

AMERICAN SOCIETY OF MAMMALOGISTS

92nd ANNUAL MEETING

Peppermill Resort, Spa, and Casino • Reno, Nevada

ASm



PROGRAM & ABSTRACTS



AMERICAN SOCIETY OF MAMMALOGISTS (ASM)

The American Society of Mammalogists (ASM) was established in 1919 for the purpose of promoting interest in the study of mammals.

An Overview

In addition to being among the most charismatic of animals, mammals are important in many disciplines from paleontology to ecology and evolution. We, of course, are mammals and thus are in the interesting position of studying ourselves in quest of a greater understanding of the role of mammals in the natural world.

The ASM is currently composed of over 4,500 members, many of who are professional scientists. Members of the Society have always had a strong interest in the public good, and this is reflected in their involvement in providing information for public policy, resources management, conservation, and education.

The Society hosts annual meetings and maintains several publications. The flagship publication is the *Journal of Mammalogy*, a journal produced 6 times per year that accepts submissions on all aspects of mammalogy. The ASM also publishes *Mammalian Species* (accounts of individual species) and *Special Publications* (books that pertain to specific taxa or topics), and we maintain a mammal images library that contains many exceptional photographs of mammals.

We encourage you to peruse the ASM web site for information about mammals and the American Society of Mammalogists. Check out our interesting history by clicking on Our History tab on the Committees Archives page. We hope it will stimulate your interest in mammals and further your appreciation of their importance.

ASM Leadership

ASM is led by a group of scientists who are elected by the membership.

ASM Committees

Much of the work that ASM does is accomplished through a large number of volunteer committees. These committees work to further the aims of the Society and the science of mammalogy as a whole.

<http://www.mammalsociety.org/>

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WELCOME

Greetings Fellow Mammalogists and Welcome to Reno,

The American Society of Mammalogists is the oldest and largest scientific society in the world dealing solely with mammalian biology. The ASM began more than 90 years ago, in 1919, in Washington, DC, when 60 of those early and great mammalogists, founders of our discipline, gathered to form a scientific society. Our first president was C. Hart Merriam, considered the father of mammalogy. One of the things the society wanted to establish was a scientific journal dealing with mammal research. The result was the *Journal of Mammalogy*, which to this day is considered the finest journal of mammalian research in the world.

The ASM grew from 60 members in that first year, to more than 4,000 members in the early 2000s. Recent years have shown some decline in membership and one of the challenges we face is finding ways to make our society increasingly relevant to scientists, especially young scientists, as they deal with the many critical and complex issues facing mammalogists today as fiscal challenges abound, as grant funds are reduced, as habitats continue to be modified, and as species diversity continues to decline. We are the people who can help deal with these issues. Indeed, we are the people who must deal with these issues, as we have throughout our history. Over the years, mammalogists have been leaders in the field of forensic science, biogeography, ecology, behavior, and systematics, as well as numerous other sub-disciplines of our science. Our expertise, passion, and curiosity are needed now, more than ever.

Over the years, the ASM has met in a variety of venues, from museums to small colleges to large universities. As travel costs have increased and as universities have become leery of supporting organizations on campus that do not obtain expensive liability insurance, we have moved the annual meeting to professional meeting locations such as hotels and conference centers. Our first meeting is here, in Reno, and I think you will find this a most enjoyable experience. As a venue designed specifically for these types of meetings, the Peppermill Resort Spa & Casino offers outstanding meeting spaces that are in close proximity, a variety of on-site and nearby restaurants and other amenities, and an ideal atmosphere for strong and enjoyable professional interactions to occur among our members. Most of the work of the Society is done at the annual meeting. Here we will forge the links that will lead to increased research collaborations, that will allow us to attract new students, that will inform us of the latest research in our discipline, and that will strengthen the bonds among friends from across the world who share the singular passion to study the many species of mammals with whom we share this planet.

Welcome to Reno!

Michael A. Mares, President, American Society of Mammalogists

ACKNOWLEDGEMENTS

Program Committee:

Janet Braun (Chair)

Brad Blood

Brandi Coyner

Liz Flaherty

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Hadley Jerman — Sam Noble Museum (2012 logo design)

Tony Ballard, Heide Burke, and Charissa Bowditch — KSU Conference Planning Services

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Illinois Natural History Survey

Anonymous

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GENERAL MEETING INFORMATION

Meeting Room Information

Please turn off all beepers and cell phones or set them to manner mode (vibrate) during presentations,

Auction — Tuscany Ballroom C & D
Banquet — Tuscany Ballroom C & D
Board of Directors Meeting I — Tuscany Ballroom 11
Board of Directors Special Session — Tuscany Ballroom 11
Board of Directors Lunch — Sierra 1748
Capstone — Tuscany Ballroom E & F
Committee Meetings — Tuscany Ballrooms 1, 2, 3, 4, 5, 6
Donor Reception — “The Edge”
Exhibit Area — Tuscany Ballroom A, B, 7, & 8
Group Photo — East Entrance
LGBT and Friends Roundtable and Mini-Mixer — Tuscany Ballroom 5 & 6
Members Meetings — Tuscany Ballroom E & F
Officers and Plenary I Speakers Lunch — White Orchid
Opening Reception — Tuscany Ballroom 9 & 10
Oral Presentations — Tuscany Ballrooms 9, 10, 11
Picnic — Poolside at The Peppermill
Plenary I — Tuscany Ballroom C & D
Plenary II — Tuscany Ballroom E & F
Poster Presentations — Tuscany Ballroom A, B, 7, & 8
Refreshment Breaks — Tuscany Ballroom A, B, 7, & 8
Registration — Welcome Center
Run for Research — Virginia Lake Park (start from the Peppermill)
Poster Social — Tuscany Ballroom 10 & 11
Pre-banquet Social — “The Edge”
Speaker Prep Room — Tuscany Ballroom 12
Special Session — Tuscany Ballroom C & D
Student Mixer — “The Edge”
Symposium I — Tuscany Ballroom E & F
Symposium II — Tuscany Ballroom E & F

Internet Access

Internet access is free to all ASM participants in conference areas, guest rooms, and common areas.

Registration Desk

The ASM Registration Desk, located at the Welcome Center of the Peppermill Resort Spa & Casino, will be open for registration from 12:00 – 11:00 p.m. Friday, 22 June, 7:30 a.m. – 4:00 p.m. Saturday, 23 June, and 9:00 a.m. – 2:00 p.m. Sunday, Monday, and Tuesday.

Business Center

The Business Center is open 24 hours for all hotel guests. The Peppermill Resort Spa & Casino Front Desk can assist you with all your copying, shipping, and faxing needs.

Messages and Job Announcements

Message boards are located near the Registration Desk. Participants may post messages for friends and colleagues. The registration staff will also post telephone and other messages on these boards. Urgent

messages should be directed to the Peppermill Resort Spa & Casino (866) 821-9996. These will be relayed to meeting coordinators and posted for participants as soon as possible.

Job announcements or information about employment opportunities may be posted on the message boards as well.

Food and Beverage

Morning and afternoon refreshment breaks will be served in Tuscany Ballroom A, B, 7 & 8.

Cash bars will be available during:

- Poster Session I, 7:00 – 9:00 p.m., Saturday 23 June
- Social, 9:00 – 11:00 p.m., Saturday 23 June
- Picnic, 6:00 – 9:00 p.m., Sunday 24 June
- Donor Reception, 5:30 – 6:00 p.m., Monday 25 June
- Pre-banquet Social, 6:00 – 7:00 p.m., Monday 25 June
- Banquet, 7:00 – 9:00 p.m., Monday 25 June
- Auction, 9:00 – 11:00 p.m., Monday 25 June

Lunch is on your own each day. The Peppermill Resort Spa & Casino offers a number of restaurants, from casual to fine dining. A list of local restaurants is listed on page 142.

Name Badge Color Scheme

- Sponsors – Turquoise
- Exhibitor – Goldenrod
- President – Emerald Green
- President Elect – Emerald Green
- Vice President – Emerald Green
- Secretary Treasurer – Emerald Green
- Recording Secretary – Emerald Green
- Trustee – Emerald Green
- Past President – Black
- Board of Directors – Emerald Green
- Committee Chair – Royal Blue
- Program Committee – Red
- Award Recipient – White
- Editor – Royal Blue
- Honorary Member – Emerald Green

14th Annual Gordon L. Kirkland Memorial Run/Walk for Research

Monday, 25 June

Race Starts: 6:00 a.m.

Start Location: Peppermill Resort Spa & Casino

Race Course: Virginia Lake Park (2 blocks west of the Peppermill)

Length: 5K run (3.5 laps) or 2K run/walk (1 lap)

Sign-up: Register on-line or during Registration hours at the Welcome Center

Entry Fee: \$15 (no t-shirt); \$30 (includes t-shirt)

All proceeds go to the American Society of Mammalogists (ASM) – Future Mammalogists Fund, which provides research grants to undergraduate and graduate student members.

PRESENTATION INFORMATION

Oral Presenters

Oral presentations will be allotted 12 min for the talk and 3 min for questions. The computers used for presentations will have internet access. Laser pointers will be available.

On the morning or afternoon prior to your scheduled presentation, please bring your PowerPoint files on a USB Flash “thumb” drive or a CD to the *Speaker Prep Room* (Tuscany Ballroom 12) to review and load them onto the network.

Your presentation must be created in, or converted to, Microsoft's PowerPoint program. The computers in the session rooms will be Windows based PCs with Microsoft Office 2007. It is recommended that all image and video files be saved into a folder with your PowerPoint file on a USB Flash “thumb” drive or a CD, or accessible from Google Docs or Drop Box in the event that there are problems when you review your presentation. PowerPoint files created on Macintosh computers should be previewed on a PC to ensure cross-platform compatibility.

A *Speaker Prep Room* is available in Tuscany Ballroom 12 and has computers available for you to review your presentation. A sign up sheet for the prep room will be available at conference registration.

Session moderators have been designated to facilitate each session. The names of the moderators are noted in the session schedule. Moderators will be provided a packet of instructions when checking in at the Registration Desk.

Poster Presenters

Poster session dates and times are as follows:

Saturday, 23 June	7:00 – 9:00 p.m.
Sunday, 24 June	1:30 – 3:00 p.m.

At least one author must be present during the entire poster session time period.

Poster Size—Poster boards (4' high and 4' long) [1.2 m high by 1.2 m wide] and pushpin or velcro attachments will be provided.

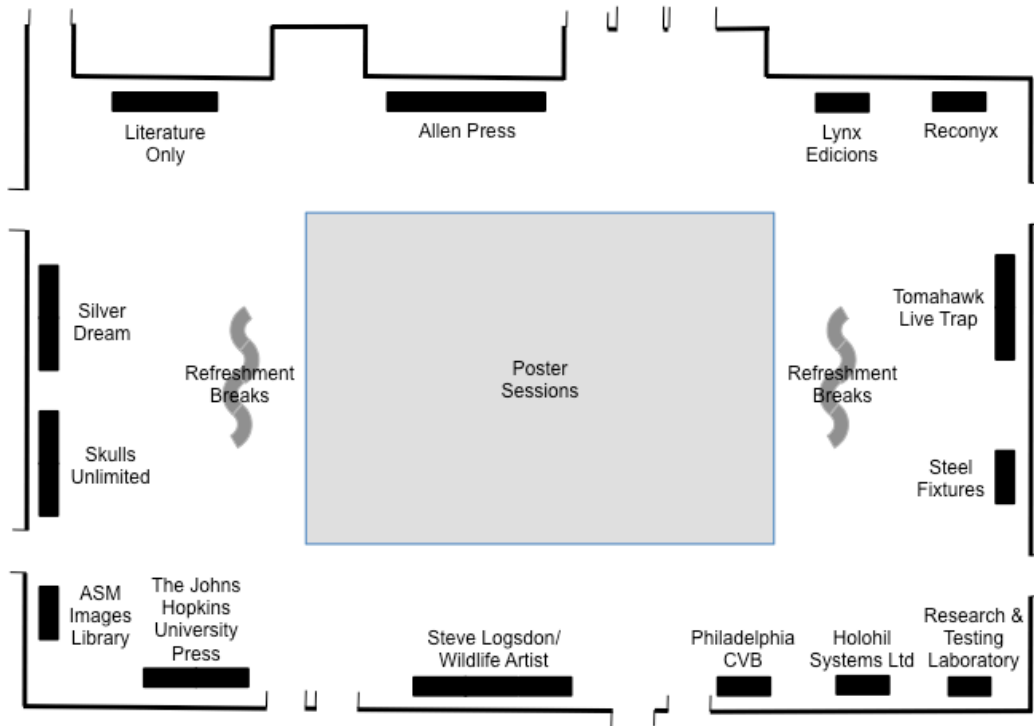
Poster Board Assignments—All poster boards will be numbered. Because some posters are being evaluated, please make sure that you place your poster in the correct location.

Poster Board Set-up and Take-down—Posters will be available for viewing during the entire meeting. You can place your poster on your assigned board beginning 8:00 a.m. Saturday, 23 June and all posters must be in place by 7:00 p.m., Saturday 23 June. Your poster must be removed by the end of the conference. If your poster is not removed or claimed by 5:00 p.m. on Tuesday, 26 June, it will be discarded.

EXHIBITORS

Exhibitors are located in Tuscan Ballrooms A, B, 7 & 8 of the Peppermill Resort Spa & Casino during following hours:

Saturday, 23 June 8:00 a.m. – 5:30 p.m., 7:00 – 9:00 p.m.
 Sunday, 24 June 8:00 a.m. – 5:30 p.m.
 Monday, 25 June 8:00 a.m. – 5:00 p.m.
 Tuesday, 26 June 8:00 a.m. – 4:00 p.m.



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The Johns Hopkins University Press publishes books, journals, and online collections for students, professionals, and general readers.

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SOCIAL EVENTS

Thursday, 21 June – 6:00 p.m.

Board of Directors Dinner – Naan and Kabob, 2740 S. Virginia Street (across from the Peppermill)

Friday, 22 June – 6:00 – 11:00 p.m.

Opening Reception – Tuscany Ballroom 9 & 10

The opening night reception will kick off the conference with hors d'oeuvres and drinks for everyone in attendance. This will be your first opportunity to socialize with other conference attendees and check out all the great exhibitors. The Opening Reception is complimentary by the Peppermill.

Saturday, 23 June – 12:30 – 2:00 p.m.

ASM Officers and Plenary Session I Speakers Lunch – White Orchid

The ASM officers invite the speakers from Plenary Session I to an informal lunch in honor of their awards.

Saturday, 23 June – 5:30 – 7:00 p.m.

Student Mixer – “The Edge”

Student members are invited to a reception in the hippest location in Reno. A cash bar will be available.

Saturday, 23 June – 9:00 – 11:00 p.m.

Social – Tuscany Ballroom 10 & 11

Socialize with other conference attendees after Poster Session I.

Sunday, 24 June – 4:15 – 5:30 p.m.

Diversity in Science: LGBT and Friends Roundtable and Mini-Mixer — Tuscany Ballroom 5 & 6

This mini-mixer and roundtable will provide an opportunity for informal conversation and discussion of issues faced by students and professionals who are lesbian, gay, bisexual, and transgender (LGBT). This event is sponsored by two anonymous Contributor Sponsors.

Sunday, 24 June – 6:00 – 9:00 p.m.

Picnic – Poolside at the Peppermill

This year's picnic will take place poolside at "The Peppermill". Bring your swimsuit, enjoy a beautiful Reno night, and still be within walking distance to your room! A cash bar will be available. Be sure to bring your ticket for admission.

Monday, 25 June – 5:30 – 6:00 p.m.

Donor Reception - “The Edge”

Individuals who made generous monetary contributions in 2011 to support ASM programs of research, education, and outreach will be acknowledged during at reception before the Pre-Banquet Social.

Monday, 25 June – 6:00 – 7:00 p.m.

Pre-Banquet Social - “The Edge”

Enjoy socializing with meeting attendees before the banquet with a selection of hors d'oeuvres and a cash bar.

Monday, 25 June – 7:00 – 9:00 p.m.

Banquet - Tuscany Ballroom C & D

Honor the 2012 award winners at the annual ASM Banquet. A cash bar will be available. Be sure to bring your ticket for admission.

Monday, 25 June – 9:00 – 11:00 p.m.

Auction – Tuscany Ballroom C & D

Come and celebrate after the banquet with the Auction. All proceeds from the auction go to the American Society of Mammalogists (ASM) – Future Mammalogists Fund, which provides research grants to undergraduate and graduate student members. A cash bar will be available.

BOARD OF DIRECTORS, MEMBERS, AND COMMITTEE MEETINGS

Note: all meeting rooms listed below are located in the Peppermill Resort Spa & Casino.

Friday, 22 June

8:00 a.m. – 5:00 p.m. Board of Directors Meeting – Tuscany Ballroom 11 (refreshments and lunch provided)

Saturday, 23 June

11:00 Latin American Fellowship Committee – Tuscany Ballroom 4
Noon Honorary Committee – Tuscany Ballroom 1
Noon Mammal Images Library Committee – Tuscany Ballroom 2
Noon International Relations Committee – Tuscany Ballroom 3
12:30 p.m. – 2:00 p.m. Publications Committee – Tuscany Ballroom 4
2:00 p.m. Human Diversity Committee – Tuscany Ballroom 1
3:00 p.m. Development Committee – Tuscany Ballroom 2

Sunday, 24 June

10:00 a.m. – Noon Members Meeting – Tuscany Ballroom E & F
Noon Education and Graduate Students Committee – Tuscany Ballroom 1
Noon Systematic Collections Committee – Tuscany Ballroom 2
Noon Jackson Award Committee – Tuscany Ballroom 3
Noon Conservation Committee – Tuscany Ballroom 4
Noon Animal Care and Use Committee – Tuscany Ballroom 5
Noon Development Committee – Tuscany Ballroom 6
1:30 p.m. Program Committee – Tuscany Ballroom 5
2:00 p.m. Grants-in-Aid Committee – Tuscany Ballroom 2
2:00 p.m. Informatics Committee – Tuscany Ballroom 4
3:00 p.m. – 4:30 p.m. Special Session of the Board of Directors – Tuscany Ballroom 11
3:00 p.m. Nomenclature Committee – Tuscany Ballroom 3

Monday, 25 June

10:30 a.m. – Noon Members Meeting – Tuscany Ballroom E & F
Noon Public Education Committee – Tuscany Ballroom 2
Noon – 1:30 p.m. Board of Directors Meeting – Sierra 1748 (lunch provided)
1:30 p.m. – 3:00 p.m. Conservation Committee – Tuscany Ballroom 5 & 6
2:00 p.m. Publications Committee – Tuscany Ballroom 1

Committees Not Scheduled to Meet

Archives Committee
ASM-AIBS Internship (ad hoc)
Checklist Committee
Honorary Membership Committee
Legislation and Regulations Committee
Marine Mammals
Planning and Finance Committee

SYMPOSIA

Sunday, 24 June

8:00 – 9:30 a.m.

Tuscany Ballroom E & F

Interactions Between Mammals and Their Pathogens

Organizer: Dr. Richard Ostfeld

Mammalogists increasingly recognize that interactions between mammals and their pathogens are fundamentally important to mammalian life histories, population dynamics, physiology, behavior, and community structure. For example, social behavior affects the probability of pathogen transmission from infected to susceptible individuals, and conversely, infection can affect behavior of mammalian hosts. Mammalian community structure, for example species diversity, can affect infection prevalence of hosts with their pathogens, and conversely, pathogens can influence the composition of mammalian communities. Moreover, many of the pathogens that infect non-human mammals can also cause disease in humans, and vice versa. This symposium will explore some of the most intriguing recent developments at the interface between mammalian biology and that of their parasites and pathogens. The general purpose is to foment excitement among mammalogists, who might otherwise neglect these often microscopic but critically important organisms, in the importance of pathogens and disease to their study organisms. Both the general topic of the symposium and those of individual presentations are intentionally broad in order to appeal to the widest possible audience of mammalogists. I have chosen speakers who are unusually dynamic and clear in their presentations and asked them to talk about their most exciting research results concerning mammal-pathogen interactions. Together, they cover a wide taxonomic and ecological diversity of mammals (mustelids, bovids, cervids, and murids; terrestrial and aquatic; forest, desert, savanna, and marine) and diversity of pathogens (helminth, protozoan, bacterial, viral, and prion). Processes affecting and affected by pathogens include behavior, pathology, immunology, population dynamics, fitness, and community dynamics. Presentations will incorporate both empirical and theoretical findings. State-of-the-art analytical methods will be discussed in the context research questions that they can uniquely address.

Tuesday, 26 June

8:00 – 9:30 a.m.

Tuscany Ballroom E & F

Great Basin Mammalian Diversity Across Time

Organizers: Dr. Marjorie Matocq and Dr. Rebecca Rowe

The Great Basin is a vast area of interior drainage including much of the region between the Sierra Nevada and Rocky Mountains. Well known for its numerous mountain ranges separated by intervening valleys, basins, and lakes, the unique geology, geography and ecology of the Great Basin has resulted in a rich local and regional biodiversity. These characteristics have attracted generations of scientists and prompted seminal studies on the paleobiology, phylogeography, biogeography, and ecology of regional mammals. Today, the Great Basin lies within a rain shadow and is generally arid, although the interior mountain ranges receive variable amounts of precipitation at higher elevations and are home to diverse communities distributed across local elevation gradients extending from desert sand dunes to alpine tundra. During the past century, anthropogenic climate change, land use and invasive plant species have greatly modified natural communities in many areas of the Great Basin. As such, the Great Basin is now considered one of the most threatened bioregions in North America. In this symposium, we bring together a broad spectrum of researchers whose work highlights Great Basin landscape dynamics through time and how such dynamics have impacted mammalian diversity. A broad range of spatial and temporal scales will be addressed and impacts assessed from individual populations and species to entire biomes.

PROGRAM AT-A-GLANCE

	Room	Saturday 23 June	Sunday 24 June	Monday 25 June	Tuesday 26 June
AM	Tuscany C & D	Plenary I			
	East Entrance	Group Photo			
	Tuscany C & D	Special Session			
	Tuscany E & F		Symposium I Members Meeting	Plenary II Members Meeting	Symposium II
	Tuscany 9				TS15 Genetics
	Tuscany 10				TS16 Population and Community Ecology
	Tuscany 11				TS17 Population Ecology and Conservation
PM	Tuscany 5 & 6		LGBT and Friends Roundtable and Mini-Mixer		
	Tuscany 9	TS1 Evolutionary Biology TS4 Biogeography	TS7 Conservation	TS9 Conservation Genetics TS12 Morphology	TS18 Biogeography
	Tuscany 10	TS2 Community Ecology TS5 Physiology	TS8 Community Ecology	TS10 Behavior TS13 Wildlife Disease	TS19 Conservation and Museology
	Tuscany 11	TS3 Behavior TS6 Behavior	Special Session of the Board of Directors	TS11 Conservation TS14 Wildlife Ecology	TS20 Natural History
	Tuscany E & F				Capstone
	Tuscany A, B, 7, 8		Poster Session II		
	"The Edge"	Student Mixer			
EVE	Tuscany A, B, 7, 8	Poster Session I			
	Tuscany 10 & 11	Social			
	Tuscany C & D			Donors Reception Pre-Banquet Social Banquet Auction	
	Poolside		Picnic		

American Society of Mammalogists 92nd Annual Meeting—Reno, Nevada

SATURDAY, 23 JUNE, MORNING SESSION

**Plenary I
Tuscany Ballroom C & D**

- 8:00 AM** **Welcome and Announcements**
President Michael A Mares
- 8:15 AM** **Anna M. Jackson Award**
1 Prey Specialization by Pumas in Patagonia and its Potential Consequences for Endangered Huemul Deer
L Mark Elbroch, H U Wittmer
- 8:35 AM** **Elmer C. Birney Award**
2 Phylogeography of *Marmosa robinsoni*, a Mouse Opossum from Dry Habitats of the Northern Neotropics
Eliécer E Gutiérrez, R P Anderson, J Ochoa-G., M Aguilera, S A Jansa
- 8:55 AM** **A. Brazier Howell Award**
3** Diversification of a Major Lineage of Neotropical Rodents (Caviomorpha: Octodontoidea): Insights from DNA Sequences and Fossil Mandibles
Nathan S Upham
- 9:15 AM** **Albert R. and Alma Shadle Award**
4 Invasion Facilitates Hybridization with Introgression in the *Rattus rattus* Species Complex
Justin B Lack, D U Greene, C J Conroy, M J Hamilton, J K Braun, M A Mares, R A Van Den Bussche
- 9:45 AM** **ASM Fellowship**
5 From Genes to Communities: Integrative Biology of Acoustic Communication in Neotropical Singing Mice
Bret Pasch
- 10:15 AM** **Closing and Announcements**
President Michael A Mares

**Oral or Poster Presentations that are being evaluated

American Society of Mammalogists 92nd Annual Meeting—Reno, Nevada

SATURDAY, 23 JUNE, MORNING SESSION

10:30 AM	GROUP PHOTO – East Entrance
10:45 AM	BREAK – Tuscany Ballroom A, B, 7, 8

Special Session Tuscany Ballroom C & D

11:30 AM Presidential Address
President Michael A Mares

12:00 PM 6 How to Explain the Facts of (Wild)Life to Your IACUC
R Sikes

12:30 PM	OFFICERS AND PLENARY I SPEAKERS LUNCH – White Orchid
12:30 PM	LUNCH

American Society of Mammalogists 92nd Annual Meeting—Reno, Nevada

SATURDAY, 23 JUNE, AFTERNOON SESSIONS

ROOM		Tuscany Ballroom 9		Tuscany Ballroom 10		Tuscany Ballroom 11
SESSION/SYMPOSIUM		Technical Session 1: Evolutionary Biology		Technical Session 2: Community Ecology		Technical Session 3: Behavior
MODERATOR		Lois Alexander		Susan Loeb		Karen Mabry
2:00 PM	7	<u>P Larsen</u> 2010-11 ASM Fellowship	12**	<u>P Eyheralde</u> , S Fairbanks	18	<u>A Foley</u> , R DeYoung, D Hewitt, M Hellickson, K Gee, M Lockwood, K Miller
		Reticulate Evolution in Mammals: An Example From the Genus <i>Artibeus</i>		Epizoochory by Bison in a Tallgrass Prairie Reconstruction		Male White-tailed Deer Mate Search Behavior: Chaotic or Strategic?
2:15 PM			13**	<u>M Mulligan</u> , R Schooley, M Ward	19**	<u>A Romero</u> , B O'Neill, R Timm, K Gerow, D McClearn
				Effects of Connectivity and Regional Dynamics on Restoration Trajectories for Small Mammal Communities on Midwestern Grasslands		Group Dynamics and Behavior of Collared Peccaries (<i>Pecari tajacu</i>) in Costa Rica's Caribbean Lowlands
2:30 PM	8	<u>P Velazco</u> , N Simmons, L Dávalos	14	<u>I Guenther</u> , <u>T Nupp</u>	20**	<u>C Day</u> , M Westover, B McMillan
		Combined Analyses of Extant and Fossil Phyllostomid Bats (Chiroptera, Phyllostomidae)		Comparison of Mammal Communities in Restored Native Grasslands and Exotic Grasslands/Hayfields at the Buffalo National River, Arkansas		Daily and Seasonal Use of Latrines by the Northern River Otter (<i>Lontra canadensis</i>) in Utah
2:45 PM	9	<u>R Norris</u> , C Strobe, A Stoltzfus	15	<u>B McMillan</u> , J Lucero, E Freeman, E Billman	21	<u>A Facka</u> , C Beach, K Smith, R Powell
		Calibrating Molecular Clocks with Fossils in Rodents: Two New Approaches and a Comparison with Existing Methods		Small Mammals and Cheatgrass in the Great Basin: The Role of Food-mediated and Refuge-mediated Apparent Competition		The Role of Predators and Temperature in the Times of Fisher (<i>Martes pennanti</i>) Den Movements
3:00 PM	10**	<u>T Giarla</u>	16**	<u>A Ricketts</u> , S Wisely, W Jensen, B Sandercock	22**	<u>L Hall</u> , C Day, M Westover, R Edgel, R Larsen, R Knight, B McMillan
		Cryptic Speciation and Synchronized Southward Range Expansions in Andean <i>Thylamys</i> Mouse Opossums		Small Mammal Community Responses to Patch-burn Grazing		A Test of Alternate Hypotheses Explaining Vigilance Behavior of Kit Foxes at Water Sources
3:15 PM	11	<u>J Diaz-N</u> , R Voss, S Jansa	17**	<u>L Heisler</u> , C Somers, R Poulin	23**	<u>T Petroelje</u> , J Belant, D Beyer
		Morphological Diagnosis of the Major Clades of the American Marsupial genus <i>Marmosops</i> (Didelphimorphia: Didelphidae)		Agriculture Activity Affects Spatial Distribution of Small Mammal Species and Alters Community Assemblages on the Canadian Prairies		Factors Affecting the Elicitation of Vocal Responses from Coyotes
3:30 PM	BREAK – Tuscany Ballroom A, B, 7, 8					

**Oral or Poster Presentations that are being evaluated

American Society of Mammalogists 92nd Annual Meeting—Reno, Nevada

SATURDAY, 23 JUNE, AFTERNOON SESSIONS

ROOM		Tuscany Ballroom 9		Tuscany Ballroom 10		Tuscany Ballroom 11
SESSION/SYMPOSIUM		Technical Session 4: Biogeography		Technical Session 5: Physiology		Technical Session 6: Behavior
MODERATOR		Kate Lyons		Tom Tomasi		Barbara Blake
4:00 PM	24	<u>R Anderson</u>	29**	<u>R Wright</u> , T Tomasi	34	<u>K Mabry</u> , D Blumstein, D Van Vuren, E Shelley, K Davis
		Advances in Ecological Niche Modeling Meet Museum Databases: Will Mammalogy Again Lead Biodiversity Informatics?		The Effects of Temperature Gradients on Hibernating Tri-colored Bats		The Evolutionary Relationship Between Social Mating System and Sex-biased Dispersal
4:15 PM	25**	<u>M Soley-G</u> , R Anderson	30	<u>A Doty</u> , N Mzilikazi	35**	<u>C Karanewsky</u> , M Bauert, P Wright
		The Biogeography of the Rodents from the Sky Islands of Costa Rica and Western Panama: A First Report Based on Fieldwork and Ecological Niche Models		Seasonal Thermoregulation of Four Species of Afrotropical Bats		Plasticity of Energy Conservation Strategies in a Heterothermic Primate: A Synthesis of Wild and Captive Research
4:30 PM	26**	<u>R Boria</u> , M Shcheglovitova, A Radosavljevic, S Jansa, L Olson, R Anderson	31	<u>J Merritt</u> , D Zegers	36**	<u>K Brooks</u> , J Mateo
		Using Ecological Niche Models to Study the Effects of Climatic Change on Species Distributions: Analyses with the Malagasy Small Mammals <i>Eliurus majori</i> and <i>Microgale longicaudata</i>		Social Thermoregulation in <i>Cryptotis parva</i>		The Social Environment and its Effect on Predation Risk, Physiology and Fitness in Belding's Ground Squirrels
4:45 PM	27**	<u>V Mathis</u> , M Hafner	32C**	<u>D Tufts</u> , J Storz	37**	<u>A Dosmann</u> , J Mateo
		Modeling Ecological Niches in a Rapid Radiation Within the <i>Thomomys umbrinus</i> Complex		Phenotypic Plasticity in Blood-oxygen Transport of High-altitude Deer Mice (<i>Peromyscus maniculatus</i>)		Food, Sex, and Predators: Animal Personality and Multidimensional Plasticity in Complex Environments
5:00 PM	28	<u>D Lee</u> , M Papes, R Van Den Bussche	33	<u>S Trumble</u> , S Usenko	38**	<u>M Buchalski</u> , G Chaverri, M Vonhof
		Ecological Niche Modeling Predicts Where Cattle Could be at Risk for Negative Effects of the Common Vampire Bat (<i>Desmodus rotundus</i>) in Relation to Current and Potential Future Distribution		Reconstructing Lifetime Anthropogenic and Physiological Data from Whale Ear Plugs		Genetic Evidence of Mating Forays in Spix's Disk-winged Bat (<i>Thyroptera tricolor</i>): A Behavioral Adaptation for Inbreeding Avoidance
5:30 PM		DINNER				
5:30 PM		STUDENT MIXER – The Edge				
7:00 PM		POSTER SESSION I – Tuscany Ballroom A, B, 7, 8				
9:00 PM		SOCIAL – Tuscany Ballroom 10 & 11				

**Oral or Poster Presentations that are being evaluated
C = Cancelled presentation

American Society of Mammalogists 92nd Annual Meeting—Reno, Nevada

SATURDAY, 23 JUNE, POSTER SESSION I

	PRESENTER (S)	TITLE
39**	<u>Moree</u>	ASM-AIBS Graduate Student Public Policy Internship
40	<u>Dyer</u> , Hornsby, Coyner, Matocq	Bringing Molecular Genetics to High School Students
41	<u>Wilson</u> , Del Hoyo	The Handbook of the Mammals of the World Project
42	<u>Thorington, Jr.</u> , Koprowski, Steele, Whatton, Bohaska	The Sciuridae: A Definitive Reference
43	<u>Cook</u> , Bloom, Spencer, Koo, Rios, Cicero, Gurlanick, Steele, Wieczorek, Russell, Bart, Vieglais	Vertebrates in the Cloud (Vertnet.Org): Are We There Yet?
44	<u>Pigage</u> , Pigage	Do <i>Thomomys talpoides retrorsus</i> Exhibit Sexual Dimorphism?
45	Peyton, <u>Pigage</u> , Bunn, Clawges, Pigage	Danger Close: A Preliminary Characterization of Ungulate Mortality at Fort Carson, Colorado
46	<u>Clark</u> , Uschyk, DeSilva, Quinn, Burton	California Valley Solar Ranch Giant Kangaroo Rat Artificial Precinct Design
47	Lendrum, Anderson, Monteith, Jenks, <u>Bowyer</u>	When to Migrate: Effects of Natural-gas Development on Migration in Mule Deer
48	<u>Kaufman</u> , Kaufman, Kaufman	Distribution and Abundance of Elliot's Short-tailed Shrew in Tallgrass Prairie: Three Decades of Precipitation, Cover, and Fire
49	<u>Kaufman</u> , Kaufman, Kaufman	Native Tallgrass Prairie, Woody Invasion, and the White-footed Mouse
50**	<u>Lee</u> , Lee, Lee	Foods of the Leopard Cat in Korea
51**	<u>Karanevsky</u> , Atsalis, Wright	The Effects of Resource Abundance on Early Dry Season Capture Rate in Mouse Lemurs
52	<u>Morano</u> , Stewart, Ellsworth	Mule Deer Demographics in the White Mountains: Impacts of Climate and Habitat Composition
53**	<u>Walsh</u> , Stewart, Vavra	Resource Selection by North American Elk: Effects of Population Density
54**	<u>Guernsey</u> , Lohse, Bowyer, Kauffman, Goheen	Sexual Segregation of Shiras Moose in Wyoming: Habitat Selection and Ecosystem Dynamics
55**	<u>Joyce</u> , Erb, Moen	Space Use and Microhabitat Structure Selection by American Marten in Minnesota
56	<u>Hodder</u> , Larsen	The Influence of Habitat Type on Winter Movements of American Mink (<i>Neovison vison</i>)
57**	<u>Ahlers</u> , Cotner, Schooley, Heske	Distribution of American Mink in Response to Urbanization

**Oral or Poster Presentations that are being evaluated

American Society of Mammalogists 92nd Annual Meeting—Reno, Nevada

SATURDAY, 23 JUNE, POSTER SESSION I

	PRESENTER (S)	TITLE
58	<u>Salsbury</u> , Ryan	The Distribution of Fox Squirrel (<i>Sciurus niger</i>) Leaf Nests Within an Urban Landscape
59	Bernal-Legaria, <u>Fariás</u>	Ringtail Abundance in an Urban Reserve in Mexico City
60	<u>Curtis</u> , Longshore, Lowrey	Potential Effects of Human Encroachment and Annual Precipitation on the Survival of Desert Bighorn Sheep Lambs in Southern Nevada
61	<u>Randa</u> , Kuipers, Klingensmith, Yunger	Effects of Urbanization on Heavy Metal Concentrations in <i>Peromyscus</i> Tissue
62	<u>Garbe</u> , Gehrt	Efficacy of Translocation as a Management Strategy for Urban Coyotes
63	<u>Donadio</u> , Buskirk, Blanco, Perrig, Crego, Kantor, Novaro	Mortality Causes and Marrow Fat Phenology of Vicuñas (<i>Vicugna vicugna</i>) in the High Andes of Argentina
64	<u>Smyser</u> , Blythe, Johnson, Swihart	Post-release Survivorship of Captive-reared Allegheny Woodrats
65	<u>Rose</u> , Longtin	Unusually High Body Mass In Virginia Meadow Voles
66	<u>Barry</u> , Chiweshe, Mundy	Population Fluctuations of Syntopic Bush and Rock Hyraxes (Hyracoidea: Procaviidae) in the Rhodes Matopos National Park, Zimbabwe, 1992-2005
67**	<u>Winter</u> , Stewart, Lohuis, Sedinger	Multi-state Analysis on the Reproductive Capabilities of Dall Sheep
68	Miara, Keenlance, <u>Jacquot</u>	Southern Flying Squirrels Do Not Read Literature: Over Wintering Non-aggregation
69	Dueser, <u>Moncrief</u> , Keišs, Porter	Brownian Particles or Brown Little Particles? Raccoon (<i>Procyon lotor</i>) Movement on the Virginia Barrier Islands
70	<u>Crawford</u> , Nielsen, Schauber	Survival and Home Range of Lagomorphs in Bottomland Hardwood Forests of Southern Illinois
71	<u>Crawford</u> , Dhanwatey, Abade, Dhanwatey, Nielsen, Sillero-Zubiri	Large Carnivore Attacks on Humans in Central India: A Case Study from the Tadoba-Andhari Tiger Reserve
72	<u>Fredebaugh-Siller</u> , Schooley, Zuckerman, Suski	Community and Physiological Responses of Small Mammals to Biofuel Crops in the Midwest
73	<u>Hauer</u> , Mech	The Effects of Wind Generated Power on Terrestrial Populations of Small Mammals
74	<u>Stevens</u> , Tello	Biodiversity of Noctilionoid Bats is Less Dimensional Than Expected
75	<u>Hitch</u> , Wiantoro, Engilis	Bat Surveys of the Mekongga Mtn. Region in Sulawesi, Indonesia
76	<u>Knowles</u> , Engelhardt, Burger, Weigl	An Agent-based Model of Grassland-Grazer Dynamics in Temperate, Montane Grasslands

**Oral or Poster Presentations that are being evaluated

American Society of Mammalogists 92nd Annual Meeting—Reno, Nevada

SATURDAY, 23 JUNE, POSTER SESSION I

	PRESENTER (S)	TITLE
77	<u>Hidalgo-Mihart</u> , Contreras-Moreno, Solano	Importance for Conservation of Medium and Large Sized Mammals of the Coastal Wetlands of Western Campeche, Mexico
78**	<u>Posthumus</u> , Koprowski	Can Red Squirrel (<i>Tamiasciurus hudsonicus</i>) Middens Affect Species Diversity?
79	<u>Remmel</u> , Trehwitt	Small Mammal Species Composition in Pinnacles National Monument Before, During, and After Restoration in Three Habitats
80	<u>Kaufman</u> , Kaufman	Small Mammals in Tallgrass Prairie: Species Responses to Fire and Bison Grazing
81	<u>Trehwitt</u> , Matson, Corral, Roberts	Small Mammal Community Structure Changes 10 Years After the Blue Fire, Warner Mountains, California
82**	<u>Dolman</u> , Leslie	Effect of Habitat Fragmentation on Small Mammals in Lower Rio Grande Valley Refuges
83**	<u>Kellner</u> , Urban, Swihart	Short-term Small Mammal Responses to Silviculture in the Central Hardwoods
84	<u>Rickart</u> , Robson, Millward, Rowe	New Insights from Old Data: Measuring Changes in Vegetation and Small Mammal Communities in the Great Basin
85	<u>Loeb</u> , Galway, Campbell	Effects Of Forest Structure And Prey Availability On Bat Activity In Western North Carolina
86**	<u>Morgan</u> , Green	Bat Species and Habitat Use in the Trans-Pecos Texas
87	<u>Morzillo</u>	Response of Small Mammals to Invasive Vegetation Species: Results of a Review
88	<u>Horner</u> , Hamilton	Assessing Habitat Occupancy and Use for Mesocarnivore Species in Great Basin National Park, Nevada
89	<u>Lisek</u> , <u>Jackson</u>	Use of Camera Traps to Assess Mammalian Assemblages in the Tuli Wilderness Area of Botswana

**Oral or Poster Presentations that are being evaluated

American Society of Mammalogists 92nd Annual Meeting—Reno, Nevada

SUNDAY, 24 JUNE, MORNING SESSION

Symposium I: Interactions Between Mammals and Their Pathogens

Tuscany Ballroom E & F

Moderator: R Ostfeld

- 8:00 AM** **90** *Toxoplasma gondii*: Exploring the Land and Sea Connection
P Conrad, E Vanwormer, J Mazet, K Shapiro, M Miller, M Grigg, J Largier
- 8:20 AM** **91** Space Use, Group Dynamics, and Contact Patterns Among White-tailed Deer: Implications for Disease Transmission and Impacts
E Schauber
- 8:40 AM** **92** Mammalian Functional Ecology: A Host of Parasite-mediated Processes?
A Jolles
- 9:10 AM** **93** The Influence of Community Complexity on Host Interactions and Pathogen Prevalence
D Dearing
- 9:20 AM** Discussion and Concluding Remarks
R Ostfeld, P Conrad, E Schauber, A Jolles, D Dearing

9:30 AM	BREAK – Tuscany Ballroom A, B, 7, 8
10:00 AM	MEMBERS MEETING – Tuscany Ballroom E & F
12:00 PM	LUNCH
1:30 PM	POSTER SESSION II – Tuscany Ballroom A, B, 7, 8

American Society of Mammalogists 92nd Annual Meeting—Reno, Nevada

SUNDAY, 24 JUNE, POSTER SESSION II

	PRESENTER (S)	TITLE
94**	<u>Goody</u> , Bird, Van Valkenburgh	The Effect of Dietary Behavior on Cribriform Plate Morphology
95**	<u>Kim</u> , Koyabu, Kim, Lee, Kimura	Morphological Homogeneity on Cranium of Two Subspecies of Water Deer in China and Korea
96	Kim, Kim, Koyabu, Oh, Kauhala, Oshida, Min, <u>Kimura</u>	Cranio-metrical Analysis of Introduced Raccoon Dogs in Europe
97	McAfee, <u>Naples</u>	First Occurrence of Supernumerary Teeth in the Two-toed Sloth, <i>Choloepus</i>
98	<u>Shaw</u>	Allometric Scaling in Order Cingulata (Armadillos, Pampatheres, and Glyptodonts)
99	<u>Lapsertis</u> , Keroack, Watwood	Species-specific Morphological Variation in Pinniped Vibrissae: Relationships with Diving and Foraging Behaviors
100	<u>Breed</u> , Leigh, Aplin, Avenant	Morphological Diversity of the Spermatozoon in the Mouse-related Clade of Rodents - its Evolution and Possible Relationship to Mating Systems
101	Gaudioso, Barquez, <u>Díaz</u>	Post-cranial Skeleton of <i>Diaemus youngi</i> (Chiroptera: Phyllostomidae): Description and Comparisons with <i>Desmodus rotundus</i>
102**	<u>Burger</u> , Davidson, Hamilton, Brown	Brain Size Allometry and Life Styles in Mammals
103	<u>Lee</u> , Choi, Woo, Min, Lee	Species Identification Key of Korean Mammalian Hair
104	<u>Moncrief</u> , Dooley	Diagnostic Test to Identify Fossils of the Eastern Fox Squirrel (<i>Sciurus niger</i>) Using Fluorescent Properties of Bones and Teeth
105	<u>Maher</u>	Personality and Behavioral Syndromes in Woodchucks (<i>Marmota monax</i>)
106	<u>Busher</u>	Beaver Food Caching Behavior
107**	<u>Schell</u> , Lonsdorf, Mateo, Santymire, Young	Influence of Parental Effects on the Development of Temperament Traits in Coyote Offspring (<i>Canis latrans</i>)
108	<u>Scheibe</u> , Essner	Launch Kinematics in Southern Flying Squirrels
109	Reyna-Arias, Carreón, Huerta-García, Castro-Campos, Lopez-Perez, Cuatepitzi, <u>Servin</u>	A Comparison Between the Coyote Food Habits from Tiburon Island and Punta Chueca Continental Area, Sonora, Mexico
110	Yeh, <u>Lin</u>	Food Partitioning of Two Rodent Communities in an Alpine Ecosystem
111**	<u>Blum</u> , Stewart, Schroeder, Wasley	Migratory Corridors for Mule Deer Using Spatial Modeling
112**	<u>Sundaram</u> , Lichti, Steele, Swihart	Predicting Foraging Costs in Eastern Gray Squirrels as a Function of Seed Attributes

**Oral or Poster Presentations that are being evaluated

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SUNDAY, 24 JUNE, POSTER SESSION II

	PRESENTER (S)	TITLE
113C	<u>Hodge</u>	Effect of Domestic Dog Activity on Camera Trap Success of the Margay (<i>Leopardus wiedii</i>) Along Forest Edges
114	Arias-Alzate, Mancera-Rodríguez, <u>Solari</u>	Impact of Climate Change and Importance of Natural Protected Areas for Conservation of Jaguar (<i>Panthera onca</i> : Felidae) in Colombia
115	<u>Pérez-Solano</u> , Contreras-Moreno, Hidalgo-Mihart	Livestock Predation by Mammalian Carnivores in the Wetlands of Mexico: Identification of Responsible Species and Quantification of Losses
116C	<u>Derugin</u> , LeBuhn, Silveira, Connor, Golet	Response of Large Mammalian Predators to Riparian Corridor Restoration in the Sacramento River National Wildlife Refuge
117	Cosentino, <u>Schooley</u> , Bestelmeyer, Kelly, Coffman	Response of a keystone rodent to landscape-scale restoration of desert grasslands
118**	<u>Soso</u> , Koziel, Poddar-Sarkar	Determining an Optimal Method for The Detection of Odorous Volatile Organic Compounds in Tiger Marking Fluid in an Effort to Preserve the Tiger Species
119	<u>Yensen</u> , Tarifa	Is Ground Squirrel Translocation a Viable Conservation Strategy?
120**	<u>Gaffney</u> , Hayssen	Reproductive Effort in Viverridae and Eupleridae
121**	<u>Chen</u> , Hayssen	Reproductive Patterns Within Family Herpestidae: Patterns Among Genera
122	<u>Frare</u> , Feldman, Hekkala	A Century of Change in Small Mammal Populations in the Tahoe Basin, California
123	<u>Poole</u> , Boley, Heist, Feldhamer	Translocation Increases Genetic Heterozygosity of a Naturally Occurring Population of Eastern Woodrats (<i>Neotoma floridana</i>) in Illinois
124C**	<u>Makkay</u> , Thomas, Hekkala	Patterns of Relatedness and Genetic Diversity in <i>Ex Situ</i> Species: An Analysis of the Captive Snow Leopard (<i>Uncia uncia</i>) Population
125**	<u>Korstian</u> , Hale, Williams	High Diversity and Lack of Genetic Structure in Eastern Red Bats (<i>Lasiurus borealis</i>)
126	<u>Adams</u> , Berg, Keane, Solomon	Molecular Analysis of Current Subspecies Classification of the Prairie Vole (<i>Microtus ochrogaster</i>)
127	<u>Conroy</u> , Parmenter, Lim, Patton	Genetic Variation Across California Vole (<i>Microtus californicus</i>) Populations in Arid Regions of Southern California
128	<u>Hill</u> , Neiswenter	Conservation Genetics of the California Leaf-nosed Bat (<i>Macrotus californicus</i>)
129	<u>Parsons</u> , Solomon, Keane	Influence of Avpr1a on Genetic Monogamy of Free-ranging Male Prairie Voles (<i>Microtus ochrogaster</i>)
130	<u>Douglas</u> , Jackson	Using MaxEnt to Estimate Habitat Suitability for the American Badger (<i>Taxidea taxus</i>) in Missouri
131	<u>Hornsby</u> , Matocq	Patterns of Habitat Suitability for Two <i>Neotoma</i> Species in the Great Basin Through Quaternary Climate Change

