

# PEROMYSCUS NEWSLETTER

Number Forty



Spring 2006

**Cover:** Circling behavior of *Peromyscus* sp. (likely *P. maniculatus* or *P. leucopus*).

Photographs, video, and article by David Jeffcott and Virgil Brack, Jr.

## ***Peromyscus* Newsletter Number 40**

Welcome to the first completely on-line version of *Peromyscus Newsletter*. Whereas no one can adequately fill Wally Dawson's shoes, I hope *PN* will remain a valuable reference for all *Peromyscus* researchers, keeping you informed about your colleagues' work in the hopes of fostering additional, exciting research with our favorite mice.

With the newsletter now exclusively in electronic format we no longer have publishing costs to consider. I think this will be liberating for *PN* as we can now include lengthier accounts (preferably no more than 2 single-spaced pages), color graphs and figures, pictures, and movies. In fact, this issue contains a fascinating movie of circling behavior in a wild *Peromyscus*, although you must have QuickTime installed in order to view it. To download a free copy of QuickTime visit <http://www.apple.com/quicktime/download/standalone.html>.

Unfortunately, the switch has meant that we have lost some subscribers. A few do not have access to email, and some have simply not sent us their email addresses. If you know of someone in one of these categories, please encourage them to send us their address. Alternatively, copies of *PN* will be posted to our website. Just go to <http://stkctr.biol.sc.edu/> and click on the Newsletter tab. Another change to accommodate this new format is a new email address. All *PN* business can now be sent to [peromyscusnewsletter@biol.sc.edu](mailto:peromyscusnewsletter@biol.sc.edu). **This is the address that should be used for all submissions and subscriptions.** Send an email to this address to sign up and you'll be added to the subscriber list.

As this is the first issue in the new format, I'm hoping some of you will send me feedback letting me know how the *Newsletter* can be improved. Any and all suggestions are welcome, from improving the look of the *Newsletter* to increasing its usefulness and distribution. Just send your comments to the above email address.

To all of you who have stuck with us throughout this transition I say thank you. To all of you new subscribers I say welcome.

Julie

**PEROMYSCUS NEWSLETTER** is produced by the

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# THE *PEROMYSCUS* GENETIC STOCK CENTER

## General

The University of South Carolina has maintained a genetic stock center for *Peromyscus* (deer mice and congeneric species) since 1985. The center was established under a grant from the Living Stocks Collection Program of the National Science Foundation and continues to be supported by NSF and the NIH Biological Models and Materials Research Program. It also receives support from the University and from user fees.

The major function of the Stock Center is to provide genetically characterized types of *Peromyscus* to scientific investigators and educators. Continuation of the center is dependent upon significant external utilization, therefore potential **users are encouraged to take advantage of this resource.**

## Policies and Procedures

The Stock Center currently maintains several categories of stocks of living animals:  
1) Closed colony random-bred<sup>1</sup> “wild-type” stocks of seven species of *Peromyscus*. 2) Two highly inbred<sup>2</sup> stocks of “wild-type” *P. leucopus*. 3) Stocks of eighteen coat color mutations, mostly in *P. maniculatus*. 4) Stocks of nine other monogenic traits. The Stock Center operates in strict compliance with the Animal Welfare Act and is located in an AAALAC approved facility. All animal care is performed by certified technicians. Stocks are monitored regularly for presence of disease and parasites and are free of hantavirus and 15 murine viruses.

The Stock Center also provides blood, organs, tissues, fetuses, skins and other biological materials from *Peromyscus*. The Stock Center operates a Molecular Bank where selected genomic libraries and probes are available. Other resources include a reference collection of more than 2,500 reprints of articles on peromyscine rodents, copies of which may be provided. The Stock Center is the primary sponsor of **PeroBase**, an on-line database dedicated to information regarding *Peromyscus* and closely related species.

Sufficient animals of the mutant types generally can be provided to initiate a breeding stock. Somewhat larger numbers, up to about 50 animals, can be provided from the wild-type stocks. Animals requested in greater numbers frequently require a “breed-up” charge and some delay in shipment.

## Orders and Pricing

A user fee is charged for animals or materials provided by the Stock Center. A schedule of fees is shown in the table on the next page. Fees vary with species and type of service provided. User assumes the cost of all shipment. Animals lost in transit are replaced without charge. Tissues, blood, skins, *etc.* are supplied at a modest fee that includes technician time. Arrangements for special orders will be negotiated. Billing will be submitted upon satisfactory delivery. **Write or call for details or special requirements.**

## SCHEDULE OF USER FEES

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Item	Academic and Government	Commercial Users
MATURE ANIMALS (each)		
Wild-type Stocks		
Smaller species ( <i>P. maniculatus</i> , <i>P. polionotus</i> , <i>P. leucopus</i> , <i>P. eremicus</i> )	\$ 22.50	\$ 35.00
Larger species ( <i>P. californicus</i> , <i>P. melanophrys</i> , <i>P. aztecus</i> )	30.00	40.00
Mutant and Inbred Stocks	30.00	40.00
Pregnant females (Smaller species)	40.00	50.00
(Larger species)	55.00	65.00
Special Attention (Diet, <i>etc.</i> )	40.00	50.00
F <sub>1</sub> Species Hybrids	30.00	40.00
TISSUE SAMPLES (Per sample)		
Solid	25.00	
Fluid (Blood, urine, saliva, <i>etc.</i> ) per ml	40.00	
Flat skins (each)	35.00	
MOLECULAR MATERIALS		
Extracted DNA, 20 µg	100.00	
PCR Primers (500 µl @ 10 µM)	10.00	
Genomic & cDNA libraries	300.00	

### OTHER CHARGES

Shipping costs = actual shipper's charges plus cost of mouse containers, packaging.

