds of thousands of land plants, and perhaps more than a thousand species of bats on Earth! Yet, for all these groups with dazzling diversity, many more groups of organisms have scarcely diversified at all.

Likewise, species in some groups show tremendous differences in form and function, but in many other groups, species are so similar to one another that only taxonomic specialists can distinguish between them. Most 'textbook' examples of evolutionary diversification, like anole lizards and African cichlid

fishes, are celebrated because they have such exceptional ecological or species diversity, but a great number of evolutionary radiations are equally noteworthy for what they lack in diversity. More than 150 years after Darwin wrote the *Origin of Species*, we still have much to learn about how and why evolutionary diversification varies so much across the Tree of Life.

Dan Rabosky, a second-year Miller Fellow, studies the evolutionary and ecological mechanisms that underlie the differences in diversity between groups that are seen in the natural world. Do some groups become more diverse than others because they have traits that cause them to form new species at higher rates? Do they have traits that buffer them from extinction? Or is species diversity mostly controlled by environmental factors such that groups living in high-resource locations (like warm, humid rainforests) diversify more than groups living in low resource environments (like cold polar deserts)? Do some groups show greater variety of features than other groups because they can evolve more quickly or more easily than others?

These are examples of questions Dan is studying through his work in the Department of Integrative Biology. He incorporates many different approaches into his work, ranging from field studies

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Call for Nominations
NEW ONLINE SYSTEM FOR COMPETITIONS

Miller Fellow nominations are due
Thursday, September 9, 2010

Miller Professor applications are due
Thursday, September 16, 2010

Visiting Miller Professor Departmental nominations are due
Monday, September 20, 2010

Please see **PAGE 3** for details on submitting nominations for the Miller Fellowship program. For complete information on all our programs, visit: http://millerinstitute.berkeley.edu

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of desert lizards in the remote deserts of Outback Australia to the development of new mathematical and computer models for studying diversification in groups ranging from plants and plankton to primates.

The challenge of lizard diversity in Australia's deserts

The deserts of interior Australia are host to some of the most diverse communities of lizards on the planet. Despite low rainfall and scorching summer temperatures, tremendous numbers of lizard species can be found crammed together in even the smallest habitat patches (Figure 1). One of the patterns that Dan found most fascinating about this system is that, despite extremely high diversity in the Australian deserts, the overall lizard community is a heterogeneous mix of species from different groups (referred to as 'clades'), a few of which have undergone dramatic evolutionary explosions in Australia – and many others of which have not. During his PhD work at Cornell University, Dan began using the evolutionary radiations of lizards across Australia as a model system to understand the factors that cause some groups to become exceptionally diverse.

A group of small and hard-to-catch lizards known as *Ctenotus* skinks is especially interesting. They are one of the most species-rich groups of vertebrates (> 100 species) and live in almost all of the different habitats in the Australian deserts, but – at least at first glance – most species are very similar in overall body shape, showing few of the dramatic anatomical specializations for habitat use seen in other groups of lizards.

Figure 1. Representative lizard diversity from Australia's Great Victoria Desert, which harbors one of the most species-rich assemblages of lizards on Earth. Clockwise from upper left: Ctenotus pantherinus, Ctenotus leonhardii, Ctenotus uber, Strophurus strophurus, Lerista picturata, and Tiliqua multi-fasciata. ***Photo credits: D. Rabosky.***

In collaboration with Australian researchers and one of his PhD advisors, Irby Lovette, Dan is using DNA sequences to reconstruct the evolutionary history of *Ctenotus* and to compare it to the history of other lizard groups from Australia. Dan developed new statistical methods for studying rates of species diversification from evolutionary histories based on DNA sequences and is applying these approaches to Australian lizards and many other groups of organisms. Dan is also trying to understand how ecological differences between species evolve within groups of lizards, and how those ecological differences relate to the overall high species diversity in the Australian deserts.

Explaining species richness across the Tree of Life

Evolutionary diversification is a complex process, with many interacting variables that shape the fates of clades over millions of years. To better understand the processes that influence biological diversity, Dan is testing for general evolutionary mechanisms that underlie patterns in a diverse range of organisms (Figure 2). To deal with some of the complexity inherent in diversification, his work emphasizes developing statistical models that allow us to distinguish between alternative hypotheses for species diversity.