**Oral or Poster Presentations that are being evaluated

C= cancelled presentation

American Society of Mammalogists 92nd Annual Meeting—Reno, Nevada

SUNDAY, 24 JUNE, POSTER SESSION II

	PRESENTER (S)	TITLE
132**	<u>Hess</u> , Powell, Webster	Distribution and Status of the Northern and Southern Short-tailed Shrews (<i>Blarina brevicauda</i> and <i>B. carolinensis</i>) in North Carolina
133	<u>Solari</u> , Botero C.	Niche Conservatism and Allopatric Speciation in <i>Monodelphis</i> (Didelphidae)
134	Hong, Kim, Kim, Lee, Kimura, <u>Min</u>	Phylogenetic Status and Genetic Structure of Raccoon Dog (<i>Nyctereutes procyonoides</i>) Populations
135**	<u>Chavez</u> , Sawyer	Cryptic Speciation Within the Dusky Shrew (<i>Sorex monticolus</i>)
136**	<u>Speer</u> , Kohli, Batsaikhan, Damdinbaza, Cook	Clarifying the Diversity of Mountain Voles (Genus <i>Alticola</i>) in Mongolia
137	<u>Almendra</u> , Rogers, González-Cózatl, Engstrom	Molecular Phylogenetics of the <i>Handleyomys alfaroi</i> Group (Rodentia: Sigmodontinae): Inferences from Multiple Loci DNA Sequences
138	<u>Ferro</u> , González-Iltig, Gardenal, Barquez	Phylogeography of <i>Akodon simulator</i> (Cricetidae, Sigmodontinae) Inferred from Cytochrome <i>b</i> Sequences
139	<u>Mychajliw</u> , Harrison	Origin and Timing of a Recent Insular Colonization of Muskrats, <i>Ondatra zibethicus</i>
140**	<u>Espinoza</u> , Bell, Batsaikhan, Damdinbaza, Cook	Species Limits and Phylogeography of Mongolian Pika
141**	<u>McLean</u> , Cook	Inferring Geographic Modes of Speciation in Ground-dwelling Sciurids
142	<u>Hanson</u>	Using 454 Pyrosequencing to Determine Phylogenetic Information from Antique Samples
143**	<u>Bell</u> , Matek, Malaney, Demboski, Cook	Untangling Lousey Chipmunk Relationships
144	<u>Hale</u> , Morris, Blount	Assessment of the Prevalence of Selected Vector-Borne Pathogens in National Parks of the Western U.S.
145	<u>Heske</u> , Merritt, Taylor, Kath, Miller, Yannarell, Mateus-Pinilla, Hustad, Lin, McClanahan	Invasion of Illinois Bat Hibernacula by <i>Geomyces destructans</i>

**Oral or Poster Presentations that are being evaluated

American Society of Mammalogists 92nd Annual Meeting—Reno, Nevada

SUNDAY, 24 JUNE, AFTERNOON SESSIONS

3:00 PM	SPECIAL SESSION OF THE BOARD OF DIRECTORS – Tuscany Ballroom 11					
ROOM		Tuscany Ballroom 9		Tuscany Ballroom 10		Tuscany Ballroom 11
SESSION/SYMPOSIUM		Technical Session 7: Conservation		Technical Session 8: Community Ecology		Special Session of the Board of Directors
MODERATOR		Steve Sheffield		Thomas Nupp		
3:00 PM	146	<u>S Sheffield</u>	150	<u>J Yunger</u> , B McMillan		
		A Century of Human-induced Mortality of Mammalian Carnivores in Canada: A GIS Approach		Removal of Tropical Forest Tree Seeds by Ants and Small Mammals		
3:15 PM	147	<u>J Kamler</u> , D Macdonald	151**	<u>A Johnston</u> , S West, M Vander Haegen		
		Ecology and Interactions of Cape Foxes, Bat-Eared Foxes, and Black-Backed Jackals in South Africa		Competition Between Eastern and Western Gray Squirrels in the Puget Sound Lowlands, Washington		
3:30 PM	148	<u>J Benson</u> , B Patterson	152	<u>K Lucia</u> , J Homyack, D Miller, M Kalcounis-Rueppell		
		Stage-specific Survival of Wolves and Coyotes in a 3-Species Hybrid Zone		Niche Overlap of White-footed Mice and House Mice in an Intercropped Switchgrass-pine System		
3:45 PM	149	<u>A Davidson</u> , M Friggens, C Hayes, J Erz	153	<u>W Longland</u> , L Dimitri		
		Population Dynamics of Reintroduced Gunnison's Prairie Dogs in a Semi-arid Grassland Environment		Mutualistic Interactions Between Granivorous Heteromyid Rodents and a Preferred Food Resource, Indian Ricegrass (<i>Achnatherum hymenoides</i>)		
4:00 PM	227	<u>C McCain</u> , S King	232	<u>P Stapp</u> , M Lindquist		
		Body Size, Activity Times, and Geographic Location are Strongly Associated With Mammalian Responses to Anthropogenic Climate Change		Synchronous Changes in a Suite of Mammalian Herbivores in Response to Climatic Variation in a Semiarid Grassland		
4:15 PM	DIVERSITY IN SCIENCE: LGBT AND FRIENDS ROUNDTABLE AND MINI-MIXER – Tuscany Ballroom 5 & 6					
6:00 PM	PICNIC – Poolside at the Peppermill					

**Oral or Poster Presentations that are being evaluated

American Society of Mammalogists 92nd Annual Meeting—Reno, Nevada

MONDAY, 25 JUNE, MORNING SESSIONS

6:30 AM	RUN FOR RESEARCH – Virginia Park Lake – Starts from the Peppermill
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Plenary II Tuscany Ballroom E & F

- 8:00 AM** **Welcome and Announcements**
President-Elect Ed Heske
- 8:00 AM** **Joseph Grinnell Award**
154 Teaching: My Thoughts and Those of the Pros
George A. Feldhamer
Introduction: Ed Heske
- 8:45 AM** **William T. Hornaday Award**
171 The Bolivian River Dolphin (*Inia boliviensis*): Current Research and Conservation in Bolivia
Enzo Aliaga-Rossel
Introduction: Victor Sanchez-Cordero
- 9:05 AM** **Aldo Leopold Award**
155 The Bats of Argentina: The Challenge of Conserving a Poorly Known Fauna
Rubén M. Barquez
Introduction: Michael A. Mares
- 9:50 AM** **Honorary Member Award**
156 Old Bottles for New Wine – Homage to Field Studies
Hans Kruuk
Introduction: R. Terry Bowyer
- Closing and Announcements**
President-Elect Ed Heske

10:00 AM	BREAK – Tuscany Ballroom A, B, 7, 8
10:30 AM	MEMBERS MEETING – Tuscany Ballroom E & F
12:00 PM	LUNCH
12:00 PM	BOARD OF DIRECTORS LUNCH – Sierra 1748

American Society of Mammalogists 92nd Annual Meeting—Reno, Nevada

MONDAY, 25 JUNE, AFTERNOON SESSIONS

ROOM		Tuscany Ballroom 9		Tuscany Ballroom 10		Tuscany Ballroom 11
SESSION/SYMPOSIUM		Technical Session 9: Conservation Genetics		Technical Session 10: Behavior		Technical Session 11: Conservation
MODERATOR		Justin Lack		Sue Fairbanks		Sergio Solari
1:30 PM	157	<u>B Patterson</u> , M. Briggs, P White, B Ament, J Dubach	162**	<u>S Cooney</u> , E Schaubert, E Hellgren	167**	<u>B Hamilton</u> , B Roeder, K Hatch, D Eggett, D Tingey
		Genetic Variation Among "Lion Conservation Units" in Eastern and Southern Africa		Agriculture Fields Have Higher Landscape Permeability Than Native Cover Types for a Wetland Specialist in Southern Illinois		Are Groundwater Resources Important to Small Mammal Communities?
1:45 PM	158**	<u>T Dutta</u> , S Sharma, J Maldonado, T Wood, H Panwar, J Seidensticker	163	<u>J Duggan</u> , E Heske, R Schooley	168**	<u>J Malaney</u> , J Cook
		Fine-scale Population Genetic Structure in a Wide-Ranging Carnivore, the Leopard (<i>Panthera pardus</i>) in Central India		Gap-crossing Decisions by Adult Franklin's Ground Squirrels in Agricultural Landscapes		Incomplete Sampling Leads to Erroneous Conservation Assessment (Again): A Significant Range Expansion for the Federally "Endangered" Preble's Jumping Mouse
2:00 PM	159**	<u>S Sharma</u> , T Dutta, J Maldonado, T Wood, H Panwar, J Seidensticker	164	<u>M Abu Baker</u> , J Brown	169**	<u>A Cheeseman</u> , E Finck
		Spatial Genetic Structure of Tigers (<i>Panthera tigris</i>) in the Satpura-Maikal Landscape of Central India		Foraging Behavior and Habitat Use of Common Duikers, <i>Sylvicapra grimmia</i> Within the Soutpansberg, South Africa		Spatial and Temporal Diet Analysis of a Declining Mesocarnivore, the Eastern Spotted Skunk (<i>Spilogale putorius</i>)
2:15 PM	160	<u>J Holbrook</u> , A Caso, R DeYoung, M Tewes	165	<u>M Merrick</u> , J Koprowski	170	<u>S Burneo</u>
		Population Genetics of Jaguarundis in México: Implications for Conservation and Future Research		Exploring the Role of Individual Behavior and Natal Experience in Dispersal of an Endangered Forest Obligate		Ecuadorian Bat Conservation Program
2:30 PM	161**	<u>H Huynh</u> , K Khidas, D McAlpine, R Bull	166**	<u>J Doudna</u> , B Danielson	171	<u>E Aliaga-Rossel</u> William T. Hornaday Award
		Hybridization Between Lynx (<i>Lynx canadensis</i>) and Bobcat (<i>L. rufus</i>) in Atlantic Canada: Biological and Conservation Implications		<i>Peromyscus maniculatus bairdii</i> Demonstrates a Perception of Risk Associated With Substrate Color	See Plenary II	The Bolivian River Dolphin (<i>Inia boliviensis</i>): Current Research and Conservation in Bolivia
3:00 PM	BREAK – Tuscany Ballroom A, B, 7, 8					

**Oral or Poster Presentations that are being evaluated

American Society of Mammalogists 92nd Annual Meeting—Reno, Nevada

MONDAY, 25 JUNE, AFTERNOON SESSIONS

ROOM		Tuscany Ballroom 9		Tuscany Ballroom 10		Tuscany Ballroom 11
SESSION/SYMPOSIUM		Technical Session 12: Morphology		Technical Session 13: Wildlife Disease		Technical Session 14: Wildlife Ecology
MODERATOR		John Scheibe		Laurie Dizney		Jan Kamler
3:15 PM	172	<u>G Bronner</u> , S Maree, P Bloomer, N Bennett, R Asher, M Mason	179	<u>S Maher</u> , A Kramer, J Pulliam, M Zokan, S Bowden, H Barton, K Magori, J Drake	185**	<u>R Long</u> , T Bowyer, J Kie, W Porter
		Unique Middle Ear Morphologies of Golden Moles: Riddled by Homoplasmy		Non-diffusive Spread of White-nose Syndrome Regulated by Spatial Heterogeneity and Climate		Linking Climatic Variability to State-dependent Behavior in Herbivores: A Bioenergetic Approach
3:30 PM	173	<u>E Sargis</u> , T Roberts, L Olson	180	<u>Craig L. Frank</u>	186**	<u>C Schroeder</u> , K Stewart, T Wasley
		Craniodental Morphology of Treeshrews (Scandentia, Tupaiidae) and a Taxonomic Re-assessment of <i>Tupaia glis</i> and <i>T. moellendorffi</i>		The Resistance of Big Brown Bats to White-nose Syndrome		Modeling Mule Deer Habitat Selection in Nevada: Effects of Introduced Elk
3:45 PM	174**	<u>A Reese</u> , H Lanier, E Sargis Undergraduate Research Award	181**	<u>M Pinto</u> , V Cottontail, K Helgen	187	<u>C McKee</u> , K Stewart, V Bleich, N Darby, D Hughson
		Skeletal Indicators of Ecological Specialization in Pika (<i>Ochotona</i>)		Bats and the Spatiotemporal Origins of <i>Trypanosoma cruzi</i> and Its Relatives		Space Use Patterns of Mule Deer in Response to Provision of Water and Wildfire in Mojave National Preserve
4:00 PM	175	<u>L Ruedas</u> , N Batsaikhan, S Gardner, S Ganzorig, S Jones, G Rácz, D Tinnin	182	<u>L Dizney</u> , D Taylor, D Dearing	188**	<u>R Luna</u> , A Duarte, F Weckerly
		Morphological Variation in Pikas (Lagomorpha: Ochotonidae: <i>Ochotona</i>) of the Mesic Habitat Islands in Mongolia's Gobi Desert		Biodiversity, Behavior and Pathogen Prevalence		Influence of Body Size on Dietary Nutrition of White-tailed Deer
4:15 PM	176	<u>B Cannon</u> , S Wisely, J Ososky	183	<u>T Holsomback</u> , A Abuzeineh, N McIntyre, J Salazar-Bravo	189	<u>D Wolcott</u> , J Asmus, F Weckerly
		Morphological Changes in Captive-bred Black-Footed Ferrets		Tenable Costs of Bayou Virus Infection in <i>Oryzomys palustris</i> (Marsh Rice Rat)		Compensatory Growth in Southern Mule Deer
4:30 PM	177	<u>J Ososky</u> , S Wisely, B Cannon	184	<u>D Salkeld</u> , M Salathe, P Stapp, J Jones	190	<u>K Monteith</u> , M Kauffman
		Changing Fluctuating Asymmetry in Black-footed Ferrets		Grasshopper Mice Drive Bubonic Plague (<i>Yersinia pestis</i>) Outbreaks in Black-tailed Prairie Dogs		Calf Recruitment of Shiras Moose: Effects of Climate and Plant Phenology?
4:45 PM	178	<u>J Dines</u> , E Otárola-Castillo, M Dean			191	<u>K Nicholson</u> , S Arthur, J Horne, E Garton
		Rudimentary Pelvic Bones in Cetacea Provide Evidence of Sexual Selection				Seasonal Ranges and Migration Routes of the Central Arctic Caribou
5:30 PM		DONORS RECEPTION – The Edge				
6:00 PM		PRE-BANQUET SOCIAL – The Edge				
7:00 PM		BANQUET– Tuscany Ballroom C & D				
9:00 PM		AUCTION – Tuscany Ballroom C & D				

**Oral or Poster Presentations that are being evaluated

American Society of Mammalogists 92nd Annual Meeting—Reno, Nevada

TUESDAY, 26 JUNE, MORNING SESSION

Symposium II: Great Basin Mammalian Diversity Across Time

Tuscany Ballroom E & F

Moderators: M Matocq, R Rowe

- 8:00 AM** **192** Great Basin Mammalian Diversity in the Context of Landscape Evolution
C Badgley, T Smiley, J Finarelli
- 8:15 AM** **193** Emerging Models of Mammalian Diversification and Distributional Dynamics in and Around the Great Basin
B Riddle, M Matocq, T Jezkova
- 8:30 AM** **194** Life in an Extreme Environment: A Historical Perspective on the Influence of Temperature on the Ecology and Evolution of Woodrats
F Smith
- 8:45 AM** **195** Recent Landscape Changes in the Great Basin
P Weisberg, R Nowak, R Tausch
- 9:00 AM** **196** Small Mammal Responses to Environmental Change: Holocene, Historical, and Modern-day Dynamics
R Rowe, R Terry
- 9:15 AM** Discussion and Concluding Remarks
M Matocq, R Rowe, C Badgley, B Riddle, F Smith, P Weisberg

9:30 AM

BREAK – Tuscany Ballroom A, B, 7, 8

American Society of Mammalogists 92nd Annual Meeting—Reno, Nevada

TUESDAY, 26 JUNE, MORNING SESSIONS

ROOM		Tuscany Ballroom 9		Tuscany Ballroom 10		Tuscany Ballroom 11
SESSION/SYMPOSIUM		Technical Session 15: Genetics		Technical Session 16: Population and Community Ecology		Technical Session 17: Population Ecology and Conservation
MODERATOR		Tereza Jezkova		Jon Pigage		Richard Stevens
10:00 AM	197	<u>J Satkoski Trask</u> , W Garnica, S Kanthaswamy, D Smith	205	<u>P Murphy</u> , M Matocq	213	<u>V Bennett</u> , A Hale
		Geographic Variation in the <i>Macaca fascicularis</i> Genome and Utility as a Model for Translational Research		Exploring Hypotheses for Diet Displacement in Woodrats in Secondary Contact in Coastal California		The Use of Resource and Activity Hotspot Mapping to Predict Bat-Wind Turbine Interactions
10:15 AM	198**	<u>R Lonsinger</u> , R Schweizer, J Pollinger, R Wayne, G Roemer	206	<u>S King</u> , C McCain	214**	<u>B Tanis</u> , E Finck
		The Influence of Habitat and Landscape Features on Fine-scale Population Genetic Structure of a Mesocarnivore		Resource Partitioning of Sympatric Shrew Species in the Rocky Mountains of Colorado		Ecological Impacts of Wind Farms on Mammalian Mesocarnivores
10:30 AM	199**	<u>M Niebels</u> , T McGreevy, B Tefft, A Gottfried, J Atoyán, T Husband	207**	<u>K Helmick</u> , T Barrett, G Barrett	215	<u>S Emerson</u> , M Abu Baker, J Brown
		Species Identification Method for New England Cottontail (<i>Sylvilagus transitionalis</i>), Eastern Cottontail (<i>Sylvilagus floridanus</i>), and Snowshoe Hare (<i>Lepus americanus</i>) Using a Mitochondrial DNA Barcode		Dietary Resource Partitioning of the Southern Flying Squirrel (<i>Glaucomys volans</i>)		When Bunnies go to College: Habitat and Diet Selection of Urban Cottontail Rabbits
10:45 AM	200**	<u>J Devine</u> , E Heist, G Feldhamer, K Ibrahim	208	<u>D-G Woo</u> , T Choi, E Lee	216	<u>S Gehrt</u> , C Anchor
		Genetics of Golden Mice (<i>Ochrotomys nuttalli</i>) and White-footed Mice (<i>Peromyscus leucopus</i>) in Southern Illinois		Food Habits of Yellow-throated Marten in the Temperate Forest, Korea		Do Urban Coyotes Adjust to Roads and Traffic? Evidence from Survival and Cause-specific Mortality
11:00 AM	201	<u>B Coyner</u> , R Drewes, M Matocq	209	<u>A Reed</u> , N Slade	217**	<u>B Gaston</u> , E Finck
		The Use of Next Generation Sequencing in the Study of Population Genetics of a Hybrid Zone of <i>Neotoma</i>		Environmental Buffering and Plasticity in Vital Rates Alters Demographic Response to Climate Variability		Comparison of Managed Versus Unmanaged Free-roaming Cat Populations
11:15 AM	202	<u>J Esselstyn</u> , A Achmadi, Maharadatunkamsi, C Siler, B Evans	210	J Barrett, <u>E Yensen</u> , J Munger, T Tarifa	218**	<u>R Edgel</u> , R Larsen, B McMillan
		Multilocus Species Delimitation Reveals Pleistocene Speciation in Javanese Shrews (<i>Crocidura</i>)		Impact of Habitat Degradation on Southern Idaho Ground Squirrel (<i>Urocitellus endemicus</i>) Demography		Short-term Response of Pygmy Rabbits (<i>Brachylagus idahoensis</i>) to Construction of the Ruby Pipeline in Northern Utah

**Oral or Poster Presentations that are being evaluated

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TUESDAY, 26 JUNE, MORNING SESSIONS

ROOM		Tuscany Ballroom 9		Tuscany Ballroom 10		Tuscany Ballroom 11
SESSION/SYMPOSIUM		Technical Session 15: Genetics		Technical Session 16: Population and Community Ecology		Technical Session 17: Population Ecology and Conservation
MODERATOR		Tereza Jezkova		Jon Pigage		Richard Stevens
11:30 AM	203	<u>J Pino</u> , M Ascunce, D Reed, J-P Hugot	211**	<u>T Orr</u> , C Sanchez, K Hammond	219**	<u>N Simpson</u> , K Stewart, T Wasley, M Cox, K Huebner
		Microsatellite-DNA Evidence Population Structure in the Endangered Laotian Rock-Rat (<i>Laonastes aenigmamus</i>)		The Effects of Reproductive State on Dietary Shifts Toward Insectivory in <i>Artibeus</i>		Wildlife Safety Crossings in Northeastern Nevada: A Story of Success
11:45	204	<u>K Pelz Serrano</u> , C van Riper, D Bergman, M Culver	212**	<u>M Mumma</u> , L Waits, K Lewis, D Fifield	220**	<u>Theresa M. Brickley</u>
		The Impact of Harvesting and Reintroductions on the Genetic Diversity of the American Beaver (<i>Castor canadensis</i>)		A Comparison of Density Estimation Techniques for Black Bears and Coyotes		Habitat Use by <i>Myotis yumanensis</i> and <i>Tadarida brasiliensis mexicana</i> in South San Francisco Bay Wetlands: An Acoustic Study
12:00 PM	LUNCH					

**Oral or Poster Presentations that are being evaluated

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TUESDAY, 26 JUNE, AFTERNOON SESSIONS

ROOM		Tuscany Ballroom 9		Tuscany Ballroom 10		Tuscany Ballroom 11
SESSION/SYMPOSIUM		Technical Session 18: Biogeography		Technical Session 19: Conservation and Museology		Technical Session 20: Natural History
MODERATOR		Enrique Lessa		Kris Helgen		Janet Rachlow
1:30 PM	221**	<u>A Soto-Centeno</u> , D Reed	227	<u>C McCain</u> , S King	235	<u>Katherine M. Thibault</u>
		The Influence of Late Pleistocene Climate on Populations of Greater Antillean Long-tongued Bat (<i>Monophyllus redmani</i>)	See TS7	Body Size, Activity Times, and Geographic Location are Strongly Associated With Mammalian Responses to Anthropogenic Climate Change		Impact of Sampling Frequency on the Population and Community Dynamics of Desert Rodents: Implications for the Design of NEON Sampling
1:45 PM	222	<u>M Matocq</u> , P Kelly, S Phillips, J Maldonado	228	<u>A Hope</u> , E Waltari, D Payer, J Cook, S Talbot	236	<u>J Rachlow</u> , M Camp, B Woods, L Shiple, T Johnson
		Reconstructing the Evolutionary History of an Endangered Subspecies Across the Changing Landscape of the Great Central Valley of California		Small Mammals Forecast Tundra Refugia in Northern Alaska		Functional Habitat Relationships: What is Cover and How Do We Measure It?
2:00 PM	223**	<u>N Ordóñez-Garza</u> , R Bradley	229	<u>R Perry</u>	237**	<u>R Stephens</u> , E Anderson
		Understanding Origin and Evolution of Rodents in the Mesoamerican Highlands		Potential Effects of Climate Change on Carolina Flying Squirrels in the Southern Appalachians		Effects of Trap Type on Measures of Small Mammal Richness and Diversity
2:15 PM	224**	<u>B Kohli</u> , V Fedorov, J Cook	230	<u>K Lyons</u> , A Tóth, A Behrensmeier	238	<u>R Seeliger</u> , T Tomasi
		A Novel Biogeographic Pattern for a Holarctic Mammal Revealed by the Range-wide Phylogeography of <i>Clethrionomys rutilus</i> (Rodentia: Arvicolinae)		Changes in Mammal Community Structure in Kenya Over the Last 100 Years		Monitoring a Gray Bat Hibernaculum Using Thermal Infrared Video
2:30 PM	225	<u>T Jezkova</u> , B Riddle	231**	<u>M Balk</u> , F Smith	239**	<u>H Hernández-Núñez</u> , <u>Y García- Feria</u> , E Martínez-Meyer, R Campos-Morales, E Servin- Zamora, V Farías
		What's Driving Phylogeographic Patterns in the Desert Kangaroo Rat (<i>Dipodomys deserti</i>)?		Asymmetrical Response to Climatic Change		Effects of Radio-attachments on Captive Volcano Rabbits (<i>Romerolagus diazi</i>)

**Oral or Poster Presentations that are being evaluated

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TUESDAY, 26 JUNE, AFTERNOON SESSIONS

ROOM		Tuscany Ballroom 9		Tuscany Ballroom 10		Tuscany Ballroom 11
SESSION/SYMPOSIUM		Technical Session 18: Biogeography		Technical Session 19: Conservation and Museology		Technical Session 20: Natural History
MODERATOR		Enrique Lessa		Kris Helgen		Janet Rachlow
2:45 PM	226	<u>L Heaney</u> , D Balete, S Jansa, S Steppan, E Rickart	232	<u>P Stapp</u> , M Lindquist	240**	<u>K Moriarty</u> , W Zielinski, P Tweedy, C Epps
		Doubling Diversity: A Cautionary Tale from Luzon Island, Philippines	See TS8	Synchronous Changes in a Suite of Mammalian Herbivores in Response to Climatic Variation in a Semiarid Grassland		Describing Marten Activity Patterns Using Accelerometers
3:00 PM			233	<u>M Revelez</u> , J Braun, M Mares	241	<u>J Servin</u> , E Chacon, V Sanchez- Cordero
				Moving Rocky Top to Oklahoma: Integration of the University of Memphis Mammal Collection to the Sam Noble Museum of Natural		Coyote Home Range Size and Availability of Food in a Forest in Durango, México
3:15 PM			234	<u>Maria Alejandra Camacho</u>	242	<u>P Polechla</u>
				Forty Years of Hard Work: Implementing a Management Plan for an Ecuadorian Mammal Collection		Tracking Methodology and Sign Inventory of Wild/Feral Horses and Implications on Behavior and Ecology
3:30 PM	BREAK – Tuscany Ballroom A, B, 7, 8					

**Oral or Poster Presentations that are being evaluated

Capstone

Tuscany Ballroom E & F

4:00 PM

Hidden Biodiversity in Cryptic Species: Lessons from Madagascar's Mouse Lemurs

Presenter: Anne Yoder

Moderator: E Lacey

ABSTRACTS

** = Evaluated Student Oral or Poster Presentation; C = Cancelled Presentation

1 ANNA M. JACKSON AWARD, Plenary I, Tuscany Ballroom C & D, Saturday 23 June 2012

L. Mark Elbroch¹, Heiko U. Wittmer²

^{1,2}*Wildlife, Fish, and Conservation Biology, 1088 Academic Surge, University of California, One Shields Ave., Davis, CA 95616 USA;* ²*School of Biological Sciences, Victoria University of Wellington, PO Box 600, Wellington 6140 New Zealand*

Prey Specialization by Pumas in Patagonia and its Potential Consequences for Endangered Huemul Deer

Population-level generalist foragers are species in which all members of a population exhibit similar, wide dietary preferences. In contrast, individual-level generalists exhibit wide dietary preferences at the population level, but are in fact composed of individuals that specialize on different foods. There is evidence that pumas (*Puma concolor*) are individual-level generalists, and that individual pumas that specialize on rare prey can severely impact endangered prey populations. We monitored 9 pumas in Chilean Patagonia using Argos-GPS technology and documented 433 puma kill sites. Male and female pumas selected different prey ($X^2_{1,6} = 123.383$, $n = 433$, $P < 0.0001$). Guanacos (*Lama guanacoe*) constituted 91.5%, domestic sheep (*Ovis aries*) constituted 6.1%, European hares (*Lepus europaeus*) constituted 1.1%, and endangered huemul (*Hippocamelus bisulcus*) constituted 1.3% of total biomass killed by pumas. At the individual level, 6 of 9 pumas specialized on guanaco, 1 on European hare, 2 on huemul, and 2 on domestic sheep. Only 2 of 6 marked pumas that overlapped with huemul in our study area, killed huemul. However, the influence of these 2 huemul specialists resulted in a population-level effect: collectively, pumas killed huemul 3 times more than expected on the basis of huemul numbers in the area. Our findings suggest that when management culling is necessary, the select removal of huemul specialists will be the best strategy for both pumas and huemul.

2 ELMER C. BIRNEY AWARD, Plenary I, Tuscany Ballroom C & D, Saturday 23 June 2012

Eliécer E. Gutiérrez^{1,2,3}, Robert P. Anderson^{1,2,4}, José Ochoa-G.⁵, Marisol Aguilera⁶, Sharon A. Jansa⁷

¹*Department of Biology, City College of the City University of New York, New York, NY USA;* ²*Graduate Center of the City University of New York, New York, NY USA;* ³*Smithsonian Institution, National Museum of Natural History, Washington DC USA;* ⁴*Division of Vertebrate Zoology (Mammalogy), American Museum of Natural History, New York, NY USA;* ⁵*Cabañas Bougainvillae;* ⁶*Departamento de Estudios Ambientales, Universidad Simón Bolívar, Caracas, Venezuela;* ⁷*Bell Museum of Natural History and Department of Ecology, Evolution, and Behavior, University of Minnesota, Minneapolis, MN USA*

Phylogeography of *Marmosa robinsoni*, a Mouse Opossum from Dry Habitats of the Northern Neotropics

Marmosa robinsoni typically inhabits xeric shrublands, savannas, and deciduous forests from Panama through Colombia and Venezuela, to the islands of Trinidad, Tobago, and Grenada. We assessed its phylogeographic structure in what, to the best of our knowledge, represents the 1st such study (based on dense geographic sampling) of a vertebrate from dry habitats of this region. We sequenced the cytochrome *b* gene, largely from dried skins and residual tissue on osteological material of museum specimens. Phylogenetic analyses revealed the existence of 2 well-supported clades that seem to correspond to an east/west split. The estimated time since divergence between these clades well postdates the Miocene; therefore, it rejects the Andean uplifts, changes in the course of the Río Orinoco, and marine transgressions of that epoch as vicariant agents. Instead, expansion of humid forest and/or marine transgressions during the late Pliocene and Pleistocene might have caused this pattern. Interestingly, we encountered little structure among populations east of the Cordillera de Mérida, suggesting a more recent expansion to this region. Surprisingly, isolated populations from the Península de Paraguaná (northwestern Venezuela) are not closely related to the geographically most-proximate populations but rather to populations in the western clade. In contrast, populations from central and eastern Venezuela are closely related to those on the islands of Trinidad and Tobago. A more extensive continental shelf during the Pleistocene could explain these patterns.

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3** A. BRAZIER HOWELL AWARD, Plenary I, Tuscany Ballroom C & D, Saturday 23 June 2012

Nathan S. Upham^{1,2}

¹Department of Zoology, Field Museum of Natural History, 1400 S. Lake Shore Drive, Chicago, IL 60605 USA; ²Committee on Evolutionary Biology, University of Chicago, 1025 E. 57th Street, Chicago, IL 60637 USA

Diversification of a Major Lineage of Neotropical Rodents (Caviomorpha: Octodontoidea): Insights from DNA Sequences and Fossil Mandibles

The Neotropical rodent superfamily Octodontoidea is especially informative because it encompasses both extensive living biodiversity and fossil records from numerous time periods to help investigate evolutionary patterns and rates. This study examines DNA sequence variation in conjunction with functional mandibular traits in fossil and living taxa to reconstruct this lineage's diversification dynamics. Octodontoidea comprises 6 living families (38 genera and 193 species), and occupies an array of rodent lifestyles from arboreal spiny rats to fossorial tuco-tucos and swimming nutria. Many living species are rare and at least one-third are threatened with extinction. Their ecological radiation dates to at least 25 million years ago, with an extensive Miocene fossil record, and they are widespread in their modern distributions across South America, Central America, and the Antilles. Here, 2 mitochondrial (cytochrome *b* and 12S rRNA) and 3 nuclear genes (vWF, GHR, and RAG1) are examined across all caviomorph families (including 113 octodontoid species), all phiomorph families, and the sole remaining hystricognath family, using the gundi (*Ctenodactylus*) and springhaas (*Pedetes*) as outgroups. Among octodontoids, Abrocomidae is consistently recovered as the basal element, sister to a pair of strongly supported clades; one includes Octodontidae and Ctenomyidae as reciprocally monophyletic lineages, whereas the other includes taxa currently allocated to Echimyidae, Capromyidae and Myocastoridae. Several taxa sequenced here for the first time (e.g., the abrocomid *Cuscomys*, and capromyid *Geocapromys*) ally closely with their hypothesized relatives, corroborating current nomenclature. Two mandible traits (shape using 7 geometric landmarks, and predicted bite force using incisor measurements) are also discussed relative to the evolutionary relationships of octodontoid rodents established in the molecular phylogeny.

4 ALBERT R. AND ALMA SHADLE AWARD, Plenary I, Tuscany Ballroom C & D, Saturday 23 June 2012

Justin B. Lack¹, Daniel U. Greene², Chris J. Conroy³, Meredith J. Hamilton¹, Janet K. Braun⁴, Michael A. Mares⁴, Ronald A. Van Den Bussche¹

¹Department of Zoology, Oklahoma State University, Stillwater, OK 74078 USA; ²Florida Fish and Wildlife Conservation Commission, Panama City, FL 32404 USA; ³Museum of Vertebrate Zoology, University of California, Berkeley, CA USA; ⁴Sam Noble Museum, University of Oklahoma, Norman, OK 73072 USA

Invasion Facilitates Hybridization With Introgression in the *Rattus rattus* Species Complex

Biological invasions result in novel species interactions, which can have significant evolutionary impacts on both native and invading taxa. One evolutionary concern with invasions is hybridization among lineages that were previously isolated, but make secondary contact in their invaded range(s). Black rats, consisting of several morphologically similar but genetically distinct taxa that have collectively invaded 6 continents, are arguably the most successful mammalian invaders on the planet. We used mitochondrial cytochrome *b* sequences, 2 nuclear loci, and 9 microsatellite loci to examine the distribution of 3 invasive black rat lineages (*R. tanezumi*, *R. rattus* I, and *R. rattus* IV) in the U.S. and Asia, and determine the extent of hybridization among these taxa. Our analyses revealed 2 mitochondrial lineages that have spread to multiple continents, whereas the 3rd lineage (*R. rattus* IV) appears to be confined to Southeast Asia. Analyses of nuclear DNA suggested significant hybridization is occurring among *R. tanezumi* and *R. rattus* I in the U.S., and among *R. tanezumi* and *R. rattus* IV in Asia. Furthermore, microsatellite analyses suggest unidirectional introgression from both *R. rattus* I and *R. rattus* IV into *R. tanezumi*. Within the U.S., introgression appears to be occurring to such a pronounced extent that we were unable to detect any nuclear genetic signal for *R. tanezumi*; a similar pattern was detected in Asia.

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5 ASM FELLOWSHIP, Plenary I, Tuscany Ballroom C & D, Saturday 23 June 2012

Bret Pasch

Section of Integrative Biology & Mechanical Engineering Department, University of Texas at Austin, Austin, TX 78712 USA

From Genes to Communities: Integrative Biology of Acoustic Communication in Neotropical Singing Mice

Many animals use long-distance acoustic signals to advertise their presence to a network of potential mates and competitors. A rich tradition of studies on acoustic communication in birds, anurans, and insects has provided important insights into disparate disciplines of biology through integration of proximate and ultimate levels of analysis. Here, I synthesize data on vocal ontogeny, hormonal control, and the adaptive function of neotropical singing mouse (*Scotinomys*) vocalizations in an ecological context. Neotropical singing mice are diurnal insectivorous rodents that inhabit montane cloud forests throughout Central America. I describe how adult vocalizations develop from pup isolation calls, how sex differences in singing arise during puberty and are modulated by androgens, and how vocalizations are used in mate attraction and male-male aggression. Between species, interspecific communication reflects underlying dominance interactions and contributes to competitive exclusion along altitudinal gradients. Accordingly, the auditory tuning of mouse brains differs between sympatric and allopatric populations to accommodate the ecological salience of song. Altogether, neotropical singing mice are emerging as important species that permit comparisons to communication systems in traditionally more tractable taxa.

6 Special Session, Tuscany Ballroom C & D, Saturday 23 June 2012

Robert S. Sikes

Department of Biology, University of Arkansas at Little Rock, Little Rock, AR 72204 USA

How to Explain the Facts of (Wild)Life to Your IACUC

Work with vertebrates also means work with IACUCs. For most of us the 1st is both our vocation and our avocation; the 2nd a compliance requirement. The path through an IACUC can be difficult for field types; guidance materials for IACUCs are focused around biomedical research and IACUC members at most institutions are far more comfortable in lab coats than field boots. Animal use protocols for field research do not fit the biomedical models IACUCs usually see. Some required sections on protocols and questions by IACUC members have little relevance for field researchers. At the same time, questions and issues central to work with wild animals are seldom addressed. The difficulties mammalogists face with IACUC oversight can be minimized by educating your IACUC about appropriate guidelines for oversight of field research—the taxon-specific guidelines published by professional societies such as our own. These changes will take a little effort on your part as a mammalogist, but your efforts will facilitate the work of all field biologists at your institution. This presentation will provide the tools to bring your IACUC up to speed.

7 2010-2011 ASM FELLOWSHIP, Technical Session 1: Evolutionary Biology, Tuscany Ballroom 9, Saturday 23 June 2012

Peter A. Larsen

Department of Biological Sciences, Texas Tech University, Lubbock, TX 79409 USA

Reticulate Evolution in Mammals: An Example From the Genus *Artibeus*

Reticulate evolution describes the process by which hybridization among species-level lineages produces a network of relationships within a given taxonomic group. Under certain conditions such reticulation may contribute to the formation of lineages (hybrid speciation). In animals, the majority of documented cases of hybrid speciation are described from insects and fish—there are few hypothesized cases in mammals. The rarity of examples of hybrid speciation in mammals may be a consequence of either unfavorable conditions for hybrid speciation to occur or a lack of empirically-based research. My research on fruit-eating bats of the genus *Artibeus* resulted in the identification of a pattern of reticulate evolution that shares characteristics with other hypothesized examples of hybrid speciation. Mitochondrial, nuclear, and morphological data indicate a zone of admixture in southern Lesser Antillean populations of *Artibeus*. The data indicate that multiple species-level lineages have come into contact on several small Caribbean islands. Subsequent hybridization among these lineages has contributed to the formation of a distinct lineage (*Artibeus schwartzi*) that is distributed on the islands of Saint Vincent and the Grenadines. The

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data from *Artibeus* indicate that speciation within the genus is a dynamic process, with genetic isolation arising through multiple pathways. Traditionally species are viewed as “closed systems;” however, data from *Artibeus* indicate that conceptualization of species as “open systems” (originating from multifaceted evolutionary processes) is appropriate.

8 Technical Session 1: Evolutionary Biology, Tuscany Ballroom 9, Saturday 23 June 2012

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Combined Analyses of Extant and Fossil Phyllostomid Bats (Chiroptera, Phyllostomidae)

The neotropical family Phyllostomidae is the most ecologically diverse family within Mammalia, containing species variously specialized for insectivory, carnivory, omnivory, nectarivory, polinivory, frugivory, and even sanguivory. It is the second largest chiropteran family with more than 55 genera and 160 species. Fossils of 4 taxa referred to Phyllostomidae are known from Mid-Miocene deposits in Colombia. Unfortunately, these fossils are fragmentary and consist only of some isolated teeth. Previous phylogenetic studies have sought to resolve phyllostomid relationships, but there is no consensus regarding the relationships among subfamilies. In this study we evaluated the phylogenetic relationships of these bats using molecular data from 8 nuclear and 2 mitochondrial genes. To date, all analyses of the timing of phyllostomid diversification have relied on placing fossils based on a limited number of morphological characters. In order to assess the phylogenetic relationships of fossils we developed a data set of 270 dental characters to help place the fossils. Using the molecular tree as a scaffold, we assessed relationships of those fossils for which dental remains are known. We recovered a strongly supported phylogeny of phyllostomids, consistent with recent multilocus phylogenies. The 4 fossil taxa were recovered nested into 2 subfamilies (Lonchophyllinae and Phyllostominae). Our analyses provide the 1st robust phylogenetic context for studies of the tempo and mode of evolution in phyllostomids.

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Calibrating Molecular Clocks with Fossils in Rodents: Two New Approaches and a Comparison with Existing Methods

An ever-growing number of studies rely on inferring evolutionary divergence times based on molecular data, but the value of the estimates generated are only as good as the validity of the calibration. Most molecular studies that estimate evolutionary divergence times in rodents suggest a Mesozoic origin for the group. These results stand in stark contrast to the fossil record, which suggests that rodents first appeared in the Paleocene. Modern molecular clock computer programs provide many options for the shape of the prior distribution at a node that is calibrated based on fossil data, but very little work has been done to determine which of these parameters are appropriate given a particular set of fossil data. We introduce 2 new methods for generating priors at calibrating nodes based upon the difference between the 2 oldest fossils (the penultimate gap) or the difference between sister lineages (the ghost lineage length). Using simulated phylogenetic trees, molecular data, and fossil records, we test the penultimate gap (PenG) and ghost lineage length (GLin) methods against existing methods. The results of our simulations indicate that PenG and GLin are relatively unbiased estimators that produce results that are both accurate and precise compared to existing methods. When applied to the question of early evolution in rodents, our new methods yield results that support a Paleocene origin for the group.

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Cryptic Speciation and Synchronized Southward Range Expansions in Andean *Thylamys* Mouse Opossums

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Thylamys mouse opossums are distributed in central and southern South America, extending from Peru to Patagonia and including both lowland and Andean habitats. Three Andean species (*Thylamys sponsorius*, *T. pallidior*, and *T. venustus*) have been previously found to have substantial cryptic genetic diversity at mitochondrial loci and could perhaps represent cryptic species. Here, I tested the species limits of cryptic lineages within each of the 3 Andean species with 15 nuclear markers using both a Bayesian species delimitation approach and a multi-species coalescent approach (i.e., species-tree analysis). I then used the same dataset to address several pertinent phylogeographic questions that illuminate the history of divergences in each species and subsequent demographic fluctuations. Results indicate that several of the morphologically cryptic lineages previously discovered using mitochondrial data are strongly supported as independent lineages at nuclear loci as well. Phylogeographic results indicate recent divergence times (late Pleistocene) among cryptic lineages and multiple instances of southward demographic expansion, possibly in response to climate warming since the last glacial maximum.

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Morphological Diagnosis of the Major Clades of the American Marsupial genus *Marmosops* (Didelphimorphia: Didelphidae)

Although considerable progress has been made delimiting species of the American marsupial genus *Marmosops* based on molecular characters, a comprehensive morphological revision is still pending. As a consequence, a significant fraction of the specimens deposited in scientific collections are misidentified either as species of other genera, or lumped into polytypic species. Herein, we present a way to morphologically diagnose the major clades within this genus. Previous molecular phylogenetic analyses of the American marsupials of the family Didelphidae had shown a basal split within the genus *Marmosops* that clustered its species into 2 groups: one comprised mainly by small-bodied forms, and the other grouping the large-bodied species. We assessed the morphology of all *Marmosops* species and describe the apomorphies diagnosing each of these groups. Although size can be informative for separating groups, we found overlapping measurements between species; nonetheless, morphological characters proved to be informative for discriminating between groups. “Large-bodied” species have single antibrachial vibrissa, rounded or antero-posteriorly constricted subsquamosal foramen, and complete absence of accessory cusps in the upper canine. In contrast, “small-bodied” species have two antibrachial vibrissae, antero-posteriorly elongated subsquamosal foramen and tend to develop accessory cusps in the upper canine. The characters here presented can aid in the species-level identification of this speciose group of opossums.

12** Technical Session 2: Community Ecology, Tuscany Ballroom 10, Saturday 23 June 2012

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Epizoochory by Bison in a Tallgrass Prairie Reconstruction

Bison have been considered keystone species in the evolution of tallgrass prairies due to grazing activities, but bison also have great potential to be effective seed dispersers. As part of a larger study, we report the seed composition found in hair clipped from bison in fall and in shed bison hair collected in spring, summer and fall. We hypothesized that seed species composition would differ by season, by sex-age class of bison, and location on the body. Hair samples were clipped from the head and/or body of 8 bulls, 10 cows and 29 juveniles in November 2010. Seeds were extracted and identified from 40 samples of shed bison hair collected in April through November 2011. Both clipped and shed bison hair contained more native than non-native seed species. Abundance of seeds per gram of hair was highest for adult females and yearling bison and lowest for calves and adult males. The majority of seed species found did not show adaptations for epizoochory dispersal. A diverse mix of native and non-native seeds was found in fall clipped and shed bison hair, suggesting that bison are potential dispersers of both forbs and

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grasses. The long-term goal of this research is to produce predictive models of seed dispersal by bison to aid in understanding, restoring, and manipulating this ecosystem process in the restoration of native plant communities.

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Effects of Connectivity and Regional Dynamics on Restoration Trajectories for Small Mammal Communities on Midwestern Grasslands

Grasslands are among the most imperiled of the North American ecosystems, with $\leq 1\%$ of tallgrass prairie remaining. The State Acres for Wildlife Enhancement (SAFE) program compensates farmers for converting agricultural fields into restored grasslands with the primary focus on improving habitat for wildlife. Because small mammals can be important indicators of ecosystem functioning, we sampled small mammal communities to evaluate restoration efforts under the SAFE program in Illinois. We live trapped small mammals during 3 summers (2009 - 2011) on plots that were recently seeded, seeded 1 - 4 years prior to sampling, or established references (> 10 yrs old). Overall, the dominant species were the deer mouse (*Peromyscus maniculatus*), prairie vole (*Microtus ochrogaster*), and meadow vole (*Microtus pennsylvanicus*); which combined represented 92 - 97% of total captures each year. Typical restoration trajectories for small mammal communities included a shift over time from dominance by generalist *Peromyscus* to more even communities that included substantial numbers of *Microtus*. During the 1st year of community assembly following restoration, the abundance of *Microtus* depended on spatial connectivity provided by linear habitats within 2 - 3 km, which probably served as movement corridors. In 2011, populations of *Microtus* experienced a regional decline, but most remaining voles occurred on restored SAFE grasslands and not on established grasslands. This surprising outcome suggests young restoration plots could function as refuges for voles during population declines in agricultural landscapes in the Midwest region.

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Comparison of Mammal Communities in Restored Native Grasslands and Exotic Grasslands/Hayfields at the Buffalo National River, Arkansas

We live trapped small mammals in 8 fields along the Buffalo National River to examine the effects of a native grassland restoration project. We assessed restoration effects at 2 different levels: 2 grassland community types (restored native grasslands or exotic grasslands/hayfields) and 4 management treatment types (no treatment, burned, annual haying, and bi-annual haying). Small mammal abundance (captures/100 trap nights; $t_9 = 3.391$, $P = 0.008$) and diversity (Shannon-Wiener diversity index; $t_9 = 4.754$, $P = 0.001$) were higher in native grasslands than exotic grasslands/hayfields. Hispid cotton rats (*Sigmodon hispidus*) and fulvous harvest mice (*Reithrodontomys fulvescens*) were the 2 most abundant species in both exotic and native grasslands. Restored native grasslands also had higher plant species richness ($t_9 = -4.707$, $P = 0.001$) and diversity ($t_9 = -2.198$, $P = 0.028$). Management actions on fields also affected small mammals; exotic grassland/hayfields that were bi-annually hayed had the fewest small mammal captures, the lowest species richness, and a zero species diversity index. Mean biomass was highest for unburned native grasslands compared to all other management treatments ($F_{3,8} = 13.61$, $P = 0.002$). Bi-annual haying used to maintain exotic grasslands had negative impacts on small mammal abundance, richness, and diversity. In contrast, restored native grasslands that had not been burned in over 1 year had the highest small mammal abundance, plant species richness, and plant species diversity.

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Small Mammals and Cheatgrass in the Great Basin: The Role of Food-mediated and Refuge-mediated Apparent Competition

Biological invasions are detrimental to biodiversity, ecosystem quality, and economic output. Several hypotheses have been posited to explain mechanisms leading to invasion, including the Apparent Competition Hypothesis (ACH). The ACH suggests that indirect effects of enemies shared by native and potentially invasive species facilitate the process of invasion. More specifically, the shared enemy must both benefit by the presence of the invasive species and increase the relative negative effect on the native species. Potential benefits to the enemy can be food-mediated, refuge-mediated, or behavior-mediated. Our objective was to determine if small mammals facilitate invasion of cheatgrass in the Great Basin. To test for food-mediated apparent competition, we employed a BACI design where we provided cheatgrass seed, ad libitum, to experimental plots and compared small mammal abundances in experimental plots to abundances in control plots. To test for refuge-mediated apparent competition, we sampled small mammal communities and performed modified Giving-Up Density (GUD) experiments at 30 randomly selected sites that varied in cheatgrass coverage from very low to very high. Small mammal communities and abundances were not different between cheatgrass-supplemented and control sites. In addition, neither the small mammal community nor the pattern of GUDs among the 30 sampled sites were consistent with predictions of the ACH. Therefore, we found no evidence that apparent competition is facilitating the invasion of cheatgrass in the Great Basin.

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Small Mammal Community Responses to Patch-burn Grazing

The prairies of North America, and species of wildlife that inhabit them, evolved under a fire and grazing interaction that created spatial heterogeneity in plant diversity and vegetative structure. Currently, the dominant rangeland management strategy in the Flint Hills of Kansas is based on annual spring burning followed by grazing and creates a relatively homogeneous environment dominated by native warm season grasses. Patch-burn grazing recently has been proposed as a land management strategy that creates a more heterogeneous vegetative environment. The impacts of patch-burn grazing on terrestrial vertebrates, especially mammals, are poorly understood. We assessed habitat and small mammal community responses to patch-burn grazing at Konza Prairie Biological Station near Manhattan, Kansas. We found significant differences in vegetative cover and small mammal diversity in patch-burn grazed and traditionally managed pastures. Patch-burn grazing created habitat heterogeneity within the rangeland ecosystem that was absent from the annually burned and grazed pasture. Patch-burn grazing is a useful tool for the maintenance of mammalian diversity in tallgrass prairie, and has the potential to bridge the gap between maintaining biodiversity in a highly managed ecosystem and maintaining the bottom line for cattle producers. Small mammals play an important ecological role as seed predators and prey for raptors and carnivores; therefore these results have implications for the maintenance of biodiversity at other trophic levels, as well.

17 Technical Session 2: Community Ecology, Tuscany Ballroom 10, Saturday 23 June 2012**

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Agriculture Activity Affects Spatial Distribution of Small Mammal Species and Alters Community Assemblages on the Canadian Prairies

Small mammals (i.e., mice, shrews, and voles) are critical components of grassland ecosystems. Despite their ecological value, small mammals have rarely been studied over broad spatial scales. We used the remains of 50,000 small mammals collected from owl pellets to assess the environmental factors affecting small mammal community assemblages across 3 prairie provinces. The most important predictor

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variables determining 2 community assemblages were annual average precipitation and sand content in the soil. In particular, high average annual precipitation is consistently associated with house mice (*Mus musculus*), meadow voles (*Microtus pennsylvanicus*), and shrews, whereas olive-backed pocket mice (*Perognathus fasciatus*) and northern grasshopper mice (*Onychomys leucogaster*) are found in regions with sandier soils. Furthermore, the distribution of deer mice (*Peromyscus maniculatus*) and sagebrush voles (*Lemmiscus curtatus*) across the landscape is determined mostly by the presence of cropland. Deer mice are found in heavily cultivated regions, while sagebrush voles are found in predominately native grassland. These results suggest that agricultural land uses affect community assemblage composition. However, our models explain an average of 32% of the total species variation, suggesting that other factors (not measured) play a role in determining small mammal community assemblages. Regardless, understanding what factors drive small mammal distribution and abundance at the landscape scale will provide much needed insight into their ecological role in prairie ecosystems.

18 Technical Session 3: Behavior, Tuscany Ballroom 11, Saturday 23 June 2012

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Male White-tailed Deer Mate Search Behavior: Chaotic or Strategic?

Mating strategies of male white-tailed deer (*Odocoileus virginianus*) have not been thoroughly investigated. Males are presumed to search widely for estrous females; however, the short breeding season (2 - 4 wks) and female estrus (1 - 2 d) suggest males would benefit by having a strategy. Additionally, mature males sire the majority of offspring, which suggests mature males may have different strategies than young males. In southern Texas, we fitted 106 adult males with GPS collars across 5 breeding seasons. Males increased movement rates during peak rut but typically used only a small portion (32 - 38%) of their home ranges. Most males had ≥ 2 focal points that they often re-visited every 20 - 28 hours. Because female estrus is ~ 24 hr, our data suggests males re-visit females or female groups to assess receptiveness. During peak rut, movement rates were lowest in yearling males and were similar in 2.5 and ≥ 3.5 year-old males. However, 2.5-year-old males were more likely to exhibit Levy-like walks, a theoretical model of efficient search strategy when resources are widely dispersed and the location is unknown. Our data suggests that yearling males did not exert high breeding effort whereas most 2.5-year-old males appeared to use a different strategy due to intraspecific competition or lack of experience. Collectively, our data provides the first detailed description of male white-tailed deer mate search strategies.

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Group Dynamics and Behavior of Collared Peccaries (*Pecari tajacu*) in Costa Rica's Caribbean Lowlands

Understanding the biology of collared peccaries (*Pecari tajacu*) is important to discern the ecology of many neotropical ecosystems. In the Caribbean lowlands of Costa Rica, we conducted walking surveys for ~ 2 years to study the behavior and population trends of collared peccaries. We found that collared peccaries are abundant at La Selva Biological Station and detection rates were relatively constant through time. A stable estimate of detection rates was not achieved until 7 - 9 months of surveying. Detection rates were similar in primary and secondary forest, yet some differences in group dynamics were found (group radius was larger, and sighting distance was greater in primary forest while the number of singletons was higher in secondary forest). More peccaries were seen closer to the laboratory clearing, for a variety of probable reasons: human habituation, lower predation and hunting pressure, and various environmental/habitat factors. Peccary groups were found to have a clumped distribution. These

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surveys help elucidate the biology of collared peccaries, and should continue in order to better understand the population trends and biology of *P. tajacu*. An understanding of the group dynamics, behavior, and habitat preference of collared peccaries is essential for management decisions and conservation efforts.

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Daily and Seasonal Use of Latrines by the Northern River Otter (*Lontra canadensis*) in Utah

Northern river otters consistently use latrine sites for scent marking and defecation. This may aid in communication between otters, especially during breeding season. To investigate otter behavior, we deployed infrared remote cameras (Reconyx PC900) at 10 randomly-selected latrine sites along the Provo River in northern Utah from March 2011 to February 2012. We predicted that latrine use would be mostly nocturnal and that seasonal use would be influenced by breeding cycles. We recorded 478 visits of river otters to latrines comprised of 4,055 pictures. Group size during visits varied between seasons and ranged from one to five otters, with an overall mean of 1.45 (\pm SE 0.038). Most visits (73%) were by single otters. Group size was greater in fall and winter, and dropped during the spring and summer months, particularly March and April. Daily visitation rates were greater in the winter and spring, and were especially low during the summer. Images also revealed greater latrine activity from evening through morning, with peaks in the crepuscular hours when otters may be traveling between rest sites and foraging sites. Low group size during breeding season (March, April) is likely the result of lone otters searching for mates. Lower daily visitation rates during the summer may be a result of otters expanding their home ranges during wetter seasons, thus yielding a lower frequency of visits at each latrine.

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The Role of Predators and Temperature in the Times of Fisher (*Martes pennanti*) Den Movements

Many mammals rear their young in dens because they offer protection from predators or extremes in environments (among others). Females should move their kits to a new den when the costs of staying exceed the benefits; thus, why animals change dens have important consequences for reproductive success. Female fishers (*Martes pennanti*) move their kits to new dens several times after they give birth but the number of dens occupied and the timing of the moves is highly variable. A female might move her litter in response to a specific type or number of predator around a den (including humans). Conversely, females may place dens so that they are exposed to early morning sun so that kits do not freeze while she forages, but then move them when kits are sufficiently developed. We collected data from > 50 fisher dens in the Northern Sierra Nevada, California during 3 denning years (2010 - 2012) to test hypotheses concerning factors that influenced female fishers to move dens. Using remotely triggered cameras at dens sites we will test the hypotheses that females move kits in response to either specific types or abundance of predators. Additionally, we will test the hypothesis that dens are moved as a function of increasing temperature at den locations. We will discuss the implications for other hypotheses depending on the support from our analysis.

22** Technical Session 3: Behavior, Tuscany Ballroom 11, Saturday 23 June 2012

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A Test of Alternate Hypotheses Explaining Vigilance Behavior of Kit Foxes at Water Sources

Animal behavior can be influenced by risk of predation. This risk may be magnified at water sources where predator encounter rates are higher. At water sources, animals face a tradeoff between drinking and vigilance behavior. This tradeoff has mainly been evaluated with gregarious species; solitary species

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may be at a disadvantage as they have little to no group dynamic to increase awareness. We used the kit fox (*Vulpes macrotis*), a solitary carnivore that is preyed upon by several species, to test alternate hypotheses explaining vigilance behavior at water sources. The visibility-vigilance hypothesis predicts that water sources with greater cover elicit increased vigilance and decreased drinking, whereas the predator-presence hypothesis predicts that vigilance increases with the risk of encountering predators. From 2010 to 2012 we used infrared-triggered video cameras to record kit fox behavior at water sources in the Mojave Desert, Utah. We found no support for the visibility-vigilance hypothesis, in fact vigilance was lower and drinking was higher at water sources with low overhead roof structures obstructing visibility (vigilance: AICc wi = 0.55; drinking: AICc wi = 0.46). Likewise, we did not find support for the predator-presence hypothesis; the likelihood of encountering predators had no significant effect on vigilance behavior or drinking. Low overhead cover that conceals kit foxes explains observed vigilance behavior and drinking better than optimal visibility or presence of predators.

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Factors Affecting the Elicitation of Vocal Responses from Coyotes

Long-distance vocalizations by canids play an important role in communication among individuals, and researchers have elicited these vocalizations to estimate canid occurrence and relative abundance. We evaluated efficacy of broadcasted coyote (*Canis latrans*) group-yip calls and gray wolf (*C. lupus*) lone howls to elicit vocal responses from 18 radio-collared coyotes on 144 occasions in Michigan's Upper Peninsula during August–September 2009 and June–September 2010 – 2011. We evaluated coyote responses to each call type using general linear mixed models with time (month), residency status (resident or transient), presence of wolf territory, gender, and call type as fixed effects hypothesized to influence coyote vocal response rates. Individual coyote and year were included as random effects. Overall, call type, gender and presence of wolf territory did not affect coyote response rates; however, coyotes did not respond to wolf calls broadcasted at distances > 2.0 km. Resident coyotes were 3 times more likely to respond than transients and greatest overall response rates occurred in August. We recommend eliciting coyote vocalizations using recorded coyote group-yip howls in areas where wolves and coyotes are sympatric during July–September to estimate species' presence or density.

24 Technical Session 4: Biogeography, Tuscany Ballroom 9, Saturday 23 June 2012

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Advances in Ecological Niche Modeling Meet Museum Databases: Will Mammalogy Again Lead Biodiversity Informatics?

Mammalogy led biodiversity informatics via the Mammal Networked Information System (MaNIS) over a decade ago, and the opportunity exists to do so again. Recent advances in ecological niche models both demand and inform a new generation of progress. Ecological niche models combine occurrence data with digital environmental information to model species niches and geographic distributions, offering key insights for academic studies and pressing environmental problems. Along with the ability to provide refined predictions, advanced modeling algorithms unfortunately show high sensitivity to violation of data-related assumptions. Due to this sensitivity, 3 pitfalls seriously hinder such research: 1) incorrect taxonomic identifications; 2) lacking or inadequate georeferences; and 3) sampling bias across geography. First, essential improvement in species identifications requires intensive alpha-level taxonomic research (morphological and genetic). Second, dramatically more accurate and precise geographic coordinates can and should be acquired by consulting a combination of detailed paper and digital maps, publications, field notes, and living collectors. Third, georeferences for entire suites of species (target groups collected with the same sampling techniques) allow modelers to correct for the effects of sampling bias across geography. Museums and museum-based scientists hold unique

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information and expertise necessary to address these challenges. Ambitious, large-scale initiatives regarding species identifications and georeferencing should facilitate high-quality modeling on a scale commensurate with the enormous potential of and need for these techniques. Should society again hire mammalogists?

25** Technical Session 4: Biogeography, Tuscany Ballroom 9, Saturday 23 June 2012

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The Biogeography of the Rodents from the Sky Islands of Costa Rica and Western Panama: A First Report Based on Fieldwork and Ecological Niche Models

This multidisciplinary project aims to develop a better understanding of a potentially highly biodiverse, but understudied system. Based on museum online databases, we built preliminary ecological niche models (ENMs) for *Nephelomys devius* and *Reithrodontomys creper* to guide field collecting in Costa Rica. We sampled several mountaintops along the Cordillera Central, Cordillera de Guanacaste, and Cordillera de Talamanca, some of which had never been sampled. Results show a fairly predictable community endemic to these highlands, including some potentially new species. Projections of preliminary ENMs to the Last Glacial Maximum suggest that the distributions of suitable habitat for these species have fluctuated with the Quaternary ice ages, extending to the lowlands during glacials, but becoming highly restricted to the mountains during warmer periods. If true, such dynamic history might have greatly influenced patterns of population connectivity and subsequent speciation in the region. After complementing material from this fieldwork with verified localities and tissues from existing museum specimens, final ENMs will be integrated with phylogeographic tools to test hypotheses of past population connectivity, local refugia and colonization routes.

26** Technical Session 4: Biogeography, Tuscany Ballroom 9, Saturday 23 June 2012

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Using Ecological Niche Models to Study the Effects of Climatic Change on Species Distributions: Analyses with the Malagasy Small Mammals *Eliurus majori* and *Microgale longicaudata*

Ecological niche models approximate the potential distribution of a species by comparing environmental conditions at localities it inhabits with overall conditions available. We compare the potential distributions of the rodent *Eliurus majori* and the tenrec *Microgale longicaudata* on Madagascar during current climatic conditions and at the Last Glacial Maximum. Both are endemic, inhabiting wet and generally cool highland regions. To reduce the effects of sampling bias, we filtered the occurrence data spatially. To meet assumption of modeling, we delimited the study region by drawing a rectangle around the localities, with a 0.5 degree buffer to the nearest one. We calibrated and evaluated models by jackknifing localities (either individual localities or spatial bins of localities, depending on the sample size). Two model settings were tuned to estimate optimal model complexity for each species by minimizing evaluation omission rate and maximizing evaluation AUC. We modeled the species' niche based on current climate and applied the model to conditions for the Last Glacial Maximum (21KYA) from the MIROC paleoreconstruction. Analyses demonstrate statistically significant and biologically meaningful models for both species. The present-day predictions indicate several disjunct areas, especially for *E. majori*. In contrast, the LGM past potential distributions were much more extensive. We predict that with increased warming in the future, the species' distributions will be even more fragmented than at present.

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27** Technical Session 4: Biogeography, Tuscany Ballroom 9, Saturday 23 June 2012

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Modeling Ecological Niches in a Rapid Radiation Within the *Thomomys umbrinus* Complex

Pocket gophers (family Geomyidae) have long been considered to represent a rapid radiation among small mammals. The genus *Thomomys* is the most diverse of this family, with 10 recognized species extending from Canada to the Trans-Mexican Volcanic Belt. Members currently recognized as *Thomomys umbrinus* represent several genetically distinct clades distributed throughout México, some of which are indicative of species level status. These clades appear to have broadly distinct ecological preferences, which may be a contributing factor to the maintenance of their genetic differences. We conducted ecological niche modeling (ENM) analyses to explore which environmental variables may be important in shaping their distinct distributions. Niche overlap tests were performed to test hypotheses that those pocket gophers within the complex that may be separate species had significantly different levels of niche equivalency. Range-breaking tests to explore possible geographic boundaries contributing to niche discordance also were performed. For the ENM analyses, temperature seasonality appeared to have the greatest contribution to predicting the niche of each of the clades. All genetic clades, regardless of whether they were putative species or not, had significantly discordant niches with very little overlap and no obvious geographic barriers. We discuss how each clade differs in its habitat preference and to what degree these preferences may have shaped the high levels of genetic diversity we see today within the *Thomomys umbrinus* complex.

28 Technical Session 4: Biogeography, Tuscany Ballroom 9, Saturday 23 June 2012

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Ecological Niche Modeling Predicts Where Cattle Could be at Risk for Negative Effects of the Common Vampire Bat (*Desmodus rotundus*) in Relation to Current and Potential Future Distribution

Success of the cattle industry in Latin America is negatively impacted by the effects of the common vampire bat, *Desmodus rotundus*, through decreases in milk production and weight gain and an increased risk of rabies. We used ecological niche modeling to predict both the current distribution of *D. rotundus* and the future distribution of the species for the years 2030, 2050, and 2080 based on the A1B climate scenario from the Intergovernmental Panel on Climate Change. We then combined our current prediction with cattle density estimates to identify areas where cattle are at higher risk for the negative impacts of *D. rotundus*. Our results indicated suitable habitat for *D. rotundus* occurs throughout most of México, Central America, portions of Venezuela, the Brazilian highlands, and along the eastern slope of the Andes Mountains. Areas of overlap between cattle density estimates and predicted suitable habitat for *D. rotundus* include the Brazilian highlands, most of Central America, and most of México with the exception of the Yucatan Peninsula. The future climate model projections predicted more areas in Brazil, Guyana, French Guyana, Suriname, western Colombia, western Ecuador, most of the Caribbean Islands, southern Florida, and extreme southern portions of Texas as suitable for *D. rotundus*, which could negatively impact the cattle industry in additional areas.

29** Technical Session 5: Physiology, Tuscany Ballroom 10, Saturday 23 June 2012

Risa M. Wright, Tom Tomasi

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The Effects of Temperature Gradients on Hibernating Tri-colored Bats

Hibernation is used by many bats in temperate environments to cope with seasonal fluctuations in temperature and food availability. Arousals during hibernation are energetically costly, and optimal ambient temperatures are different for aroused vs. torpid bats. It is hypothesized that individuals hibernating with a range of temperatures available will choose relatively cooler temperatures while torpid and move into warmer areas while aroused in order to reduce the total energetic costs of hibernation. In this study, 16 tri-colored bats (*Perimyotis subflavus*) were placed into 2 treatment groups ($n = 8$). Bats in

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the experimental group were housed individually in hibernation chambers with a thermal gradient (8 - 17° C), and bats in the control group were similarly housed but at a uniform temperature (8° C). Movement within chambers while aroused, frequency and duration of torpor and arousals, activity budget while aroused, and mass lost over the winter were compared between treatments. Preliminary analysis of the data suggests that bats provided with a temperature gradient experienced more frequent but shorter arousals than bats housed at a uniform temperature. A greater understanding of temperature effects on hibernation behavior is important for the conservation of bats and their existing hibernacula, as well as for the construction of artificial roosts.

30 Technical Session 5: Physiology, Tuscany Ballroom 10, Saturday 23 June 2012

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Seasonal Thermoregulation of Four Species of Afrotropical Bats

Bats comprise one fifth of all mammalian species and although many studies have investigated the thermoregulatory capabilities of many endothermic small mammals, relatively few studies have investigated thermoregulation of bats especially in the South African context. In this study, the thermoregulatory capability of 4 co-existing species (*Rhinolophus clivosus*, *R. capensis*, *Myotis tricolor* and *Miniopterus natalensis*) was investigated by exposing the bats to a range of environmental temperatures from 10°C to 35°C and measuring their metabolic rates (MR) and body temperatures (T_b) during winter and summer. All 4 species had a high propensity for torpor, especially at low ambient temperatures (T_a s), generally in both seasons. Up to 100% of all species were observed to be torpid between T_a 10 - 28°C. The animals were hardly normothermic except at $T_a > 30$ °C. In summer, the torpor MR of *R. clivosus* was reduced by up to 84% of the normothermic value at 10°C. The species measured in this study were thermoconforming and the species with the least propensity for torpor under laboratory conditions was *R. clivosus*. In addition, *R. clivosus* had a tendency to maintain normothermia in winter and to enter torpor more frequently during summer. This study increases the available data on thermoregulation of South African bats by 16%. There still remains need for free-ranging T_b data to investigate parameters such as torpor bout duration, frequency and depth.

31 Technical Session 5: Physiology, Tuscany Ballroom 10, Saturday 23 June 2012

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Social Thermoregulation in *Cryptotis parva*

Winter-active small mammals residing in seasonal environments employ many mechanisms to cope with cold. In the eastern hemisphere, shrews of the subfamily Crocidurinae evolved in warmer, more southern latitudes; some undergo torpor and nest communally. In the Western Hemisphere, Soricinae evolved in more northerly latitudes; most do not enter daily torpor and do not exhibit communal nesting, e.g., *B. brevicauda* and *S. cinereus* exhibit northern geographic range limits of 54° and 65° N latitude, respectively. In response to cold, they exhibit high metabolic rates (RMR max = 3.86 ml O₂ g⁻¹ h⁻¹; 8.30 ml O₂ g⁻¹ h⁻¹, respectively). In contrast, *C. parva* exhibits range and ecological requirements unique among North American soricids; its geographic distribution ranges from 8.8° N to 44° N latitude. Like crocidurines, *C. parva* exhibit low metabolic rates (RMR mean = 3.06 ml O₂ g⁻¹ h⁻¹), and communally nest. We utilized oxygen consumption techniques to examine metabolism, and used videography to document activity patterns and group nesting of *C. parva*. Individual $\dot{V}O_2$ was measured in groups ranging in size from 1 to 10 huddling animals at ambient temperatures of 4, 14, 24, and 34 °C. Both the number of huddling individuals and T_a influenced metabolic rate. Thermoregulatory mechanisms of these 3 species are compared.

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32C** Technical Session 5: Physiology, Tuscany Ballroom 10, Saturday 23 June 2012

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Phenotypic Plasticity in Blood-oxygen Transport of High-altitude Deer Mice (*Peromyscus maniculatus*)

Organisms living at high altitudes face certain biological stressors and have evolved mechanisms for adapting to their hypoxic environment. These environments are ideal for studying mechanisms of adaptation on whole-organism performance and survival because physiological differences can be observed between different elevational zones. For example, phenotypic plasticity in the oxygen-carrying capacity of blood may be advantageous in organisms that sojourn to high altitude. Our goal was to determine the degree of plasticity exhibited in hematological parameters of deer mice (*Peromyscus maniculatus*) native to high and low altitudes. We collected *in situ* data of various hematological parameters (i.e., hemoglobin concentration [Hb], hematocrit (Hct), red blood cell size (RBC size), and red blood cell count (RBC count)) from mice residing at Mt. Evans, Colorado (4,347 m) and Lincoln, Nebraska (320 m). To measure physiological plasticity in hematological traits, we used a common-garden experimental design in which wild-caught mice from both locations were measured at the time of capture and again after a 6-wk acclimation period at low altitude. We found that [Hb] and Hct were significantly higher in high altitude mice *in situ*. RBCs were significantly smaller in high altitude mice and significantly increased in size after acclimation. Additionally, high altitude mice had a significantly higher RBC count after 6 wks. This data suggests that certain hematological parameters do exhibit a physiological response to high altitude environments.

33 Technical Session 5: Physiology, Tuscany Ballroom 10, Saturday 23 June 2012

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Reconstructing Lifetime Anthropogenic and Physiological Data from Whale Ear Plugs

We have determined that whale ear plugs represent a potential high-resolution short-term marine matrix capable of recording and archiving anthropogenic and physiological data. Similar to their terrestrial counterparts, whales excrete wax where it has been used to estimate age. Recently, our labs have been successful in extracting historic-use contaminants profiles (i.e., pesticides) and hormones (cortisol) from a blue whale ear plug, suggesting lipophilic compounds accumulate in this waxy ester and lipids rich matrix. From this sample, we have recovered lifetime (12 yrs) cortisol as well as contaminant data at the migration resolution (6 months). In essence, our novel technique was used to reconstruct physiological and anthropogenic profiles through time. We believe this demonstrates that long-lived whales are active marine monitoring systems with the ability record and archive data via ear plugs. The ecosystems these whales inhabit span the Arctic Ocean to the Southern Ocean and the development of ear plugs as a new analytical tool for historical trend reconstruction could potentially improve our understanding of the fate and transport of contaminants on global scale as well as provide chronological profile on the health and/or stress of the whale.

34 Technical Session 6: Behavior, Tuscany Ballroom 10, Saturday 23 June 2012

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The Evolutionary Relationship Between Social Mating System and Sex-biased Dispersal

In vertebrate animals, natal dispersal is often sex-biased (one sex disperses farther, or more frequently, than the other). Birds are often socially monogamous and have female-biased dispersal, while mammals are typically socially polygynous or promiscuous and have male-biased dispersal. A hypothesized evolutionary relationship between social mating system and sex-biased dispersal in vertebrates is widely accepted, but has never been subjected to a phylogenetic analysis. We applied modern comparative

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methods to elucidate the evolutionary relationship between mating system and dispersal in birds and mammals. We found evidence that a change from the ancestral state for social mating system preceded a change from the ancestral state for sex-biased dispersal direction for mammals, but not for birds. Overall, our analyses suggest that the relationship between social mating system and sex-biased dispersal in birds and mammals may be more complex than previously thought.

35** Technical Session 6: Behavior, Tuscany Ballroom 10, Saturday 23 June 2012

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Plasticity of Energy Conservation Strategies in a Heterothermic Primate: A Synthesis of Wild and Captive Research

Mouse lemurs (*Microcebus*) are members of the nocturnal, small-bodied family Cheirogaleidae, and are the only primates currently known to use torpor and hibernation, a trait which seems to be more plastic in this clade than in other small mammals. Previous mark-recapture studies have suggested a pattern of biased sex ratio throughout the dry winter as a result of females hibernating while most males remain active, with significant variation between species, study sites, and years. I have studied dry season activity patterns in wild populations of *Microcebus rufus* in Ranomafana, Madagascar as well as a captive population of another eastern rain forest species, *M. lehilahytsara*, at Zoo Zurich, in order to determine how this behavior varies with sex, environment, and age in eastern mouse lemurs. Results suggest that the “ideal” dry season behavior for both male and female mouse lemurs is hibernation, triggered by changing day length and mediated by temperature and food availability controlled by social interactions. In both wild and captive conditions, most non-hibernators were offspring less than one year old. Comparison to previous work on *M. rufus* reveals a lack of support for the previously observed skewed sex ratio, possibly due to adaptation to disturbance and edge conditions. Although eastern mouse lemurs seemed to fare well in disturbed habitats, temperatures and light levels in disturbed areas were higher, which may create conditions unsuitable for hibernation.

36** Technical Session 6: Behavior, Tuscany Ballroom 10, Saturday 23 June 2012

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The Social Environment and its Effect on Predation Risk, Physiology and Fitness in Belding's Ground Squirrels

Belding's ground squirrels, *Urocitellus beldingi*, live in groups of female kin and unrelated females and males. Females behave nepotistically towards their close female kin by alarm calling to warn relatives of predators and by cooperative territory defense. A 3-year field study explored how the social environment influenced perceived predation risk, or vigilance behavior, in approximately 160 squirrels. Utilizing focal sampling methods, we recorded behavior, group size and composition, wind speed and location within the meadow. With these data, we looked for group size effects on vigilance as well as whether squirrels perceived diluted risk or an increased chance of detecting a predator in larger groups. We also explored the relationships among vigilance behavior, kinship, immune function and fitness. Fecal samples were analyzed for fecal glucocorticoid metabolites using radioimmunoassay and blood samples were analyzed for bacteria killing ability, the ability of plasma proteins to kill bacteria *ex vivo*. We defined kinship through maternal relatedness and considered two individuals to be kin if they have a coefficient of relatedness (r) ≥ 0.125 . Fitness was measured by overwinter survival. Results are discussed in terms of the adaptive value of sociality, as well as how proximate mechanisms may promote social evolution.

37** Technical Session 6: Behavior, Tuscany Ballroom 10, Saturday 23 June 2012

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Food, Sex, and Predators: Animal Personality and Multidimensional Plasticity in Complex Environments

Payoffs of an individual's behavior vary with changing environmental conditions. Animals often modify behaviors accordingly, but paradoxically retain consistent individual differences. Studies of behavioral plasticity and animal personality focus on behavioral change across levels of a single environmental variable, yet natural environments are considerably more complex. Multidimensional plasticity, where multiple environmental variables influence a single trait, is surely pervasive and important to evolution of flexible traits. However, its relation to animal personality has not been experimentally tested. We manipulated combinations of foraging, mating, and predation risk variables to measure their effect on anti-predator behavior of Belding's ground squirrels (*Urocitellus beldingi*). Squirrels exhibited plasticity across predation risk, but plasticity across foraging and mating environments was conditional on predation risk. Individual differences in plasticity to 1 variable were consistent across change in the 2nd variable, verifying behavioral plasticity as a potential target of selection. Finally, animal personality persisted across manipulations, raising a hypothesis that temporal aspects of multidimensional plasticity produce limited plasticity.

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Genetic Evidence of Mating Forays in Spix's Disk-winged Bat (*Thyroptera tricolor*): A Behavioral Adaptation for Inbreeding Avoidance

A variety of behaviors that prevent consanguineous mating have been observed in highly social, philopatric mammals, including mating forays outside of individual home ranges. Spix's disk-winged bat is a neotropical species known to form highly cohesive roosting groups occupying small home ranges, and demonstrates all sex philopatry. Our study objective was to describe patterns of mate choice for the purpose of identifying adaptations for inbreeding avoidance, such as mating forays. We used a combination of microsatellite and mark-recapture data to study 2 local populations in southwestern Costa Rica over 4 breeding seasons. Despite few observations of dispersal, heterozygosities were high and inbreeding values were low ($F_{IS} = 0.010$). Spatial autocorrelation analyses indicated significant genetic similarity ($r_c = 0.145$) over short distances (< 75 m), reflecting the matrilinear nature and small home range size of roosting groups. Parentage analysis for young-of-the-year from all 4 years identified 47 mated pairs. In all cases, mates were members of different roosting groups, separated by distances ($\bar{x} = 500$ m) greater than the scale of genetic autocorrelation. Maximum likelihood estimates of mean pair wise relatedness indicated that mates were unrelated ($r = 0.04$). These results suggest that mating forays outside of roosting home ranges facilitate gene flow despite limited natal dispersal.

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ASM-AIBS Graduate Student Public Policy Internship

The American Society of Mammalogists (ASM) provides a unique internship opportunity for graduate student members. Partnering with the American Institute of Biological Sciences (AIBS), ASM provides a generous monthly stipend for an intern to live in Washington DC while working in the AIBS Public Policy Office. The ASM-AIBS Public Policy Internship is an opportunity to gain hands-on experience in public policy at the national level. Interns learn how scientific societies, non-governmental organizations, executive branch agencies, and the legislative branch interact to craft science policy. Additional duties include attending science coalition meetings, congressional and agency briefings, hearings, and press conferences. Interns serve as the ASM representative to the AIBS Council and are expected to provide the ASM a written report of their time on Capitol Hill. My personal experience was interactive and rewarding. I found myself attending numerous events throughout DC, with a focus on the White House and Congressional Office Buildings. I published articles in the AIBS Bimonthly Newsletter, as well as assisted in the updating and maintenance of the AIBS website. I regularly attended and participated in

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meetings of the Climate Science Working Group and the U.S. Geological Survey Coalition; I also worked on projects for evolution education and National Science Foundation funding. This unique internship provided me with significant exposure to understanding public policy development in our nation's Capitol.

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Bringing Molecular Genetics to High School Students

Under Content Standard L12, Nevada State Standards of Science require that all high school students have a basic understanding of genetic information, how it is passed from generation to generation, and how biological evolution shapes the diversity of life. Content Standard N12 requires that high school students understand how to safely conduct scientific experiments and the societal benefits of science and technology. Despite similar standards in other states, Nevada consistently ranks among the lowest in education in the U.S. (51st in 2009) and has the lowest graduation rate in the U.S. (42% in 2009). In an effort to increase scientific understanding and interest in scientific careers, we established a program that trains high school biology teachers in molecular techniques and assists them with a week-long fully hands on experiment in their classrooms. Over the course of the week, students isolate DNA, use thermal cyclers to amplify their DNA, and use restriction digest and gel electrophoresis to visualize their alleles for a one-gene, one-trait character. To date, we have partnered with 15 high school biology teachers from 4 area schools, and thousands of students have gone through the program. While it is too soon to see the long-term effects of the program, comparisons of pre- and post-experiment surveys show an increase in student understanding of genetics, phylogenetics, and evolution.

41 Poster Session I, Tuscany Ballroom A, B, 7, 8, Saturday 23 June 2012

Don E. Wilson¹, Josep Del Hoyo²

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The Handbook of the Mammals of the World Project

The Handbook of the Mammals of the World will be an unprecedented reference work for the Class Mammalia. This series of 8 volumes, 2 of which are already published, will describe every currently recognized mammal species, along with an overview of each mammalian family. It will provide up-to-date information on the systematic relationships, natural history, ecology, and current conservation status for all the mammals. Every species will be illustrated and each chapter will also include many color photographs. The collection is innovative in a number of respects, including extensive descriptions of the families and the illustration of every species, which means some taxa will be shown for the 1st time. Furthermore, the selection of photographs is much wider than in any previous work, and a list of common names in English, German, French and Spanish is being prepared in tandem with the series. Much effort has been expended in incorporating the maximum available information and the most recent bibliographical content. By making this material more widely accessible the editors wish to stimulate informed debate, especially regarding the most recent developments in taxonomy.

42 Poster Session I, Tuscany Ballroom A, B, 7, 8, Saturday 23 June 2012

Richard W. Thorington, Jr.¹, John L. Koprowski², Michael A. Steele³, James F. Whatton¹, Paula W. Bohaska¹

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The Sciuridae: A Definitive Reference

The book *Squirrels of the World* is due to be published by Johns Hopkins University Press in the fall of 2012. It is the 1st modern comprehensive examination of the family Sciuridae. Collectively, the authors share more than 100 years of experience studying this widespread and fascinating group of mammals. The text presents a detailed look at each species of ground squirrel, tree squirrel, flying squirrel, prairie

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dog, and chipmunk through a species account that describes distinguishing characteristics, reviews the ecology and natural history, details conservation status and threats, and lists the currently recognized subspecies for each of the 285 species. The distribution of each squirrel is presented in a colorful range map. Photographs of 230 species also provide often visually stunning glimpses of rarely seen species. Our book provides the most thorough treatment of the Sciuridae of the last century and we hope it will serve as the definitive reference for years to come.

43 Poster Session I, Tuscany Ballroom A, B, 7, 8, Saturday 23 June 2012

Joseph A. Cook¹, David Bloom², Carol Spencer², Michelle Koo², Nelson Rios³, Carla Cicero², Rob Gurlanick⁴, Aaron Steele², John Wieczorek², Laura Russell⁵, Hank Bart³, David Vieglais⁵

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Vertebrates in the Cloud (Vertnet.Org): Are We There Yet?

The NSF-funded VertNet project brings together FishNet2, MaNIS, HerpNet, and ORNIS into a single cloud-based platform for querying, visualizing, and annotating distributed vertebrate biodiversity data. VertNet will combine the 4 vertebrate networks, making it easier for researchers to aggregate and synthesize data across all vertebrates. VertNet will provide 5 new and improved features, including: 1) sustainability (no local servers and fewer IT problems); 2) performance and reliability (faster searching, better visualization, more mapping features); 3) discovery (creating a thesaurus of synonyms for taxonomy and geography); 4) data improvement (enabling annotations from users, potential crowd-sourcing); and 5) integrations with other projects (including Arctos and Specify, Map of Life, Encyclopedia of Life, AmphibiaWeb, iNaturalist). Development of VertNet APIs (Application Programming Interfaces) will be available to any online project for searching and visualizing VertNet data. In addition to infrastructure development, VertNet has been very active in outreach. Since January 2011, we have given 6 georeferencing workshops (in South Africa, Alabama, California, and North Carolina) that have trained 129 people from 13 countries. A Biodiversity Informatics Training Workshop held in June 2012 at Boulder, Colorado, trained an additional 25 students from 9 countries. We will work with institutions from existing networks over the next 6 months to put their data in the cloud, and the new prototype VertNet portal will be functional within the year.

44 Poster Session I, Tuscany Ballroom A, B, 7, 8, Saturday 23 June 2012

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Do *Thomomys talpoides retrorsus* Exhibit Sexual Dimorphism?

We examined body size in the northern pocket gopher (*Thomomys talpoides retrorsus*), to determine if they exhibit male-biased sexual dimorphism. We collected 270 *T. t. retrorsus* from alfalfa fields in Elbert County, Colorado from 2002 - 2004. Animals were sexed, weighed, and skulls and long bones were measured. In this study, only animals classified as adults (males, $n = 76$; females, $n = 109$) based on degree of closure of the exoccipital-supraoccipital and basioccipital-basisphenoid sutures were used. We compared mass, body length, skull measurements, femur and humerus lengths. Male pocket gophers were heavier than females (146.6 g and 134.8 g, respectively) a difference of 8.0%, however, body length (males, 205.4 mm; females, 201.2 mm) differed by 2%. In addition, 18 different skull measurements differed by 0% to 2.8% with males exhibiting larger dimensions on 14 of the characteristics observed.

45 Poster Session I, Tuscany Ballroom A, B, 7, 8, Saturday 23 June 2012

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Danger Close: A Preliminary Characterization of Ungulate Mortality at Fort Carson, Colorado

We evaluated the primary causes of mortality at Fort Carson Military Reservation, Colorado of 14/44 collared female mule deer (*Odocoileus hemionus*) and 13 other ungulate carcasses found within the study area (55,441 ha) from 2008 to the present. Excluding hunting, the primary causes of mortality were mountain lion (*Puma concolor*) kills, unknown (probably predator), poaching, vehicle accidents, chronic wasting disease (CWD), and military training respectively from highest to lowest. Over 50% of known lion kills were within 400 m of urban development. Most were in streambeds (corridors) and were often less than 15 m from tree and shrub cover. Only 2 deer were killed in open terrain and dragged more than 50 m before caching. Of the 8 collared lion-killed deer, 4 were determined to have been killed around 0600-0800, with 2 during 0100-0200, and 2 during 2200-2300 (\pm 3 hr MST). Ungulates harvested by hunters were tested to determine CWD status. Of the mule deer, 13/72 or 18% were positive for CWD while 2/9 or 22% of white-tailed deer (*O. virginianus*) were positive. None of the 8 elk (*Cervus elaphus*) tested positive.

46 Poster Session I, Tuscany Ballroom A, B, 7, 8, Saturday 23 June 2012

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California Valley Solar Ranch Giant Kangaroo Rat Artificial Precinct Design

Development of the California Valley Solar Ranch (CVSR) on the Carrizo Plain, San Luis Obispo County, includes some unavoidable impacts to giant kangaroo rats (*Dipodomys ingens*), a species protected by both the federal Endangered Species Act and the California Endangered Species Act. The U.S. Fish and Wildlife Service and the California Department of Fish and Game have recommended that in addition to modifying the project design to minimize impacts to the species, unavoidable impacts should be mitigated in part by developing and implementing a program to relocate giant kangaroo rats from impacted areas of the project site to suitable unoccupied areas of the project site that will be managed for conservation of giant kangaroo rats and several other species. A central component of the relocation program is a soft-release artificial precinct enclosure that provides shelter, food, and an opportunity for the relocated animals to establish new burrow precincts in areas of the project site not directly impacted. Here we provide the specifications of an artificial burrow and enclosure design that has been successfully implemented in the relocation of giant kangaroo rats at the CVSR project site.

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When to Migrate: Effects of Natural-gas Development on Migration in Mule Deer

Migration is an adaptive strategy that enables animals to minimize resource shortages and reduce risk of predation at a broad geographic scale. Ungulate migrations generally occur along traditional routes, many of which have been disrupted by anthropogenic disturbances. Timing of spring migration in ungulates is of particular importance for conservation planning because it is closely coupled with timing of parturition. We compared patterns of spring migration of adult female mule deer (*Odocoileus hemionus*) fitted with GPS collars ($n = 189$) among 4 study areas that had varying degrees of natural-gas development from 2008 to 2010 in the Piceance Basin of northwest Colorado, USA. Timing of spring migration was most strongly related to winter severity, particularly snow depth, and access to emerging vegetation, which varied among years, but was highly synchronous across study areas within years. Additionally, we observed more rapid rates of travel by mule deer migrating through the most developed areas compared with deer in less developed areas. Mule deer moving faster through areas of increased development may reduce the capability of females to utilize favorable forage conditions on winter range, at stop-over sites during

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migration, and on summer range. We hypothesize that this trophic mismatch might reduce nutrient intake by gestating females, which could lead to reduced neonatal survival or the transmission of a negative maternal effect that could affect future generations.

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Distribution and Abundance of Elliot's Short-tailed Shrew in Tallgrass Prairie: Three Decades of Precipitation, Cover, and Fire

Elliot's short-tailed shrew (*Blarina hylophaga*) is a common component of the small mammal community in tallgrass prairie. As an insectivore, *B. hylophaga* is highly dependent on moisture for the maintenance of its food base (i.e., earthworms, insects, and other invertebrates) and to support its own high metabolism; the presence of a litter layer also is critically important. We examined the abundance and distribution of this shrew as part of a 30+ year study of small mammals conducted in native tallgrass prairie at the Konza Prairie Biological Station (~3,500-ha field station in the Flint Hills of northeastern Kansas). Early in this study, precipitation emerged as an important limiting factor, exhibiting a strong positive relationship with autumn abundance. However, as the study progressed, an overall decrease in "regional" litter occurred (as the proportion of Konza burned on an annual basis increased), which corresponded with a decreased number of shrews. Further, consistent with this regional-scale effect of fire, increased time since fire at individual sites (as a proxy for the growing litter layer) showed a positive effect on shrew abundance (until 3 to 4 years after fire, when abundance stabilizes). Through 20 years, shrews exhibited a general numerical decrease through time; however, after three decades of study, these shrews reveal variation that simply is consistent with responses to their current environmental conditions, rather than a directional long-term change.

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Native Tallgrass Prairie, Woody Invasion, and the White-footed Mouse

In 1981, the Konza Prairie Long-Term Ecological Research Project (LTER) was initiated to assess patterns of temporal responses to experimental manipulations of fire and grazers and to natural variation in weather and topography. Konza Prairie has experienced a steady increase in woody vegetation within the grassland matrix (Briggs et al. 2005), due to previous suppression of prairie fires (since settlement) and due to current experimental fire regimes. Our sampling over the last 30 years demonstrates changes in small mammals associated with meso-scale expansion of woody vegetation, particularly a general increase in white-footed mice (*Peromyscus leucopus*). More interesting is the deconstruction of overall spatiotemporal variation among years (and seasons) and among and within each of the 14 individual sites. Among sites, abundance of white-footed mice is positively related to the magnitude of expansion of woody vegetation (dependent on experimental fire regime, particularly to relatively long-term "unburned" areas). Furthermore, white-footed mice exhibit spatiotemporal nestedness, occurring more frequently in sites with woody vegetation and in years with a smaller portion of the sampling area burned. But, what drives the considerable temporal variation in abundance observed for white-footed mice in individual sites and what drives or allows the spatial distribution and local abundance observed for these mice within each of our study sites? In other words, what are the drivers of individual patterns?

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Foods of the Leopard Cat in Korea

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We collected leopard cat stomachs ($n = 10$) taken from road-kill between October 2005 and May 2006, and scats ($n = 280$) collected between June 2006 and July 2007, in Korea. Results of the analysis of the contents of the stomachs and scats found 11 classification groups in the stomachs and 18 classification groups in the scats. Small-size mammals were found in the scats and stomachs of biggest group with 71% and 69.9% value, respectively. Plants were found in the stomachs and scats of the next order. In seasonal prey analysis, the highest number of species was shown in autumn and class groups were divided into 13, and the most preferable prey, among the mammals, was rodents. In winter, rodents occupied 62.2% of prey, and followed by summer, autumn and spring.

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The Effects of Resource Abundance on Early Dry Season Capture Rate in Mouse Lemurs

Mouse lemurs are small nocturnal primates with highly seasonal behaviors, including hibernation and torpor during the resource-poor dry season. Researchers throughout Madagascar sometimes encounter low capture rates during the transition between the wet and dry seasons from February to May, though the cause has not been fully explored. In the east coast rainforest of Ranomafana National Park, when comparing mark-recapture data on *Microcebus rufus* between 1993 - 1994 and 2007 - 2011, we found that differential capture rate during the early dry season may be determined by food availability. We examined the relationship between capture rate and rainfall, temperature, cyclone intensity, invasive species and ripe fruit abundance. Low capture rates were found during the early dry season in both 1993 - 1994 and 2007 - 2011, with 2007 - 2011 rates significantly lower, suggesting a common reason for low trappability that has persisted and possibly intensified with habitat disturbance over time. Results show that capture rates tend to increase once fruit availability falls below a certain level; low capture rates seem to be linked to higher fruit abundance. Mouse lemurs, which have been shown to plan out their foraging routes, may avoid traps during times of high fruit availability in favor of clumped ripe fruits for fat gain in preparation for hibernation. Researchers using mark-recapture studies to estimate population should be advised that capture rates may not always indicate actual population densities or habitat quality.

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Mule Deer Demographics in the White Mountains: Impacts of Climate and Habitat Composition

Many populations of large mammals are regulated by density dependent feedbacks. Understanding the influence of resource limitation and density dependence on population regulation, in relation to other processes, such as environmental variation or predation is necessary to properly manage populations. Both precipitation patterns through their influence on resource availability, and habitat composition can influence energy available for reproduction and survival. By using demographic data from mule deer in the White Mountains of California, we assessed the status of the population with respect to K , and determine how environmental fluctuations along with individual variation in habitat use influence life-history traits such as reproduction and survival. The results identified a linear relationship between annual precipitation and recruitment and a quadratic relationship between fetal counts and snow pack. There was also a negative relationship between the amount of woodland habitat within an individual's home range and fetal rates. These results suggest that climate and habitat composition influence reproductive output in this population. The identification of a quadratic response rather than a linear response of fetal rates to climate indicates that there are other processes limiting reproduction, even in very productive years. It is possible that only in years when resources are high and less limiting are the effects of density dependent population regulation detectable. Also, individual variation in habitat selection may interact with climate to influence reproductive output.