When looking at major clades of birds, for example, why is there so much variation in species richness? Are some groups older than other groups, such that they have had longer time for species diversity to build up? Or do some groups have inherently faster rates of diversification, perhaps because of intrinsic biological traits that favor rapid species formation? Dan's research suggests that neither of these explanations can fully account for species diversity in many types of organisms. Rather, it seems that ecological

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Miller Research Competitions

All 2010 program competitions nominations and applications must be made online!

Information about the Miller Institute programs is available at http://millerinstitute.berkeley.edu

Direct questions to Kathryn Day at the Miller Institute office at 642-4088 or at millerinstitute@berkeley.edu

Miller Research Fellowship 2011-2014
Online Nomination Deadline:
Thursday, September 9, 2010.

http://millerinstitute.berkeley.edu/page.php?nav=11

The Miller Institute for Basic Research in Science invites department chairs, faculty advisors, professors and Ph.D. research scientists at institutions around the world to submit nominations for the Miller Research Fellowship in the basic sciences. Miller Research Fellowships are intended to bring brilliant young women and men of great promise to the Berkeley campus who have recently been awarded, or who are about to be awarded, the doctoral degree. Ph.D. must be received by 9/30/11 to be eligible. A nominee cannot hold a paid or unpaid position on the Berkeley campus at the time of nomination or throughout the competition and award cycle. Nominees who are non-US citizens must show eligibility for obtaining J-1 Scholar visa status for the duration of the Miller Fellowship. The Miller Institute does not support H1B visa status.

The Miller Institute is the home administrative department for each Miller Fellow. All research is performed in the facilities provided by the UC Berkeley academic department and host faculty. The Fellowship term must commence between July 1 and October 1, 2011. Early nominations are encouraged to allow the candidates more time to prepare and submit their online applications and request references by deadline. Nominations cannot be made by students or postdocs. Direct applications and self-nominations are not accepted.

The nomination must be completed in a single online session. Nominators will need the following information to complete the process:

- Nominee's complete full and legal name
- Nominee's complete and current **active** E-mail address
- Nominee's current Institution, mailing address, telephone
- Nominee's Ph.D. Institution
- Nominee's (expected) Date of Ph.D. (month & year required-must be received by 9/30/11 to be eligible. Nominator's letter of recommendation and judgment of nominee's potential. Note: the recommendation can either be typed directly into the online form or may be uploaded as a pdf file.

Successful nominations will be confirmed by email within 24 business hours. Eligible nominees will be invited to submit an online application which will be due October 8, 2010. An announcement of awards will be made in the spring.

Miller Research Professorship 2011-2012
Online Application Deadline:
Thursday, September 16, 2010.

http://millerinstitute.berkeley.edu/page.php?nav=15

Miller Professorships are available only to faculty of the University of California, but are not restricted to Berkeley faculty. The Miller behest requires, however, that research be conducted on the Berkeley campus, so extended absences from the campus should not be planned for the term of appointment. Other UC campus faculty must seek sponsorship of a Berkeley campus academic department before making an application and must solicit an endorsement letter from the Berkeley campus Department Chair as well as their home campus Department Chair. The term of appointment is for either the full academic year, beginning July 1, 2011, or one semester of Academic Year 2011-2012. Professorial salary and benefits for a regular 9/12 academic year or semester will be paid by the Miller Institute. Note: Miller Professors do not accrue time towards sabbatical leave. Applications are judged competitively and awards will be announced in December.

Visiting Miller Research Professorship 2011-2012
Online Departmental Nomination Deadline:
Monday, September 20, 2010.

http://millerinstitute.berkeley.edu/page.php?nav=24

The Miller Institute for Basic Research in Science invites Berkeley faculty to submit online nominations for Visiting Miller Research Professorships. The purpose of the Visiting Miller Professorship is to bring promising or eminent scientists to the Berkeley campus on a short-term basis for collaborative research interactions. It is required that awardees be in residence at Berkeley during their entire Miller Institute appointment term and that the visit must run in consecutive weeks. It is the academic department host faculty member's responsibility to ensure their presence on campus. Travel during the appointment is not allowed and will result in adjusted stipend and living expense payments.