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Resource Selection by North American Elk: Effects of Population Density

Large herbivores exhibit strong density dependence and often select resources over large spatial scales. Nonetheless, little is known regarding how resource selection varies with population density relative to ecological carrying capacity. Our objective was to determine if selection of resources differed at high and low population densities of elk, *Cervus elaphus*. We hypothesized that selection of resources would vary among population densities of elk resulting from differences in intraspecific competition and varying availability of resources. We hypothesized that resource selection would be stronger at lower densities because of a greater ability to partition resources compared with high density where intense intraspecific competition would result in lower availability of resources. Resource selection models were created for areas of high and low density and compared to random locations to determine how selection differs for resources including habitat type, distance to roads and water, elevation, slope, and aspect. We evaluated resource selection models to determine which variables were most significant for predicting resource selection by population density. Selection by elk varied significantly at different densities for slope and elevation. At higher densities elk selected for higher elevations and steeper slopes and at lower densities elk selected for lower elevations and shallower slopes. These results indicate population density relative to ecological carrying capacity should be included in models of resource selection by large mammals.

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Sexual Segregation of Shiras Moose in Wyoming: Habitat Selection and Ecosystem Dynamics

Moose (*Alces alces*) exhibit sexual segregation, defined as the differential use of space or other resources by sexes outside the mating season. These large herbivores have also been shown to have profound effects on ecosystem processes such as nitrogen cycling and carbon turnover. However, we still know very little about how differential use of habitat by the sexes influences ecosystem processes. Our overarching hypotheses are that moose will segregate in spring, resulting in marked differences in habitat selection and the nutrient quality of selected forage between sexes. Differential habitat use, density, and nutrient demands will result in concentrated nutrient cycling, with important consequences for foliar nutrient content and plant productivity. To test these hypotheses, we are employing GPS-VHF radio-collar data collected from 23 females and 7 male Shiras moose near the Hoback River, in Sublette County, Wyoming, USA. We will evaluate the seasonal movements and investigate the potential effects of differential habitat use among the sexes on carbon and nitrogen dynamics. In addition, we will experimentally fertilize preferred moose forage, willows (*Salix* spp.), with nitrogen using a matched-case design and observe forage responses and soil nutrient dynamics to understand the influence of moose on ecosystem processes. Preliminary data show differential use of habitat during peak segregation with the male appearing to use upland sites, whereas females use riparian corridors.

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Space Use and Microhabitat Structure Selection by American Marten in Minnesota

Track counts and harvest data indicate that the American marten population may be declining in Minnesota. Rest sites and reproductive dens provide marten with protection from predators and severe

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weather. Current knowledge of home range size, rest sites, and reproductive dens has been heavily weighted towards western mountainous and eastern habitats. We deployed radiocollars on 131 American marten. To determine space-use we calculated annual home ranges and core-areas for 54 marten (31 males, 23 females) with > 30 locations per year. We estimated home ranges with minimum-convex-polygon (MCP) and fixed-kernel methods. There was no significant difference between 95% fixed-kernel and MCP home ranges or between home range size of males and females. Fixed-kernel home ranges of males were 10.8 km² (SEM = 1.4, range 2.3 – 34.2 km²) compared to females with 7.8 km² fixed-kernel home ranges (SEM = 1.7, range 1.3 – 29.2 km²). The mean core-area (60% isopleth) size of males (2.5 ± 0.3 km², range 0.5 – 8.0 km²) was significantly larger than that of females (1.5 ± 0.3 km², range 0.2 – 7.7 km²). We used radiotelemetry to locate 58 rest sites (7 males and 16 females) and 16 reproductive dens (*n* = 7 females). Marten used both above-ground (*n* = 30) and ground-level structures (*n* = 28) as rest sites, while a majority of reproductive dens were at or below ground level (63%, *n* = 10).

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The Influence of Habitat Type on Winter Movements of American Mink (*Neovison vison*)

American mink (*Neovison vison*) are widespread in North America and have invasively expanded their global range as a result of fur farm escapes. Despite the intensive historical use of mink as an important furbearer, its ecology across its native range is poorly understood. In an effort to better understand the role and habitat requirements of this generalist predator during winter in north-central British Columbia, Canada, we radio-tagged 11 mink from autumn 2010 to winter 2012 with intraperitoneal transmitters. We then GPS recorded 80 km of snow tracks of tagged and untagged individuals over 2 winter periods. We investigated fine-scale movement behavior in relation to habitat characteristics and presence of competitor species. Mink overnight movements were on average 1,188 m and most tortuous in riparian habitats that were characterized by heavy snow press of sedge and shrub habitat types. Though mink were clearly associated with riparian habitats, aquatic forays were rare and forays into upland forest habitats were common where sub-nivian explorations were mainly in areas of blow-down trees or at red squirrel middens. Our results suggest that American mink, during winter, forage mostly in sub-nivian environments associated with riparian areas by taking advantage of tunnels created by snow press of herbaceous and shrubby vegetation.

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Distribution of American Mink in Response to Urbanization

Widespread habitat loss and urbanization have altered the distribution of carnivore communities. Information concerning relative sensitivities to these landscape changes are available for some carnivore species, however, data for most species are still lacking. American mink (*Neovison vison*), a semi-aquatic carnivore native to North America, occur along riparian areas in human-dominated agroecosystems. Furthermore, factors that affect the distribution of American mink in their native range are still unclear. We used 5 years of presence-absence data to determine the relative influence of water availability, urbanization, and upland habitat on occupancy, colonization, and extinction dynamics in resource patches for American mink. Occupancy and colonization probabilities were related positively to water depth, but only urbanization was related negatively to colonization. Our study provides insight into how the spatial distribution of American mink is affected by increasing urbanization.

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The Distribution of Fox Squirrel (*Sciurus niger*) Leaf Nests Within an Urban Landscape

We monitored the location and number of fox squirrel leaf nests in residential neighborhoods in Indianapolis, IN to elucidate patterns of distribution and abundance in these highly human-influenced habitats. We identified all active leaf nests within 10 haphazardly chosen plots of varying size (3 - 7 ha) within a residential neighborhood over a 4-year period (2006 - 2009). We also identified all active leaf nests located along 5, north – south street transects (each approximately 2.85 km in length) in January and February of 2010. Mean nest density across all plots and all years was 4.82 nests/ha, a value similar to that reported for suburban/urban woodlots within Indianapolis. In 2009, nest density was highest in December in each plot and it decreased by an average of 64% across all plots by February. The numbers of nests varied along each street transect and the frequency and location of nests was correlated with the number of habitable trees available. Further, the number of habitable trees was positively correlated with the assessed value of the residential property. In both the plots and on the street transects the occurrence of trees with multiple nests was greater than previously observed in nearby woodlots. These relationships suggest the importance of underlying anthropogenic factors in influencing fox squirrel abundance and distribution within urban areas.

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Ringtail Abundance in an Urban Reserve in Mexico City

Ringtails (*Bassariscus astutus*) are the most abundant carnivores in Reserva Ecológica del Pedregal de San Ángel (REPSA), a remnant patch of unique xeric vegetation composed of palo loco (*Pittocaulon praecox*) scrub, within the main campus of UNAM at Mexico City. In this study we estimated the relative abundance of ringtails from April 2008 to March 2009 using 2 methods: scat counts, and scent stations. Surveys were conducted every month during 2 consecutive days and nights. After sunrise, the observer walked a line transect of 4.6 km; thus, an effort of 111 km allowed recording 375 scats of which 268 were identified as ringtail feces. Before sunset, 14 scent stations were activated; therefore, 336 stations-nights permitted 178 occasions of ringtail visits. Ringtails were present in REPSA throughout the year, and in accordance with previous studies elsewhere, highest relative abundance was detected during summer and autumn, whereas winter showed the least abundance. Ringtails used native vegetation more in comparison with gardens and introduced vegetation. Scent stations allowed inferring the age category (adult or juvenile) of ringtails according to footprint size, which in turn suggested that the reproductive season occurred at least from February through September in REPSA. Monitoring should continue because the ringtail population at REPSA may be threatened by feral dogs (*Canis lupus familiaris*) and loss of native vegetation.

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Potential Effects of Human Encroachment and Annual Precipitation on the Survival of Desert Bighorn Sheep Lambs in Southern Nevada

The encroachment of urban areas upon mammalian habitat represents a great challenge for conservation. When mammal species use urban areas, both their survival and natural population processes may be affected. We examine how the use of a municipal park affects the relationship between fall-winter precipitation and desert bighorn sheep (*Ovis canadensis nelsonii*) lamb survival/recruitment in the River Mountains, Nevada. Using annual aerial surveys performed by Nevada Department of Wildlife from 1969 to 2006, we first estimated lamb survival from lamb/ewe ratios. We then analyzed the relationships

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between precipitation and lamb survival both pre-park (before 1985) and after park completion. Greater winter rainfall (November, December, January) precipitation was predictive of greater lamb/ewe ratios before 1985 ($F_{3,14} = 8.61$, $R_2 = 0.65$). However, after 1985 this relationship between precipitation and lamb/ewe ratios was not found ($F_{3,14} = 1.13$, $R_2 = 0.185$). Year-round access to urban forage and water from 1985 may have altered the relationship between precipitation and survival of bighorn sheep lambs in this population. We further discuss both the positive and negative implications of desert bighorn use of urban areas.

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Effects of Urbanization on Heavy Metal Concentrations in *Peromyscus* Tissue

Metals are released into the environment from various landscape features and anthropogenic causes. Terrestrial small mammals may consume metals present in food sources or incidentally ingest soil contaminated with metals, where they accumulate in various body tissues. We examined concentrations of nine metals in the liver tissues of two species of male and female mice (*Peromyscus* spp.) living within a variety of natural and anthropogenic habitats in a large metropolitan area. Given the relatively small home ranges of *Peromyscus*, we hypothesized that tissue and soil metal concentrations would correlate significantly. We also expected differences between tissue metal concentrations between males and females due to differing physiological demands of reproduction. Soil and tissue samples of male and female *P. leucopus* and *P. maniculatus* were collected at 34 locations, distributed among regions that varied in their degree of urbanization. ICP argon plasma spectrometry was used to analyze metal concentrations of soil and tissues. Heavy metals were significantly higher in urban than non-urban areas. Calcium and strontium levels differed between male and female *Peromyscus* in urbanized areas while lead and zinc levels for urban mice differed between sexes and the two species. High liver calcium and strontium concentrations in females may be related to their reproductive activity. Lead and zinc concentrations in the liver samples likely reflect higher, recent ingestion rates among urban females, especially *P. leucopus*.

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Efficacy of Translocation as a Management Strategy for Urban Coyotes

Coyotes (*Canis latrans*) in large cities are increasingly forcing agencies to mitigate potential human-coyote conflicts. When coyotes become nuisance animals, agencies may use relocation to remove animals; however, the fate of relocated urban coyotes is unknown. We report the fate of relocated coyotes as part of a larger ecological study of coyotes in the metropolitan area of Chicago, Illinois. Thirteen coyotes were captured as nuisances in the city core and released at the edge of the metropolitan area. Animals were ear tagged, radio-collared, and tracked during 2000 - 2008. No coyotes remained at the release site, with the number of days post-release located near the release site ranging from 0 to 84 days. Of 13 coyotes, 92% (12) dispersed from the release site. During dispersal, 7 were confirmed dead and the rest were eventually lost. None of the coyotes were documented establishing residency and the annual survival of relocated coyotes ranged between $S = 0.00 - 0.33$, which was lower than annual survival rates ($S = 0.74$) for resident urban coyotes ($n = 208$) monitored during the same period. Although translocation may still be considered an effective management tool for removal of specific coyotes or for socio-political reasons, it may be questionable from an animal welfare perspective given the relatively low survival rate of relocated coyotes.

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Mortality Causes and Marrow Fat Phenology of Vicuñas (*Vicugna vicugna*) in the High Andes of Argentina

Ungulates can be limited by predation or food. Consequently, knowledge of how these factors influence mortality is essential to uncover the processes that drive ungulate numbers. During 2008 – 2011, we investigated causes and patterns of mortality of adult vicuñas at San Guillermo National Park (SGNP), Argentina. We quantified cause of death by conducting necropsies on carcasses, and explored how body condition of carcasses (percent femur marrow fat [PFMF]) related to primary productivity (NDVI) and diet quality (percent nitrogen content in pellets). Vicuñas ($n = 89$) died from puma (*Puma concolor*) predation (91%), unknown causes (5%), and starvation (3%). Body condition of puma-killed vicuñas varied seasonally: individuals with high (\bar{x} [95% CI] = 87% [76 - 98], $n = 30$) and low (49% [36 - 62], $n = 31$) PFMF dominated in mid-summer–late winter and spring–early summer, respectively. Primary productivity and diet quality were $\sim 1.7\times$ and $\sim 1.5\times$ higher in mid-summer–early fall than during the rest of the year. Pumas appeared to kill vicuñas in good and poor body condition according to their availability, which likely reflected seasonal changes in primary productivity and forage quality. This finding suggests that, although puma predation is the main proximate cause of death, vicuñas at SGNP are more sensitive to food than predator limitation. The operating mechanism is unclear, but the availability of high quality forage during the growing season appears critical.

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Post-release Survivorship of Captive-reared Allegheny Woodrats

Over the past 40 years Allegheny woodrats (*Neotoma magister*) have declined dramatically throughout their range due to an array of demographic pressures and disruptions of metapopulation function. Within Indiana, the demographic collapse of the woodrat metapopulation precipitated the onset of inbreeding depression, indicative of entrance into an extinction vortex. In response to this threat, we initiated a captive breeding program in an effort to use the release of captive-reared woodrats to maintain genetic diversity among isolated subpopulations. To evaluate the relative ability of captive-reared woodrats to survive in a wild environment, we radio-marked 16 captive-reared woodrats and a parallel sample of 16 wild-caught young-of-the-year woodrats and monitored post-release survival through a 120-day period. Only 3 captive-reared individuals survived through the duration of the monitoring period with 50% of individuals lost within the first 2-weeks post-release. In contrast, 5 wild-caught individuals survived through the duration of the monitoring period with mortality events distributed evenly throughout. In response to the observed rapid mortality of captive-reared woodrats, in 2012 we are modifying release strategies in which we will introduce captive-reared woodrats into large enclosures that contain artificial den structures and then remove the enclosures following a 2-week acclimation period. We hope that the acclimation period will help establish a homing instinct for captive-reared woodrats, limit initial post-release movement patterns, and thereby reduce acute losses to predation.

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Unusually High Body Mass in Virginia Meadow Voles

We used monthly capture-mark-recapture information to determine growth rates and lifespans for 2 populations of meadow voles, *Microtus pennsylvanicus*, studied for 28 and 29 months in eastern Virginia in order to learn whether the exceptionally large body masses of some voles were due to rapid growth,

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long lives, or both. On 1 study grid, 64 males (19%) and 43 non-pregnant females (11%) were > 70 g, with the largest male being 89 g. Mostly positive growth rates (averaging 1.1-3.9 g/mo) were recorded, even in autumn and winter months, times when meadow voles are losing mass in northern populations, where most studies of body growth have been conducted. Periods of low mean body mass were associated with low population density more than high body mass was associated with high population density. Patterns of body mass dynamics were related more to season than to density in our populations. We concluded that the large body masses we observed in some voles were due more to long field lives than to unusually high rates of body growth.

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Population Fluctuations of Syntopic Bush and Rock Hyraxes (Hyracoidea: Procaviidae) in the Rhodes Matopos National Park, Zimbabwe, 1992 - 2005

Bush (*Heterohyrax brucei*) and rock (*Procavia capensis*) hyraxes (Hyracoidea: Procaviidae) are abundant small mammals, strict herbivores, and important prey for raptors and other vertebrate carnivores in the Rhodes Matopos National Park (MNP), Zimbabwe. We initiated a 14-year study of hyrax populations in the 424 km² MNP in 1992 to characterize annual fluctuations in abundance and productivity (proportion of the population comprised of juveniles) in relation to annual rainfall. Annual surveys of hyraxes were conducted at 10 - 20 sites within the MNP. Point estimates of hyrax abundances ranged from 25,200 to 81,400 *H. brucei* and 29,600 to 59,200 *P. capensis*. Median annual fluctuations in abundance were 39% for *H. brucei* and 12% for *P. capensis*, and interspecifically synchronous; fluctuations were not cyclic. No significant relationships ($P > 0.05$) were observed between hyrax abundances or productivity and either rainfall in the concurrent austral summer (rainy season) or rainfall of the austral summer of the previous year, although a positive relationship ($P = 0.080$) between *H. brucei* abundance and rainfall of the previous year and a negative relationship ($P = 0.055$) between *P. capensis* productivity and concurrent rainfall were suggested. Annual rainfall, within the range observed (27.3 - 96.5 cm), may be a contributing factor to marked annual population fluctuations, but much variability in abundance and productivity remains unexplained. Additional abiotic and biotic factors potentially affecting hyrax populations are chronicled.

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Multi-state Analysis on the Reproductive Capabilities of Dall Sheep

Concerns over declines in North American wild sheep populations has spurred research on their demographics and prompted reintroduction efforts. Multi-state modeling investigating transitions between demographic states has been used to evaluate demography of a variety of species including ungulates but not wild sheep. Our objective was to develop a multi-state model to estimate the transition between reproductive (with a lamb) and non-reproductive (not with a lamb) states. We hypothesized that having a lamb in the 1st year would increase the probability of having a lamb in the 2nd year. The data came from a study done 1977-1984 by the Alaska Department of Fish and Game in which 120 Dall sheep (*Ovis dalli*) ewes were individually marked and observed at the Robertson River mineral lick in the Alaska Range. We analyzed this data in Program Mark using Multi-State Recapture Only modeling and included covariates of age, winter temperature, winter precipitation, snowfall, and snow depth. The best-supported model estimated high detection probabilities and high constant survival typical of most ungulates. Transition probabilities indicated that ewes with lambs were more likely to lamb in successive years than their non-lamb counterparts. These results suggest intrinsic or extrinsic factors may be influencing individual reproductive quality. Applying modern analytical methods to historic data can inform comparisons with current and future datasets, and improve understanding of contemporary reproductive trends.

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Southern Flying Squirrels Do Not Read Literature: Over-wintering Non-aggregation

Winter ecology of any species is generally less well known than summer ecology for practical reasons. Over the winter of 2010 - 2011 we radio-collared 15 southern flying squirrels (*Glaucomys volans*) in southwest Michigan. One research goal was to better understand the dynamics of SFS over-wintering social behavior (i.e., communal nesting). Den sites were identified almost every day from November through February (i.e., 108 of 121 possible days). Contrary to past reports of SFS forming large winter aggregations we found it most common for spatially close individuals to select individual den sites during this timeframe (440/661 observations, 67%). Mean group size was 1.59 ± 0.02 (SE) squirrels. The largest group sizes noted were 5 and 6 individuals; however, throughout the 4-month monitoring period these were documented 9 and 5 times, respectively (combined < 2% of observations). Individual squirrels switched nests periodically during winter, occupying 3.47 ± 0.60 (SE) different den sites over the 4-month monitoring period (range 1 – 8). Although all 15 individuals were in close spatial proximity (i.e., all were captured within a 100 m radius) we cannot guarantee all local squirrels were captured, so our estimates should be interpreted conservatively. Our results suggest the over-wintering social behavior of SFS is more dynamic and variable than previously recognized.

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Brownian Particles or Brown Little Particles? Raccoon (*Procyon lotor*) Movement on the Virginia Barrier Islands

Circumstantial evidence suggests that the distribution of raccoons (*Procyon lotor*) has increased on the Virginia barrier islands over the past 30+ years. Estimates of the timing, frequency, and trajectory of movements by individuals are among the most challenging data to obtain. We examined 4 lines of evidence for raccoon movements in this island system between 1999 and 2007. We observed inter-island movement by 5 of 203 individuals that were ear-tagged and released at the site of capture on 9 islands. We documented inter-island movement by 3 of 50 animals that were radio-collared and released at the site of capture on 8 islands. We also radio-collared and translocated 27 animals to a different island before releasing them. We observed return movements by 19 of those individuals. Finally, we examined frequency of re-colonization for 6 islands subject to biennial removal of raccoons. The 3 islands near the mainland were re-colonized repeatedly. Our translocation experiments confirm that raccoons are readily capable of crossing marshes and open water in order to move between islands. However, evidence from animals that were marked and released at the site of capture suggests that such movements are relatively rare. Except for islands very near the mainland, we suspect that island-to-island movements are more important in determining the distribution of raccoons on the Virginia barrier islands than are mainland-to-island movements.

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Survival and Home Range of Lagomorphs in Bottomland Hardwood Forests of Southern Illinois

Swamp rabbit (*Sylvilagus aquaticus*) and eastern cottontail (*S. floridanus*) populations have declined considerably in Illinois. Loss of bottomland hardwood forests has left swamp rabbit populations patchily distributed along major rivers in the southern portion of the state. Our research seeks to identify factors that influence habitat use and survival of swamp rabbits and cottontails where they co-occur. During 2009 - 2011, we captured and radiocollared 77 swamp rabbits and 37 cottontails within the Cache River watershed. We monitored survival daily and located rabbits > 2 times/week. The primary cause of

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mortality was predation (76%), followed by weather (13%), hunting (8%), and unknown causes (2%). Survival was highest during the summer and fall, and lowest during the winter through early spring. Annual survival averaged 0.21 ± 0.06 (SE) across both study years. Home ranges were calculated using kernel density estimates for animals with ≥ 30 locations. Overall, cottontails and swamp rabbits did not differ in average home range size for either the 95% (9.2 ± 4.5 ha) or the 50% core area estimate (2.0 ± 1.2 ha). Breeding season home ranges generally were larger in both species. Habitat availability, predator abundance, and intraspecific interactions likely have strong influences on survival and movements in both species.

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Large Carnivore Attacks on Humans in Central India: A Case Study From the Tadoba-Andhari Tiger Reserve

Villages located along reserve borders and corridors represent the “frontline” in conflicts between humans and tigers (*Panthera tigris*), where there is a need for community-focused preventative strategies and timely responsive management by officials. Since 2001, the Tiger Research and Conservation Trust has been working with government agencies in and around the Tadoba-Andhari Tiger Reserve in central India to reduce and mitigate human-carnivore conflicts. We examined human and ecological attributes of attacks by tigers and leopards (*P. pardus*) on humans during 2005 - 2011. We documented 132 carnivore attacks on humans, 71 (54%) of which were lethal to humans. Tigers and leopards were responsible for 78% and 22% of attacks, respectively. More victims were attacked while collecting minor forest products than during other activities ($P < 0.001$). Probability of attack decreased with increasing distance from forests and villages, and attacks occurred most frequently along a forested corridor in the northeastern portion of the study area. We recommend increasing access to alternative fuel sources and the implementation of rapid response teams to mitigate and prevent conflict from escalating in affected villages. In the absence of a complete separation of humans and large carnivore habitats, local preventative strategies and effective response to human-tiger conflicts will be key factors in the success of tiger reserves.

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Community and Physiological Responses of Small Mammals to Biofuel Crops in the Midwest

Increased energy demands have led to a necessity for the development of alternative energy sources, such as biofuels. Increased production of biofuels could greatly alter landscapes, which has conservation implications for wildlife in agroecosystems. In 2011, we evaluated responses of small mammals to 4 biofuel crops planted in replicated experimental plots at the University of Illinois Bioenergy Farm. We predicted that habitat quality of crops would follow this ranking: mixed prairie > switchgrass (*Panicum virgatum*) > miscanthus (*Miscanthus x giganteus*) > corn. We evaluated community responses via repeated livetrapping. We also evaluated stress responses for the dominant species (deer mouse, *Peromyscus maniculatus*; 89% of captures) using corticosterone levels from fecal samples. Species richness of small mammals was greater in switchgrass and mixed prairie compared to miscanthus and corn. Grassland voles (*Microtus ochrogaster* and *M. pennsylvanicus*) were mostly restricted to switchgrass and mixed prairie. Surprisingly, deer mice in switchgrass and mixed prairie plots had higher corticosterone levels relative to those in miscanthus and corn plots. We hypothesize that the elevated stress levels of deer mice in switchgrass and prairie reflected presence of behaviorally dominant voles in those habitats as opposed to differences in perceived predation risk related to habitat structure. Landscape changes from

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biofuel crops have the potential to affect diversity of small mammal communities and the stress physiology of the dominant species in the system.

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The Effects of Wind Generated Power on Terrestrial Populations of Small Mammals

In recent decades, wind energy has become an increasingly important part of the electrical power industry and has raised concerns about potential detrimental impacts on wildlife populations. While there has been a great deal of research focused on the effects of wind-generated power on bird and bat populations, little research has been conducted concerning terrestrial species. In this pilot study, a trapping web design was used to estimate small mammal density at sites with and without windmills present to determine the effects of wind generated power on terrestrial populations of small mammals. We compared the population densities and persistence times of terrestrial small mammals and the sound levels between the trapping sites. We hypothesized that decreased avian predation would increase population densities and the persistence times of small mammals at the wind power facilities. Alternatively, we hypothesized that increased noise production as well as habitat fragmentation resulting from the infrastructure development associated with wind power facilities would decrease population densities and persistence times of small mammals. Results showed that at the site nearest windmills had the highest population density, but lowest persistence times. There were also significant differences in the sound levels between the 4 sampling sites. These results are based on a small sample size such that future work should increase the sample size to verify these results.

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Biodiversity of Noctilionoid Bats is Less Dimensional Than Expected

Billions of years of environmental dynamics and evolution have lead to unimaginable biological complexity. Despite centuries of documenting the biota, patterns of biodiversity and the mechanisms that generate such natural phenomena are still poorly understood. Nescience stems from unidimensional approaches, in particular a focus on species richness, that have traditionally been used to understand the multidimensional phenomenon of biodiversity. Indeed, patterns of taxonomic, phylogenetic, functional, and phenotypic diversity (TPFP diversity) exhibit complimentary yet different gradients. Still, even basic information of how these dimensions are related to each other is virtually unknown. Dimensions represent only complimentary facets of the same entities (i.e., species) and thus likely exhibit correlation to some degree. Moreover, strong richness gradients characterize variation in biodiversity in nature, further enhancing correlation among indices that are sensitive to variation in a number of things. This research has 3 aims: 1) characterize correlations among indices of TFPF diversity, 2) examine if correlations are different than null model expectations and 3) determine true dimensionality of this multivariate dataset and examine if dimensionality is different than null model expectations. Ten measures characterizing TFPF diversity exhibited high correlation with all but one different from null model expectations. Accordingly, dimensionality of was low (2) and lower than null model expectations. Most biodiversity measures are redundant and ecologists should strive to enhance the characterization of the complexity of life on earth.

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Bat Surveys of the Mekongga Mtn. Region in Sulawesi, Indonesia

Mammal surveys were conducted in the Mekongga Mtn region of SE Sulawesi from 2009 - 2011 along an

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elevational gradient from sea level to 2,500 m. Preliminary analysis shows a high diversity of bats in this region. In 2010 a total of 17 species of bats were collected of which 5 species are endemic to Sulawesi. These collections comprised 4 families and 11 genera. In addition to museum collections, a total of 15 insectivorous bat species were detected by using acoustic bat-detectors. These findings show that a critical component of biodiversity surveys is the use of multiple detection methods. We also may have collected a new species from the genus *Thoopterus* that is undergoing some taxonomic changes. We also collected numerous ectoparasites from bats; many of which may prove interesting taxonomically and will provide a basis for investigation of the ecology and associations between ectoparasites and volant mammals. We developed species specific models of detection to assess how estimates of detectability are affected by external sources of variation such as time of year, survey effort and habitat type. We incorporated these detection models into models of species occupancy and diversity in order to calculate un-biased estimates of species occupancy and diversity. We found that species specific detectability was highly heterogeneous across species and if not accounted for may result in biased estimates of occupancy, abundance and diversity.

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An Agent-based Model of Grassland-grazer Dynamics in Temperate, Montane Grasslands

Temperate montane grasslands and their associated biodiversity are in decline, and their origin and maintenance are poorly understood. We propose three candidate ecosystems as case studies: Southern Appalachian grass balds, East Carpathian poloninas, and Oregon Coast Range balds. Two of us (Weigl and Knowles) hypothesized previously that grazing and browsing are missing processes that helped maintain these communities and their diverse, light-demanding flora. We develop a conceptual model that predicts that short growing season and elevational migration of herbivores concentrated grazing on mountain peaks. Late Pleistocene through Holocene reduction of herbivore diversity and density resulted in shrinking areal extent of these grasslands and their restriction to isolated peaks and ridges. Here we describe an agent-based simulation model to test this hypothesis. The model incorporates a grid space with cells containing woody vegetation or grasses. The agents are grazers that move in a biased random walk, through time steps. We estimate maximum density of grazers using allometric relationships of body size and density from extant mammals. Manipulating density will allow us to test the effects of grazers on maintenance and distribution of these grasslands. Other model parameters include seasonal changes in browse quality, rate of invasion by woody vegetation, and grazer herding behavior. This model has potential to provide insight into the evolutionary and ecological processes that generate and maintain these unique ecosystems and associated flora.

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Importance for Conservation of Medium and Large Sized Mammals of the Coastal Wetlands of Western Campeche, México

Coastal wetlands in tropical areas (including mangroves, marshlands and other seasonally flooded ecosystems) are considered as areas with elevated biodiversity. However, due to the difficulties to access these ecosystems and the limitations to use many of the techniques to study mammals, the comprehension about mammals in these areas has been limited. In order to determine the species richness of medium and large sized mammals of the coastal wetlands of western Campeche, México, from 2009 to 2012 we set 75 camera traps in 3 different areas around the Terminos lagoon. During 6,500 camera trap nights we obtained 4,700 photographs of medium and large sized mammals from 23 species (8 considered as protected by the Mexican law), from 8 different orders. This study allowed us to record the northernmost population of white-lipped peccaries (*Tayassu pecari*), which was considered extinct in

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the region. Also, the study confirmed the presence of jaguars (*Panthera onca*) in the area, and the presence of and widely distributed population of European wild boar (*Sus scrofa*). The results showed that the wetlands around the Terminos lagoon had a very high species richness of these group of mammals, which associated with the low human population density of the region, could give to this area an important role for mammal conservation.

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Can Red Squirrel (*Tamiasciurus hudsonicus*) Middens Affect Species Diversity?

Red squirrels, *Tamiasciurus hudsonicus*, widespread throughout coniferous forests in large parts of North America, disperse seeds, serve as prey, create structure via cone scale piles (middens) that result from feeding, and are hypothesized to function as a keystone species. Whereas middens are associated with higher vertebrate species richness, little is known of the midden characteristics that attract these species. The federally endangered Mount Graham red squirrel (*T. hudsonicus grahamensis*), with its long-term data on midden occupancy, offers a unique opportunity to study the impact of middens on mammalian and avian diversity. We conducted small mammal trapping and avian point counts, used camera traps for medium and large mammals, and measured midden characteristics (i.e., vegetation features, food resources, midden structure, and midden microclimate) at occupied and unoccupied middens and random locations. Occupied middens have higher total species richness of mammals and birds than random sites. Canopy cover and cone scale pile area are positively related to midden occupancy. Small mammal species richness was positively correlated to number of seeds at each site. Increased knowledge of the interaction strength of the red squirrel with its environment may be used to enhance ongoing recovery efforts for an endangered subspecies, inform decisions in forest management and restoration throughout North America, and offer insight on the conservation value of larderhoarding mammals worldwide.

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Small Mammal Species Composition in Pinnacles National Monument Before, During, and After Restoration in Three Habitats

Small mammals can be an important indicator of health and productivity of an ecosystem. We are studying the effects of different management techniques in White Root Sedge and Deer Grass areas that were historically managed and comparing them to an adjacent area of similar size of naturally growing Yerba Santa chaparral. Our study site is located at Pinnacles National Monument in an area that has been undisturbed by humans since the Native Americans inhabited the region. Native American tribes historically managed the Deer Grass and White Root Sedge areas for basket weaving. The National Monument in partnership with the Native American tribe is in the process of managing those areas as they historically were. We are reporting on preliminary data of small mammal populations in the 3 discrete areas and the differences in species richness and composition. Over the last year we have found consistently higher species richness and higher abundances of species during each trapping session in the naturally growing Yerba Santa compared to the almost monoculture sites of Deer Grass and White Root Sedge. The least diverse area consistently has been the White Root Sedge with only 5 of the 8 species being caught over all trapping sessions. Over the next year this data will be compared to the data we collect after burning and manual removal management techniques are employed.

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Small Mammals in Tallgrass Prairie: Species Responses to Fire and Bison Grazing

Native ungulates and fire, along with climate, were important drivers shaping the tallgrass prairie of North

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America. Because no endemic small mammals occur here, it is important to understand how small mammals from other faunal regions adapted to grazing and fire in this recent habitat. To investigate this idea, we used data collected from autumn 1982 through spring 2010 on 14 permanent traplines in 7 treatment units (2 burned annually in spring, 3 burned about every 4 years, and 2 burned only 1 - 2 times) on Konza Prairie near Manhattan, Kansas. Bison were introduced in 1992 on 3 treatments: 1 burned annually, 1 burned about every 4 years, and 1 burned only twice. Censuses were conducted for 4 days in each treatment unit in autumn and in spring. Significantly more small mammals were captured in spring after native grazers were introduced (expected frequencies adjusted for number of springs) than before the introduction occurred. In contrast, significantly fewer small mammals were captured in autumn than expected after native grazers were introduced. These contrasting seasonal patterns suggest that small mammals are reacting differentially (i.e., species specific) to the effect of fire and native grazers that create a patchy environment (where some trap stations were grazed and others were not) within the tallgrass prairie.

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Small Mammal Community Structure Changes 10 Years After the Blue Fire, Warner Mountains, California

During 2003, 2005, 2006 and 2011 small mammals were trapped in 3 habitat types in the Warner Mountains, Lassen County, California. All of the habitats are located in an area that burned in a major fire in 2001 "Blue Fire." The habitats are located at Blue Lake (elevation 1880 m). Each habitat is composed of distinct vegetation types and have seen successional changes after recovery from the Blue Fire. In 2003, a total of 390 individuals representing 9 species of small mammals was trapped. Overall, *Peromyscus maniculatus*, was the dominant small mammal, accounting for 81% of the total catch in all habitats. In 2005, a total of 105 individuals representing 7 species of small mammals was trapped. Again, *P. maniculatus* was the dominant small mammal captured representing 82%. In 2006, a total of 64 individuals from 6 species was trapped. *P. maniculatus* was the dominant small mammal captured, but only represented 43% of total catches. In 2011, a total of 139 individuals representing 12 species was trapped. *P. maniculatus* was again the dominant species caught at 44%, however, it was no longer the dominant species caught in each different habitat as was seen in 2003. We attribute the changes in species composition, dominance and richness in each habitat to the successional changes seen each habitat since the major Blue Fire of 2001.

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Effect of Habitat Fragmentation on Small Mammals in Lower Rio Grande Valley Refuges

Following the escalated conversion of the Lower Rio Grande Valley (LRGV) to agricultural and urban use beginning in the 1920s, native brushland was reduced by > 95%. Despite significant anthropogenic impacts, > 500 vertebrate and 170 woody species occur in LRGV, but 75 of them are listed as threatened or endangered by federal or state agencies. Although several habitat centric studies have been performed in LRGV, further investigation will provide a perspective on habitat fragmentation and connectivity. We have 3 research objectives: (1) determine the response of small mammals to habitat loss and fragmentation, (2) measure the degree of functional connectivity in LRGV by measuring the extent that small mammals use and move through agricultural matrices surrounding refuge tracts, and (3) use genetic methods to determine the genetic diversity of small mammal species in tracts of varying size and quality. Fifteen tracts of varying size within the geographic center of LRGV National Wildlife Refuge are being sampled for small mammals. Species diversity, density, and demographic measurements will be determined from data collected using 5-by-5 trapping grids for small mammals. The 1st of 6 collection trips

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consisted of 2,100 trap nights with a 72% trap success (1,503 individuals) and 3% recapture rate. Dominant species captured were *Peromyscus leucopus*, *Sigmodon hispidus*, and *Oryzomys couesi*.

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Short-term Small Mammal Responses to Silviculture in the Central Hardwoods

Identifying the effects of land management on plant and animal communities is important for managers seeking to preserve ecosystem function. For example, silviculture (timber harvesting) impacts many forest species, including small mammals, a key component of forest food webs. We studied short-term responses of several common small mammal species to silviculture in hardwood forests of southern Indiana. Small mammals were trapped at 32 stands over a 5-year period; 2 years of trapping occurred before harvest. Each stand received a silvicultural treatment: clearcutting (4 ha openings), shelterwood harvest (4 ha), patch cutting (≤ 2 ha) or no harvest. Following harvest, small mammals were trapped for 3 additional years. We used an *N*-mixture model fit in a Bayesian framework to estimate abundance from capture data and compared estimates before and after harvests. The eastern chipmunk (*Tamias striatus*) increased in abundance in clearcuts and patch cuts. The short-tailed shrew (*Blarina brevicauda*) and pine vole (*Microtus pinetorum*) declined following clearcuts. The white-footed mouse (*Peromyscus leucopus*), did not respond numerically to most harvest treatments. Abundance of all species was unchanged following the 1st phase of shelterwood harvests. This study provides evidence of changes in small mammal communities following silviculture and identifies species sensitive to conditions following harvest. It also presents a method for estimating abundance that is less labor-intensive and offers greater utility than traditional mark-release-recapture approaches when populations are small.

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New Insights from Old Data: Measuring Changes in Vegetation and Small Mammal Communities in the Great Basin

Over the past century, land use, invasive species, and climate change have greatly altered biotic communities in the Great Basin of the western USA. Using historical and modern comparative data from photographs and faunal surveys, we measured changes in both vegetation structure and small mammal assemblages across 80-year intervals at localities in the central Great Basin. Our results show widespread expansion of piñon-juniper woodland into areas formerly dominated by sagebrush. This has been accompanied by reduction or disappearance of shrub-associated mammals and increase in woodland species. Historical reduction in livestock grazing is associated with recovery of vegetation, particularly in riparian habitats, but has had less influence on small mammal assemblages. Historical-modern comparisons reliably document changes in community structure. Determining the relative importance of climate and land use in driving these changes remains a challenge. Museum and K-12 educators are using data from this project to produce teaching materials on the topic of biotic change, providing students with real-world challenges while fostering a deeper understanding of the scientific process.

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Effects of Forest Structure and Prey Availability on Bat Activity in Western North Carolina

In general, bat activity increases as clutter (physical obstructions such as branches and leaves) within forests decreases. The increase in activity with decreased clutter has been attributed to increased ease of flight and decreased acoustic interference. Thus, forest management activities that decrease clutter such

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as prescribed fire and thinning often result in increased bat activity. This increase in activity is usually attributed to decreased clutter, but forest management activities may also affect bats' insect prey base. The objective of this study was to test whether changes in bat activity in response to forest management activities were related to changes in forest structure and/or insect prey availability. Five replicates of 4 treatments were installed in the Cold Mountain Game Land in Western North Carolina: Control, Midstory Removal, Prescribed Fire, and Shelterwood Harvest. Bat activity was measured with AnabatII bat detectors and insects were collected using light-weight Townes traps monthly from June through August 2008-2011 (pre- and post-treatment). Seven bat species were documented through acoustics and mist-netting. Bat activity increased 10-13.7 times after the Shelterwood treatment but there was no significant increase in activity in the other treatments compared to the Control. Insect availability did not differ significantly among treatments. Our results suggest that forest structure was a greater driver of bat activity than insect availability.

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Bat Species and Habitat Use in the Trans-Pecos Texas

Understanding species-environmental relationships are crucial to predictive ecological modeling; however there have been limited studies of these relationships in bats. We examine the relationships between bat species and habitat and elevation at Elephant Mountain Wildlife Management Area, Brewster County, Texas. Mist netting was conducted July 2010 - July 2011. The sites were located over an elevational range of 610 m in 3 distinct habitat types; the desert flats surrounding the mountain, slopes and canyons of Elephant Mountain, and desert grassland on top of the mountain. A total of 9 species were captured during a total of 560 netting hours. Two species (*Antrozous pallidus*, *Tadarida brasiliensis*) were found at all elevations and habitats sampled while 2 species (*Eptesicus fuscus* and *Eumops perotis*) were found only at low elevation sites in desert flats. The remaining 5 species (*Pipstrellus hesperus*, *Myotis* sp., *Corynorhinus (Plecotus) townsendii*, *Lasiurus cinereus*, and *Myotis velifer*) were found at both mid and low elevation in desert flats and slopes and canyons. Most bats emit an ultrasonic call while foraging. Recording these calls allowed us to survey areas in which mist nets could not be used. Echolocation calls were captured at 14 sites from June 2011 - July 2011. The sites were distributed throughout the elevational change of the mountain. Over 18 species were identified via species call characteristics.

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Response of Small Mammals to Invasive Vegetation Species: Results of a Review

Replacement of native vegetation by non-native species is a current concern in natural resource management in ecological, economic, and social contexts. Related to this is the impact that invasion may have on other ecosystem components, such as wildlife. We completed a review of current knowledge about impacts of non-native vegetation on small mammals. Very few studies were found that compared small mammal populations among native versus non-native vegetation, and results varied among them. Response variables were relatively consistent among studies and included species abundance, species richness, and minimum number known alive. Some studies, but not all, included differences in vegetation composition and structure between locations with and without non-natives. Species such as spotted knapweed may disturb native vegetation but concurrently provide an alternative food source for small mammals. Conversely, Scot's broom outcompetes native grassland species resulting in negative impacts to small mammal abundance. Although illustrating potential for biofuels production, miscanthus and reed canary-grass may result in negative impact to small mammal communities, similar to other row-crop agriculture landscapes. Therefore, both positive and negative impacts of non-natives on small mammals exist, but overall our knowledge of this emerging area of research is limited.

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Assessing Habitat Occupancy and Use for Mesocarnivore Species in Great Basin National Park, Nevada

Sixty-seven species of mammals occur in Great Basin National Park, Nevada and vicinity. Little is known about the presence or distribution of mesocarnivores. These species are difficult to sample due to their presumed rarity and secretive life histories, but information on their presence and distribution is important because of their designation as species of management concern and because they play important roles as predators, scavengers and prey items. We targeted 5 species of sensitive mesocarnivores: spotted skunk (*Spilogale gracilis*), ringtail (*Bassaris astutus*), ermine (*Mustela erminea*), long-tailed weasel (*Mustela frenata*), and striped skunk (*Mephitis mephitis*) using remote camera traps to determine presence, distribution and establish the proportion of use between riparian and upland habitats. Riparian habitat accounts for only 1% of the park's total area. Despite its limited area, riparian habitat in the Great Basin is essential to many wildlife species, steering our hypothesis that mesocarnivores would utilize riparian habitat more than upland habitat types. A total of 133 remote cameras were installed at 65 riparian and 68 upland sites resulting in 2,320 total captures of 29 animal species including 249 captures of 4 target mesocarnivores. Capture rates for target mesocarnivores did not differ significantly between riparian and upland sites, but total captures of target mesocarnivores were greater at riparian sites.

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Use of Camera Traps to Assess Mammalian Assemblages in the Tuli Wilderness Area of Botswana

An important aspect of managing and maintaining any community or ecosystem involves knowing which species reside within the core area of interest. A common method for obtaining such information employs the utilization of camera traps to survey a region or area of interest in order to determine site occupancy. The utilization of occupancy modeling is effective in determining the probability of species occurrence when studying rare or elusive mammals. We sampled a total of 39 camera sites with a total of 38 species observed throughout the approximately 6,000-ha core study area. A variety of large charismatic fauna were detected, such as the African elephant (*Loxodonta africana*) and lion (*Panthera leo*), and a variety of lesser-known species such as the white-tailed mongoose (*Ichneumia albicauda*) and aardvark (*Orycteropus afer*). Species detection was greatest along roadways and differed significantly within drainage lines, but not among other locations (Tukey-Kramer test, $\alpha = 0.05$). We found significant differences in species richness among camera sites located within different habitat patches (one way parametric ANOVA, $P = 0.022$). We used PRESENCE 3.1 software to determine site occupancy rates for each of the individual mammalian species present. Completed models show a best-fit model for the detection of an individual species based on site covariates. Estimations of the proportion of sites occupied aid in continued monitoring and management of species occurrence and population assessments. Camera trapping is an effective non-invasive tool for surveying/observing mammalian species within the Tuli Wilderness Area. This method of sampling would prove beneficial for many other areas within the African landscape.

90 Symposium I: Interactions Between Mammals and Their Pathogens, Tuscany Ballroom E & F, Sunday 24 June 2012

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***Toxoplasma gondii*: Exploring the Land and Sea Connection**

Environmental transmission of *Toxoplasma gondii*, a zoonotic protozoan parasite, can adversely impact the health of human and animal populations worldwide. *Toxoplasma gondii* is a significant cause of

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mortality in threatened Southern sea otters, which serve as sentinels for detecting disease threats to people and animals in coastal environments. As wild and domestic felids are the only recognized hosts capable of shedding *Toxoplasma* into the environment, infection of marine animals suggests land to sea pathogen transmission. To assess relative contributions to terrestrial parasite loading, *Toxoplasma* infection and shedding were evaluated among feral domestic cats, mountain lions, and bobcats in coastal California. Genotypes of *Toxoplasma* in the coastal terrestrial environment were also examined in diverse domestic and wild carnivores, and compared to the types found in marine mammals. *Toxoplasma* exposure and shedding differed significantly among sympatric coastal domestic and wild cats, with increased odds of shedding oocysts detected in bobcats and unmanaged feral cats. Building upon the shedding data for wild and domestic cats, a spatially explicit environmental parasite loading and transport model was developed to evaluate the impact of land use and climate on the distribution and coastal run-off of *Toxoplasma* along the sea otter range. Continued development of coastal landscapes has the potential to change cat population numbers and spatial distribution, increase terrestrial pathogens in fresh-water run-off, and alter disease dynamics at the human-animal-environment interface.

91 Symposium I: Interactions Between Mammals and Their Pathogens, Tuscany Ballroom E & F, Sunday 24 June 2012

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Space Use, Group Dynamics, and Contact Patterns Among White-tailed Deer: Implications for Disease Transmission and Impacts

Epidemiological theory builds from simplifying assumptions, but the most interesting aspects of real organisms are how they violate such oversimplifications. White-tailed deer present an intriguing example. Deer form discrete (but not rigid) groups, intermediate between solitariness and herding. These groups inhabit stable home ranges that overlap somewhat with others, intermediate between mass-action and strict territoriality. My lab is exploring the implications of these behavioral patterns for direct and indirect transmission of disease, combining extensive GPS telemetry data with detailed simulation models, plus more general models. We found that deer within matrilineal groups show much higher direct contact rates with group members than nonmembers, but extensive home-range overlap provides ample opportunity for indirect transmission. Some individuals have loose group affiliation, their degree of association fluctuating greatly between seasons and even days. A first-principles model of home range behavior indicates that transmission should be a decelerating function of population density, a pattern found in several species. We built an individual-based model upon random walk models with home range behavior, fitted to deer GPS data, and the results indicate that transmission rates can remain high until population densities drop substantially, especially in fragmented habitat. Currently, we are experimentally testing “social need” as a mechanism for frequency-dependent transmission. Our findings highlight the poor fit between simple models and deer biology, and the complex factors influencing their host-pathogen dynamics.