Terms of appointment may range from a minimum of thirty days to a maximum of one semester (120 days). Appointments must take place during the regular academic year 2011-2012 (Fall 2011 or Spring 2012). It is not appropriate to request a starting date between semesters or during the summer, and the visit must run in consecutive weeks. Non-US citizens must be eligible for J-1 Scholar visa status. Visitors cannot be supported on H1B or B visa status. Nominations are judged competitively and awards will be announced in December.

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factors – including the nature and abundance of resources in the environment, as well as the ability of organisms to use those resources – play a key role in explaining diversity.

New Tools for Old Questions

The amount of data for testing hypotheses about diversification has exploded in recent years, driven especially by the availability of DNA sequences and evolutionary trees. However, methods for testing even simple hypotheses with these data have lagged behind, and the sheer size of the new datasets often requires computationally intensive analysis. In collaboration with his Miller host John Huelsenbeck (a former Miller Fellow), Dan is developing methods that allow rigorous investigation of questions that have challenged evolutionary biologists for decades. Paleontologists, for example, have long noted that evolutionary rates vary dramatically through time and among groups of organisms. How do we combine information from the fossil record - which provides our only real window into the process of extinction - with the new DNA sequence-based evolutionary trees, to study the dynamics of evolutionary rates? How do we link rates and patterns of morphological evolution to rates of speciation and extinction? Dan believes that by developing new methods and applying them broadly across the Tree of Life, we will ultimately improve our understanding of why some groups have undergone dramatic evolutionary explosions and why many other groups have failed to diversify.