92 Symposium I: Interactions Between Mammals and Their Pathogens, Tuscany Ballroom E & F, Sunday 24 June 2012

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Mammalian Functional Ecology: A Host of Parasite-mediated Processes?

Most mammals become infected with a multitude of parasites throughout their lifetime, with many infections persisting chronically and causing few clinical manifestations. Chronic infections imply some degree of tolerance by the host to the parasite; – to survive with chronic infections, hosts must limit acute damage by the parasite and by their own immune responses. Tolerance mechanisms, and their fitness consequences, are only beginning to be explored in the disease ecological literature. Here I argue that host responses to chronic infections may have far-reaching effects on host physiology, including stress responses, immunity, and hematology. I present original data from different mammalian hosts and their chronically infecting parasites to illustrate these ideas. Theory predicts that tolerance interactions may

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allow parasites to achieve high infection prevalences, because virulence and transmission are decoupled by the host's damage mitigation responses. I discuss possible consequences of host physiological adaptation to ubiquitous chronic infections, including the potential for physiological dysregulation when parasites are removed. Physiological changes due to parasite removal may have wide-reaching implications, from host health to invasion biology.

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The Influence of Community Complexity on Host Interactions and Pathogen Prevalence

Many pathogens of wildlife and humans are transmitted through direct contacts between hosts. Information on the frequency of contacts between individuals and the distribution of contact rates in the population is critical to predicting the pathogen prevalence. However, contact rates are notoriously difficult to document especially in small, nocturnal species. We have been investigating the contact rates and social networks of deer mice (*Peromyscus maniculatus*) with respect to infection with *Sin Nombre* virus (SNV), a zoonotic pathogen, and the biodiversity of the mammalian community. Our work and that of others has documented that prevalence of SNV in deer mice is related to the complexity of the mammalian community such that pathogen prevalence is lower within more diverse communities. Moreover, we found evidence that contact rates between deer mice differ with respect to biodiversity. Deer mice in more complex communities had fewer intraspecific interactions than those in less diverse communities. Contact rates of individual deer mice were highly variable with a minority of the deer mice accounting for a majority of the interactions. The connectedness of an individual within a social network was predictive of its pathogen status; more connected individuals had a greater probability of infection. The results of these studies have implications for pathogen management in wildlife and humans. Recent advances in technology will permit documenting contact rates in a variety of species.

94** Poster Session II, Tuscany Ballroom A, B, 7, 8, Sunday 24 June 2012

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The Effect of Dietary Behavior on Cribriform Plate Morphology

Olfaction plays a critical role in feeding behavior among mammals. Canids, which occupy a range of dietary ecologies, are thought to possess a keen sense of smell. This study explores the relationship between canid dietary behavior and the morphology of one olfactory skull feature, the cribriform plate. The cribriform plate (CP) is a cup of bone on the anterior end of the brain case that is perforated with foramina through which nerve fibers from the olfactory epithelium of the snout pass to reach the olfactory bulb of the brain. Marked variation in CP size and the number and surface area of the foramina likely reflects differing levels of reliance on olfaction. I hypothesize here that highly carnivorous canids, which need to locate and track their prey, have a larger and more complex CP morphology than omnivorous canids. Virtual models of the CP, constructed from CT scans and 3-D imaging software, were used to estimate the surface area of the CP, the total cross-sectional area of the foramina and the total number of foramina of each species. We found that carnivores have a more robust CP morphology than their omnivorous relatives. This suggests that feeding strategy is related to the divergence in cribriform plate morphology.

95** Poster Session II, Tuscany Ballroom A, B, 7, 8, Sunday 24 June 2012

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Morphological Homogeneity on Cranium of Two Subspecies of Water Deer in China and Korea

Water deer (*Hydropotes inermis*) have been classified into 2 subspecies according to geographic distribution and pelage color pattern: *H. i. inermis* from China and *H. i. argyropus* from Korea. However, the results of a recent molecular study have questioned this subspecific classification. To further reappraise classification, we examined morphological variations in craniodental measurements. Results of *t*-test and factor analysis demonstrated that these 2 subspecies are not well differentiated, suggesting that individuals of the 2 populations share common morphological traits. Despite the distribution of the subspecies at different latitudes, no clear morphocline was detected, suggesting that Bergmann's rule does not apply. Discriminant analysis indicated that some individuals are shared by both populations and suggests that not all individuals can be arranged to their original population. Result of PCA showed 2 populations shared more than 75% of individuals, and was congruent with 75% rule that explains the concept of subspecies. In neighbor-joining and unweighted pair group method with arithmetic mean cluster analyses, specimens of *H. i. argyropus* and *H. i. inermis* were highly mixed with one another in the cladograms. These results indicate that the overall morphological variation of the 2 subspecies overlaps considerably and that there is no coherent craniodental difference to distinguish the 2 subspecies. The present findings combined with prior observation concerning molecular biogeography point out that the taxonomic division of water deer into 2 subspecies should be revisited.

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Craniometrical Analysis of Introduced Raccoon Dogs in Europe

Raccoon dogs are today one of the most widely spread alien species in Europe. They were introduced to Europe from Russian Far East for fur and leather industry approximately 70 years ago. To clarify the morphological variation between the original and introduced populations, skull traits were compared among Far Eastern (Russian), Finnish, and German populations. We examined craniometrical variation using 71 specimens from the Far East (Zoological Museum of Moscow State University, Moscow, Russia), 70 specimens from Finland (Finnish Game and Fisheries Research Institute), and 75 specimens from North Eastern Germany (Technical University of Dresden, Germany). Fifty-seven (57) linear traits were measured by caliper and the data obtained were analyzed with ANOVA and PCA. Results of ANOVA indicated that 16 traits showed significantly larger mean values in Finnish populations ($P < 0.05$). PCA result explained that skull size mainly contributed to the separation of the Finnish from Russian and German populations. Compared to the Russian and German populations, Finnish raccoon dogs are significantly characterized by larger skull size in several traits including the zygomatic breadth by both ANOVA and PCA. Given these results, we suggest that severely cold climate in high latitude has caused the rapid morphological selection in the Finnish raccoon dogs. On the other hand, the German population may have remained similar to the original Russian population due to the milder climate and the lack of severe selection pressure. Our findings provide an example of rapid microevolution that occurred within a short period.

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First Occurrence of Supernumerary Teeth in the Two-toed Sloth, *Choloepus*

Supernumerary teeth have been documented as occurring in nearly all modern mammalian orders, although no cases have previously been published among the Pilosans. This study reports 3 individuals of the sloth genus *Choloepus*, 2 of Hoffman's two-toed sloth (*C. hoffmanni*), and 1 of Linnaeus's two-toed sloth (*C. didactylus*), that exhibit supernumerary teeth. All of the duplicated teeth occur in the maxillae, and all but 1 on the right side. The single individual with a duplicated tooth on the left is 1 of the 2 *C.*

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hoffmanni specimens, suggesting the duplication pattern is neither species nor toothrow side specific. The additional teeth alter the dental formula and have implications for the dental occlusal patterns. Sloth teeth erupt as simple rounded cones and therefore, the different “cusp” patterns characteristic of each genus (both living and extinct) arise from wear and the half tooth length offset of the spacing of the upper and lower dentitions. Additional teeth disrupt these relationships, and may alter the orientation of the typical anterolingual masticatory power stroke in these animals.

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Allometric Scaling in Order Cingulata (Armadillos, Pampatheres, and Glyptodonts)

The members of Cingulata (armadillos, pampatheres, and glyptodonts) are generally power diggers. The extant species of Cingulata are tiny compared to their extinct relatives. They range in size from the 12 cm *Chlamyphorus* (fairy armadillos) to the more than 3 m glyptodont, like *Panochthus*. Locomotion for this order is more similar to their distant relatives, Order Pilosa (sloths and anteaters), than to other mammals. To better understand the locomotion of glyptodonts and pampatheres, the best model is therefore using extant but small armadillos. This calls into question allometric scaling. Because of the digging lifestyle, bones in the small extant species are very robust. What degree is isometric vs. allometric scaling between glyptodonts and pampatheres to armadillos? The closer the isometric scaling is between them, the better the model. This study examines isometric and allometric scaling between the extinct and extant cingulatans. The data indicate that armadillos are a good isometric model when examining their larger extinct relatives.

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Species-specific Morphological Variation in Pinniped Vibrissae: Relationships With Diving and Foraging Behaviors

Vibrissae, or whiskers, are specialized sensory hairs found around the mouth, nose, and eyes of mammals. Recent studies have suggested that pinnipeds use vibrissae for hydrodynamic tracking and identification of prey or detection of objects from turbulent wakes. Phocids, with the exception of the monk seals, have further derived vibrissae with a dorsoventrally flattened and laterally sinusoidal pattern of “bumps.” These bumps may also function to reduce vortex-induced vibrations during swimming and active tracking; however, not all pinnipeds possess bumpy whiskers (i.e., only non-monachine phocids) and morphological characteristics are variable. In this study, we present a species-specific analysis of variation in vibrissae morphology including overall length and basal width; number, frequency and amplitude of bumps; and color, facial arrangement and distribution in all extant pinniped species. These characters are analyzed in relation to species, sex, geographic location, dive behavior, and prey type and size to assess the structure-function relationship between vibrissae morphology and behavioral ecology. Specimens were examined from strandings, fisheries by-catch, and museum collections (Smithsonian Institution; Burke Museum; NOAA/NMFS National Marine Mammal Laboratory). Mean and maximum dive depths are examined to assess morphological characters that contribute to this non-visual, non-auditory sensory modality. Antarctic pinnipeds exhibit distinct differentiation of vibrissae morphology that may relate to prey partitioning among these sympatric species. Additional sampling is ongoing, and future study will include examination of follicle-sinus complex microstructure.

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Morphological Diversity of the Spermatozoon in the Mouse-related Clade of Rodents - its Evolution and Possible Relationship to Mating Systems

Muroid rodents have marked interspecific variation in sperm morphology which, it has been suggested, relates to differences in mating system with high levels of intermale sperm competition resulting in evolution of hooked sperm heads and long tails. Here we determine sperm morphology for species within the mouse-related clade that diverged from the other major muroid families at, or near, the base of the clade. From these data we draw tentative conclusions of polarity of sperm evolution and hypothesise the mating systems that may occur. Our findings show that members of the Spalacidae (*Rhizomys* and *Tachyoryctes* spp.), Dipodidae (*Jaculus* and *Allactaga* spp.) and the springhaas (*Pedetes*) have sperm heads that are either bullet, club or paddle-shaped and comparatively short sperm tails. By contrast the 3 *Dipodomys* and 2 *Heteromys* (family Heteromyidae) species had a sperm head with an apical hook and long tail. Placing these findings on a phylogeny suggests the latter sperm form is the derived state and shows convergence to that of many murid rodents. If sperm head shape and tail lengths do indeed reflect levels of intermale sperm competition, the findings suggest that *Dipodomys* and *Heteromys* have a multimale mating system, whereas in species of Spalacidae, Dipodidae and Pedetidae, monogamy occurs. These predictions now need to be tested to determine the generality of postcopulatory sexual selection driving sperm shape and form.

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Post-cranial Skeleton of *Diaemus youngi* (Chiroptera: Phyllostomidae): Description and Comparisons with *Desmodus rotundus*

We describe in detail the complete post-cranial skeleton of *Diaemus youngi*, a rare species of vampire bat. The species is widely distributed, but uncommon throughout most of its geographic range, and few records are present in collections. We describe the structure, size, shape and orientation of each element of the post-cranial skeleton, and make comparisons with the skeleton of the other species of vampire, *Desmodus rotundus*. *D. rotundus* has been widely studied and the locomotion morphology and characteristics of the post-cranial skeleton are known in detail, while data for *D. youngi* are scarce. The study was based on complete skeletons of specimens deposited in the CML collection (Colección Mamíferos Lillo), National University of Tucumán, and Miguel Lillo Foundation, Argentina. Differences were found in both the axial and appendicular skeleton of the 2 species. Remarkable differences were found in the development of some structures of the column such as vertebral transverse processes, the shape of the articular fovea, and the number of lumbar vertebrae. Differences also were observed in the girdles (in the clavicle, scapula, sternum, and ischium), and limbs (proximal epiphysis of the humerus, deltoid crest of the humerus, among others). After this detailed description, the main question is how these differences impact on the mode of locomotion of the species, since *Desmodus* is more terrestrial in its movement and *Diaemus* is more arboreal.

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Brain Size Allometry and Life Styles in Mammals

Variation in relative brain size (also referred to as encephalization) has fascinated biologists since Darwin. Ecological, behavioral and life history traits such as diet, sociality, and development are known to

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correlate with relative brain size. However, the influences of these variables are not mutually exclusive but instead interact in context dependence. We use a new dataset of brain sizes and a suite of ecological, behavioral and life history variables for ~1,500 mammal species to determine the interactions among these traits and relative brain size. Residual values from brain-body size allometries provide a metric of encephalization. We use a machine learning approach to understand the multiple intrinsic and extrinsic factors, and their interactions, associated with relative brain size. Correlates of relative brain size vary widely across mammals, implying unique evolutionary pathways to encephalization for species with different combinations of ecological, behavioral and life history traits. Our analysis suggests that relative brain size has evolved to balance cognitive requirements for certain behavioral and ecological lifestyles with energetic and development costs of the brain that are compensated via life history.

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Species Identification Key of Korean Mammalian Hair

To construct a species identification system, we studied hair of Korean mammals. All hair samples were dorsal guard hairs taken from mature adult mammals preserved as museum specimens in the National Institute of Environment Research and road kill specimens from all over Korea preserved by the Conservation Genome Resource Bank for Korean Wildlife. We studied the hair structure of 25 species representing 5 orders, 12 families, and 22 genera. In cuticular scale pattern, Insectivora, Carnivora, Rodentia, and Lagomorpha had the petal pattern in their hair shaft; the pattern for Artiodactyla was regular and/or irregular wave. In medullar structure, Insectivora had the unicellular ladder type, and Carnivora, Rodentia, and Lagomorpha had the multicellular type. Artiodactyla was multicellular and amorphous type, except for 3 deer species that were the filled lattice type. However, we found the significant differences among deer cuticular scale height using one-way analysis of variance (ANOVA) ($P < 0.001$). The results of this study will contribute to forensic science, zoo archaeology, forensic medicine, and wildlife conservation.

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Diagnostic Test to Identify Fossils of the Eastern Fox Squirrel (*Sciurus niger*) Using Fluorescent Properties of Bones and Teeth

Remains of tree squirrels of the genus *Sciurus* are relatively common components of Pleistocene microvertebrate assemblages and Holocene archaeological deposits. In eastern North America, two species (the eastern gray squirrel, *S. carolinensis*, and the eastern fox squirrel, *S. niger*) are frequently reported. However, their morphological similarity and generally sympatric distributions make it difficult to distinguish between these taxa in mixed assemblages, complicating paleobiogeographic and paleoenvironmental studies. A genetic condition, congenital erythropoietic porphyria (CEP), occurs in most, if not all, living eastern fox squirrels, but is absent in eastern gray squirrels and other members of the genus *Sciurus*. Due to an excess of uroporphyrin I, the bones of animals with CEP fluoresce pink under ultraviolet (UV) light, especially at approximately 400 nm. Examination of sciurid remains from several paleontological and archaeological sites has confirmed that UV fluorescence can be detected in ancient *S. niger* remains. This technique provides an inexpensive, non-destructive test that can definitively distinguish between *S. niger* and *S. carolinensis* in mixed fossil assemblages, and may aid in understanding how *Sciurus* populations repopulated eastern North America following the Wisconsinan glaciation.

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Personality and Behavioral Syndromes in Woodchucks (*Marmota monax*)

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Although animals often vary in their behavior patterns within populations, specific individuals may display similar responses in different contexts, i.e., they have personalities or behavioral types. Furthermore, correlations among behavior patterns may represent behavioral syndromes. Consistent individual differences in behavior may have adaptive significance; however, the 1st step in exploring effects of personality and behavioral syndromes on life history and evolution is to document their occurrence. I studied woodchucks (*Marmota monax*) in a natural field setting to determine: 1) if individuals exhibit behavioral types and 2) if behavioral traits are correlated and thus form behavioral syndromes. Specifically, I used open field tests to measure activity in a novel environment, mirror image simulation to measure aggressiveness and sociability, and struggling rates in a handling bag to measure docility. For open field tests, 3 principal components explained 78.4% of the variation, reflecting exploration, immobility, and stress responses. For mirror image simulations, 3 principal components explained 72.4% of the variation, representing aggressiveness, immobility, and submissiveness. Woodchucks with higher exploration scores had higher struggling rates and were more aggressive; however, aggressiveness and struggling rates were not significantly correlated. Preliminary results suggest the presence of behavioral types and behavioral syndromes in woodchucks. Future work will explore the consistency of responses over time and the impacts of these traits on other behavioral and life history variables.

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Beaver Food Caching Behavior

At northern latitudes both species of beaver (*Castor canadensis* and *C. fiber*) cut and store branches of woody species during the autumn. The North American beaver (*C. canadensis*) exhibits this behavior more consistently than the Eurasian beaver (*C. fiber*). The branches in the food caches provide nutritional content during the winter when plant productivity is low and the ponds freeze limiting beaver movement. Past studies have documented that beavers change their forage preferences as the autumn progresses and increase caching activity in response to decreasing temperatures (Busher 1996, *Am. Mid. Nat.*, 135; Busher 2003, *Lutra*, 46). This paper presents additional data on beaver food caching behavior collected on the Prescott Peninsula, Quabbin Reservation, Massachusetts. Variation in the initiation of cache construction (both between family groups and years) was observed. Food caching activity is more variable in early autumn (September to October) than in late autumn (November to December) and beavers store fewer branches in the early autumn and more branches in late autumn. These data add to our understanding of food caching behavior and illustrate a temporal change in behavior that is associated with climatic changes as autumn progresses.

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Influence of Parental Effects on the Development of Temperament Traits in Coyote Offspring (*Canis latrans*)

Adaptive parental responses to local ecological pressures can confer fitness benefits to progeny non-genetically. Because temperament flexibility is considered a contributing factor to success of coyotes (*Canis latrans*) in non-native environments, our objective was to determine the degree of influence parental effects have on offspring temperament development. To do so, we conducted a study on several captive breeding pairs and litters in 2011 at the National Wildlife Research Center in Millville, UT. As a proxy for local ecological pressures, we provided mated pairs with foreign scent lures ("scent litters", $n = 4$) or water ("control litters", $n = 4$) repeatedly during pregnancy then observed pups over a 4-month period. At 5 weeks of age, temperament was evaluated on 29 coyote pups using a domestic dog pup aptitude test (PAT). Additionally, we conducted feeding observations to measure instances of pup

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emergence from the den. Scent litters had higher average PAT scores than control litters. From 5 - 7 weeks of age, scent litters emerged from the den during feeding more frequently than control litters. Results suggest that foreign scent provision to parents indirectly increased boldness in litters. Higher boldness may indicate that parents under repeated pressures produce young more tolerant to stochastic changes, a condition characteristic of urban areas. Further analysis of physiological measures may provide insight into the proximate mechanism modulating this response.

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Launch Kinematics in Southern Flying Squirrels

We used high-speed video and an instrumented branch to explore launch kinematics in southern flying squirrels (*Glaucomys volans*). A calibrated instrumented branch was used to measure peak take-off forces for animals as they launched into glides covering distances of 0.5 to 1.5 m. Video footage recorded at frame rates of either 240 or 120 fps was used to record the spatial and temporal position of each launching animal, as well as angle of attack. A polynomial regression line was fitted to the position data, and subsequently, acceleration, velocity, and peak take-off forces were computed. The resultant data show that southern flying squirrel launch performance is similar to that of northern flying squirrels. The animals exhibit gliding postures even over short distances, and stall before landing on a vertical force pole.

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A Comparison Between the Coyote Food Habits from Tiburon Island and Punta Chueca Continental Area, Sonora, México

We report for the first time the coyote (*Canis latrans*) food habits on Tiburon Island and Punta Chueca continental area, Sonora, México. We collected scats from the island and continental area during 2009. We found that for both areas mammals were the highest values of prey consumed (Island = 54.08%; Continent = 40.82%), *Lepus alleni* was the most consumed food item, followed by birds (I = 2.24%; C = 14.01%), reptiles (I = 8.84%; C = 8.70%), fish (I = 8.16%; C = 10.87%), vegetal items (I = 7.82%; C = 6.52%), arthropods (I = 7.48%; C = 13.77%), and crustaceans (I = 1.36%; C = 5.31%). The coyote predation level on bighorn sheep (*Ovis canadensis*) and mule deer (*Odocoileus hemionus*) was low and occasional, using them as carrion consumption. The trophic diversity index was higher in the mainland (HC' = 3,183) and lowest in the Tiburon Island (HI' = 2753); the Simpson index values showed the hares (*Lepus alleni*) as an evident dominant species in the diet of the coyote in both studies areas (DI = 0.093; DC = 0.056). The Morisita-Horn index (ICI = 0.647) suggests that the food habits on the island and on the mainland were similar. The coyote consume a total of 44 taxa of which share 24. This is the 1st coyote food habits report for the Tiburon Island, due these populations remain isolated from continental coyote population.

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Food Partitioning of Two Rodent Communities in an Alpine Ecosystem

The niche structures of 2 communities with similar species composition (Taiwan vole: *Microtus kikuchii*, wood rat: *Apodemus semotus*, and white-bellied rat: *Niviventer culturatus*) may differ. We used stable isotope technique to analyze the food partitioning of rodent communities in the alpine meadow and forest in central Taiwan. Grids were set up in both habitats for sampling rodent furs and potential food sources

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in growing and non-growing seasons during 2009-2010. Three aspects of food partitioning were examined: habitat, season, and species differences. Results showed that the 2 seasons exhibited similar trends: Taiwan voles had lower carbon and nitrogen values than wood rats in the meadow, while they were lower than other rodents in only carbon values in the forest. Taiwan voles had similar food sources in both seasons, with meadow individuals consuming more plants than did forest ones. Wood rats also had similar food sources in both seasons, with forest individuals consuming more fungi than did meadow ones. Seasonal difference in diets only existed in white-bellied rats, with more invertebrates consumed in non-growing than growing seasons. Overall, the 3 species did partition their food resources. The 2 communities had different niche structures. The analyses also revealed that fungi played an important role in rodents' diet in the forest.

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Migratory Corridors for Mule Deer Using Spatial Modeling

Over the past century, mule deer (*Odocoileus hemionus*) have suffered dramatic declines throughout the western United States due, in part, to loss of wintering habitat and migratory corridors. Proper delineation of mule deer migratory corridors based on resource selection are essential for establishment of management programs to protect those corridors across the United States. We collected approximately 600 aerial telemetry data points from 80 radio collared mule deer during their annual migrations between summer and winter ranges from January 2011 to September 2011. We used Circuitscape 3.5, to map potential migration corridors based on landscape attributes in paths established from mule deer locations. We set habitat parameters of forage value, elevation, slope, and aspect as indicators of mule deer migration routes. Parameters were assigned values of resistance based on interpretations of habitat use and selection of mule deer migratory corridors. We hypothesized that Circuitscape would accurately predict migration corridors used by the mule deer from their winter to summer ranges. Two of the three models created showed a strong use by mule deer determined from VHF data locations. Further model testing may recognize strength in other selection parameters and add increased value to the models for habitat conservation and protection of migratory corridors.

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Predicting Foraging Costs in Eastern Gray Squirrels as a Function of Seed Attributes

Seed traits including mass, perishability and nutritional value are important predictors of seed consumption and caching decisions made by rodents. However, the extent to which individual traits affect consumer handling time and related behaviors has not been examined systematically. Using eastern gray squirrels (*Sciurus carolinensis*), we modeled 3 foraging metrics: 1) time taken to consume; 2) time taken to cache; and 3) distance moved when handling a seed, as a function of caloric concentration, seed hardness (force required to penetrate a nut), seed shell thickness, seed mass, germination schedule and tannin concentration. Foraging metrics were obtained from video recordings of free-ranging squirrels to which single seeds were presented sequentially. A total of 273 presentations of 22 different seed types were made. Seed trait information was obtained from laboratory assays. After correcting for fractional consumption, seed hardness (positive) and energy concentration (negative) were important predictors of consumption time ($R^2 = 0.91$). Seed mass was a positive predictor of the time taken to cache a seed ($R^2 = 0.31$). Similarly, hardness and mass of a seed were positive predictors of the distance moved before caching a seed ($R^2 = 0.77$). Our results suggest that physical attributes of seeds influence handling costs for gray squirrels, and may therefore play a role in determining seed use.

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Effect of Domestic Dog Activity on Camera Trap Success of the Margay (*Leopardus wiedii*) Along Forest Edges

Forest fragmentation is a critical conservation issue in the Neotropics, and can alter movement patterns of forest animals by allowing domestic animals or other species to encroach into newly accessible forested areas. For example, domestic canines have been shown to alter wild carnivore behavior and movement patterns, and forest fragmentation may increase the presence of dogs in wooded areas. In the present study, a remote camera survey was conducted to assess the impacts of domestic dogs on margay (*Leopardus wiedii*) camera trap success along forest margins in 2 forest patches in the eastern Andean foothills of Ecuador. The average distance on both transects from the road to camera stations that captured margays to the exclusion of dogs was significantly farther than the average distance from the road to stations that captured dogs to the exclusion of margays ($P = .002$; $P < 0.001$). On one transect, the average distance to all stations capturing margays (including stations that also captured dogs) was significantly farther than that of all stations capturing dogs, ($P < 0.001$) while on the other the difference was not significant ($P = 0.19$). Determining the depth to which “edge” zones extend into the forest of critical importance for future conservation efforts, as it can significantly affect the effective protected area for a patch of a given size or shape.

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Impact of Climate Change and Importance of Natural Protected Areas for Conservation of Jaguar (*Panthera onca*: Felidae) in Colombia

The geographic range of the jaguar (*Panthera onca*) has observed a drastic reduction and currently occupies only 62% of its original South American distribution. We georeferenced and analyzed all verified records of jaguar in Colombia. Using a Geographic Information Systems and ecological niche modeling approach we estimated current and future changes in distribution over the next decades; climate change scenarios were incorporated in these models to estimate their potential impact on the species. Our results suggest a potential range of 875,838 km², representing 77% of the Colombian territory. According to the climatic scenarios, the species is expected to be affected not only in terms of area loss but also with possible local or regional extinctions. Only 6 national parks covering its distribution and remaining stable under climate changes have sufficient size (over 6,000 km²) to ensure the species long-term conservation. Therefore, it is necessary to implement management and conservation actions, especially in areas (Jaguar Conservation Units, JCU) where possible populations have been identified. Here we identify and suggest 2 additional JCUs (Serranía de San Lucas, and Nukak National Park), that because of their size, physical continuity and habitat connectivity plus no major changes in the context of climate change might contribute to the jaguar conservation, not only in Colombia but also in the whole conservation context, connecting populations between Central and South America.

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Livestock Predation by Mammalian Carnivores in the Wetlands of México: Identification of Responsible Species and Quantification of Losses

Livestock predation by mammalian carnivores is a common cause of conflict between wildlife and humans. To understand the magnitude and causes of the conflict it's important to identify the responsible species, as well the quantification of the damage. In order to determine the magnitude of livestock

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predation in the wetlands of western Campeche, México, during 2011 we conducted 104 interviews with cattle producers from 7 communities of this region, in which we asked about the occurrence of livestock predation by mammalian carnivores. We found that 45 producers suffered cattle predation during the last 5 years. Thirty-nine of the producers that reported predations informed us that jaguars were liable for their losses. In 3 cases they identified coyotes as the responsible species and in other 3 the cause was not identified. We found that in the communities located in areas adjacent to the wetlands, and where cattle is moved during the dry season, 90% of the producers reported predation, while in communities where this is not usual only 13% of the producers suffered losses. Identification of areas where predations occur will help to identify the production schemes that favor livestock predation. Also, this probably will help to reduce the jaguar hunting due to livestock predation, which only during 2011, resulted in the killing of 3 jaguars.

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Response of Large Mammalian Predators to Riparian Corridor Restoration in the Sacramento River National Wildlife Refuge

Habitat conservation initiatives increasingly focus on the restoration of "corridors," parcels of land that promote the connectivity necessary for organisms' daily travel, recolonization of habitat patches, migration, and dispersal. Most studies of organisms' responses to corridor restoration focus on species at the lower trophic levels. Top predators (often, keystone species) have received less attention. Riparian corridor restoration in the Sacramento River National Wildlife Refuge provides an opportune setting to investigate the response of large mammalian predators to corridor restoration. This large-scale conservation initiative focuses on wetland and otherwise riparian habitats—areas that naturally support high biodiversity, and therefore are of particular ecological value. In Colusa, Glenn, and Tehama Counties, we investigate mammalian predator use of 17 such riparian corridor units. Units vary in their age since restoration and landscape context (assessed in terms of habitat patch size). We use remote cameras to collect data on predator species richness and frequency of detection. While we expected to find that predator species richness is positively correlated with restoration age, we in fact find that predator species richness is lowest in oldest sample sites. Our study will indicate how time and landscape context affect the outcome of riparian restoration efforts. More specifically, this study will help guide wetland acquisition strategies by identifying the threshold habitat patch size that best fosters large mammalian predators' return at restored locations.

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Response of a Keystone Rodent to Landscape-scale Restoration of Desert Grasslands

Over the last century, many grasslands in the Chihuahuan Desert have converted to shrublands. Loss and isolation of desert grasslands has led to declines of grassland-dependent wildlife species. Grassland restoration efforts have been dominated by application of herbicides to control shrubs, especially creosotebush (*Larrea tridentata*), over large spatial scales. We examined whether landscape-scale restoration treatments in southern New Mexico have increased abundances of the banner-tailed kangaroo rat (*Dipodomys spectabilis*), a keystone rodent in the ecosystem. We compared abundances of *D. spectabilis* between 21 sites treated with herbicide (7 - 29 years ago) and paired reference sites dominated by creosotebush. To examine potential constraints on restoration success, we also tested whether response by *D. spectabilis* depended on time since treatment, treatment area, and landscape connectivity. The abundance of *D. spectabilis* was greater on sites treated with herbicide than on paired

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references. However, the response of *D. spectabilis* depended on time since treatment and spatial connectivity. Abundance was related positively to treatment age and to connectivity, suggesting a lagged response of *D. spectabilis* to restoration that depended on landscape context. Abundance was particularly high at sites located near old treatments. Recolonization by *D. spectabilis* at restored grasslands may depend on the spatial mosaic of treated areas, and recovery of ecosystem functioning provided by this keystone rodent could take a decade or longer.

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Determining an Optimal Method for The Detection of Odorous Volatile Organic Compounds in Tiger Marking Fluid in an Effort to Preserve the Tiger Species

Chemical communication plays an integral part of conserving tigers. Tigers, elephants, lions, and many other mammals use marking fluid (MF) and other excrements as means to communicate with each other and their ecosystem. This research focuses on understanding which compounds eluted in tiger (MF) contribute to the overall odor of MF. Specifically, which compounds are responsible for behavioral responses. This study collected MF samples from 4, 16-year-old *Panthera tigris tigris* from South Khayerbari Tiger Rescue Center in West Bengal, India. In this work, MF has been studied to gain a perspective on how tigers utilize MF for territorial and reproductive communication. Specifically, this study expanded upon previous research methodologies that characterized the odor of MF, of *Panthera tigris tigris*, based on thin-layer chromatography (TLC). TLC was utilized for the separation and identification of lipid compounds. Alkali was added to the TLC paper for the identification of compounds, specifically 2-acetyl-1-pyrroline (2-AP). This research study compared the concepts of TLC against solid-phase microextraction (SPME) and multidimensional gas chromatography mass spectrometry-olfactometry (MDGCMS-O) for detection of odorous volatile organic compounds. TLC analysis of the samples was performed at the University of Calcutta and MDGCMS-O work was performed at Iowa State University. The MDGCMS-O technique uncovered 23 odorous compounds including 2-AP, suggesting that 2-AP is not the only contributing odor to the smell of *Panthera tigris tigris* MF.

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Is Ground Squirrel Translocation a Viable Conservation Strategy?

Translocation can be an important conservation tool. There have been notable translocation successes, but it often ends in failure. Ground squirrel translocation likewise has had variable results. There are examples of successful ground squirrel translocations, but the majority of attempts have ended in failure. Our goal was to design a protocol that could be used to establish new ground squirrel populations or augment existing ones with a high probability of success. We analyzed > 30 published and unpublished ground squirrel, marmot, and prairie dog translocation studies and found 22 tactics associated with successful translocations or that had empirical evidence supporting their utility. The applicable tactics were incorporated into our translocation protocol. We field tested our protocol in 2010 with southern Idaho ground squirrels. Ground squirrels stayed at the release site, survived, and reproduced in 2011 and 2012. The site was at higher elevation and contained a high percentage of native plants. In 2012, we began testing the protocol at a low elevation site dominated by invasive plant species. We report good initial success based on survivorship, body mass of surviving squirrels, and radio locations. Based on our review of the literature and personal experience, translocation can be a successful conservation strategy but it is not to be undertaken lightly.

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Reproductive Effort in Viverridae and Eupleridae

Reproductive effort is important to evolution. Important components of reproductive effort in mammals include litter size, neonatal mass, gestation, and lactation. These components can vary with respect to phylogeny, body size, or ecology. Reproductive effort has been assessed in large carnivores but the smaller carnivores have received less attention. Thus, reproductive data were analyzed among the families Viverridae and Eupleridae to determine the relative importance of allometry, phylogeny, or ecology to reproduction in these small carnivores. An allometric effect on reproduction was seen, for the 2 families overall. Litter size, gestation, and lactation do not vary with body size, whereas neonatal mass and litter mass do. Phylogenetic differences were also observed, as the euplerids have a reproductive profile distinct from the larger and more diverse viverrids. Species of family Eupleridae have a longer gestation period yet a smaller litter mass than those of family Viverridae. The longer gestation period yielding smaller litter mass suggests habitat or energetic constraints among euplerids. Their distinct reproductive profile can also be attributed to the limited biogeography of euplerids, which are restricted from Madagascar, whereas the viverrids are found spread across Southern Europe, Africa, and Asia. Certain aspects of the reproductive profiles of the small carnivores in the families Eupleridae and Viverridae can be attributed to allometry, while phylogeny and ecology also play a role.

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Reproductive Patterns Within Family Herpestidae: Patterns Among Genera

Reproductive effort is important to understanding the evolution of a species. Reproductive effort can be measured by the average litter size the individual produces, neonatal mass, gestation length, and lactation length. Major factors that affect reproductive effort include phylogeny, body size, and the ecology of the organism. Reproductive effort has been widely researched in larger carnivores, but has not been extensively analyzed in smaller carnivores. Our analysis (regression of log-transformed variables) examines the allometry of reproductive effort (litter size, neonatal weight, gestation length, and lactation length) among 14 genera (18 species) in the Herpestidae: *Atilax*, *Bdeogale*, *Crossarchus*, *Cynictis*, *Dologale*, *Galerella*, *Helogale*, *Herpestes*, *Ichneumia*, *Libertictis*, *Mungos*, *Paracynictis*, *Rhynchogale*, and *Suricata*. Litter size (1 to 4 yg per litter), gestation length (48 - 88 days), and lactation length (16 - 54 days) have no significant correlation with the body mass. In addition, no trade-off occurs between litter size and neonatal mass. However, neonatal mass ($P = 0.056$; range 21 - 800 g) and litter mass at birth ($P = 0.083$; range 65 - 2538 g) are positively correlated with adult body mass; the larger the female, the larger the young. Thus, for herpestids, the energetic but not the temporal component of reproductive effort is influenced by body size.

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A Century of Change in Small Mammal Populations in the Tahoe Basin, California

Evaluation of past and present ecosystem architect populations may indicate a community response to disturbance. While small mammals are not typically thought of as ecosystem architects they are because they are seed dispersers and play a role in soil maintenance. We investigated patterns of genetic change within 4 species of chipmunks (*Neotamias* sp.), in the Tahoe Basin, California. Chipmunks in the Sierra Nevada have experienced range and community composition shifts over the last decade. Using tissues from both modern and historic individuals we assessed loss of connectivity and allelic diversity in populations at 2 sites, over 100 years. While there are generalities in how the chipmunk species are responding to climate and anthropogenic change, the species specific differences are causing a shift in community composition. Evidence for change in distributional patterns of these chipmunks suggests that

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climate change will negatively impact intraspecific relationships and functional roles. ~~of~~ genetic analyses clarify how climate and anthropogenic change will affect ecosystem health, and dynamics, by disrupting patterns of association among component species. This study allows us to empirically establish chipmunk range and genetic diversity for a time prior to human modification of the environment. This baseline provides us with the information to determine what changes have occurred as a response to anthropogenic effects and, therefore, more accurately predict how chipmunk populations will respond to future disturbances.

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Translocation Increases Genetic Heterozygosity of a Naturally Occurring Population of Eastern Woodrats (*Neotoma floridana*) in Illinois

Historically, eastern woodrats (*Neotoma floridana*) were widespread in suitable habitats throughout southern Illinois, where they were once considered “common.” Woodrats are now one of the most endangered mammalian species in the state. Four extant, remnant populations currently remain in Illinois and the largest, most secure, and best studied of these populations occurs at Pine Hills. As part of a recovery project, from May 2003 to May 2004, 40 woodrats were removed from the Pine Hills population and from June 2004 to February 2005, 41 woodrats from various locations in Arkansas and Missouri were released at Pine Hills. Subsequent trapping at Pine Hills resulted in the capture of 41 “new,” unmarked individuals. Tissue was collected from all woodrats and 12 polymorphic microsatellite loci were amplified and sequenced from each sample. Data were analyzed with the computer programs GENEPOP and STRUCTURE. The average number of alleles per locus and average heterozygosity increased after translocation suggesting a small augmentation can have a considerable impact on the genetic diversity of a population.

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Patterns of Relatedness and Genetic Diversity in *Ex Situ* Species: An Analysis of the Captive Snow Leopard (*Uncia uncia*) Population

The current human-dominated, anthropogenically modified, landscape limits the effectiveness of traditional *in situ* conservation planning. When small populations continue to decline in size, despite *in situ* conservation efforts, a way to ensure species survival is maintaining a population under carefully monitored human created conditions. The 6,000+ Association of Zoos and Aquariums (AZA) institutions that maintain *ex situ* populations manage them with Species Survival Plans (SSP). The objective of an SSP is to manage and conserve the genetic diversity of a threatened or endangered, *ex situ* species. The snow leopard (*Uncia uncia*) SSP is one of the longest running, identifiable plans. Every year the snow leopard SSP makes management recommendations focused on maintaining the genetic diversity of the founders and ensuring a demographically stable population. Recent analysis and examination of maintained genetic variation in the *ex situ* snow leopard population suggests the population is not sustainable. These determinations are based on mean kinship (MK) and mean inbreeding (F) calculations, as determined by the snow leopard studbook. Recent research has suggested determined mean kinship values are not necessarily comparable to empirically derived measures from molecular genetic data. If studbook data and molecular genetic data differ for the captive snow leopard population, breeding recommendations may not be conserving genetic diversity. This study examines breeding success compared to mean kinship data derived from studbook data. Collaborations with Panthera’s Global Felid Genetics Program and the American Museum of Natural History’s Center for Conservation Genetics provide a database of wild snow leopard samples. The genetic information from their samples will allow individuals and lineages to be sourced to their population of origin. This information is invaluable to conservation efforts, understanding both *in situ* and *ex situ* population differentiation, and local adaptation.

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High Diversity and Lack of Genetic Structure in Eastern Red Bats (*Lasiurus borealis*)

Large numbers of migratory tree bats are being killed at wind facilities worldwide, and yet we know very little about the factors contributing to bat-turbine collisions. The purpose of our study was to characterize the genetic diversity of eastern red bats (*Lasiurus borealis*) killed during fall migration at a wind farm in north-central Texas over a 3-year period (2009-2011). We examined the data for any evidence of population genetic structure, which if present, could provide much needed information about migratory patterns and population connectivity to improve future wind farm siting. We genotyped 405 eastern red bats at 7 microsatellite loci and sequenced a 550 bp segment of the mitochondrial COI gene. Both microsatellite loci and mitochondrial haplotypes showed high levels of genetic diversity in this species. The pattern of diversity observed in the haplotype network is consistent with what is seen in species that have undergone rapid population and range expansions since the last ice age. Both clustering analysis (i.e., grouping individuals by genetics alone) and partitioning analysis (i.e., grouping by specific characteristics such as year, fatality pulse, sex) indicated that our samples represent a single population without genetically distinct subunits. The eastern red bats sampled from our study site, which includes a mix of migratory and resident individuals, likely represents one, large population of bats with high levels of gene flow among local populations.

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Molecular Analysis of Current Subspecies Classification of the Prairie Vole (*Microtus ochrogaster*)

Historically, taxonomic classifications have been constructed using morphological traits. However, established phylogenies based on morphological data may not resemble those constructed for the same taxa using molecular data. In some cases, the inclusion of molecular data has resulted in a dramatic reclassification of organisms. Thus, as more DNA and protein analyses are being conducted across a broad range of taxa, scientists are beginning to reassess current classifications based only on morphological data. Early work divided the prairie vole (*Microtus ochrogaster*) into 7 subspecies based on morphological characteristics, but subsequent quantitative examination of morphological features measured from 3 subspecies (*M. o. haydenii*, *M. o. ochrogaster*, *M. o. taylori*) showed no consistent differences among them. We are in the process of conducting the 1st molecular phylogenetic analysis of prairie vole subspecies using a 750 bp fragment of the cytochrome *b* mitochondrial gene and 7 microsatellite loci. Preliminary data from 3 prairie vole populations sampled across the range of the subspecies *M. o. ochrogaster* indicate greater genetic differentiation between populations with increasing geographic distance. However, the genetic differentiation among populations is less than that detected between subspecies of other rodents, thus the populations we have sampled are all likely members of the same subspecies. We are currently analyzing populations located within the ranges of the other subspecies to assess if molecular data support the current subspecies classification of this species.

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Genetic Variation Across California Vole (*Microtus californicus*) Populations in Arid Regions of Southern California

Animals that survive in habitat islands persisting from past climate conditions can be used to understand how changes in the environment affect population diversity. One kind of habitat island are patches of mesic environments in the desert ecosystem of the eastern Sierra Nevada and Mojave Desert of California. These patches (narrow canyons, springs and ponds) vary over size and degree of isolation from one another. One common mammal inhabitant of these patchy environments is the California vole

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(*Microtus californicus*), a species more commonly encountered in grasslands and oak woodlands of California. Anthropogenic changes to the environment (e.g., agricultural, diversions, and wastewater treatment) also play a role in their distribution. Here we investigate genetic diversity in and among these relictual desert populations using mitochondrial DNA and nuclear microsatellite variation. We discuss our results in the context of paleoclimates and ongoing change in the environment.

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Conservation Genetics of the California Leaf-nosed Bat (*Macrotus californicus*)

The Lower Colorado River Multi-species Conservation Program (LCR MSCP) is a 50-yr interagency program designed to offset the effects of damming and river operations. The program covers 22 species along 400 mi of the Lower Colorado River. *Macrotus californicus* is listed under the LCR MSCP as an evaluation species, and requires further research before a conservation plan can be implemented. *Macrotus californicus* is distributed throughout the Sonoran, Mojave, and Baja California Deserts in northern México and the southwestern United States. The species does not migrate or hibernate but relies on geothermally heated caves and mines in the northern portions of its range. Little is known concerning population level genetic structure of this species. By surveying the genetic structure, we hope to highlight unique genotypes and important roosts within the LCR region. This knowledge will allow us to design an efficient conservation strategy for *Macrotus californicus*. We have currently sequenced the cytochrome *b* gene from over 40 individuals from throughout the range. Preliminary results show 2 mtDNA clades. One clade is found in Sonora, México and the other occurs along the Colorado River in Arizona and California, USA and in Baja California Sur, México. Future plans include additional sampling in central and southern Arizona as well as the addition of microsatellites to examine detailed genetic structuring and movement between roosts in the northern clade.

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Influence of AVPR1A on Genetic Monogamy of Free-ranging Male Prairie Voles (*Microtus ochrogaster*)

In nature, many species exhibit intraspecific variation in social and genetic monogamy. Social monogamy is characterized by pair bonding with a member of the opposite sex, while genetic monogamy is defined by a male and female pair mating exclusively. This variation has generally been attributed to varying environmental conditions but specific genes also appear to influence sociosexual behavior. Prairie voles can form behavioral attachments to one opposite-sex partner during their lifetime, making them suitable models for studying the basis of social and genetic monogamy. Data from laboratory and semi-natural populations suggest that microsatellite length polymorphism in the gene (*avpr1a*) that codes for the vasopressin 1a receptor (V1aR) contributes to variation in male prairie vole sociosexual behavior by regulating neural V1aR expression. Our research is the first to investigate reproductive behavior in nature over a time interval equivalent to the average prairie vole lifespan (~12 wks) to examine if male *avpr1a* genotypes were correlated with genetic monogamy. Preliminary data from our 15-week study indicate a male's *avpr1a* genotype does not predict the number of offspring sired or the number of females with which he sires offspring. These results suggest that factors other than male *avpr1a* genotype are more important determinants of genetic monogamy in nature and illustrate the importance of investigating if findings from studies of captive animals are biologically important in natural populations.

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Using MaxEnt to Estimate Habitat Suitability for the American Badger (*Taxidea taxus*) in Missouri

American badgers (*Taxidea taxus*) are important consumers in agriculture and prairie regions due to their predation upon rodents, insects, and snakes as well as their consumption of carrion. Badger populations in Missouri have decreased significantly and are now considered uncommon. The loss of prairie habitat is believed to be a critical factor affecting badger populations. Predicting suitable badger habitat is important for developing strategies to increase and manage populations. This study focuses on using MaxEnt, which uses presence only data and environmental variables, to determine locations with the highest relative habitat suitability. Presence data from Missouri Department of Conservation sightings and trapping surveys were used to determine latitudinal and longitudinal coordinates for use in MaxEnt. Land cover and land use, soil type, and water bodies are the environmental variables that are being used to predict habitat suitability. The output for the MaxEnt models will include statistical analysis of results, plots, and model images of predicted habitat.

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Patterns of Habitat Suitability for Two *Neotoma* Species in the Great Basin Through Quaternary Climate Change

The Great Basin in the western United States has undergone drastic Quaternary climate changes that affected the distributions and population demographic patterns of many plants and animals. An increasingly popular way to investigate these dynamics is through species distribution models projected to paleoclimate models representing different points in time. Here, we focus on estimating patterns of suitable habitat for 2 woodrat species (*Neotoma lepida* and *Neotoma cinerea*) with different climate affinities at modern, middle Holocene, last glacial maximum, and last interglacial times. As expected based on their broad affinities, *N. cinerea* shows more highly suitable habitat in the Great Basin during the high glacial interval, while *N. lepida* shows more habitat during warmer interglacial intervals. These patterns are corroborated by previous occupancy and demographic data from the paleomidden record and genetic information (cytochrome *b*).

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Distribution and Status of the Northern and Southern Short-tailed Shrews (*Blarina brevicauda* and *B. carolinensis*) in North Carolina

Two species of the short-tailed shrews (genus *Blarina* Gray, 1838) exist in North Carolina. The northern (*Blarina brevicauda* (Say, 1823)) and the southern (*Blarina carolinensis* (Bachman, 1837)) short-tailed shrews can be distinguished in most cases morphometrically. Throughout North Carolina, these 2 shrew species are parapatric with very little overlap. However, the Middle Atlantic Coastal Plains and Southeastern Plains ecoregions show areas where both species may coexist. Morphometric data, consisting of 15 cranial and dental characters, were collected from museum voucher specimens of *B. brevicauda* and *B. carolinensis* within the state of North Carolina. There was no difference between genders so the data was pooled to increase the sample size. Multivariate Principal Components and Maximum Likelihood Analysis were used to determine the factors contributing to the variation in measurements. The resulting plots show a clear separation of the 2 species including the suggestion of a localized subspecies, which was further supported by Classification and Regression Tree Analysis. Based upon the museum locality data, each specimen was geo-referenced and mapped to view the current distribution for the genus *Blarina* in North Carolina with its current taxonomic designation. Future genetic analysis will test for concordance with the morphological findings for the species and subspecies, and look for evidence of gene flow in eastern North Carolina.

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Niche Conservatism and Allopatric Speciation in *Monodelphis* (Didelphidae)

Niche conservatism is the tendency to retain similar traits of ecological niches over evolutionary time scales; it might result in a failure to adapt to new environmental conditions, which is a key factor in initially isolating populations and promoting diversification. An appropriate assessment of this conservatism would be the degree to which climatic tolerance of closely related and allopatric species predicts each other's geographic range. Ecological niche modeling approaches allow these analyses, as well as identification of possible barriers or discontinuities favoring allopatric speciation. Molecular phylogenies of short-tailed opossums (*Monodelphis*) revealed several independent lineages with distinctive biogeographic patterns; 2 species groups (*adusta* and *brevicaudata*) exhibit geographic patterns and relationships suggesting allopatric speciation, which could be assessed in terms of niche conservatism. We georeferenced all available records of these taxa, incorporated 19 climatic variables (WorldClim) and used MaxEnt software to model their potential niches. For both species-groups we found a major discontinuity (*adusta* vs. *peruviana* + *osgoodi*; *brevicaudata* vs. *glirina* + *domestica*) around the Amazon River, which has been suggested as a significant barrier for other mammals. The larger overlap among predicted areas of southwestern Amazonian taxa suggests differentiation associated to habitat gradients (parapatric) rather than to physical barriers (allopatric). Additional taxonomic and geographic sampling is required to test these patterns, but niche conservatism seems a useful paradigm to study diversification patterns in particularly rich taxa.

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Phylogenetic Status and Genetic Structure of Raccoon Dog (*Nyctereutes procyonoides*) Populations

In the raccoon dog (*Nyctereutes procyonoides*), 6 endemic subspecies are distributed in the various parts of East Asia including Korea and the status of this species is still debated. Moreover, in Korea, its predators and competitors are almost extinct so the raccoon dog population has grown rapidly in a short time. This increase has raised concern for public health due to various contagious diseases including zoonosis. To examine the phylogenetic relationship and investigate genetic diversity as well as population relationships, we analyzed 3 mitochondrial genes (cytochrome *b*, COI, and control region sequences) and 11 microsatellite loci of raccoon dog populations from Korea, Russia, China, Finland, Vietnam and Japan. Both phylogenetic trees and microsatellite analysis showed that there are 2 groups; continental populations (Korea, China and Russia) and a Japanese population. There was a significant level of genetic differentiation ($d = 0.024$, mt *cyt b*; 0.011 , mt COI; 0.039 , mt con; and $F_{ST} = 0.314$, mi) between continental and Japanese raccoon dog populations. We also confirmed that Korean population revealed relatively low genetic diversity ($\pi = 0.297$, con) but, differentiated tendency among Korean populations (1, Gangwon and Seoul/Gyeonggi; 2, Chungcheong and Gyeongsang; 3, Jeonnam) was shown. Moreover, moderate but significant differentiation among continental populations was detected.

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Cryptic Speciation Within the Dusky Shrew (*Sorex monticolus*)

All species, no matter how mundane or unique, carry an evolutionary story waiting to be told. The narrative of the dusky shrew, *Sorex monticolus*, indicates that species boundaries and taxonomy are unclear, with a high potential for cryptic speciation. Previous work hypothesized the existence of 2

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subspecies, identifying them as either a Coastal or a Continental lineage. Additionally, a Northern and Southern partition within the Continental group was suggested. Preliminary haplotype networks, phylogenetic trees, and population demographics were constructed using mitochondrial DNA (cytochrome *b*). Preliminary analysis supported the hypothesis that at least 2 divergent groups (probably at the species level) of shrews exist within *S. monticolus*. Major differences between the Coastal and the Continental groups were found, but limited differences were found between the Northern and Southern Continental groups. Recent nuclear analyses have also shown some differentiation within the *S. monticolus* complex.

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Clarifying the Diversity of Mountain Voles (Genus *Alticola*) in Mongolia

Phylogenetic research has been fruitful in characterizing mammalian diversity, but systematics of species of the genus *Alticola* remains unresolved. Voles of this genus are distributed throughout most of central and northern Asia. The dynamic geologic and glacial history of the region likely stimulated diversification within terrestrial organisms and has perhaps generated cryptic diversity within species, especially among montane species isolated in mountain ranges found in the Gobi Desert. Previous molecular studies of *Alticola* included few individuals representing a limited set of localities. Those studies highlighted confusion surrounding relationships between species of *Alticola* and *Clethrionomys*, but were based only on mitochondrial genes. An examination of potential inter- and intraspecific diversity is necessary to clarify previous findings and provide a more complete foundation for future studies of these widespread rodents in central Asia. Using GenBank records and recently collected samples from Mongolia, we assessed phylogenetic relationships of 6 species of *Alticola* using mtDNA (cytochrome *b*) for 80 individuals from 26 localities and 2 nuclear loci in 17 individuals across central and eastern Asia. To address possible paraphyly, we included 4 Asian species of *Clethrionomys*. Bayesian phylogenetic analysis recovered monophyletic species groupings with low levels of variation observed within species. In contrast to montane situations of the arid North American Southwest, we found no significant cryptic diversity, suggesting isolation in mountain ranges in the Gobi has been minimal.

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Molecular Phylogenetics of the *Handleyomys alfaroi* Group (Rodentia: Sigmodontinae): Inferences from Multiple Loci DNA Sequences

Mesoamerica is considered a biodiversity hot spot, even though levels of endemism and species diversity likely are underestimated. The subfamily Sigmodontinae is the most species rich and complex group of New World mammals. Not surprisingly, the taxonomic history of Oryzomini, the largest Sigmodontinae tribe, also has been exceptionally complex. Recent studies have helped to clarify phylogenetic relationships among major clades, but have left the evolutionary histories of several groups unresolved. Such is the case for the genus *Handleyomys* (*H. intectus*, *H. fuscatus*, *H. alfaroi*, *H. chapmani*, *H. melanotis*, *H. saturator*, *H. rostratus*, and *H. rhapsops*). We used a multi-loci approach to generate a robust phylogenetic hypothesis for members of the *Handleyomys* (“*alfaroi* group”) and to assess the genealogical position of this group with respect to several other genera of Oryzomini using objective methods for phylogeny reconstruction and divergence time estimates. Results show that *H. chapmani* and *H. rostratus* are composite taxa. In addition, *H. chapmani* is paraphyletic with respect to *H. saturator*, a species proposed as its sister group. All species-level clades we recovered correlate strongly with mountain ranges in Mesoamerica (Sierra Madre Oriental, Sierra Madre del Sur, the Oaxacan Highlands, and the Mayan highlands). Divergence time estimates associate isolation of these clades to late

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Pleistocene climatic changes likely reinforced by barriers such as the Isthmus of Tehuantepec and central valleys of Oaxaca in México.

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Phylogeography of *Akodon simulator* (Cricetidae, Sigmodontinae) Inferred from Cytochrome *b* Sequences

Akodon simulator, *A. tartareus*, *A. glaucinus* and *A. varius* are a group of species distributed in the Yungas forest of Bolivia and Argentina, so closely allied that have been frequently treated as synonymous, or subspecies, by different authors. The most widely used arrangement considers *A. varius* as a different species and *A. simulator* containing 3 subspecies distributed from southern Bolivia to the southernmost Yungas forest in NW Argentina: *A. simulator tartareus* (north); *A. s. simulator* (center); *A. s. glaucinus* (south). A recent study based on cytochrome *b* sequences recognizes them as different species. In the present study, the taxonomic sampling was enhanced in order to assess their specific limits and phylogenetic relationships. We added 30 *cyt b* sequences from 13 localities throughout the complete latitudinal range of the Argentine Yungas to the existing 10 GeneBank sequences. We found 34 haplotypes. Relationships among them were inferred from phylogenetic analyses (parsimony and likelihood). The trees obtained by both methods showed 2 major well-supported clades. One included haplotypes from S Bolivia and N Argentina (*A. tartareus*) as the sister of *A. varius*; this group was in turn sister to haplotypes from the southernmost localities (*A. glaucinus*). The other major clade showed no strong phylogeographic structure including haplotypes from the complete latitudinal range of the Argentine Yungas, some of them from the same localities clustered in the former clade.

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Origin and Timing of a Recent Insular Colonization of Muskrats, *Ondatra zibethicus*

Muskrats are semiaquatic rodents native to North America, and have become a highly successful introduced species in Europe as a consequence of fur farming. Translocation by humans may have played a direct role in their colonization of several islands within the Isles of Shoals archipelago, located 6 mi from the Maine (ME) and New Hampshire (NH) coastline. Anecdotal and archaeological evidence suggests that muskrats arrived on this archipelago in the early 1900s, although the presence of muskrats could also be explained by historic colonization via a land bridge 7,000 - 11,000 ybp. To test these hypotheses, mitochondrial cytochrome *b* for 79 muskrats and 8 microsatellite loci for 85 muskrats were compared from Appledore Island (AP), ME, and NH. AP muskrats consistently displayed reduced genetic diversity as compared with mainland populations, and showed signatures of a recent bottleneck. The distribution of mitochondrial haplotypes suggests that AP muskrats derive from a NH source population. Microsatellite data reveal AP to be a distinct population cluster with high pairwise differentiation between the island and mainland regions. AP muskrats lack private alleles or unique haplotypes, suggesting that no *in situ* divergence has occurred. The data presented here are consistent with a single, human-mediated introduction from NH that occurred in the early 1900s. This is the 1st phylogeographic study of the Isles of Shoals and it provides a unique contrast with other studies of introduced muskrat populations worldwide.

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Species Limits and Phylogeography of Mongolian Pika

Phylogenetic analyses provide insight into the historical processes governing geographic distributions of genealogical lineages, especially those among closely related species. Pika (*Ochotona* sp.) form a species-rich (30 species) group of mammals with a Holarctic distribution. While research has investigated the phylogeography and distribution of the 2 North American pika species, less is known about the more diverse component in Asia, including the 4 nominal species of pika in Mongolia. In this study, we use DNA sequences both mitochondrial (cytochrome *b*) and 2 nuclear loci to begin to address questions regarding species distributions and limits of these lagomorph Mongolian species (*O. alpina*, *O. dauurica*, *O. hyperborea*, *O. pallasii*) based on 60 specimens from 14 localities across Mongolia. Additionally, we explore the phylogeography or patterns of genetic differentiation among isolated populations of the widespread *O. pallasii*. Bayesian phylogenetic analyses reveal genetic structure that generally corresponds to species designations, but only limited, within species genetic structure. We discuss these results in the context of broader phylogeographic studies in eastern Asia. Future work will focus on investigating the relationships within and among Mongolian pika with additional samples and nuclear loci.

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Inferring Geographic Modes of Speciation in Ground-dwelling Sciurids

Geography plays a central role in speciation, yet the predominance of any particular geographic mode of speciation has been debated. Correct inferences of speciation modes are, however, central to understanding the generation of biodiversity. Here we employ a methodology termed age-range correlation (ARC) analysis to infer geographic modes of speciation in ground-dwelling sciurids (ground squirrels, antelope ground squirrels, prairie dogs, marmots) of North America and Asia, a particularly diverse group believed to have undergone a major radiation within and across these continents. ARC analysis integrates species-level phylogenetic information with geographic range data, allowing inference of speciation modes from the extent of sympatry observed between sister clades across the phylogeny. Previous ARC analyses were performed for ground squirrels (*Spermophilus* sensu lato), but were incomplete due to omission of marmots (*Marmota*), prairie dogs (*Cynomys*), and antelope ground squirrels (*Ammospermophilus*), which along with *Spermophilus* s.l. comprise a monophyletic group. Our ARC analysis expands these efforts by incorporating the aforementioned taxa as well as recent changes in ground squirrel taxonomy. A conclusion similar to that of previous researchers was reached, namely that allopatric speciation likely predominates among ground-dwelling sciurids, but our analysis also highlights interesting generic trends that may contribute to better understanding the biogeography and community assembly of this diverse group.

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Using 454 Pyrosequencing to Determine Phylogenetic Information From Antique Samples

Determining phylogenetic placement of antique museum samples can be difficult depending on the age, preservation technique, and anatomical source of material used to extract DNA. These considerations coupled with low amounts of DNA and comparable amounts of potential contaminating DNA as well as chemical changes in the DNA molecule can severely restrict the ability to recover phylogenetically reliable sequences. We examined the use of 454 sequencing, with its required clonal emulsion PCR, to overcome

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some of these hindrances. DNA was extracted from different anatomical locations (e.g., lips, skin, toes) of both skin and dry specimens. These samples were amplified for both nuclear and mitochondrial regions and then put through the 454 workflow. 454 sequencing allowed for separation of contaminate DNA as well as an examination of molecular changes in the DNA structure. Further, the large coverage for each sequence allowed for higher confidence levels than standard Sanger sequencing techniques.

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Kayce C. Bell¹, Diego J. Matek¹, Jason L. Malaney¹, John R. Demboski², Joseph A. Cook¹

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Untangling Lousey Chipmunk Relationships

Many factors influence host-parasite interactions. While the interacting species may directly impact each other, abiotic factors may also play a role in determining biotic distributions. Obligate parasites of mammals are usually considered in the context that their host is the prime environmental factor and then investigated to determine if that association is driving the parasite's distribution. However, growing evidence suggests that some parasites are susceptible to external climate conditions such as temperature and humidity. Here we investigate 2 questions concerning sucking lice and chipmunks in western North America (genus *Tamias*, subgenus *Neotamias*). Are sucking lice lineages co-diverging with individual chipmunk species? Are sucking lice distributions dictated solely by host distributions, or are they constrained by climate factors? We use molecular data to estimate phylogenetic relationships among one species of sucking louse that parasitizes western chipmunks. In addition, we use species distribution models to explore the relationship between the climates parasites and hosts are found in. Lice were obtained from recently collected chipmunks as well as museum specimens at the Museum of Southwestern Biology. Preliminary findings suggest that lice lineages are co-diverging with each chipmunk species, but that abiotic variables may play a role in constraining the current distributions of sucking lice. Understanding the roles of biotic and abiotic factors in determining species distributions provides a critical backdrop to phylogeographic and host-parasite investigations.

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David W. Hale, David C. Morris, Keith W. Blount

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Assessment of the Prevalence of Selected Vector-borne Pathogens in National Parks of the Western U.S.

The objective of this ongoing study is to assess the human health risks of selected vector-borne zoonoses (e.g., plague, West Nile encephalitis) in national parks of the western U.S. In the 1st phase of this project, the prevalence of selected pathogens (*Yersinia pestis*, West Nile virus) was determined from arthropod vectors collected from mammalian hosts or in carbon dioxide-baited light traps at Grand Canyon National Park. Preparations from fleas were tested for *Yersinia pestis* by polymerase chain reaction, while mosquitoes were screened for West Nile virus via immunoassay. All samples from various South Rim localities in the park were negative for these pathogens. The data are provided to National Park Service personnel to assist in disease-risk mitigation for park visitors, personnel, and wildlife.

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Edward J. Heske¹, Joseph F. Merritt¹, Steven J. Taylor¹, Joseph A. Kath², Andrew N. Miller¹, Anthony C. Yannarell³, Nohra Mateus-Pinilla¹, Vincent P. Hustad⁴, Hue-Ming Lin³, Rod D. McClanahan⁵

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Invasion of Illinois Bat Hibernacula by *Geomyces destructans*

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In anticipation of the invasion of *Geomyces destructans*, we are monitoring bat hibernacula in Illinois. We use molecular and culture-based approaches to evaluate dead and live-caught bats and cave and mine substrates for the presence of *G. destructans*, and describe the microbial and fungal communities of sampled animals and caves. Beginning in winter 2012, we will visit 8 - 10 hibernacula per year for 3 years, and sample active bats during summer. We are collecting swab and wing-punch samples from asymptomatic and symptomatic bats; soil, air, and various other substrate samples from hibernacula; and temperature, humidity, and light data to characterize cave environments. Our study will provide data on the occurrence and distribution of *G. destructans* in hibernacula on the leading edge of the spread of White-nose Syndrome, and the fungal and microbial ecosystems in which it becomes established. Depending on the timing and extent of the invasion into Illinois, we hope to better understand potential competing or synergistic interactions between *G. destructans* and other components of fungal and microbial communities on bats and in caves related to the establishment of *G. destructans*.

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Steven R. Sheffield

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A Century of Human-induced Mortality of Mammalian Carnivores in Canada: A GIS Approach

Throughout history, mammalian carnivores have been taken through human activities such as hunting and trapping due to their economic and subsistence value. In recent history, the hunting and trapping of these species are managed by state and provincial wildlife agencies in North America. Generally, accepted practice allows take of only a certain percentage of the total population. Population size is estimated through a variety of methods, and the accuracy of these estimations varies but largely is unknown. Mortality data for felids, canids, ursids, mustelids, mephitids, and procyonids was collected for 5 Canadian provinces (Ontario, Manitoba, Saskatchewan, Alberta, and British Columbia) for the years 1919-present. This record of mortality is highly conservative as it does not include such mortality factors as roadkill, predator control, subsistence, illegal, and non-economic take. GIS was used to allow a closer assessment of mortality in each province. GIS layers used included species range, habitat, estimated species density, and human population within each province. This assessment allowed the ability to estimate whether or not known take is consistent with known biology and management of each species. Possible ecological implications of widespread killing of so many carnivorous mammals on an annual basis was analyzed by combining data for various guilds (e.g., small canids, large canids) and assemblages (e.g., mustelid, mesocarnivores, large carnivores, all carnivores). Based on the known take of these species, plus the unknown level of mortality caused by other mortality factors, it is suggested that mammalian carnivores must receive greater overall recognition of their ecological importance.

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Ecology and Interactions of Cape Foxes, Bat-Eared Foxes, and Black-Backed Jackals in South Africa

Cape foxes (*Vulpes chama*) and bat-eared foxes (*Otocyon megalotis*) are sympatric with black-backed jackals (*Canis mesomelas*) over much of southern Africa, although competition with and/or predation by jackals may suppress local fox populations. To investigate their ecology and interactions, 20 cape foxes, 40 bat-eared foxes, and 15 black-backed jackals were radio collared on 2 adjacent sites in South Africa that differed significantly in jackal densities. High jackal numbers caused home ranges to increase from 9.2 to 27.7 km² for cape foxes, and from 2.8 to 5.0 km² for bat-eared foxes. Both fox species used jackal core areas less than expected, suggesting areas outside jackal core areas functioned as competition refuges for the foxes. High jackal numbers also caused cape fox densities to decrease 64%, while nearly doubling group sizes of bat-eared foxes. The fox species exhibited various levels of dietary, temporal, and habitat partitioning with jackals. Overall, jackals killed at least 4 collared cape foxes and 7 collared bat-eared foxes, indicating potential interference competition, probably for exclusive use of territorial space

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rather than over shared resources. Surprisingly, the fox species exhibited positive associations with each other, despite being similar in body size and having high overlap in resource use. Our results showed how jackals could suppress fox populations, yet also showed how foxes, in turn, used different mechanisms to coexist with a dominant canid.

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Stage-specific Survival of Wolves and Coyotes in a 3-Species Hybrid Zone

Understanding the relative fitness of parental and hybrid individuals in relation to environmental conditions is an important goal when studying hybrid zones. Eastern wolves (*Canis lycaon*) are a “species of special concern” in Canada and Ontario and have hybridized extensively with coyotes (*C. latrans*) and gray wolves (*C. lupus*) in central Ontario. A diverse 3-species hybrid zone exists in and around Algonquin Provincial Park (APP) where parental types and hybrids occur as a patchwork across the landscape. We studied > 240 wolves, coyotes, and hybrids in and adjacent to APP to investigate the relative influences of genetic ancestry and environmental conditions on stage-specific survival. We found that adults and yearlings within APP survived better than those in adjacent areas, which was likely related to protection from harvest. Surprisingly, pups survived poorly in APP compared with adjacent areas, possibly due to low summer food availability and/or the population being close to carrying capacity. For adults and yearlings, we found that coyotes and eastern wolves survived better and worse, respectively outside of APP compared to other genotypes. Additionally, residency status, higher prey availability, and lower road densities positively influenced survival of wolves, coyotes, and hybrids. Our results indicate that eastern wolves survive poorly relative to other genotypes in areas adjacent to APP primarily due to human-caused mortality, which highlights the challenges of conserving eastern wolves in unprotected landscapes.

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Population Dynamics of Reintroduced Gunnison’s Prairie Dogs in a Semi-arid Grassland Environment

Prairie dog (*Cynomys* spp.) populations have declined by 98% across their range. Conservation and management efforts increasingly involve reintroductions of prairie dogs into parts of their historical range where they have been extirpated. Research on prairie dog population dynamics following reintroductions has been scarce, however, so little is known about the success of reintroductions, and how they might vary across different parts of their range that differ greatly in habitat and climate. Most research on the topic has been short-term, and on black-tailed prairie dogs (*C. ludovicianus*). Our research evaluated the population dynamics of Gunnison’s prairie dogs (*C. gunnisoni*) over a 7-year period, following their reintroduction to the Sevilleta National Wildlife Refuge, in central New Mexico. We found that Gunnison’s prairie dog populations were not only impacted by predation during the 1st few years, but also were highly variable over time following reintroduction into this climatically variable, semi-arid grassland ecosystem. Consequently, reintroductions of prairie dogs in the more xeric parts of their range require intensive adaptive management, with a combination of significant augmentation of populations to off-set predation, supplemental feeding during dry periods, and modest predator control. Our findings have important implications for Gunnison’s prairie dog management and conservation in semi-arid grassland ecosystems throughout their geographic range.

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Removal of Tropical Forest Tree Seeds by Ants and Small Mammals

Mammals, particularly rodents, are important dispersers of seeds. Within the Neotropics, paca (*Cuniculus paca*) and Central American agouti (*Dasyprocta punctata*) are often recognized as some of the most important seed dispersal agents. However, the importance of different seed dispersers varies between forest interior and edge. This work was conducted at Las Cuevas Research Station in Chiquibul Forest Reserve, Belize. The site is tropical submontane wet forest over quartzite and karst geological features. We partitioned seed removal among 4 functional groups: paca, agouti, small rodents, and ants. The removal rates of these 4 groups were compared between forest edge and interior. Field experiments were completed in January and July, the beginning and end of the wet season. Ten stations along an edge and 10 stations in the forest interior had three 1-m diameter plots: accessible by all seed predators, access by vertebrates smaller than paca, and accessible by ants. Two seed sizes were used on each plot. Ants removed significantly fewer small and large seeds than mammals. Both large and small seeds were removed at a significantly greater rate at the edge than the interior. This may be attributed to greater small rodent abundance near the edge than in the forest.

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Competition Between Eastern and Western Gray Squirrels in the Puget Sound Lowlands, Washington

Populations of state-threatened western gray squirrels (*Sciurus griseus*) have declined in areas invaded by introduced eastern gray squirrels (*S. carolinensis*) in the Western United States, but little is known about competitive interactions between these species. The western gray squirrel is an ecologically important member of oak woodlands, and intensive efforts to recover this species are underway in Washington (WA). We tracked eastern and western gray squirrels with radiotelemetry for over 4 years to investigate resource use and interactions between species on Joint Base Lewis-McChord near Tacoma, WA. We experimentally removed eastern gray squirrels from two sites and radiotracked both species at 2 control sites to measure competitive effects on western gray squirrels based on spatial-partitioning metrics and fitness correlates (e.g., mass, fecundity, survival). Eastern and western gray squirrels did not share space and had little overlap in their selection of habitat types. Western gray squirrels were found primarily in coniferous uplands with little cover of understory vegetation, whereas eastern gray squirrels were in riparian areas characterized by conifers, oaks, and moderate cover of understory vegetation. Following removal of eastern gray squirrels, use of their former territories by western gray squirrels remained low. Although interspecies avoidance or competitive interactions may occur in habitat suitable for both species, the prevailing pattern we observed was differential habitat selection.

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Niche Overlap of White-footed Mice and House Mice in an Intercropped Switchgrass-pine System

Production of alternative energy sources from forests, including intercropping perennial grasses and removal of residual biomass, may influence biodiversity. At an experimental site within an intensively managed pine (*Pinus* spp.) matrix in eastern North Carolina, established and maintained by Catchlight Energy LLC (a Chevron|Weyerhaeuser joint venture), we have shown that presence of switchgrass, a biofuel feedstock crop, in a managed pine system influences relative abundance of native and non-native rodent species at the plot-treatment level. In the presence of switchgrass, non-native *Mus musculus* are

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more abundant than native *Peromyscus leucopus*. A mechanism that may explain this difference between species is niche divergence at a microhabitat scale. We used microhabitat measures and live-trapping data to examine interspecific habitat associations at the levels of trap station and core home range on plots where both species were resident. Habitat measures included distance to nearest tree, height of vegetation, and percentages of pine, grass, forbs, fungus, woody debris, non-woody debris, and bare ground. *Mus musculus* was trapped at stations with more grass, less pine, farther from nearest trees, and with less woody debris than traps that captured *P. leucopus*. *Mus musculus* core home ranges had less woody debris than those of *P. leucopus*. Thus, at a microhabitat scale, niche divergence is a viable mechanism to explain observed negative relationship between *P. leucopus* and *M. musculus* at the plot-treatment scale.

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Mutualistic Interactions Between Granivorous Heteromyid Rodents and a Preferred Food Resource, Indian Ricegrass (*Achnatherum hymenoides*)

Granivorous heteromyid rodent species and Indian ricegrass (*Achnatherum hymenoides*), a perennial grass common on sandy soils, are both widely distributed throughout North American deserts. Previous research demonstrated that the vast majority (~95%) of Indian ricegrass seedling recruitment occurs from seed clusters cached in shallowly-buried scatterhoards by heteromyids, especially Merriam's kangaroo rat (*Dipodomys merriami*). Here, I discuss how emergence of seedlings in aggregated clusters from scatterhoards affects subsequent seedling survival and establishment. In 2 western Nevada field studies, I monitored single Indian ricegrass seedlings and clumped seedlings in scatterhoards over the course of a year. Individual seedlings within clumps generally had higher survival rates than seedlings growing singly, and whole caches routinely had higher survival than single seedlings. I followed these observational studies with a field experiment in which Indian ricegrass seedlings were transplanted inside fenced plots either singly or in clumps of 25 or 35 seedlings and survival was compared through their first winter. Clumped seedlings had higher survival than single seedlings, and clumps of 35 seedlings generally had maximum survival. These results suggest a mutualism involving heteromyid rodents and Indian ricegrass. Indian ricegrass seeds provide a highly preferred food resource to heteromyids, and benefits to Indian ricegrass can extend beyond seed dispersal and seedling emergence into the longer-term survival of the plant. Finally, I discuss implications of this work for arid-land restoration.

154 JOSEPH GRINNELL AWARD, Plenary II, Tuscany Ballroom E & F, Monday 25 June 2012

George A. Feldhamer

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Teaching: My Thoughts and Those of the Pros

Can we be successful university teachers without formal instruction in the art and craft of teaching? With no teaching certificate and little knowledge of the models for student learning, I have taught mammalogy and many other undergraduate and graduate courses for over 30 years—I would like to think successfully. In this talk I discuss the criteria that I feel are necessary to be a good teacher—a short “how to” approach derived from personal experience and without knowledge of the variety of student learning models. There is a rich literature in Curriculum and Instruction on post-secondary intellectual development and its relevance to effective university teaching. Several models have been proposed as to how students learn—most based on Bloom's Taxonomy for the Cognitive Domain. Such models of student learning include: Experiential Learning (Kolb 1986); Multiple Intelligences (Gardner 1993); Reflective Judgment (King and Kitchener 1994); and Ways of Knowing (Baxter-Magolda 1999). I compare my criteria for effective teaching with those of professional educators, including Pratt's (1998) Five Perspectives on Teaching Adults based on various models of learning, and discuss similarities and contrasts. Although formal teacher training may be helpful, I believe we certainly can be successful teachers and enhance student learning without formal training—in fact, most of us do.

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155 ALDO LEOPOLD AWARD, Plenary II, Tuscany Ballroom E & F, Monday 25 June 2012

Rubén M. Barquez

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The Bats of Argentina: The Challenge of Conserving a Poorly Known Fauna

Studies of mammalian biodiversity in Argentina were hampered in the decades prior to and including the 1970s because political policies of the government and cultural attitudes of the people were not supportive of the growth and development of field biology or its extension and influence on regional and national conservation policies. The growth of the present generation of active students of mammalian systematics, ecology, biology, and conservation was only achieved by very extreme personal dedication and passion for the study of mammals, with significant intellectual, financial, and infrastructure assistance of friends and colleagues from different parts of the world. The story of how I and my students and colleagues worked over the last 40 years to understand the bat fauna of Argentina and to move to protect bats and other mammals from the many challenges they face illustrates the difficulties that had to be overcome to conduct research in a lesser developed country during periods of political turmoil. Indeed, the challenges faced by mammalian biologists working in conservation in Argentina and many other countries still require passion and sacrifice from investigators if one is to succeed in influencing species declines across vast regions. To study bats was to enter into the distribution and ecology of some of the most poorly known mammals in Argentina, with minimal information on distribution and ecology. After learning the basics of bat biology across the complex landscapes of Argentina, we were challenged to convey the information to government officials and to the public to garner support for conservation actions. Bats were not the most popular mammals in Argentina with many folk tales, myths, and fears being a part of public perception. Actions were taken on multiple fronts to change public and official perception of bats. These actions have resulted in the formation of several South American associations of mammalogists that promote the study and conservation of bats and other mammals, as well as the scientific, cultural and academic growth of mammalogists in various countries. "Facing south" is a message that we are betting on for future generations, to raise self-esteem and encourage the development of native mammalogists who have the responsibility to deal with conservation problems in their countries. Two of my professors, an American and a Swede, contributed to my philosophical underpinnings, and today I have the opportunity to transmit the results of our intellectual efforts across the decades from the South to the North.

156 HONORARY MEMBER AWARD, Plenary II, Tuscany Ballroom E & F, Monday 25 June 2012

Hans Kruuk

Old Bottles for New Wine – Homage to Field Studies

This presentation discusses changes in our science where it relates to natural history, animal ecology and behavior. Exactly 50 years ago Niko Tinbergen, in 1973 recipient of the Nobel Prize, wrote his landmark paper about studies in animal behavior, which also has wider relevance, and I recap some of his ideas ('The four whys'). Currently there is a need for field studies of the kind advocated by Niko Tinbergen all those years ago. Ecological models now in use in conservation, e.g., in Population Viability Analysis, make assumptions that often cannot be verified or justified due to lack of field data, because relevant expertise and funding is lacking; an example is provided from research on Eurasian otters. The present lack of natural history interest and experience is of concern. In mammalogy, senior scientists could develop useful expertise by encouraging and supporting students with appropriate skills in field work.

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Genetic Variation Among "Lion Conservation Units" in Eastern and Southern Africa

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The lion (*Panthera leo*) has experienced geographic and population collapse, much of it happening during the last century because of human activities. A single population remains in Asia, while in Africa lions persist mainly in larger parks and reserves over an area covering no more than 20% of its historic range. The IUCN Cat Specialist Group and African Lion Working Group identified 66 lion populations in Eastern and Southern Africa as important for conserving the species. The lion conservation units (LCUs) were classified as (I) viable, (II) potentially viable, and (III) doubtfully viable; together, they cover about 61% of the species' current range (1.7 million km²). We obtained samples from 13 LCUs over most of the region and representing all 3 viability classes. We generated complete cytochrome *b* sequences for 66 individuals from the 13 LCUs, plus 10 others originating in Uganda, Cameroon, and Zimbabwe. We analyzed these against existing information for lion *cyt b* and generated a phylogeographic reconstruction for the species using MEGA 5.0 and a haplotype substitution network using NETWORK 4.6.1.0. We also genotyped 480 lions for 11 microsatellite loci and looked at alleles per locus, heterozygosity, and other genetic parameters as a function of LCU area, location, and perceived viability. Results offer guidelines for more effectively managing lion populations, including limits to the widespread use of translocation.

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Fine-scale Population Genetic Structure in a Wide-Ranging Carnivore, the Leopard (*Panthera pardus*) in Central India

In this study, we used non-invasively collected fecal samples to investigate the genetic structure of leopards (*Panthera pardus*) in the Satpura-Maikal landscape of central India. We conducted this study in a 45,000 km² area in central India, in 5 Tiger Reserves: Kanha Tiger Reserve, Satpura Tiger Reserve, Melghat Tiger Reserve, Pench MP (Madhya Pradesh) and Pench Mh (Maharashtra) Tiger reserves, and in the forest corridors connecting these reserves. We sampled 15,000 km of forest trails and collected 1,411 felid fecal samples in 2009 - 2010. We used a panel of 7 highly polymorphic microsatellite loci to identify 217 individuals from 287 leopard scats, and identified 101 males and 92 females by amplifying a fragment of the Amelogenin protein gene. Leopards showed high levels of genetic diversity in all sampled populations. Bayesian analyses revealed at least 2 admixed genetic populations, contrary to our hypothesis of panmixia. We identified 9 individuals as migrants, most of which were in reserves connected by corridors. Genetic differentiation between populations was not explained by geographic distance, and we did not detect any signature of a genetic bottleneck in any of these populations. This study highlights that leopards, an adaptable and vagile species, can become rapidly differentiated with increased habitat fragmentation. We discuss the functionality of the corridors in this landscape.

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Spatial Genetic Structure of Tigers (*Panthera tigris*) in the Satpura- Maikal Landscape of Central India

We investigated the spatial genetic structure of the tiger meta-population in the Satpura-Maikal landscape of central India using population- and individual-based genetic clustering methods on multilocus genotypic data from 273 individuals. We used non-invasive field sampling and molecular methods using 7 polymorphic microsatellite loci to obtain the multilocus genotypes. We found that the tiger meta-population in the Satpura-Maikal landscape has high genetic variation and very low genetic subdivision. Individual-based Bayesian clustering algorithms reveal two highly admixed genetic populations, and no

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evidence of past population bottleneck. We attribute this to connectivity and high gene flow in this landscape. However, deforestation, road widening, and mining may sever this connectivity, impede gene exchange, and further exacerbate the genetic division of tigers in central India.

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Population Genetics of Jaguarundis in México: Implications for Conservation and Future Research

The jaguarundi (*Puma yagouaroundi*) is a small felid native to tropical environments from southern North America to South America. Jaguarundi population ecology and genetic attributes are poorly understood due to their elusive nature, which hinders estimates of population parameters. During 1991 - 2004 we live-trapped 11 jaguarundis in west-central México, and collected blood for genetic analyses. We screened a panel of 12 microsatellite loci and mtDNA primers. We evaluated genetic diversity and the feasibility of discriminating among individuals. For microsatellite loci, we found moderate levels of observed and expected heterozygosity ($H_e = 0.49$), and allelic richness ($ar = 3.75$). Despite nuclear DNA diversity, we documented only 1 maternal lineage with our mtDNA analysis. The nuclear diversity of the sampled jaguarundis was comparable to robust populations of ocelots in México; however, mtDNA diversity was lower. Given the nuclear diversity, the probability of identifying 2 unrelated jaguarundis as the same was extremely low ($P(\text{ID}) = < 0.0001$) using only 4 of the 12 microsatellite loci. However, in the presence of siblings 7 loci would result in a low probability of misidentification ($P(\text{ID}) \text{ sib} = < 0.01$). Identifying individuals can be used in non-invasive mark-recapture studies to estimate important parameters such as population size and survival. To our knowledge this study is the 1st genetic evaluation of free-ranging jaguarundis, providing important baseline information for future research.

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Hybridization Between Lynx (*Lynx canadensis*) and Bobcat (*L. rufus*) in Atlantic Canada: Biological and Conservation Implications

Lynx, *Lynx canadensis*, are an endangered species in Atlantic Canada. Bobcats, *L. rufus*, are a relatively new immigrant species to the region. Hybridization between these 2 congeners has recently been detected in Atlantic Canada in the province of New Brunswick and possibly in Nova Scotia. Herein, we present craniometric and external morphological data from identified lynx-bobcats hybrids. Qualitatively, lynx-bobcat hybrids inherit external characters from both parental species. Multivariate statistical analyses were performed on 17 craniodental characters recorded from examined hybrid, lynx, and bobcat skulls from several museum collections. Principal components analysis revealed that craniodental characters of hybrids are intermediate to those of the parental species, while discriminant function analysis demonstrated that hybrid skulls can be identified and separated from purebred lynx and bobcat skulls. However, molecular genetic analysis in the form of microsatellite profiling currently remains the only method to positively identify hybrids. We also discuss the biological and conservation implications of lynx-bobcat hybridization and what it portends to the endangered populations of lynx in Atlantic Canada.

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Agriculture Fields Have Higher Landscape Permeability Than Native Cover Types for a Wetland Specialist in Southern Illinois

The permeability of surrounding land cover types can influence the probability of animals leaving a patch and dispersing across the unsuitable matrix. The marsh rice rat *Oryzomys palustris* persists in wetlands

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that are often isolated by upland cover types. Our objective was to quantify the permeability of 3 land cover types (grassland, agriculture, and forest) to identify areas facilitating rice rat dispersal. Between March 2011 and January 2012, we set trap lines extending 95 m from wetlands into unsuitable cover. We calculated the slope of capture rate (log-transformed) vs. distance from wetland as an inverse measure of permeability. We also measured inundation, rice rat abundance, and matrix vegetation density as potential covariates of matrix use. Using repeated-measures linear regression, we compared matrix capture rates and permeability levels among cover types, inundation, abundance, and vegetation density. After 19,352 trap-nights, we caught rice rats 198 times in wetland habitat (132 novel individuals) and 43 times in the matrix; 23 times in agriculture, 11 times in grassland, and 9 times in forest. We also found agriculture had the highest overall permeability (slope = -0.02) followed by forest (-0.04) and grassland (-0.09). Both population abundance in wetlands and vegetation density < 0.5 m high had positive effects on matrix captures. This study suggests that agriculture may promote inter-patch connectivity more than native land cover types during seasonal peaks in population and groundcover.

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Gap-crossing Decisions by Adult Franklin's Ground Squirrels in Agricultural Landscapes

In the mid-western United States, grassland habitat is fragmented by row-crop agriculture and urbanization. In spring and early summer, grassland animals facing a decision to either enter a fallow crop field or detour around it likely balance trade-offs between predation risk and travel costs, similar to forest animals encountering a clearcut. We tested if Franklin's ground squirrel (*Poliocitellus franklinii*), a grassland mammal, based gap-crossing decisions on lengths of alternate movement routes or on energetic constraints by translocating radiocollared adult squirrels across crop fields and tracking their routes home. Giving-up densities of food resources from a field experiment indicated Franklin's ground squirrels perceived a higher risk of predation in crop fields than in grass, but squirrels did not appear to compensate for risk by adjusting travel speed through crop fields. Body mass was the only predictor of gap crossing; lighter squirrels were more likely than heavier squirrels to cross crop fields. Squirrels did not appear to base gap-crossing decisions on detour efficiency (distance across gap divided by distance of detour). Additionally, likelihood of homing within 24 h of release decreased with increasing crossing distance. The importance of body mass in gap-crossing decisions by Franklin's ground squirrels suggests movements through heterogeneous landscapes are partly explained by trade-offs between predation risk and energetic constraints.

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Foraging Behavior and Habitat Use of Common Duikers, *Sylvicapra grimmia* Within the Soutpansberg, South Africa

We used foraging activity and camera trapping to test for habitat selection and foraging behavior by common duikers (*Sylvicapra grimmia*) in a grassland containing "islands" of woody vegetation. Giving-up densities (GUD) were higher at the edges and within the islands than at 6 and 12 m stations in the grassland. GUDs were lower in portions with long grass and scattered ferns and highest in areas with short grass. Using 2 grids of 5 X 5 stations, we mapped the landscapes of fear for the duikers on a larger scale that incorporated neighboring rocky hillsides. The duikers preferred feeding in open areas with long grass and scattered fern (sufficient cover and escape routes), followed by wooded islands and thick fern (lack escape routes and presence of predator-ambush sites), whereas little foraging occurred at the edge habitats and rocky areas (hard substrate that impede escape potential). 873 photos revealed solitary activity is highest in late afternoons and midnight. Photos of vigilant individuals were mostly on the rocks and in fern habitats and were higher for females. Due to the perceived risk of predation, the duikers

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biased their foraging behavior by allocating their feeding efforts, activity, and vigilance patterns. This was most pronounced at the larger habitat scale than at the microhabitat scale. These methods are broadly applicable for predator-prey studies and for assessing the impacts of habitat heterogeneity on habitat use and foraging behavior.

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Exploring the Role of Individual Behavior and Natal Experience in Dispersal of an Endangered Forest Obligate

Natal dispersal and settlement are critical processes structuring populations both demographically and genetically. The dispersal process (emigration, exploration, and immigration) has tremendous fitness consequences in terms of individual survival and reproductive success and may be influenced by individual behavioral differences and experience in the natal area. Whether an individual remains philopatric or disperses completely from the natal area may be correlated with behavioral phenotypes. If experience in the natal area causes habitat imprinting, structural characteristics of the natal area are likely to be similar to those in the place an animal chooses to settle. We combine methods for quantifying behavioral differences with an active remote sensing application to examine effects of both behavior and natal habitat structure on individual dispersal and settlement decisions in the Mt. Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*), an endangered, endemic forest obligate. A long-term monitoring project has examined demography, space use, and habitat associations of adult Mt. Graham red squirrels since 1989. In 2010, we initiated a radio telemetry study to assess juvenile red squirrel behavior and track dispersal movements, exploration and settlement habitat affinities, and survival. We radio-collared 36 juvenile Mt. Graham red squirrels in 2010 - 2011 and scored individual behaviors, measured dispersal distances, and compared natal forest structure to settlement and random forest structure. Increased activity levels and aggression are positively correlated with individual dispersal distance and individuals tend to settle in areas structurally similar to their natal territory. Our results suggest behavior and natal experience may play important roles in the process of natal dispersal.

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***Peromyscus maniculatus bairdii* Demonstrates a Perception of Risk Associated With Substrate Color**

Fear influences foraging strategies by causing reduced foraging efficiency in risky patches. Offsetting this cost are adaptations that allow species to reduce the risk of foraging. Some small mammals have camouflaging coloration to reduce predation risk, while others mitigate predation risk by foraging less on bright, moonlit nights. *Peromyscus maniculatus bairdii* is an evolutionary product of dense prairie vegetation and deep snow cover. These habitat characteristics may have ameliorated risk associated with visual predators, and limited selection for highly specialized anti-predator behaviors. Today, however, the vast majority of this species is found in intensively cultivated crop fields, which at ground level are essentially bare, particularly in winter. Could such a species that evolved in dense prairie have a behavioral adaptation to recognize risky substrates in modern cropland? To answer this question, we allowed individuals to choose between contrasting-colored substrates while foraging in 4 outdoor aviaries modified to hold mice. Within each enclosure, we manipulated light to mimic no and moderate moonlight levels. Mice were allowed to forage in a 3-m long runway with light or dark sand substrate. From this, we quantified foraging behavior as a proxy for risk perception by the mice. Mice responded to risk cues associated with substrate, suggesting they have a sophisticated decision system for maximizing survival in this novel and seemingly hostile landscape.

167** Technical Session 11: Conservation, Tuscany Ballroom 11, Monday 25 June 2012

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Are Groundwater Resources Important to Small Mammal Communities?

Groundwater is an important resource in arid areas. Groundwater supports perennial streams, riparian vegetation and facilitates biodiversity. We examined the incorporation of groundwater resources into small mammal communities in Great Basin National Park using stable isotopes. Perennial streams, springs and small mammals integrate precipitation values for deuterium. There was no relationship between small mammal deuterium values and stream distance. Carbon isotopes for riparian vegetation were significantly depleted relative to upland vegetation. Depleted carbon values are due to groundwater availability that allows more efficient discrimination against heavier carbon isotopes. *Microtus montanus* and *M. longicaudus* were the only small mammal species that incorporated riparian carbon into hair. Other small mammals, even those living directly in riparian areas, did not incorporate riparian carbon into their tissues. Our results suggest that in our study site, riparian resources are only utilized for food and water by voles.

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Incomplete Sampling Leads to Erroneous Conservation Assessment (Again): A Significant Range Expansion for the Federally “Endangered” Preble’s Jumping Mouse

Our aim is to highlight how a prolonged and rancorous debate over the status of the federally endangered Preble’s jumping mouse (*Zapus hudsonius preblei*) has been misguided due to violation of a basic tenet of biology—adequate sampling. Failure to assess genetic variation throughout the range of this species led to an incomplete view of taxonomic differentiation. We increase geographic, taxonomic, and genomic sampling and then apply conservation phylogenetics to show that, within North American zapodids, the lineage represented by this subspecies is distributed from Colorado to Alaska and of minor conservation concern. Previous efforts to unravel the molecular signature were handicapped by incomplete sampling. Joint evaluation of genetic diversity, and ecological niche models, establish the taxonomic entities (e.g., distinct population segments) that are on independent evolutionary trajectories.

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Spatial and Temporal Diet Analysis of a Declining Mesocarnivore, the Eastern Spotted Skunk (*Spilogale putorius*)

Commercialization and intensification of agriculture has increasingly and severely changed the landscape since the early 1900s. The eastern spotted skunk (*Spilogale putorius*) has experienced drastic population declines during this time, and several authors suggested this decline might result from a declining prey base following large scale changes in agricultural practices. Our study seeks to address the hypothesis that a change in agricultural practices has caused a change in the diet composition of *S. putorius*. As a species with a similar diet and stable populations, we used the striped skunk (*Mephitis mephitis*) as a comparison species during this study. We conducted $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ isotope analysis on *S. putorius* and *M. mephitis* hairs collected from Kansas from 1894 - 2011. Results indicated that while *M. mephitis* has undergone a slight increase in trophic level, the reliance on C_3/C_4 plants has remained the same over time. $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of *S. putorius* have increased in variance and range over time, indicating an increase in the number of individuals consuming at the limits of their trophic level and a more absolute reliance on C_3 or C_4 plants in some individuals. Distinct jumps in variance of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ isotopes for *S. putorius* correspond to periods of intense agricultural change, suggesting a relationship between changing agricultural practices and diet composition.

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Ecuadorian Bat Conservation Program

In November 2011, as part of the First Ecuadorian Mammal Meeting organized by the Ecuadorian Mammalogists Association, the Ecuadorian Bat Conservation Program (PCME, Spanish acronym) was created. The information presented here is a summary of the proposed strategies and conservation activities that have been developed in the 1st semester of existence of the PCME. In December 2011, an outbreak of rabies struck the southeast of the country that led to the creation of a National Rabies Emergency Committee to which PCME was invited to participate. Our role in the rabies emergency was to support the government office designated to control the infected vampire bat colonies in the affected areas, and to develop an educational campaign aimed to schools of affected areas designed to inform about the importance of bats in the environment, the real relationship between bat and rabies, and to discuss myths and legends associated with these animals in the light of current scientific knowledge. Bat Conservation International is funding this initiative. Other activities that we have developed are part of the Latin-American Network of Bat Conservation (RELCOM) to which PCME has belonged since February 2012, including preparing the designation of Important Bat Conservation Areas and Sites, and the “Murcimaleta” initiative (roughly translated “Bat Luggage”). Also, a national agenda, future plans, and information for potential supporters is presented.