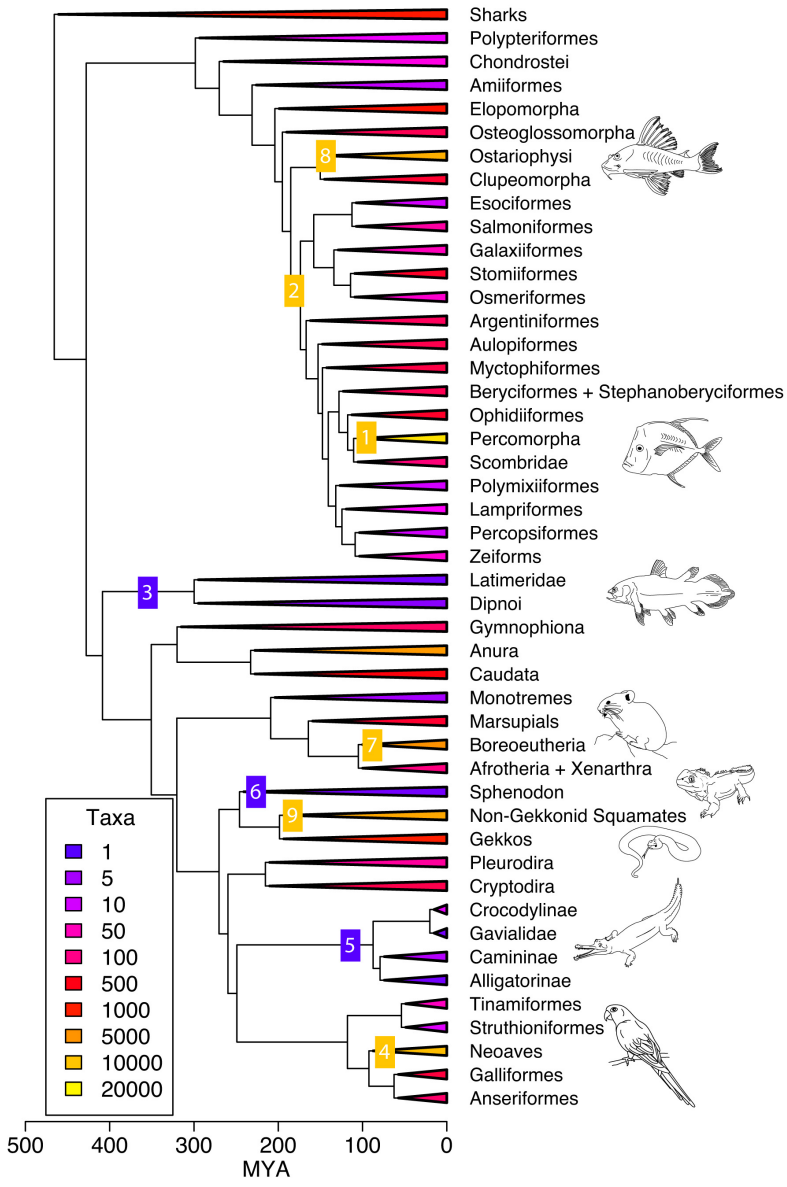


Figure 2. Distribution of species diversity across the vertebrate evolutionary tree. Branch colors indicate the number of non-extinct species in each group. Numbers on branches denote groups with exceptionally fast or slow rates of species diversification. *Credit: M. Alfaro et al., Proceedings of the National Academy of Sciences of the U.S.A. (2009).*

Dan has been obsessed with evolution and biological diversity since he found his first wild snake at the age of 5, an eastern garter snake that he named *Blue Streak*. His interests ultimately led him to pursue a PhD in evolutionary biology at Cornell University under the dual mentorship of Amy McCune and Irby Lovette. In his spare time, Dan is often found climbing hills on his road bike, studying natural history, cooking, and exploring wild places both near and far.

Awards and Honors

June 10, 2010: **Maryam Modjaz** (Miller Fellow 2007 - 2010) has been awarded the German Astronomical Society's 2010 Ludwig Biermann Award for outstanding young astronomers.

June 7, 2010: **Yue Wu** (Miller Fellow 2006 - 2009) has been awarded a DuPont Young Professor Grant.

May 27, 2010: **Raman Sanyal** (Miller Fellow 2008 - 2011) has been awarded the Berlin Tiburtius Prize for his outstanding dissertation.

May 17, 2010: **Alex Filippenko** (Miller Fellow 1984 - 1986, Miller Professor Spring 1996, Miller Professor Spring 2005) has been awarded the Emmons Award for excellence in the teaching of introductory astronomy for non-science majors.

April 27, 2010: The Miller Institute would like to congratulate the following new members of the National Academy of Sciences:

--**David Aldous**, Foreign Associate, (Miller Professor Spring 1993)
--**Richard Eisenberg** (Visiting Miller Professor Spring 2005)
--**James Haber** (Visiting Miller Professor Spring 2005)
--**David Jablonski** (Miller Fellow 1980 - 1982)
--**Michael Jordan** (Miller Professor Fall 2008)
--**Steven Kivelson** (Visiting Miller Professor Fall 1995)
--**Jonathan Lunine** (Visiting Miller Professor Fall 2001)
--**Ignacio Rodriguez-Iturbe** (Visiting Miller Professor Spring 2004)

April 26, 2010: **David Milstein** (Visiting Miller Professor Spring 2006) has been awarded the Royal Society of Chemistry Sir Geoffrey Wilkinson Award.

April 23, 2010: **Ronald Hoy** (Visiting Miller Professor Spring 2005) and **Richard A. Muller** (Miller Professor 1990) have both been elected to the American Academy of Arts & Sciences.

April 22, 2010: **Leon Chua** (Miller Professor 1976 - 1977) has won a 2010 Guggenheim Fellowship award.

Birth Announcement

The Miller Institute congratulates Doug Young and **Stacey Combes** (Miller Fellow 2004 - 2007) on the birth of Logan Douglas Young born June 29, 2010.

Obituaries

Don Backer (Miller Professor Spring 2007) passed away on July 25, 2010.

Gerson Goldhaber (Miller Professor 1958 - 1959, 1975 - 1976, 1984 - 1985) passed away on July 19, 2010.

Henry Helson (Miller Professor Fall 1964) passed away on January 10, 2010.

New Executive Director

Dear Friends and Family of the Miller Institute,

It is nothing but a pleasure to serve on the Miller Executive Committee and to work with a dedicated staff and Executive Committee. This year we welcome two new committee members, Jasper Rine from Molecular and Cell Biology and Craig Evans from Mathematics. I would like to thank the two outgoing members of the Executive Committee for their years of service, Mimi Koehl, the most recent Executive Director, and Alberto Grunbaum. Mimi's patience and Alberto's sense of humor will be missed in the long grueling meetings in which we review nominations.