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Enzo Aliaga-Rossel

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The Bolivian River Dolphin (*Inia boliviensis*): Current Research and Conservation in Bolivia

The pink river dolphin genus *Inia*, is widely distributed in the Orinoco and Amazon basin. The Bolivian river dolphin, locally called the bufeo (*Inia boliviensis*), is an endemic species of the upper Madeira basin, geographically isolated from main stem Amazon *Inia* populations by a series of rapids between Guayaramerin, Bolivia and Porto Velho, Brazil. Despite the local endemism and being the only cetacean present in a land-locked country, the knowledge and the conservation of this species is still deficient. The bufeo is considered Vulnerable by the “Red Book of Vertebrates of Bolivia,” and declared as “Natural Heritage” by the Beni Department; however, there are no governmental actions or laws currently that explicitly protect this cetacean, and consequently the only relatively legal protection for this species is inside protected areas. This presentation includes information on the studies that have been conducted in Bolivia, aspects related to the geographic distribution of the species, its behavior, ecology, population size, highlights of the threats and possible means of protection, and current projects involved in the conservation of this charismatic species.

172 Technical Session 12: Morphology, Tuscany Ballroom 9, Monday 25 June 2012

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Unique Middle Ear Morphologies of Golden Moles: Riddled by Homoplasy

Golden moles (Chrysochloridae) show considerable diversity in middle ear morphology. Four genera (*Huetia*, *Amblysomus*, *Neamblysomus* and *Calcochloris*) have small mallei with a “freely mobile” morphology similar to those in other terrestrial mammals. Other genera show varying degrees of middle ear specialization, notably malleus head enlargement ranging from moderately inflated (*Chlorotalpa* and *Carpitalpa*) to hypertrophied and club-shaped (*Chrysochloris*, *Cryptochloris* and *Kilimatalpa*), ovoid (*Eremitalpa*) or spherical (*Chrysospalax*). The functional explanation for these enlarged ossicles is

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increased sensitivity to low-frequency seismic vibrations, probably by inertial bone conduction. Middle ear characters featured prominently in previous systematic revisions of chrysochlorids. As their nearest sister groups (Tenrecidae and Macroscelididae) do not show malleus hypertrophy, the small, “freely mobile” morphology present in some chrysochlorids has been assumed plesiomorphic. Various authors proposed a graded sequence of ossicular enlargement with divergent evolutionary trajectories warranting recognition of three subfamilies. Polarities of middle ear character states have, however, remained uncertain owing to the lack of a robust phylogeny for chrysochlorids. By optimizing middle ear characters onto a new, fully-resolved phylogeny, we show that small mallei characterize the most nested, as opposed to basal, genera. Malleus enlargement has occurred convergently in numerous clades, and is most pronounced in some basal lineages, suggesting that ossicular hypertrophy arose early during chrysochlorid diversification. Other middle ear characters (incus enlargement, development of the epitympanic recess and interbullar connection) show similar convergent trends.

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Craniodental Morphology of Treeshrews (Scandentia, Tupaiidae) and a Taxonomic Re-assessment of *Tupaia glis* and *T. moellendorffi*

Recent phylogenetic and phylogeographic results for treeshrews, squirrel-sized mammals from South and Southeast Asia, provide hypotheses of divergence that can be tested with morphometric data. *Tupaia glis* and *T. belangeri* are sisters and are most closely related to a clade uniting *T. chrysogaster* and *T. longipes*. The 2 species from the Palawan faunal region of the Philippines, *T. palawanensis* and the recently resurrected *T. moellendorffi*, are sisters that diverged very recently. *Tupaia glis* is distinguished from *T. belangeri* based on geographic distribution and mammary formula; it includes 27 synonyms, and our phylogeographic analysis identified several distinct lineages within it. We measured 22 craniodental variables on 300 skulls of *T. glis*, *T. chrysogaster*, *T. longipes*, *T. palawanensis*, and *T. moellendorffi*, including several subspecies. We analyzed these data using one-way ANOVA with the Tukey honest significant difference post hoc test and principal components analyses. *Tupaia moellendorffi moellendorffi* and *T. m. cuyonis* are somewhat distinct from *T. palawanensis*, though *T. m. busuangae* is not. *Tupaia glis* populations from Bangka Island and Sumatra, both distinct lineages in our molecular study, are also distinct morphologically, supporting the recognition of 2 additional *Tupaia* species in Indonesia. Our findings have implications for the conservation status of these species.

174** UNDERGRADUATE STUDENT RESEARCH AWARD, Technical Session 12: Morphology, Tuscany Ballroom 9, Monday 25 June 2012

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Skeletal Indicators of Ecological Specialization in Pika (*Ochotona*)

Pika species vary in behavior and life history according to their habitat and ecology, but little morphological variation has previously been documented. The aim of this study was to test if postcranial features related to burrowing are present in meadow-dwelling species and if talus-dwelling species exhibit postcranial modifications in relation to frequent leaping between rocks. To test this, the scapula, humerus, ulna, radius, pelvis, femur, tibia, and calcaneus of 15 species were studied and measured with fine-point digital calipers. Twenty-three (23) measurements were taken on 199 skeletons, and 15 indices were constructed from these measurements. Indices were compared between the 2 ecotypes using Student's *t*-test. Comparisons among ecotypes (meadow, talus, and intermediate), species, and the 3 subgenera were made using one-way ANOVA with the Tukey honest significant difference post hoc test. Multivariate results were generated using principal components analyses. Some forelimb and hind limb features proved significant in differentiating the meadow-dwelling, talus-dwelling, and intermediate forms. Many of these features are associated with burrowing or leaping in other mammals, thereby supporting the hypothesis that postcranial modifications in pika are related to their locomotor differences. This evidence

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of morphological responses to ecological specialization will be useful for reconstructing the paleobiology of extinct taxa, assessing the behavioral variability of extant species, and improving our understanding of the evolutionary history of pika.

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Morphological Variation in Pikas (Lagomorpha: Ochotonidae: *Ochotona*) of the Mesic Habitat Islands in Mongolia's Gobi Desert

Pikas were collected in Mongolia's Gobi, in islands of mesic habitat surrounded by desert. All sites included extensive mesic uplands, including the only remnant patches of forest in southern Mongolia. *Ochotona pallasii* were present in all sites; *O. dauurica* at all but 1 site; *O. alpina* at only 1 site. External morphology suggested that more species could be present than initially recognized; in particular, *O. dauurica* may be constituted by as many as 3 discrete taxa. Morphotypes appear to be distinguished by growth patterns and variances in adult sex ratios. Furthermore, rather than being singularly distributed on individual isolated mountain ranges, these morphotypes are sympatrically distributed across the Gobi ranges. In contrast, *O. pallasii* appear to be morphologically consistent across the geographic range that we sampled. Our results suggest hypotheses to be tested using distinct methods. Traditional models of speciation have invoked the Würm glaciation as driving force for speciation in *Ochotona*. Were that the case, morphological variants observed within *O. dauurica* would be isolated to single mountains, as they would have been unable to traverse the arid Gobi. Multiple glaciations occurred in Pleistocene Mongolia, including at least 7 through the Early Pleistocene. Our findings of multiple cryptic morphospecies in *Ochotona dauurica* supports earlier interglacial isolation and possibly speciation, with populations isolated during subsequent glacial periods.

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Morphological Changes in Captive-bred Black-Footed Ferrets

For 31 years black-footed ferret (*Mustela nigripes*) species survival has been dependent on a captive breeding program. Previous research suggested that morphological changes occurred in response to the captive setting. In the current study we assessed morphological changes between 2000 and 2010. We measured 10 cranial, dental, and 2 long bone traits of 37 captive-bred ferrets, born between 2000 and 2010 and inspected each skull for evidence of periodontal disease. These results were compared with a previous study of earlier specimens, in which 85 specimens from animals that died in the wild prior to captivity and 31 captive-bred specimens that died prior to 2000 were measured in the same manner. While the skulls of captive-bred ferrets that died prior to 2000 were significantly reduced in size, and changed in shape, from pre-captive specimens, animals that died in captivity after 2000 have rebounded to pre-captive size and shape. Previous research suggested that these body size changes were not indicative of inbreeding depression, but were primarily influenced by *ex situ* environmental conditions. Improved animal husbandry was the likely factor in the return of captive raised ferrets to a pre-captivity body size and shape. The increase in body size of captive ferrets was accompanied by a sharp reduction in prevalence of periodontal disease, which afflicts many captive-bred ferrets.

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Changing Fluctuating Asymmetry in Black-footed Ferrets

We assessed fluctuating asymmetry (FA), an index of developmental stress from genetic or environmental factors, in wild black-footed ferrets (*Mustela nigripes*) collected prior to a 1981 population bottleneck and in 2 groups of ferrets that were born and raised in captivity pre- and post-2000. We measured 44 skulls from captive-bred ferrets born between 2000 and 2010, examining 9 cranial and dental traits. We compared these results with measurements from an earlier study, including 85 specimens from the pre-captive population and 24 captive-bred specimens collected prior to 2000. Animals born in captivity that died prior to 2000 showed 68% less FA than pre-captive specimens. However measurements taken from specimens representing animals born after 2000 showed a significant increase in FA compared to either of the other groups. These specimens showed greater FA in 5 cranial and dental features than in the earlier captive-bred specimens, and had greater FA in 3 dental features than in pre-captive specimens. The earlier study hypothesized that the decrease in FA in post-bottleneck animals was the result of decreased environmental stress in the captive environment. That FA increased in captive animals that died after 2000 is curious, as environmental conditions had improved which increased body size and decreased periodontal disease. We hypothesize this results either from undetected environmental stressors, or genetic stress from continued inbreeding in this closed population.

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Rudimentary Pelvic Bones in Cetacea Provide Evidence of Sexual Selection

Male genitalia evolve more rapidly than any other morphology. Because morphological variance accumulates most rapidly in species with high levels of sperm competition, it is generally thought that sexual selection drives this divergence. In cetaceans, the highly reduced pelvic bones no longer function in locomotion and have lost their articulation with the vertebral column, but serve as attachment sites for muscles that control the penis. Here we tested the hypothesis that morphological divergence of pelvic bones is correlated to mating ecology. Morphometric analyses across 20 species of whales and dolphins showed that as the level of promiscuity in a species increased, so did: i) the relative size; ii) the shape complexity; iii) the degree of sexual dimorphism; and iv) the variance between the right and left pelvic bones of the same individual. Taken together, these results suggest that far from simply being a reduced structure, the pelvic bones are essentially an extension of the male genitalia and evolve in response to sexual selection. We discuss how the morphological phenomena observed here may enable males to stimulate females more effectively, and/or remove sperm from previous matings.

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Non-diffusive Spread of White-nose Syndrome Regulated by Spatial Heterogeneity and Climate

Wildlife and plant diseases can reduce biodiversity, disrupt ecosystem services and threaten human health. Emerging pathogens have displayed a variety of spatial spread patterns due to differences in host ecology, including diffusive spread from an epicenter (West Nile virus), jump dispersal on a network (foot-and-mouth disease), or a combination of these (sudden oak death). White-nose Syndrome (WNS) is a highly-pathogenic infectious disease of bats currently spreading across North America. Understanding how bat ecology influences this spread is crucial to management of infected and vulnerable populations.

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Here we show WNS spread is not diffusive but rather mediated by patchily distributed potential hibernacula and large-scale gradients in winter climate. Simulations predict rapid expansion and infection of most counties with caves in the contiguous United States by 2105 - 2106. Our findings show the unique pattern of WNS spread corresponds to ecological traits of the host and suggest hypotheses for local scale mechanisms.

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The Resistance of Big Brown Bats to White-nose Syndrome

White-nose Syndrome (WNS) greatly increases the over-winter mortality of little brown (*Myotis lucifugus*), Indiana (*Myotis sodalis*), northern (*Myotis septentrionalis*), and tricolored (*Perimyotis subflavus*) bats in eastern North America, and is caused by cutaneous infection with the fungus *Geomyces destructans*. Cutaneous infection with *G. destructans* causes bats to die during hibernation by disrupting their normal torpor patterns, which leads to the premature depletion of body fat reserves. The results of 2 published studies suggest that big brown bats (*Eptesicus fuscus*) are resistant to cutaneous infection with *G. destructans*. A field study was conducted during the winter of 2011 - 12 on the torpor patterns of free-ranging *E. fuscus* hibernating at a site where *G. destructans* is found, using radio telemetry. The torpor bouts of female big brown bats had a mean duration of 19.4 d, and a mean skin (body) temperature of 12.3° C was maintained during torpor. The mean body fat content of *E. fuscus* in February was nearly twice that of *M. lucifugus* hibernating in the same area during this period. No *E. fuscus* developed cutaneous fungal infections during hibernation. The torpor patterns of *E. fuscus* at this site were within the normal range of bout lengths and body temperatures previously reported for this species during hibernation. These findings indicate that big brown bats are resistant to WNS.

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Bats and the Spatiotemporal Origins of *Trypanosoma cruzi* and Its Relatives

Despite the public health importance of Chagas disease, there are still doubts on the evolutionary history of *T. cruzi* and its relatives, which form the *T. cruzi* clade. This clade is composed of around 15 species of trypanosomes, distributed around the globe and parasitizing volant and non-volant mammals. Two scenarios have been proposed to explain the origins of this clade: *the marsupial* and *the bat* hypotheses, which refer to the ancestral hosts for the clade, but where evidence in either hypothesis has been indecisive. Here, we analyze data of the 18S rRNA and gGAPDH genes of previously known trypanosomes and new bat trypanosomes from the New and Old Worlds. We used phylogenetic model based methods for time estimates, ancestral reconstructions, and historical biogeography. Our analyses support the bat hypothesis and a New World/Australia origin for the clade. In addition, we determine the current distribution of the group as being explained by long distance dispersal, provide a temporal hypothesis of divergences in the group, and argue favoring a recent origin for Chagas disease. These results suggest a scenario where bats were key players for a small radiation of trypanosomes, triggered by long distance dispersal of parasites and posterior host switches to terrestrial mammals.

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Biodiversity, Behavior and Pathogen Prevalence

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Biodiversity has a documented effect on several zoonotic pathogens, such that prevalence is lower in communities of greater diversity. This consequence of species diversity is known as the Dilution Effect, and while established for several pathogens, e.g., *Sin Nombre* hantavirus (SNV), the mechanism is largely unknown. SNV is hosted by deer mice (*Peromyscus maniculatus*) and is likely spread between hosts through biting and scratching. We investigated a putative mechanism for the dilution effect in this host-pathogen system. We hypothesized that high biodiversity in the rodent community alters deer mouse behaviors that affect SNV transmission. We compared host behaviors between low and high diversity sites, which varied in SNV prevalence, yet were similar in host densities. Using a novel surveillance system, behaviors were observed on 72 nights from 2009 - 2011 at nine stations consisting of foraging arenas, infrared cameras and PIT tag readers. We found significant behavioral differences between the sites. Deer mice on the more diverse site spent less time on foraging arenas, encountered and engaged in fewer fights and chases with other individuals, and spent more time being vigilant than on the low diversity site. Our findings suggest that high community diversity affects pathogen transmission by altering behaviors, such that contacts and aggression between deer mice are reduced. These results have implications for communities undergoing loss of biodiversity.

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Tenable Costs of Bayou Virus Infection in *Oryzomys palustris* (Marsh Rice Rat)

Although current dogma holds that rodent hosts infected with hantaviruses suffer no negative consequences, most studies to date have examined only adult males. A mounting body of evidence, however, suggests that females and other age classes should be examined. We found evidence supporting costs of infection from the genotype Bayou virus in wild juvenile, subadult, and female adult marsh rice rats *Oryzomys palustris* (Harlan, 1837) in terms of decreased weights, increased trap myopathy, decreased residency times, and defending increased home-range sizes by seropositive relative to seronegative conspecifics. These discoveries impel a re-examination of host-hantavirus ecology and the reigning paradigm of hantavirus infection benignity in host rodents.

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Grasshopper Mice Drive Bubonic Plague (*Yersinia pestis*) Outbreaks in Black-tailed Prairie Dogs

Highly lethal pathogens (e.g., hantaviruses, hendra virus, anthrax or plague) often appear to periodically flare into outbreaks before disappearing into long quiescent phases. A key element to their possible control and eradication is being able to understand where they persist in the latent phase and how to identify the conditions that result in sporadic epidemics or epizootics. In American grasslands, plague, caused by *Yersinia pestis*, exemplifies this quiescent-outbreak pattern, because it sporadically erupts in epizootics that decimate prairie dog (*Cynomys ludovicianus*) colonies, yet the causes of outbreaks and mechanisms for interepizootic persistence of this disease are poorly understood. Using field data on prairie community ecology, flea behavior, and plague-transmission biology, we find that plague can persist in prairie-dog colonies for prolonged periods, because host movement is highly spatially constrained. The abundance of an alternate host for disease vectors, the grasshopper mouse (*Onychomys leucogaster*), drives plague outbreaks by increasing the connectivity of the prairie dog hosts and therefore, permitting percolation of the disease throughout the primary host population. These results offer an alternative perspective on plague's ecology (i.e., disease transmission exacerbated by alternative hosts) and suggest that abundance thresholds of alternate hosts may be a key phenomenon determining outbreaks of disease in many multihost-disease systems.

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Linking Climatic Variability to State-dependent Behavior in Herbivores: A Bioenergetic Approach

Little is known about how large herbivores respond behaviorally to spatiotemporal variability in the thermal environment, or about how those responses may be influenced by nutritional condition. We evaluated effects of the thermal environment on behavior of North American elk (*Cervus elaphus*) occupying a temperate montane forest versus an arid sagebrush steppe ecosystem. We used a mechanistic biophysical model that combined detailed data on microclimate, topography, habitat, physiology, and morphology to produce estimates of metabolic costs faced by elk during spring-autumn. Energy expended on locomotion was calculated from hourly GPS locations, and nutritional condition during early spring was quantified by estimating percent ingesta-free body fat as a function of rump fat depth (measured via ultrasonography) and body mass. Our results indicate that elk occupying arid sagebrush-steppe habitat faced substantially greater demands for energy and water than those occupying forested habitat, particularly during summer months, and that the thermal environment played a much more important role in structuring daily and seasonal patterns of behavior among elk in the desert than in the forest. In addition, we documented a significant positive relationship between nutritional condition in early spring and energy expended on locomotion throughout the remainder of the year for elk in the sagebrush-steppe. These results provide important clues about how large herbivores like elk may alter their patterns of behavior in response to rising global temperatures.

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Modeling Mule Deer Habitat Selection in Nevada: Effects of Introduced Elk

Competition for spatial and temporal resources between sympatric species of ungulates has been well documented in the wildlife literature. Previous studies have examined both the spatial and dietary differences between populations of mule deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*) that have co-existed for many years; however, the short-term effects of introduced competition have not been tested. We hypothesized that mule deer would be strongly affected in both spatial distribution and selection of different habitat types after the introduction of a larger and highly gregarious competitor. We used geospatial statistics and maximum-entropy software (MAXENT) to model the effects of elk re-introduction on the distribution of mule deer using winter ranges in eastern Nevada, USA. Additionally, we quantified relative changes in snow-cover using MODIS satellite imagery. Our results suggest that deer selected habitats differently and exhibited a shift in use of space during winter, after the introduction of elk. Deer partitioned space by using different elevations, slope-aspects, and habitat types immediately after the introduction of elk. The observed results may help to evaluate the effects of future elk introductions on mule deer populations throughout the western United States.

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Space Use Patterns of Mule Deer in Response to Provision of Water and Wildfire in Mojave National Preserve

Providing permanent water to habitats that are water-limited has been assumed to provide both practical and intrinsic benefits to wildlife populations in arid regions. Recent studies attempting to delineate costs and benefits of permanent water to wildlife have been inconclusive. We investigated the effects of water provisioning and wildfire on patterns of space use by mule deer (*Odocoileus hemionus*) in 3 study areas (control, water-provided, and water-limited) of Mojave National Preserve, California, 2008 - 2011. We

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used general linear models to evaluate differences in daily movements and area of 95% and 50% utilization distributions (UDs) of mule deer in response to water provisioning. We used nonlinear mixed models to evaluate permanent water in selection of resources. Daily movements differed among study areas in, areas of the 95% and 50% UD. Daily movements were similar in the water-provided area and water-treatment area but less than the control area. UD were smaller in the water-provided area than both the water-limited area and control area. Use of water was important in models of resource selection among the 3 study areas but the use in the water-provided area was likely influenced by wildfire. Wildfire often promotes regeneration of high-quality forage, which likely contains higher content of preformed water. Our results suggest wildfire may explain, in part, the differences observed in UD of mule deer among the 3 study areas.

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Influence of Body Size on Dietary Nutrition of White-tailed Deer

A definitive reason for intra-specific forage niche partitioning still eludes ecologists. There is an inter-specific body size influence on forage selection with smaller-bodied individuals exhibiting greater mass-specific metabolic demands. Nonetheless, on an intra-specific basis, data are lacking that demonstrate smaller-bodied individuals select and consume a higher-quality diet. We examined diet quality across a range of body masses in free-ranging white-tailed deer ($n = 108$) to determine if body size influenced forage consumed. The quality of forage selected was determined by crude protein (CP) and acid detergent fiber (ADF) content of digesta in the rumen-reticulum. The proportion of CP within the digesta declined as body mass increased, while the proportion of ADF remained constant with increasing body mass. Results also indicated that in relation to body mass, the CP:ADF was greater for smaller-bodied white-tailed deer. By selecting a diet high in CP, small-bodied individuals would meet their high mass-specific metabolic demands more efficiently. Furthermore, selective foraging of small-bodied individuals might also reduce competition across body sizes foraging within the same area.

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Compensatory Growth in Southern Mule Deer

Compensatory growth is the accelerated growth of an individual, after a period of poor nutrition. Studies have demonstrated compensatory growth in ungulates at high latitudes but the compensation is incomplete. Animals demonstrating compensatory growth do not achieve the same adult size as animals that do not experience nutritional deprivation during growth. Few studies have examined compensatory growth at low latitudes where winter weather is more amenable to animal growth. This study evaluated compensatory growth in response to nutrition and competition in southern mule deer (*Odocoileus hemionus*). Over the 15-year study, the dressed weight, sex, and age of 1,286 mule deer were measured at Marine Corps Base Camp Pendleton in southern California. Models were then created to assess the effects that nutrition and competition have on dressed weights. We used Akaike Information Criteria to determine that a model, with predictors for sex, age, and precipitation best explained the variance in dressed weight ($r^2 = 0.81$). There was a positive relationship between dressed weight and precipitation in juvenile (0.5 years of age). This relationship was not present in subadults (1.5 years of age) or in adults (2.5 years of age). Our study suggests that southern mule deer juveniles, that experience a nutritionally poor year, completely compensate for the weight disparity by the sub-adult stage.

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Calf Recruitment of Shiras Moose: Effects of Climate and Plant Phenology?

Populations of Shiras moose (*Alces alces shirasi*) in most western states have experienced declines in population size during recent decades, yet the underlying causes of declines remain uncertain. Wildlife managers have expressed increasing concern for moose population trajectories, and harvest quotas have been reduced accordingly. Various hypotheses have been proposed to explain recent declines in moose abundance including: negative effects of climate change, competition or disease transmission from other ungulates, habitat disturbance, and increased predation. We explored the influence of climate and plant phenology on long-term trends in calf recruitment using herd composition data (i.e., calf:cow ratios) collected by agency personnel for 18 herd units in Wyoming, Utah, and Colorado since 1980. We extracted temperature and precipitation data from the PRISM modeling system, and NDVI data from AVHRR sensors for seasonal ranges occupied by moose. Climate warming and shifts in plant phenology were evident during the past 3 decades with increased temperatures and increased rate of spring green-up both having negative effects on calf recruitment. Moose at the southern-most edge of their range may be particularly sensitive to climate warming, but the lack of negative effects on newly reintroduced and expanding herds suggests that climate effects are likely mediated by habitat quality and animal density. We discuss the relevance of recent population declines in terms of the nutritional implications of climate and other limiting factors.

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Seasonal Ranges and Migration Routes of the Central Arctic Caribou

Migration is an important ecological phenomenon that is a critical component to the life history of many animal species. Persistence of large terrestrial migrations is being challenged by climate change, overexploitation, and anthropogenic forces that result in habitat destruction and habitat fragmentation by the creation of obstacles and barriers. In Alaska, 1 of the 4 barren ground caribou (*Rangifer tarandus*) sub-populations, the Central Arctic Herd (CAH), makes large seasonal migrations. However, very little is known about the specifics of their seasonal and migration behavior. Between 2003 and 2007, we collared and monitored 54 female caribou on the North Slope of Alaska. We collected > 126,000 locations and calculated individual seasonal ranges for each year (2003 – 2004, $n = 49$; 2004 – 2005, $n = 48$; 2005 – 2006, $n = 35$; 2006 – 2007, $n = 28$). The proportion of seasonal range overlap varied between summer and winter (AI = 5 - 21%). Fidelity of caribou to yearly summer ranges was high, as expected, but the location of their wintering ranges varied. We calculated Brownian bridges for the populations fall and spring migration yearly then created an averaged route for all 4 years to identify what parts of the landscape were repeatedly used. Retroactive preservation is a challenge for protecting large expanses of landscape; however, with the appropriate prior knowledge regarding movements, threats, and meta-population structure, protection is often possible by local decision makers.

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Great Basin Mammalian Diversity in the Context of Landscape Evolution

The Great Basin contains over 130 species of native mammals today, with higher regional species density than either the Great Plains or the eastern United States at similar latitudes. High spatial turnover from desert basins to montane slopes characterizes modern faunas with most of this turnover in rodents. We traced the evolutionary history of this diversity over the last 20 million years in relation to geological and climatic changes in the landscape. The Great Basin has experienced significant increase in both land area and topographic complexity over the last 20 million years, during which time mammalian diversity

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fluctuated considerably. The Miocene climatic optimum, a warm interval diverging from a long-term trend in global cooling, accompanied volcanism and faulting in the Great Basin. Diversification and geographic-range shifts of mammals peaked during this interval, accompanied by major changes in faunal composition. Phylogenetic analyses of both small and large mammals (e.g., sciurids, heteromyids, and canids) reveal deep branching events coincident with this time period. Later in the Miocene, mammalian diversity declined to below modern values, indicating that high diversity has not always characterized the Great Basin or the intermontane West. These patterns suggest that tectonic and climatic history have had strong effects on diversification and assembly of mammalian faunas.

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Emerging Models of Mammalian Diversification and Distributional Dynamics in and Around the Great Basin

The Great Basin, which has become a distinct and topographically complex geological province within the past 20 million years, contains relatively few mammalian species that do not also occur in one or more adjacent provinces, suggesting a pervasive history of divergence and distributional dynamics at spatial scales that include, but are not exclusive to the Great Basin. Yet, molecular phylogeographic and biogeographic research has revealed a pattern of cryptic divergence within several species that is consistent with a long history of endemism within the Great Basin proper. Alternatively, similar studies in other species suggest ephemeral occupation of the Great Basin, likely resulting from range expansion and contraction responses to Quaternary climatic oscillations. We can postulate therefore that modern mammalian assemblages within the Great Basin are comprised of a mosaic of persistent and more ephemeral species. As we build toward a general model of mammalian history in and around the Great Basin, we argue that a suite of physical, biogeographic, ecological, and evolutionary factors be considered explicitly, including: the spatio-temporal geography of source lineages; habitat associations along latitudinal, elevational, and substrate gradients; adaptive evolutionary changes; and population-level dynamics. We employ several case studies to illustrate the importance of these attributes.

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Life in an Extreme Environment: A Historical Perspective on the Influence of Temperature on the Ecology and Evolution of Woodrats

The Great Basin is one of the most climatically variable regions in the Northern Hemisphere. This results from the Basin and Range topography that can lead to extreme physiographic relief; the gradient from Badwater (-87 m) to Telescope Peak (3,392 m) changes 3,479 m within 24 km. Because the Great Basin contains such drastic elevation changes from the low valleys to the high peaks, it supports an impressive diversity of plant and animal species. Our research investigates the adaptive response of *Neotoma* (woodrats) to temperature change over the late Quaternary along one of these steep elevational and environmental gradients. We focus on a ~2000 m gradient in the Grapevine Mountains within Death Valley. By combining fieldwork on extant animals living on the valley floor with historical information from museum specimens and paleomiddens, we reconstruct the evolutionary histories of 2 species (*N. lepida* and *N. cinerea*) differing significantly in size and habitat preferences. Here, at the modern limit of their thermal and ecological thresholds, we find fluctuations in body size and range boundaries over the Holocene as climate shifted. Although *N. cinerea* are extirpated in this area, they were ubiquitous throughout the late Quaternary. Moreover, we find fundamental differences in the adaptive response of woodrats related to elevation and local microclimate. Our results illustrate the profound influence temperature has on all aspects of woodrat life history, ecology, distribution and evolution.

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Recent Landscape Changes in the Great Basin

Ecological changes over the past 150 years have been dramatic in the Great Basin, leading to concern over long-term sustainability for many of its keystone species and plant community types. We place recent changes in a longer-term context and provide a prognosis for future change. Vegetation reconstructions from fossil *Neotoma* middens show that *Juniperus* trees have experienced only modest range changes over the past 30,000 years whereas *Pinus monophylla* have shown great sensitivity to past climatic variability, with the understory component showing variable and species-specific responses. Since Euro-American settlement land-use changes have interacted with and often dominated vegetation responses to climate variability. Vegetation has become greatly altered through a progression of land uses including the introduction of widespread and intensive grazing, extensive woodland removal treatments, and past and present wood harvesting. Altered fire regimes have resulted, with nearly 30 years of increased fire frequency and size facilitating a wave of exotic plant invasions leading to near-complete landscape transformation. The outcome is a simplification of habitat structure and the plant community, from one of diverse, fine-textured mosaics to extensive near-monocultures of native and non-native plant species that are adapted to the contemporary disturbance regime. Both climate and land-use change threaten to intensify, and we discuss how these two global change factors are expected to interactively shape the structure of future Great Basin landscapes.

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Small Mammal Responses to Environmental Change: Holocene, Historical, and Modern-day Dynamics

Small mammal species and their communities have long been recognized as indicators of environmental change and ecosystem health. Here we contrast small mammal species and community responses during the Holocene (last 10,000 years) with those over the past century in the Great Basin. The climate has become warmer and drier over the past 10,000 years in the Great Basin. Today, this region is considered one of the most threatened in North America due to changes in climate as well as land use and the introduction of invasive species. Specific topics include patterns of community similarity across space and through time, as well as analysis of species-specific abundance and range dynamics, with an emphasis on granivores. Fossil data from long-term owl roosts show general stability in richness and community structure over the Holocene with species abundances shifting in response to climatic changes. In contrast, comparisons including historical and recent time intervals reveal rapid restructuring of small mammal communities, with greatest changes at sites that have experienced the most landscape modification. These comparisons suggest that modern-day land-use practices are modifying climate-based expectations for community and species dynamics and highlight the benefits of expanding the temporal scope of ecological analyses for conservation.

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Geographic Variation in the *Macaca fascicularis* Genome and Utility as a Model for Translational Research

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The cynomolgus macaque (*Macaca fascicularis*) is frequently included in transplantation research protocols and studies of drug toxicity. *M. fascicularis* is broadly distributed throughout Southeast Asia, but individuals originating (or with parents originating) from Indonesia, Malaysia, the Philippines, Cambodia or Vietnam may be found in a single captive breeding population or employed as a model for the study of the same disease. A genome-wide investigation of population-specific polymorphism in this species, especially with regard to genes of the primary immune system, would allow researchers to minimize the variance due to geographic origin in research populations and allow the identification of genetic markers associated with disease susceptibility or resistance. In this study, we used DNA extracted from 25 *M. fascicularis* individuals sampled from each of 4 geographic regions: Vietnam, Mauritius, the southern Philippines and southern Sumatra to create 4 regionally-specific pools. We then created reduced representation libraries by digesting each pooled sample with the restriction enzyme HinfI, extracting fragments between 200 - 500 bp, and sequencing the fragments on the Illumina GAI platform using a paired-end protocol. The resulting sequences were aligned to a draft sequence of the Mauritian-origin *M. fascicularis* genome. We identified approximately 3,000 novel polymorphisms and the vast majority of polymorphisms were shared among all geographic populations. We also identified both functional and non-functional population-specific polymorphisms in genes of the primary immune system.

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The Influence of Habitat and Landscape Features on Fine-scale Population Genetic Structure of a Mesocarnivore

The genetic structure of a population is a function of landscape features and individual decisions and accomplishments: the decision to disperse, where to settle and with whom to mate, followed by the successful rearing of young. An individual that settles in a habitat similar to its natal habitat may have a competitive edge over others because of past experience and familiarity, but this proclivity also may result in genetic structuring of a population in the absence of physical barriers to dispersal. We hypothesized that fine-scale genetic structure occurs in the ringtail (*Bassariscus astutus*), a generalist mesocarnivore with limited dispersal capability, and that this structure is a consequence of habitat-dependent settlement patterns. Using 15 microsatellite loci and the program GENELAND, we observed complex genetic structure in a population of ringtails inhabiting the Guadalupe Mountains of New Mexico and Texas. We then used the genetic clusters identified by GENELAND as *a priori* groups and were able to classify a high proportion of the individuals (> 87%) to their observed genetic clusters based exclusively on habitat and landscape characteristics with a discriminant function analysis. These results support our hypothesis that selection for natal habitat during dispersal and settlement can drive fine-scale genetic structure in the absence of physical barriers that could impede movement.

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Species Identification Method for New England Cottontail (*Sylvilagus transitionalis*), Eastern Cottontail (*Sylvilagus floridanus*), and Snowshoe Hare (*Lepus americanus*) Using a Mitochondrial DNA Barcode

New England cottontail (*Sylvilagus transitionalis*; NEC), a regional endemic, has been declining dramatically and exists in only 14% of its historical range. Externally, the NEC is often indistinguishable from the eastern cottontail (*S. floridanus*; EC), an introduced species. Traditionally, identifying the 2 species has relied upon differing skull characteristics. Using this approach is impractical, however, as NEC is a candidate species. Extraction of DNA from fecal material is a non-invasive technique that allows

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sampling NEC, EC, and snowshoe hare (*Lepus americanus*; SH) over large geographical areas with minimal cost. A restriction enzyme technique has been published that distinguishes among species based on the number of bands produced from a 4 nucleotide cut site window within the control region of the mitochondrial genome; this technique assumes that variation within species does not interrupt cut patterns. In 2011, we sequenced over 1,000 fecal and tissue samples from Connecticut, Massachusetts, New Hampshire, and Rhode Island. We identified 12 NEC, 1 SH, and 81 EC haplotypes. All haplotypes were analyzed using the restriction enzyme technique. We found several instances of conflicting cut sites between haplotypes and previously published work. To provide an unambiguous and reliable identification method, we created a DNA barcode for the mitochondrial control region and identified 56 diagnostic nucleotides. We propose using a DNA barcode system for species identification that is more reliable than the restriction enzyme method.

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Population Genetics of Golden Mice (*Ochrotomys nuttalli*) and White-footed Mice (*Peromyscus leucopus*) in Southern Illinois

Golden mice (*Ochrotomys nuttalli*) are generally an elusive and rare species throughout their geographic range in the southeastern United States. They are considered to be habitat specialists that prefer dense understory consisting of shrubs and vines. It is hypothesized that habitat specialists like golden mice have lower genetic diversity and are more genetically subdivided compared to habitat generalists such as sympatric white-footed mice (*Peromyscus leucopus*). We collected tissue samples from 6 golden mouse and white-footed mouse populations throughout southern Illinois. We analyzed 9 and 4 microsatellite markers as well as 593 and 623 bps of the mitochondrial control region for golden mice and white-footed mice, respectively, to characterize and compare the genetic diversity and population structure of both species. Overall haplotype diversity and nucleotide diversity was lower in golden mice (0.58 and 0.21%, respectively) compared to white footed mice (0.96 and 0.92%). Results of an AMOVA using the mitochondrial control region revealed more subdivision among the 6 populations of golden mice ($\Phi_{st} = 0.154$, $P < 0.001$) than among the 6 populations of white-footed mice ($\Phi_{st} = 0.062$, $P = 0.002$). Microsatellite loci showed a similar trend with overall F_{ST} values of 0.043 ($P < 0.001$) for golden mice and 0.005 ($P = 0.34$) for white-footed mice. Results of Bayesian clustering methods and assignment tests will be discussed.

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The Use of Next Generation Sequencing in the Study of Population Genetics of a Hybrid Zone of *Neotoma*

Next-generation sequencing has the potential to provide a more cost-effective and time-efficient way to generate genetic data. Several techniques show promise in the study of phylogenetic, phylogeographic, and population genetic relationships among non-model organisms, but sample preparation and bioinformatics remain problematic in the study of such organisms. We used a modified restriction digest method to reduce genomic complexity and massively multiplex barcoded samples. We sequenced 70 million reads from 736 samples collected from across a hybrid zone between *Neotoma macrotis* and *N. fuscipes*. Number of reads varied greatly among individuals. Pre-packaged alignment programs failed to align our data or identify orthologous loci, so we developed a programming pipeline that aligned individual reads, created a pseudo-reference genome, and prepared data for downstream analyses. Useful variation, identifiable SNPs, and other analyses will be discussed.

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Multilocus Species Delimitation Reveals Pleistocene Speciation in Javanese Shrews (*Crocidura*)

The shrews of Java Island, in Indonesia, have a tortuous taxonomic history involving small sample sizes, typographical errors, and a failure to designate type specimens. The most recent revision recognized only 3 species (*Crocidura brunnea*, *C. monticola*, and *C. orientalis*) among the 8 published names. We use recent collections from Java and sequences of 9 independently evolving loci to test these taxonomic hypotheses. Our results indicate that Javan *C. monticola* includes 2 closely related sister species, referable to *C. maxi* and *C. monticola*. Genetic data also support the recognition of *C. brunnea* and *C. orientalis*. In the tradition of naming shrews based on single specimens, we note evidence that a single specimen from West Java represents a 5th species endemic to the island. The speciation event that produced the sympatric *C. maxi* and *C. monticola* appears to have happened recently, around 200 Kya.

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Microsatellite-DNA Evidence Population Structure in the Endangered Laotian Rock-Rat (*Laonastes aenigmamus*)

The Laotian rock rat, locally known as the kha-nyou (*Laonastes aenigmamus*), is considered a living fossil due the ancient divergence of its lineage within the order Rodentia. Although there is scarce information on the species boundaries, its distribution is mainly known from Southeast Asia, more specifically from a karstic region in Laos Republic. The affinity of *Laonastes* to karstic-uplifts suggests that its populations will show high population structure and potentially substantial genetic differentiation across their known distributional range. Here we developed and tested microsatellite markers *de novo*, and used microsatellite DNA variation to assess the population structure of *Laonastes* along a geographic range in Central Laos. We found evidence that indicates the presence of 3 major clusters or populations along the surveyed range and some degree of admixture among populations. These data are of importance for future explorations of the species boundaries. The microsatellite markers we developed offer a venue for studying demographic aspects of this threatened species.

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The Impact of Harvesting and Reintroductions on the Genetic Diversity of the American Beaver (*Castor canadensis*)

The American beaver is considered an ecosystem engineer due to the modification this mammal does to its environment. However, in the 1600's the beaver was also considered an important fur-trading item that resulted in the overexploitation and near eradication of the species in the late 1800's. By the beginning of the 20th century pelt traders and biologist conducted translocations and reintroductions to restore beaver populations. The purpose of this study was to assess if there was an impact of overexploitation and different management actions on the genetic diversity of the beaver in 7 areas across North America. We used 9 microsatellite loci to assess genetic diversity measures of 153 individuals from Alabama, Arizona, Maine, Minnesota, South Carolina, Texas, and Wisconsin. Our results show high genetic diversity (average observed heterozygosity was 0.613, and expected heterozygosity was 0.740), and high genetic differentiation (average F_{ST} = 0.128, 95% CI from 0.093 to 0.182; average R_{ST} = 0.199, $P < 0.001$) across populations. No evidence of past population bottlenecks or isolation by distance could be detected.

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Despite the fact that beavers demonstrate a high genetic diversity in neutral markers, we recommend assessment of genetic diversity of other parts of the genome of this species, and that the substantial differentiation found among the populations studied be considered for future management and conservation plans of the beaver.

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Exploring Hypotheses for Diet Displacement in Woodrats in Secondary Contact in Coastal California

When closely related species come into secondary contact, similar ecologies may result in competition for food. Selection to reduce competition may favor displacement in diet that arises from differences in foraging abilities, or from behavioral dominance (territoriality), or a combination of these processes. We looked for evidence of such displacement in a contact zone between the woodrats *Neotoma fuscipes* and *N. macrotis* in the coast range of California. Using stable isotopes isolated from hair, we compared the dietary signatures across the contact zone, from allopatry (Nf) to sympatry to allopatry (Nm). Across the same transect we quantified the vegetative community to detect any differences in food resources. We also conducted behavioral trials to assess differences in dominance that may enable one species to exclude the other from a preferred resource. Finally, we assessed trends in body size, a correlate of dominance in *Neotoma*, across the contact zone. Dietary signatures based on isotopic carbon differed between the species in sympatry compared to allopatry but isotopic nitrogen showed the opposite pattern. The vegetative community was more dense and diverse in sympatry than in allopatry. *N. fuscipes* was more aggressive in trials than *N. macrotis*, correlating with its larger body size. Our study indicates that the 2 species differ in their diets when in contact, potentially resulting in part from interference competition between the species.

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Resource Partitioning of Sympatric Shrew Species in the Rocky Mountains of Colorado

Shrew species are commonly observed in sympatry and are thought to minimize competition either by differential microhabitat use or by consumption of differential prey sizes. Here we examine factors indicating such differences in ecological niches of sympatric shrews in the southern Rocky Mountains during the summers of 2010 and 2011. Data on shrew distributions and insect abundance was assessed using 800 pitfall traps, paired with 1,200 vegetation surveys from 20 sites along 3 elevational gradients in Colorado. Seven shrew species were detected (*Sorex cinereus*, *S. monticolus*, *S. hoyi*, *S. nanus*, *S. merriami*, and *Notiosorex crawfordi*), although only the first 4 listed were captured in sufficient numbers for inclusion in analyses. Our results suggest that sympatric shrew species partition resources based largely on habitat factors, particularly among habitat types within a site and specifically indicating differential occurrence with bare ground, tree canopy coverage, and tree size (DBH). *Sorex cinereus* and *S. monticolus* were the most abundant species, but differed in elevational distribution, microhabitat use, and coincident insect biomass, particularly biomass of Orthoptera (grasshoppers). *Sorex nanus* was found more than expected in rocky habitat, and *S. hoyi* was only found at high elevations. Overall, the Rocky Mountain distributions of the 4 common shrews could be reliably predicted from elevation, habitat type, and microhabitat characteristics as well as by differential abundances of insect prey.

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Dietary Resource Partitioning of the Southern Flying Squirrel (*Glaucomys volans*)

There is a paucity of information regarding the feeding habits of the southern flying squirrel, *Glaucomys volans*. We investigated dietary preference of *G. volans* by computing the mean daily rate of ingested energy. Five food resources were provided to 12 southern flying squirrels (8 male, 4 female) for 5 consecutive days. Individuals were contained in separate experimental mesocosm tanks. Each individual was provided with fruits of *Cornus florida*; acorns of *Quercus alba*, *Q. nigra*, and *Q. velutina*; and nuts of *Carya glabra*. The preferred food of *G. volans* was *Q. alba*, averaging $0.93 \text{ Kcal} \cdot \text{g live wt}^{-1} \cdot \text{day}^{-1}$. The average rate of ingestion for the southern flying squirrel was $1.87 \text{ Kcal} \cdot \text{g live wt}^{-1} \cdot \text{day}^{-1}$; thus *Q. alba* constituted 49.7% of their mean daily diet. *Q. velutina* and *Q. nigra* were ranked next in dietary preference. Southern flying squirrels consumed $0.31 \text{ Kcal} \cdot \text{g live wt}^{-1} \cdot \text{day}^{-1}$ of *Q. velutina* and $0.30 \text{ Kcal} \cdot \text{g live wt}^{-1} \cdot \text{day}^{-1}$ of *Q. nigra*. The least preferred food types were the nuts of *C. glabra* and fruits of *C. florida*, averaging $0.16 \text{ Kcal} \cdot \text{g live wt}^{-1} \cdot \text{day}^{-1}$ and $0.14 \text{ Kcal} \cdot \text{g live wt}^{-1} \cdot \text{day}^{-1}$, respectively. Findings suggest that survivorship of *G. volans* relates to abundance and diversity of *Quercus* acorns.

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Food Habits of Yellow-throated Marten in the Temperate Forest, Korea

Little is known about the diet of yellow-throated marten (*Martes flavigula*) in temperate regions. Information on the diet of the yellow-throated marten is vital to understanding the habitat requirements of populations of this species. The diet of yellow-throated marten in Jirisan National Park, Korea was investigated by scat analysis. The scats were collected during 2009 to 2011. The dry weight of prey items found in 414 scat samples included: 49.4% plant material, 29.1% mammals, 11.7% birds, 6.2% honey, 2.4% insects, and 1.1% amphibians and reptiles. Bower actinidia (*Actinidia arguta*) and date plum (*Diospyros lotus*) were especially important throughout autumn and winter. Martens ate mammals in all seasons, with a peak in winter, and also ate Chinese water deer (*Hydropotes inermis*), roe deer (*Capreolus pygargus*), and wild boar (*Sus scrofa*). Food niche breadth was broader in summer (BS = 0.73) than in winter (BS = 0.39). Food habits indicate that yellow-throated martens are opportunistic foragers, feeding on variety groups and species. The maintenance of forest with good fruiting species diversity is desirable for yellow-throated marten conservation.

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Environmental Buffering and Plasticity in Vital Rates Alters Demographic Response to Climate Variability

Environmental buffering—low variability in the most influential vital rates—is expected to limit the effect of climate variability on population growth rate. Vital rate plasticity also can make populations less vulnerable to climate change in a predictable environment. We used simulation models, parameterized from a long-term data set, to test these predictions in 2 populations of common small mammals: *Sigmodon hispidus* and *Microtus ochrogaster*. We linked structured matrix models to climate projections of 2 common Global Circulation Models (GCM; A1B and B1). We reduced environmental buffering by increasing the variance associated with adult survival by 10% and removed plasticity in reproduction by setting reproduction equal to the long-term average reproduction. Models included current patterns of climate variability and autocorrelation and those projected by both CGMs. In all cases increased variability in adult survival reduced the population growth rate. However, plasticity in reproduction resulted in higher population growth rates only in models with current patterns of environmental autocorrelation. The population growth rate was maximized by constant reproduction with projected change in climate

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autocorrelation. Our results suggest that environmental buffering does reduce the effects of climate change on populations but also that change in climate autocorrelation negatively affects the population response to a warming climate.

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Impact of Habitat Degradation on Southern Idaho Ground Squirrel (*Urocyonotellus endemicus*) Demography

Southern Idaho ground squirrels (*Urocyonotellus endemicus*) have a small geographic range in just 3 counties in southwestern Idaho. Their habitat is degraded rangeland usually dominated by invasive plants and fragmented by agriculture. We wished to determine if habitat degradation was negatively affecting southern Idaho ground squirrel populations. We monitored 7 local populations for 3 years in habitats of varying quality to determine numbers of squirrels in each age and gender class as well as reproductive and survival rates. Body mass and body fat were monitored throughout the active season. Reproductive rates were similar to other *Urocyonotellus* species, but *U. endemicus* juveniles had substantially lower survival rates (similar to congeneric rates during droughts and population declines). Overall, persistence was not sufficient to maintain long-term viability of isolated local populations. Juvenile female survival had the largest influence on population viability, and it was correlated with pre-hibernation body mass. Population persistence was highest at sites with fewer invasive grasses and lower yearly fluctuation in body mass or fat. Emergence body condition was highest in habitats with the most forbs. Forbs were also positively correlated with higher reproductive rates and survival rates of juvenile males. Enhancing habitat quality and limiting invasive annual grasses should be a high priority in any attempt to reverse the long-term decline in the southern Idaho ground squirrel.

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The Effects of Reproductive State on Dietary Shifts Toward Insectivory in *Artibeus*

Frugivory in many neotropical bats is physiologically demanding. Because fruit are nitrogen (N) poor, during reproduction frugivorous bats are likely N-limited. Insects provide a good source of protein and many otherwise frugivorous bats include insects in their diet facultatively. However, it has been unclear if this incorporation is seasonally or physiologically determined. We expected females of *Artibeus jamaicensis*, the Jamaican fruit bat, and the closely related Mexican endemic species *Artibeus hirsutus*, the hairy tailed fruit bat to supplement their frugivorous diets with insects during the nitrogen demanding periods of late stage pregnancy and lactation. To test this, we measured naturally occurring stable isotopes of nitrogen ($\delta^{15}\text{N}$) to examine the roles of fruit vs. insects in the diets of these two species. Because isotopic composition of an animal's tissues reflects its diet we evaluated $\delta^{15}\text{N}$ of plasma to assess trophic level differences among individuals of various reproductive states. Our data indicate that males exhibited the narrowest dietary breadth and lactating females the greatest. The highest insect usages were noted in pregnant females. Our isotopic data combined with seed and fecal samples from under roosts indicate that insects are likely a valuable source of nitrogen during reproduction. We discuss individual dietary differences observed and the importance of this variation as well as the prevalence of dietary supplementation with insects among frugivorous bats in general.

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A Comparison of Density Estimation Techniques for Black Bears and Coyotes

The Newfoundland woodland caribou (*Rangifer tarandus*) population has decreased by greater than 66% since 1996; habitat loss and overgrazing are two probable causes, but current recruitment is low due to high calf predation by black bears (*Ursus americanus*) and invasive coyotes (*Canis latrans*). To help understand predator-prey dynamics, we are evaluating the population density of these 2 species during the calving season. In 2009 and 2010, we collected 1,549 hair and scat samples across 2 study areas using non-invasive genetic sampling. Black bears were sampled using baited hair snags across ~550 km² in central Newfoundland, and scat detecting dogs were used to locate black bear and coyote scats across ~2,000 km² in Newfoundland's Northern Peninsula. We designed a mitochondrial DNA species identification test to distinguish among black bears, coyotes, lynx (*Lynx canadensis*), and red foxes (*Vulpes vulpes*). For individual identification of black bears and coyotes, we used 11 and 9 microsatellite loci. We found 112 unique black bears using hair snags and 77 unique black bears and 114 unique coyotes using scat-detecting dogs. Population sizes estimated in program MARK and program CAPWIRE will be converted to densities using ad-hoc methods and compared to density estimates from program DENSITY. Establishing an accurate estimate of Newfoundland's predator population densities will allow managers to make informed decisions in a complex multi-predator, multi-prey system.

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The Use of Resource and Activity Hotspot Mapping to Predict Bat-Wind Turbine Interactions

Wind farms provide an important source of green energy. However, with this rapidly growing industry are concerns about their impacts on wildlife, particularly tree-dwelling bats. Thus, there is a real need for tools that aid site selection for installation, and at existing wind resources help develop effective curtailment strategies that alleviate bat-turbine interactions. To address this, we conducted resource and activity mapping surveys for 6 bat species found at Wolf Ridge Wind, LLC in north central Texas. In resource mapping, we undertook ground truth surveys to locate potential roost opportunities, foraging sites, water sources and commuting routes for each species. In activity mapping, we carried out passive and active acoustic surveys, mist netting and roost emergence surveys to map the activities and movements of each species across the wind farm. We then compared both resource and activity maps to fatality data collected from ongoing fatality searches conducted since 2009. Our surveys revealed that among 4 species, resource, activity and fatality hotspots correlated, suggesting that resource mapping for such species could be used to aid site selection for future wind resource installments. However, approximately 40% of eastern red and hoary bat fatalities did not correspond with resource availability or activity. We found that fatality hotspots were consistent across all years, suggesting that 1) these represent migrants and 2) frequently used migration routes may be identifiable.

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Ecological Impacts of Wind Farms on Mammalian Mesocarnivores

Wind energy is among the most rapidly growing industries in the United States, with support for development coming from both state and federal governments. While the industry strives to be environmentally friendly, the addition of infrastructure associated with wind farms alters ecosystems in novel ways. Numerous studies have shown the impacts wind turbines have on bird and bat species

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mortality; however, far less attention has been given to responses of terrestrial organisms to wind facilities. Mammalian mesocarnivores are model organisms to document the alteration of communities surrounding wind turbines as they respond to addition of turbines and human activity, addition and improvement of roadways as movement corridors, and increases in turbine-induced carrion. In October of 2011, a yearlong study was established surrounding the Central Plains Wind Facility in western Kansas to document patterns associated with the occupancy of mammalian mesocarnivores within turbine and turbine-free habitats. We placed 34 scent-baited trail cameras among turbine and control habitats, with a subset randomly placed along roadways. We recorded mesocarnivores detection histories during 28-day survey periods along with habitat covariates by using PRESENCE 4.1. Coyote (*Canis latrans*) and swift fox (*Vulpes velox*) were the most abundant mesocarnivores detected with a trap success around 3%. Coyote occupancy was impacted negatively by roadways and turbines, while swift fox occupancy was associated positively to turbines.

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When Bunnies go to College: Habitat and Diet Selection of Urban Cottontail Rabbits

Urban cottontails can act as model animals for examining many ecological questions. We tested diet and habitat selection of eastern cottontails (*Sylvilagus floridanus*) on the campuses of the University of Illinois at Chicago and Lawrence University with artificial food patches. Using giving up density (GUD), where lower GUD = higher foraging intensity, we quantified: 1) diet selection among pellets of varying nutritional quality; 2) diet selection among pellets treated with water or secondary compounds; and 3) habitat selection among bush-open microhabitats. We predicted that GUDs would vary as follows: for protein, $GUD_{low} > GUD_{medium} > GUD_{high}$; for treated pellets, $GUD_{control} < GUD_{quebracho\ tannin} = GUD_{tannic\ acid} < GUD_{oxalic\ acid}$; for microhabitat distances from cover, $GUD_{0m} < GUD_{3m} < GUD_{6m}$. Depending upon the experiment, the cottontails rejected the high or medium protein pellets, each time preferring the other 2 pellets roughly equally. The order of preference of treated pellets appeared to be $GUD_{control} = GUD_{quebracho\ tannin} = GUD_{tannic\ acid} \leq GUD_{oxalic\ acid}$. The order for distance from cover was $GUD_{0m} \leq GUD_{3m} \leq GUD_{6m}$. We conclude that cottontails use criteria beyond protein in diet selection, differentially respond to secondary compounds in their food, and prefer to forage under cover, especially continuous shrubs.

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Do Urban Coyotes Adjust to Roads and Traffic? Evidence from Survival and Cause-specific Mortality

Coyotes (*Canis latrans*) have recently become established as top carnivores in many metropolitan areas across North America. We use information from survival and cause-specific mortality to evaluate the possibility that coyotes reduce their risk from vehicle-related mortality, and this contributes to their success in urban landscapes. Specifically, we determine estimates of mortality related to roads, and test the hypothesis that risk increases with road density. We monitored survival of 181 radio-collared coyotes residing within the Chicago, Illinois, metropolitan area during 2000 - 2008. Annual survival ranged between 0.58 for subadult females and 0.70 for adult females; however, there were no significant (all P 's > 0.1) differences between demographic groups. We recorded 68 mortalities, of which 62% died from collisions with vehicles, 18% were shot, 10% died from mange, and 10% died from other causes. Patterns of survival in this heavily-urbanized landscape were higher than reported survival for rural coyotes, especially for juveniles. When survival models with covariates were compared, road density in the home range contributed minimally to data fit, especially when the analysis was restricted to only animals with vehicle-related mortality. These results illustrate the importance of roads for the success of synanthropic

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wildlife species, and the ability of coyotes to adjust to traffic likely contributes to their success in urban areas.

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Comparison of Managed Versus Unmanaged Free-roaming Cat Populations

Throughout the United States, estimates for domestic cat (*Felis catus*) populations have reached over 100 million individuals. Many lost or abandoned cats will revert to living outdoors as free-roaming or feral individuals. To try and control the growing densities of free-roaming cats, trap-neuter-release (TNR) programs have been implemented across the United States. However, conservationists question the effectiveness of TNR programs. The objectives of our study were to determine population densities and survival rates of free-roaming cats in 4 locations around the city of Hays, Kansas. Starting in September 2011, free-roaming cats were trapped and marked with hair dye at 2 sites managed by TNR, and 2 unmanaged sites. We obtained monthly population estimates and we compared these among the sites. Preliminary results showed population changes across seasons in the unmanaged sites, but conflicting results with the TNR sites. The unmanaged sites showed expected increases in the spring and a decrease in population through the winter months. The TNR site with a high neuter rate remained relatively constant throughout the seasons whereas the TNR site with a poor neuter rate showed a slight decrease in winter months and a sharp population increase during the spring. These data suggest TNR programs will need high trap success and proportion of animals neutered to prevent population increases and an unknown amount of time until these populations are locally extinct.

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Short-term Response of Pygmy Rabbits (*Brachylagus idahoensis*) to Construction of the Ruby Pipeline in Northern Utah

The installation of a large-scale natural gas pipeline (Ruby Pipeline) in northern Utah provided a unique opportunity to assess short-term response of pygmy rabbits (*Brachylagus idahoensis*) to construction-associated habitat manipulation and disturbance. Pygmy rabbits are sagebrush obligates that rely on sagebrush for food and cover during all phases of their life cycle and may be particularly sensitive to such disturbance. We captured and radio-marked pygmy rabbits at burrows within the pipeline right of way (ROW; $n = 31$) prior to construction and were able to monitor before and after survival and movements. We also radio-marked rabbits at an adjacent reference area ($n = 24$) where no construction activity occurred. There was no direct mortality from construction activities and overall annual survival rates were not different between the ROW and reference sites. The combined annual survival rate for both ROW and reference area was ($S = 0.062$; 95% CI $\pm 0.034 - 0.112$). We found that survival was lowest during the winter months and the breeding season. Pygmy rabbits captured in the disturbed area moved core areas away from the ROW and we detected only a few occasions where radio-marked pygmy rabbits crossed the ROW suggesting that the cleared area served as a barrier to movement. Our findings indicate that direct mortality from pipeline construction projects is likely minimal, but that indirect effects such as fragmentation of useable habitat occurred.

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Wildlife Safety Crossings in Northeastern Nevada; A Story of Success

Declines in mule deer (*Odocoileus hemionus*) populations throughout Nevada and high rates of deer-vehicle collisions during migratory periods have caused the Nevada Department of Wildlife, University of Nevada Reno, and Nevada Department of Transportation to collaborate efforts to reduce deer-vehicle collisions, restore habitat connectivity, and decrease human injury. Two overpasses and 3 underpasses were constructed on U.S. Highway 93 between Wells and Contact, Nevada; an area shown to have high rates of deer-vehicle collisions. Our objectives were to investigate use of the wildlife safety crossings by mule deer and other species of wildlife and determine effectiveness of the crossings for reducing deer-vehicle collisions during the 1st 4 migrations the safety crossings were available for use. Daily mortality counts were conducted within the study site and wildlife cameras were used to document species use of the wildlife safety crossings and movement around the exclusionary fence ends. We collected more than 250,000 still photos of mule deer and other species using the crossing structures. The 2 overpasses were visited by the largest number of individuals, had the fewest retractions, and had a higher percentage of successful crossings when compared to the 3 underpasses. This research provides information that will be used to create more effective wildlife safety crossings to further reduce wildlife-vehicle collisions, increase public safety, reduce wildlife mortalities, and create sustainable wildlife corridors through fragmented landscapes.

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Habitat Use by *Myotis yumanensis* and *Tadarida brasiliensis mexicana* in South San Francisco Bay Wetlands: An Acoustic Study

The purposes of this study were to determine whether Yuma myotis (*Myotis yumanensis*) and Mexican free-tailed bats (*Tadarida brasiliensis mexicana*) differentiate between open water and marsh within saline and brackish habitats and to examine whether climatic factors are correlated with general activity and tidal height with foraging of the 2 species. I randomly deployed 2 Anabat II[®] detectors each survey night in open salt water and salt marsh, or, open brackish water and brackish marsh over 30 survey nights in Alviso, California. I identified *M. yumanensis* and *T. b. mexicana* echolocation sequences within each of the 4 habitats and feeding buzzes in open brackish water and brackish marsh. Additionally, air temperature and wind speed per hour, % moonlight visibility per survey night, and tidal height at 15-min intervals were logged. I recorded 1,896 sequences, 845 from *M. yumanensis* and 983 from *T. b. mexicana*. Both species preferred open water over marsh for saline but not for brackish habitat. Although *T. b. mexicana* call frequency increased with higher air temperature and lower moonlight visibility, presence/absence of echolocation calls from the 2 species could not be predicted from the 3 climatic variables. There was no relationship between mean tidal height and *M. yumanensis* and *T. b. mexicana* feeding buzzes in brackish habitats. The results should provide important information to enhance bat conservation in coastal wetlands.

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The Influence of Late Pleistocene Climate on Populations of Greater Antillean Long-tongued Bat (*Monophyllus redmani*)

Recent studies have addressed the probability of current gene-flow among Greater Antillean bat populations. However, the ability to infer the historical events that caused changes in these bat populations is essential to understand range-wide phylogeographic patterns. Late Pleistocene climate change is characterized by over 11 glaciation events that affected the size and shape of West Indian islands. These glacial cycles likely influenced the historical demographic processes that produced the phylogeographic signature observed in today's Greater Antillean populations of bats. We used distribution models at the population level (PDM) projected at current and Last Glacial Maximum (LGM) climate to develop *a priori* hypotheses that take into account historical population structure of the West Indian

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endemic nectarivorous bat *Monophyllus redmani*. These hypotheses were tested using coalescent simulations analyzing 5 population level summary statistics. Preliminary results suggest that populations of *M. redmani* on Puerto Rico and Dominican Republic diverged around 700 ky, which coincides with the onset of Late Pleistocene glacial cycles. Additional models remain to be tested to fully understand the genetic patterns shaping *M. redmani* populations. However, the coupling of PDM with coalescent simulations allows us to evaluate patterns of genetic variation under alternative historical scenarios that contribute to the contemporary phylogeographic patterns observed in *M. redmani*.

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Reconstructing the Evolutionary History of an Endangered Subspecies Across the Changing Landscape of the Great Central Valley of California

Identifying historic patterns of population genetic diversity and connectivity is a primary challenge in efforts to re-establish the processes that have generated and maintained genetic variation across natural landscapes. This challenge is even greater in altered landscapes where population extinctions and demographic fluctuations may have substantially altered historic patterns. We seek to reconstruct historic patterns of diversity and connectivity in an endangered subspecies of woodrat that now occupies only 1 - 2 remnant locations within the highly altered landscape of the Great Central Valley of California. We examine patterns of diversity and connectivity using 14 microsatellite loci and sequence data from a mitochondrial locus and a nuclear intron. We reconstruct temporal change in habitat availability to establish several historical scenarios that could have led to contemporary patterns of diversity, and use an approximate Bayesian computation approach to test which of these scenarios is most consistent with our observed data. We find that the Central Valley populations harbor unique genetic variation coupled with a history of admixture between the well-differentiated species of woodrats that are currently restricted to the woodlands flanking the Valley. Our simulations also show that certain commonly used analytical approaches may fail to recover a history of admixture when populations have experienced severe bottlenecks. Our study shows the strength of combining empirical and simulation analyses to recover the history of populations occupying highly altered landscapes.

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Understanding Origin and Evolution of Rodents in the Mesoamerican Highlands

The distribution of several terrestrial small mammals in Mesoamerica follows that of the montane forest, conforming to naturally occurring discontinuous highlands from southern México to Nicaragua. One of the hypotheses describing this diversification infers that differentiation within Mesoamerica may be attributable to separate mountain systems providing a disjunctive, cool-adapted, highland environment in a tropical ecosystem. This scenario suggests that different taxa adapted to changes in climate during the past resulting in a considerable impact on phylogeographic patterns within and among closely related species. The goal of this study is to use inferred phylogeographic relationships, genetic differentiation, and divergence times of small mammals to identify broad-scale historical events that have shaped the evolutionary history of Mesoamerican highland taxa. The species used to test this hypothesis are *Baiomys musculus*, *Nyctomys sumichrasti*, *Reithrodontomys mexicanus*, *Reithrodontomys sumichrasti*, *Peromyscus beatae*, *Peromyscus mexicanus*, *Peromyscus oaxacensis*, and *Neotoma isthmica*. Preliminary results show that these species exhibit geographical partition that suggests that the Isthmus of Tehuantepec is a barrier for distribution and speciation patterns. However taxa such as *Baiomys musculus* and *Nyctomys sumichrasti* show patterns that do not correspond to the Tehuantepec division noticed for other taxa, probably due to the lowland distributional pattern of the later taxa. More data and

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taxa are required to support hypotheses of expansion of distribution and colonization followed by speciation of cricetid rodents on Mesoamerica.

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A Novel Biogeographic Pattern for a Holarctic Mammal Revealed by the Range-wide Phylogeography of *Clethrionomys rutilus* (Rodentia: Arvicolinae)

The effects of glacial cycles, demographic history, and geographic distribution are paramount to understanding contemporary genetic diversity in Arctic species. We use a multilocus phylogeographic approach (1 mtDNA, 3 nuclear genes) to investigate genetic variation in a Holarctic mammal, northern red-backed voles (*Clethrionomys rutilus*), in response to environmental change. Sampling includes over 250 individuals from nearly 100 localities. This species is 1 of only 14 mammal species found in both Eurasia and North America and is strongly associated with boreal forest habitat, one of the most widespread ecosystems in the world and one predicted to be strongly affected by the current climate change. We present a comprehensive phylogeographic assessment using samples from throughout the range, a species tree approach for integration of multiple lines of genetic evidence, and Bayesian techniques for estimating demographic variation to elucidate the biogeographic and demographic history of northern red-backed voles. Our results identify 5 separate lineages whose relationships do not match existing simplistic models of population divergence that typically associate geographic proximity with relatedness among lineages. The dynamic geographic, genealogic, and demographic history of this Holarctic mammal provides insight into the biogeography of the Arctic and emphasizes the importance of comprehensive phylogeographic sampling. This work also provides critical foundational knowledge for addressing taxonomic issues within the genus *Clethrionomys* (e.g., interspecific hybridization and suspected paraphyly with at least 2 other genera).

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What's Driving Phylogeographic Patterns in the Desert Kangaroo Rat (*Dipodomys deserti*)?

The Desert Kangaroo Rat, *Dipodomys deserti*, is a sand dune specialist distributed within the Sonoran, Mojave, and Great Basin deserts. It is one of the largest species of kangaroo rat and represents a basal clade on the *Dipodomys* phylogeny. We sampled over 300 individuals of *D. deserti* across the entire species' range and evaluated phylogeographic structure of mitochondrial DNA sequences. We derived indices of genetic variation among- and diversity within populations and interpolated them across landscape. We assessed what environmental variables influence phylogeographic patterns in *D. deserti*. In particular, we correlated the genetic patterns of *D. deserti* with estimates of patch size, habitat stability, and habitat suitability. We also compared phylogeographic patterns of *D. deserti* with those of a sympatrically distributed congener, *D. merriami*. We tested a prediction that the ecological differences between *D. deserti*, a habitat specialist, and *D. merriami*, a habitat generalist, reflect differences in their responses to Pleistocene climatic oscillations.

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Doubling Diversity: A Cautionary Tale from Luzon Island, Philippines

In 2000, we began intensive surveys and phylogenetic studies of mammals on Luzon Island, Philippines, to determine how many non-volant mammals are present. Luzon is a topographically and geologically complex tropical oceanic island of 104,000 km². Our studies were guided by a simple, predictive model:

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areas of highland habitat separated by intervening lowland habitat constitute unique areas of endemism. We have discovered 27 new species, increasing the total by 96%, from 28 to 55. All of the newly discovered species are members of 2 endemic clades of murids that have undergone extensive diversification. The bulk of the new species come from five previously unknown centers of endemism. About 90% of the Luzon endemic species occur in only one center of endemism. We suggest that on other large, complex oceanic islands, 1) the diversity of even “well-known” taxa may be substantially underestimated; 2) the number of local centers of endemism may be far greater than currently estimated; 3) a large percentage of species may have smaller areas of distribution than a single island; 4) mammalian communities are highly co-evolved assemblages composed mostly of species in endemic clades that have evolved on a single island; 5) priorities for conservation based on species richness may underestimate the importance of tropical oceanic islands; and 6) protected area systems may often fail to include significant numbers of locally endemic species.

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Body Size, Activity Times, and Geographic Location are Strongly Associated With Mammalian Responses to Anthropogenic Climate Change

Mammals are predicted to experience population extirpations, range contractions, range shifts, and changes in abundance, phenology, morphology, and genetics due to recent anthropogenic climate change. Among the 120 populations of 73 North American mammals measured the predicted responses are concentrated in populations at high latitudes, mid to high elevations, and at lower and upper portions of geographic ranges. Responses linked to extinction risk are concentrated in mountain top populations and in the southern portion of species' geographic ranges. Surprisingly, predicted responses are much more likely in relatively large (> 100 g), diurnal mammals with medium to large ranges (> 1 million km²). We conclude that geographic predictions about mammalian climate change responses are robust, but that body size, activity times, and thus behavioral interactions with climate have unanticipated consequences on mammalian responses to rapid climate change.

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Small Mammals Forecast Tundra Refugia in Northern Alaska

Climate change in the Arctic is a growing concern for natural resource conservation and management due to accelerated warming and associated shifts in distribution and abundance of northern species. This study introduces a predictive framework for assessing the future distribution of Arctic tundra and associated species in northern Alaska, and demonstrates the technique for 2 closely related species of *Sorex* shrews. We use geo-referenced museum specimens to predict the rate of distributional change of these small mammal species into the next century and then compare predicted refugial areas to current land use status on the Arctic Coastal Plain of Alaska. The reliability of predicting future distributions for study species is strengthened by modeling present and past distributions and by analyzing demographic shifts evident from genetic signatures. Preliminary results indicate a response to environmental change through the late-Quaternary consistent with past and future models that trace rapid contraction of available tundra habitat. Future refugia are forecast to significantly overlap areas that now have distinctive patterns of land use and levels of protection, including the National Petroleum Reserve—Alaska and the

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Arctic National Wildlife Refuge. Future work will incorporate a greater number of Arctic taxa (mammals and birds) into these models to identify hotspots of tundra diversity that should persist temporally to aid research prioritization and management planning.

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Potential Effects of Climate Change on Carolina Flying Squirrels in the Southern Appalachians

Increases in average temperature and changes in precipitation resulting from climate change could adversely affect many mammal species. The Carolina flying squirrel (*Glaucomys sabrinus coloratus*) is a federally endangered subspecies that inhabits high-elevation forests of red spruce (*Picea rubens*) and Fraser fir (*Abies fraseri*) that currently occur on mountain tops above approximately 1,610 m in elevation in the southern Appalachian Mountains. I modeled potential effects of climate change on distribution of this habitat under best-case and worst-case scenarios, which were chosen from an assortment of combined climate change circulation models and future economic/human population growth scenarios. Under the best-case scenario, the minimum elevation for this habitat will rise to 1,848 m, resulting in a 94% reduction in habitat area by the year 2060. Under the worst-case scenario, minimum elevation for occurrence of this habitat will be higher than the tallest peaks in the region, resulting in elimination of this habitat by 2060. Caveats to this modeling along with various ideas to mitigate the effects of climate change on Carolina flying squirrels will be addressed.

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Changes in Mammal Community Structure in Kenya Over the Last 100 Years

It is commonly assumed that biodiversity is in decline over much of the planet because of the increasing impact of anthropogenic influences at various scales. To counter this trend, many countries with biodiversity hotspots are preserving their resources by establishing protected areas where they attempt to minimize anthropogenic disturbance. Historical data that could show how well this strategy is working over decades to centuries generally is lacking, however. In this study we compiled extensive historic museum records of mammal diversity (collections from early 20th Century expeditions to Africa) and compared them to modern mammalian species diversity in 6 sites in Kenya where historic sampling efforts correspond with modern protected areas. We compared the community structure of historical site to modern sites using body size distributions, trophic distributions, and beta diversity across sites and across time. We ran separate tests with all species separated by body size and visibility to address the possibility that smaller, less visible species were undersampled in the historic record. We conclude that mammal diversity in our sampling locations is stable or increased from the early 20th Century, indicating that the preserves and parks are fulfilling the goal of preserving biodiversity. However, this pattern for individual sites has resulted in communities that are more similar now than they were historically, indicating a marked decrease in community uniqueness across sites over time.

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Asymmetrical Response to Climatic Change

A major focus of contemporary scientific research is determining the likely influence of anthropogenic climatic change on organisms. This is where a historical perspective is particularly useful. After all, extant species have coped with severe climate fluctuations in the recent past. Potential responses include the

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ability to move, adapt *in situ*, or become locally extirpated. Of these, the ability to adapt is considered of minimum importance. Using materials collected from woodrat (*Neotoma*) paleomiddens, we examine the adaptive ability of woodrats to climate shifts over the past 25,000 years. Woodrats are the poster child for Bergmann's rule; they exhibit a pattern of morphological variation that is positively related to environmental temperature. Here we address 3 questions: 1) Is the recovery of paleomiddens biased towards a particular temperature regime? 2) Do woodrats demonstrate an asymmetrical response to direction of temperature change? 3) Is there a rate of temperature change that is too fast for *in situ* adaptation? In general, chronosequences plotted for various locations show that woodrats respond as expected by Bergmann's rule. Interestingly, we find certain time periods, such as the Younger Dryas and the 8.2 ka-cold event, underrepresented, while warm periods are overrepresented, in the paleomidden record, despite having a cooler climate regime over majority of the Late Quaternary. Our results indicate woodrats respond more rapidly to warming temperature than to cooling temperature.

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Synchronous Changes in a Suite of Mammalian Herbivores in Response to Climatic Variation in a Semiarid Grassland

Recent long-term analyses have underscored the effects of climatic variation on mammal populations, but most studies have focused on one or a few species. Since 1994, we have tracked patterns of abundance and activity of rodents and rabbits on the Shortgrass Steppe LTER site in northern Colorado. We detected dramatic changes in abundance and diversity of herbivorous mammals, seemingly in response to drought conditions from 2000-2004. Some groups responded relatively quickly, whereas changes in other groups were not immediately apparent, suggesting an indirect mechanism. Kangaroo rats and black-tailed jackrabbits, species typically associated with drier grasslands, increased and persisted for years after normal conditions resumed. The wholesale shift in rodent community composition was most pronounced on shrub-dominated sites, but kangaroo rats and pocket mice also invaded grasslands where they were previously absent. Jackrabbits also increased their use of grasslands, presumably in response to increasing shrub cover. Black-tailed prairie dog colonies expanded and grew exponentially, while pocket gopher activity declined and remained low. We hypothesize that some groups increased because drought combined with cattle grazing disrupted the dominance of shortgrass cover. These disturbances provided opportunities for establishment of seed-bearing annual forbs, cool-season grasses and shrubs. Our results suggest that herbivores of different body sizes and functional groups respond to and recover from climate-induced variation in habitat and resources differently, providing insights into consequences of future global change.

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Moving Rocky Top to Oklahoma: Integration of the University of Memphis Mammal Collection to the Sam Noble Museum

The University of Memphis mammal collection (MSUMZ) was the largest collection of Tennessee mammals and contained ca. 23,000 specimens collected over the past 50 years. The collection grew under the care of Michael L. Kennedy and represents nearly 40 years of his life's work. In 2011, the collection was orphaned and transferred to the Collection of Mammals (OMNH) at the Sam Noble Museum (SNM). The incorporation of the MSUMZ collection is supported by a NSF Biological Research and Collections grant "Curation, Digitization, and Integration of the Orphaned University of Memphis Collection" (1057439). Protocols and procedures will be discussed that involve the renovation of the SNM collection space, the packing and moving of the MSUMZ collection, and the curation of the specimens.

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The Memphis collection will increase the SNM collection to more than 65,000 specimens and elevate it to the 8th largest university-based collection in the Western Hemisphere and the 15th largest overall.

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Forty Years of Hard Work: Implementing a Management Plan for an Ecuadorian Mammal Collection

The mammal collection of the Museum of Zoology of the Pontificia Universidad Católica del Ecuador (QCAZ) has been active for the last 40 years collecting, preserving, and supporting research and publications with information on mammals of Ecuador. It has become the most representative collection of the country and was the 2nd in Latin America to achieve ASM accreditation. Nowadays, the collection houses 12,600 specimens that represent 84% of the Ecuadorian species. Although essential in the management of scientific collections, recently a set of policies and procedures were created for the mammal collection at QCAZ. These policies were the basis for the creation and implementation of a collection management system that allows us to record, retrieve, and know the current status of each specimen that is accessioned and stored in the permanent collection. Although the implementation of this management system has been laborious, it has created a level of organization that has improved the efficiency of collection management and has considerably decreased confusion or loss of specimens. Here, our goal is to present and make available to the international scientific community this collection in 1 of the countries with the highest diversity of mammals in the world, and invite those interested in studies involving mammalian fauna of the Neotropics to look for collaboration projects with QCAZ.

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Impact of Sampling Frequency on the Population and Community Dynamics of Desert Rodents: Implications for the Design of NEON Sampling

A major component of the National Ecological Observatory Network (NEON) is continental-scale terrestrial sampling, including the temporal dynamics in (a) the demography and disease prevalence of *Peromyscus* spp. and (b) small mammal community diversity and structure, as they relate to climate, productivity, and land use. The standardization of protocols across all sites, varying in area from 10 km² up to 500 km², and across multi-decadal time scales is critical. Sampling at these spatial and temporal scales is unprecedented, but existing long-term data can be used to inform how to best concentrate sampling to achieve objectives and maximize efficiency. Monthly mark-recapture data collected at the long-term site established by J. H. Brown and colleagues in 1977 near Portal, Arizona, USA were sub-sampled to represent 3 alternative sampling regimes: semi-annual, quarterly, and bi-monthly. Means and variances of relevant population and community measures were compared among the 4 sampling frequencies, including cumulative species richness, minimum number known alive (MNKA), and proportion of reproductive females. Significant differences were found in these and additional variables, with less frequent sampling generally underestimating abundances and diversity. The discrepancies are particularly marked for the rarest species, 3 of which were not detected by semi-annual sampling and 2 by quarterly sampling. Such analyses offer empirical insight into the best design for a continental network of mammal sampling.

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Functional Habitat Relationships: What is Cover and How Do We Measure It?

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Cover is broadly considered one of the primary resource needs of wildlife, and it serves many potential functions. Cover can provide refuge from climatic conditions (thermal cover), protection from predators or conspecifics (security cover), opportunities to evade predators (escape cover), or the ability to avoid detection by potential prey (ambush cover). We conducted a review of the literature to assess how researchers have defined cover in mammalian studies, what habitat features were assessed, and how they were quantified. The most common type of cover considered in the studies we reviewed was security cover, usually measured as the function of concealment (i.e., the ability of the habitat to hide an individual). Most often, these measures were conducted using profile poles or cover boards. We suggest that such an approach simplifies this important concept in several ways that might obscure underlying habitat relationships. First, concealment provided by habitat structure has an opposing functional property (i.e., visibility or availability of sightlines that allow prey animals to detect predators). Second, assessments of security cover should consider the diversity of potential predators, their sensory and motor capabilities, and how variation in antipredator strategy might differ. Third, in addition to visual security cover, many mammals also likely use habitat features that provide olfactory or auditory cover. We use examples from our field studies to illustrate these concepts. We suggest that our understanding of wildlife-habitat relationships would be advanced by a more functional characterization of cover focused on evaluating how habitat features interact with animal behavior to influence parameters associated with fitness.

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Effects of Trap Type on Measures of Small Mammal Richness and Diversity

Many studies uncritically evaluate richness and diversity of small mammal communities without considering the impact that trap bias may have on these indices. The objectives of our study were to determine species-specific trap biases, relative to Sherman and pitfall live traps, and to assess the impact that these biases have on measures of species richness and diversity. In the summers of 2009 and 2010, we trapped throughout Wisconsin in 5 broad natural communities (barrens, dry forest, dry prairie, forested wetlands, wet prairie/wetlands). We used 180 transects (190 m-long) of 20 Sherman live traps spaced every 10 m and 10 pitfall traps spaced every 20 m for 4 consecutive nights. We trapped 3,260 small mammals of 22 species. Sherman live traps captured 1,923 individuals of 21 species in 22,599 trap nights. Pitfalls accounted for 1,337 individuals of 16 species in 11,636 trap-nights. Sherman traps exclusively captured 6 species (all > 50 g), and pitfalls had 1 unique capture. Pitfall traps were more effective at capturing shrews and voles, whereas Sherman traps captured more mice (*Peromyscus*) and squirrels. Both trap types together captured significantly higher species richness and diversity than either trap type independently. Our results indicate that Sherman live and pitfall traps capture different portions of the small mammal community and should be used in combination when assessing species richness and diversity in an area.

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Monitoring a Gray Bat Hibernaculum Using Thermal Infrared Video

Thermal infrared video was used to record the spring emergence of gray bats from a major hibernaculum in Missouri from dusk to dawn in March-April 2012. This method was developed and used to limit disruption to the colony, and because human access to the cave interior is very difficult. Bats in the video footage were counted with a computer program to determine nightly net emergence and estimate the total hibernating population. Weather and insect data were also collected to determine the influence of environmental factors on timing of emergence both seasonally and nightly. Emergence occurred several weeks earlier than expected this year, possibly due to unusually warm spring temperatures.

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Effects of Radio-attachments on Captive Volcano Rabbits (*Romerolagus diazi*)

The Volcano rabbit (*Romerolagus diazi*) is a secretive and elusive species in high risk of extinction; therefore, radio tracking becomes a central tool to gather accurate ecology data for its conservation. The aim of this study was to test the effect of different radio-attachment devices on captive individuals in the Chapultepec Zoo, México City. We tested 2 designs, a collar and a harness, on weight change, skin injuries, and grooming time. Monitoring was made in 2 phases of 21 days each one. In phase 1 (Backstage), 28 rabbits (average initial weight 546 g \pm 89 g) were divided into control ($n = 9$), collar ($n = 9$), and harness ($n = 10$). In phase 2 (Exhibits), 19 rabbits (541 g \pm 4 g) were divided into control ($n = 10$) and collar ($n = 9$). At Backstage, average daily food consumption was 134 g \pm 28 g, and there were not statistical differences among groups ($F = 1.175$, $P > 0.05$). Weight changes between rabbits with collar and control were not different ($t = -0.3725$, $P > 0.05$; $t = -1.4577$, $P > 0.05$), but rabbits with harness gained weight ($t = -3.0189$, $P < 0.01$). At Exhibit, there were no significant variations in weight changes ($P > 0.05$). In both designs and phases, skin lesions were patchy alopecia and dermal injuries, such as edema and abrasion, but none were risky for rabbit survival, although injuries caused by harnesses were qualitatively more invasive. At Exhibit, grooming time increased. Both designs resulted acceptable for fitting radio-transmitters, but collars seem advantageous because they caused less negative effects on Volcano rabbits.

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Describing Marten Activity Patterns Using Accelerometers

North American martens (*Martes americana*, *M. caurina*) are forest-dwelling species associated with complex vegetation structure. Five previous studies that used signal modulation of VHF collars to assess marten activity types (e.g., diurnal, crepuscular) did not find consistent patterns, suggesting that behavior varies seasonally, with weather, and with activity of prey. We deployed micro-GPS collars with activity sensors (accelerometers) on adult Pacific martens (*M. caurina*; $n = 5$ females, 14 males) in Lassen National Forest, California between August 2010 and March 2012. Accelerometers collected an index of activity every 2 min for up to 17.5 days, providing a consistent and continuous representation of activity patterns. We compared accelerometer-derived activity patterns with published data and evaluated individual activity types in relation to season (snowfree, snow). When all data were combined, diel activity patterns were similar to previous studies in California. However, seasonal patterns in our study differed from previous descriptions. Surprisingly, activity type varied among individuals: 8 marten were primarily diurnal, 4 were nocturnal, and 4 were arrhythmic. Individuals with deployments in both seasons demonstrated the same activity patterns. These high-resolution data will allow us to assess the effects of habitat type, prey and predator activity, and landscape configuration on marten activity. Although logistical constraints such as battery life are severe, micro-GPS collars with an accelerometer may be an effective research tool to quantify mustelid activity patterns.

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Coyote Home Range Size and Availability of Food in a Forest in Durango, México

American Society of Mammalogists 92nd Annual Meeting—Reno, Nevada

We studied coyotes (*Canis latrans*) in a pine-oak forest in Durango, México. Forty-seven (47) coyotes were captured, of which 32 adults were attached with radio-collars. Of these, 7 females and 8 males provided data in order to estimate home range size during 2 consecutive years. The results documented 3,500 locations through 2 years. The mean home range size for all coyotes was $11.79 \pm 3.77 \text{ km}^2$ ($n = 63$). Home range size for males ($12.96 \pm 3.27 \text{ km}^2$; $n = 38$) was larger than home range size for females ($10.05 \pm 3.85 \text{ km}^2$; $n = 26$). The home range size has significant variation during the year ($P < 0.001$). A negative correlation ($r = -0.742$; $P = 0.034$) was found between home range size and consumption of mammals during the biological periods studied. Meanwhile, a significantly positive correlation was found between home range size and fruit consumption ($r = 0.745$; $P = 0.033$). Our data suggest mammals were chosen and consumed as food priority during periods of breeding and gestation as a behavioral strategy to maximize their reproductive success. Coyotes in the study area tend to make an optimal combination of election of food item consumed with respect to their movements, maintaining an appropriate home range size. If they make a right choice, it will bring them in energy profits and increase their success reproductive and its persistence in the geographical range.

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Tracking Methodology and Sign Inventory of Wild/Feral Horses and Implications on Behavior and Ecology

There is much literature about horses or tracking but very few works include tracking horses. When tracking guides carry information about horses they include only an outline of the track. There are many instances why detailed knowledge of wild horse tracking is required. 1) When round-up is required for genetic assessment and/or management reasons, the placement of the corral is crucial. 2) It is needed when taking equine photographs to record coat color. 3) It is desired to determine details of ecology or ethology. 4) It is needed to document a crime scene or to settle a livestock brand or an estray case. 5) It is necessary when horses occur on large tracts of land or in areas with abundant cover or rocky terrain. Tracking of wild horses was done over 10 years in 4 states (New Mexico, Colorado, Montana, and Nevada) in 2 National Forest Wild Horse Territories, 2 Bureau of Land Management Wild Horse Management Areas, 4 Native American tribal lands, and 7 private preserves. Trailing, track documentation, and sign identification skills are discussed. A total of 15 different signs made by horses were recorded. Signs of wild horses were compared to other members of the order *Perrisodactyla*. One sign common to the entire order is the behavior of repeated defecations at a locality.

243 CAPSTONE, Tuscany Ballroom E & F, Tuesday 26 June 2012

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Hidden Biodiversity in Cryptic Species: Lessons from Madagascar's Mouse Lemurs

Global loss of biodiversity is one of the greatest threats facing the earth. But in order to measure loss, we must first determine existing levels of biological diversity. Virtually all measures of biodiversity rely at least to some degree upon counting the number of species within communities and ecosystems, yet quantifying species numbers is a complicated enterprise, under the best of circumstances. The process is made all the more complicated by the continuing disagreement among biologists as to what constitutes a species in the first place. Mouse lemurs are emblematic of these difficulties. These small-bodied nocturnal primates are endemic to Madagascar, an island nation that is universally acknowledged to be one of the world's hottest biodiversity hotspots, with habitats disappearing at breathtaking rates. Over the past 20 years, mouse lemur taxonomy has been inflated from only 2 recognized species to more than 16. My talk will focus on mouse lemurs as a case study in the complexities of species determination within a group of mammals for which morphological variation is extremely subtle, thus qualifying them as "cryptic". The talk will examine the question of species determination not from the perspective of the mammalogist, but from the perspective of the organisms themselves. It matters not whether we recognize species boundaries among mouse lemurs, but whether—and how—mouse lemurs themselves make these discriminations.

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National Automobile Museum (www.automuseum.org)

The Discovery Museum for Children (<http://www.nvdm.org/>)

Arboretum and Museum at San Rancho Rafael Regional Park
(<http://www.washoecounty.us/parks/museum/museum.html>)

Rose Garden at Idlewild Park (<http://www.reno.gov/Index.aspx?page=455>)

Historic Reno Preservation Society Walking Tours (<http://www.historicreno.org/>)

Reno Aces (<http://www.milb.com/index.jsp?sid=t2310>)

Sierra Safari Zoo (<http://www.sierrasafarizoo.org/>)

Animal Ark Wildlife Sanctuary (<http://www.animalark.org/>)

Nevada State Museum in Carson City (<http://museums.nevadaculture.org/>)

Donner Emigrant Trail Museum in Truckee, CA (http://www.parks.ca.gov/?page_id=503)

Art Galleries and Shops

Nevada Museum of Art (<http://www.nevadaart.org/>)

Sheppard Fine Arts Gallery (<http://www.unr.edu/art>)

Stremmel Gallery (<http://www.unr.edu/art/>)

Riverwalk District (<http://www.renoriver.org/>)

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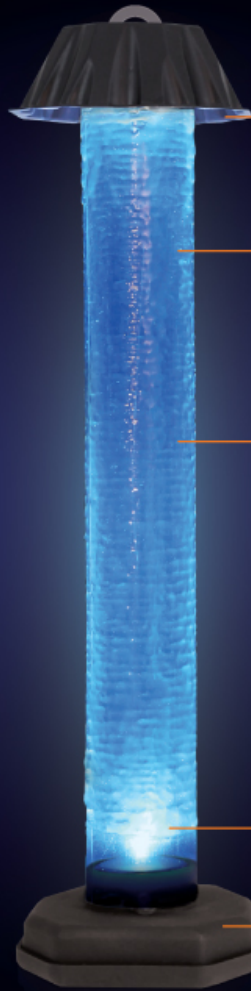


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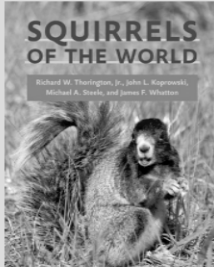


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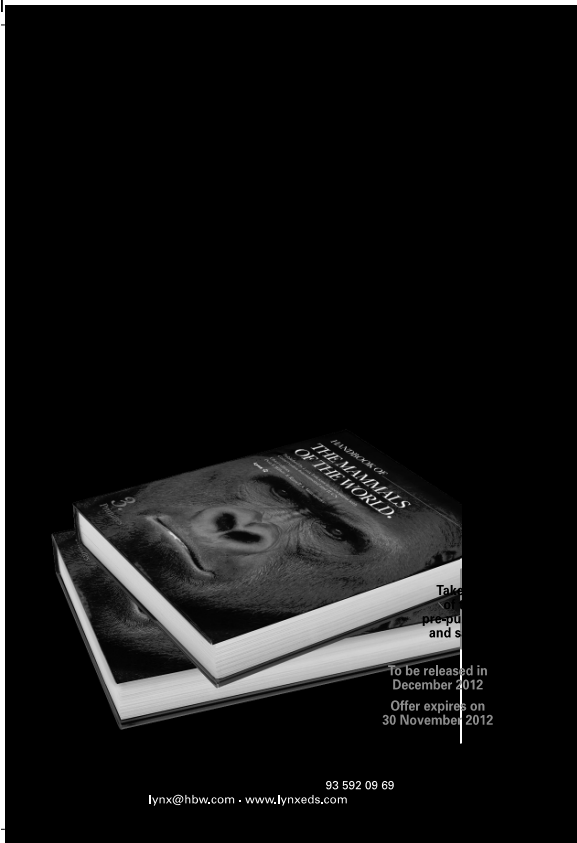
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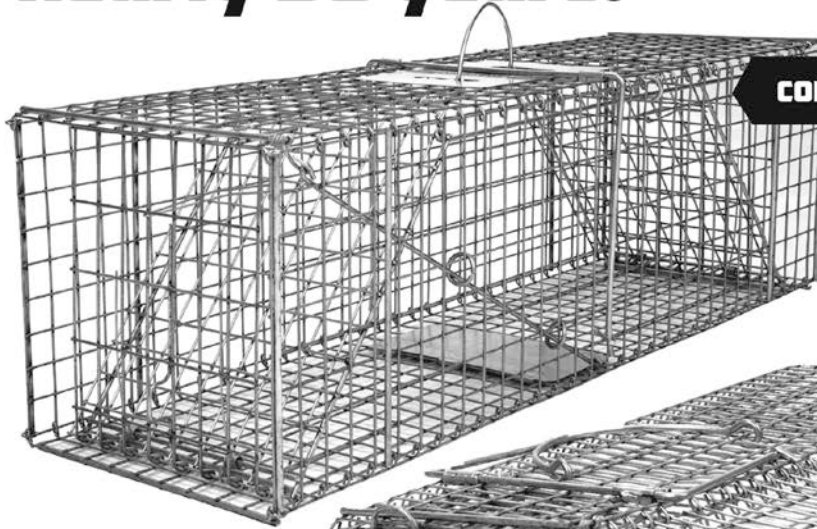


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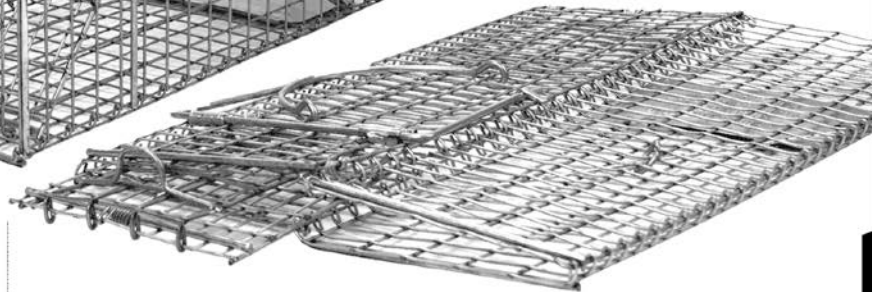
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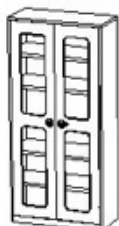
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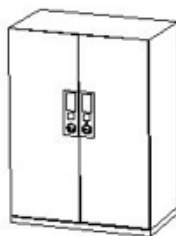
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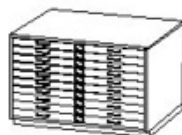
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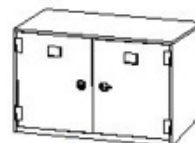
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