The Miller Institute has been an integral part of my academic life. I was a Miller Fellow, a Miller Professor, and I have hosted several Miller Fellows who remain good colleagues today. While it is not possible to repay the Institute for these opportunities, I look forward to playing a role in the Institute's future.

With the slowdown in hiring at so many institutions it is reassuring that so many of our Fellows continue to move on to excellent faculty positions and other research positions. The Miller Institute, however, has not been spared from the nation's financial woes. Because we rely almost entirely on income from our endowment we had to make some difficult decisions over the past year. The number, duration and support of Miller Fellowships remains unchanged. The number of Visiting Miller Professors, however, was reduced, and Miller Professorships could only be granted for one semester.

Our objective is simple: to support innovative research in basic science and attract the most creative scientists to Berkeley. To that end, if you have any suggestions for new initiatives or general comments about the Institute, please do not hesitate to share your thoughts with me.

Looking forward to another year of stimulating talks,

-Michael Manga, Executive Director

Publications

The following Miller Institute members have recently published works resulting from research during their Miller Institute terms. For more information about these publications, please visit the Miller Institute's website at: millerinstitute.berkeley.edu/publications.htm.

Tessa Burch-Smith
Miller Fellow 2007 - 2010

Tanja Cuk
Miller Fellow 2007 - 2010

Phil Hopkins
Miller Fellow 2008 - 2011

Prashant Jain
Miller Fellow 2008 - 2011

Mark Kirkpatrick
Miller Fellow 1983 - 1985
Visiting Miller Professor Fall 2009

Stephen Leone
Visiting Miller Professor Fall 1990
Miller Professor Spring 2010

Erick Matsen
Miller Fellow 2007 - 2010

Isamu Matsuyama
Miller Fellow 2008 - 2011

Eliot Quataert
Miller Professor 2009 - 2010

Dan Stamper-Kurn
Miller Professor 2009 - 2010

Ashvin Vishwanath
Miller Professor Fall 2009

Interdisciplinary Symposium June 4-6, 2010

The Miller Institute hosted its 14th annual Interdisciplinary Symposium at the Marconi Conference Center during the weekend of June 4-6, 2010. A complete list of speakers and more photos can found at: http://millerinstitute.berkeley.edu/page.php?nav=53.

Candace Chan and Alex Engström

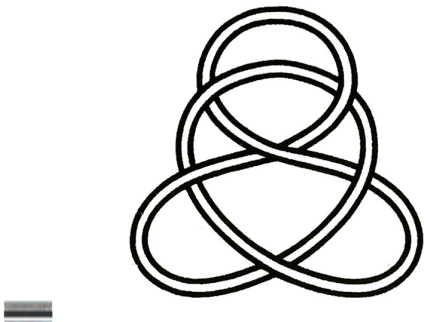
Enjoying lunch at Point Reyes

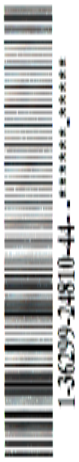
Julius Lucks and Thomas Juenger

Mimi Koehl and Beth Burnside

Lisa Kewley and Genevieve Graves

Chris Douglas, Greg Crutsinger, and Dan Nicolau





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miller_adm@berkeley.edu

Next Steps

The Miller Institute congratulates the following Miller Fellows on their next endeavors.

Tessa Burch-Smith
Post-Doctoral Associate
Plant & Microbial Biology
UC Berkeley

Tanja Cuk
Assistant Professor
Chemistry
UC Berkeley

Chris Douglas
University Lecturer
Mathematics
Oxford University

Erick Matsen
Assistant Member
Program in Computational Biology
Fred Hutchinson Cancer Research Center
Seattle, WA

Maryam Modjaz
2010-2011
Hubble Postdoctoral Fellow
Columbia University
Beginning Fall 2011
Assistant Professor
Physics
NYU

The Miller Institute is "dedicated to the encouragement of creative thought and the conduct of research and investigation in the field of pure science and investigation in the field of applied science in so far as such research and investigation are deemed by the Advisory Board to offer a promising approach to fundamental problems."