Lab fee for sample preparation.

Breed-up fees (for orders exceeding 50 animals) = *per diem* cage charges X cages required.



## STOCKS AVAILABLE

### WILD TYPE STOCKS

### ORIGIN

<i>P. maniculatus bairdii</i> (BW Stock) Deer Mouse	Closed colony bred in captivity since 1948. Descended from 40 ancestors wild-caught near Ann Arbor MI.
<i>P. maniculatus sonoriensis</i> (SM2 Stock) Sonoran Deer Mouse	Derived from about 50 animals wild-caught by Jack Hayes in 1995 near White Mountain Research Station CA.
<i>P. polionotus subgriseus</i> (PO Stock) Oldfield Mouse	Closed colony since 1952. Derived from 21 ancestors wild-caught in Ocala Nat'l. Forest FL. High inbreeding coefficient.
<i>P. polionotus leucocephalus</i> (LS Stock) Beach Mouse	Derived from beach mice wild-caught on Santa Rosa Island FL between 1987-1988 and bred by R. Lacy.
<i>P. leucopus</i> (LL Stock) White-footed Mouse	Derived from 38 wild ancestors captured between 1982 and 1985 near Linville NC.
<i>P. californicus insignis</i> (IS Stock) California Mouse	Derived from about 60 ancestors collected between 1979 and 1987 in Santa Monica Mts. CA.
<i>P. aztecus</i> (AM Stock) Aztec Mouse	Derived from animals collected on Sierra Chincua Michoacan, Mexico in 1986.
<i>P. melanophrys</i> (XZ Stock) Plateau Mouse	Derived from animals collected between 1970 and 1978 from Zacatecas, Mexico and bred by R. Hill.
<i>P. eremicus</i> (EP Stock) Cactus Mouse	Originated from 10-12 animals collected at Tucson AZ in 1993.

### INTERSPECIFIC HYBRIDS

<i>P. maniculatus</i> X <i>P. polionotus</i> F <sub>1</sub> Hybrids	Bred by special order.
<i>P. leucopus</i> X <i>P. gossypinus</i> F <sub>1</sub> Hybrids	Sometimes available by special arrangement.

### <sup>3</sup>COAT COLORS

### ORIGINAL SOURCE

Blonde <i>bln/bln</i>	Mich. State U. colony (Pratt and Robbins, 1982)
Albino <i>c/c</i>	Sumner's albino deer mice (Sumner, 1922)
Ashy <i>ahy/ahy</i>	Wild-caught in Oregon ~ 1960 (Teed et al., 1990)
Black (Non-agouti) <i>a/a</i>	Horner's black mutant (Horner et al., 1980)
<sup>4</sup> Brown <i>b/b</i>	Huestis stocks (Huestis and Barto, 1934)
California blonde <i>cfb/cfb</i>	Santa Cruz I., Calif., stock (Roth and Dawson, 1996)
Dominant spotting <i>S/+</i>	Wild caught in Illinois (Feldman, 1936)
Golden nugget <i>b<sup>gn</sup>/b<sup>gn</sup></i>	Wild caught <i>P. leucopus</i> (Horner and Dawson, 1993)
Ivory <i>i/i</i>	Wild caught in Oregon (Huestis, 1938)
<sup>5</sup> Pink-eyed dilution <i>p/p</i>	Sumner's "pallid" deer mice (Sumner, 1917)
Platinum <i>plt/plt</i>	Barto stock at U. Mich. (Dodson et al., 1987)
<sup>4</sup> Silver <i>sil/sil</i>	Huestis stock (Huestis and Barto, 1934)
Tan streak <i>tns/tns</i>	Clemson U. stock from NC (Wang et al., 1993)
Variable white <i>Vw/+</i>	Mich. State U. colony (Cowling et al., 1994)
White-belly non-agouti <i>a<sup>w</sup>/a<sup>w</sup></i>	Egoscue's "non-agouti" (Egoscue, 1971)
Wide-band agouti <i>A<sup>Nb</sup>/a</i>	Natural polymorphism U. Mich. (McIntosh, 1954)

### OTHER MUTATIONS AND VARIANTS

Alcohol dehydrogenase negative <i>Adh<sup>0</sup>/Adh<sup>0</sup></i>	South Carolina BW stock (Felder, 1975)
Alcohol dehydrogenase positive <i>Adh<sup>f</sup>/Adh<sup>f</sup></i>	South Carolina BW stock (Felder, 1975)
Boggler <i>bgl/bgl</i>	Blair's <i>P. m. blandus</i> stock (Barto, 1955)
Cataract-webbed <i>cwb/cwb</i>	From Huestis stocks (Anderson and Burns, 1979)
Epilepsy <i>epl/epl</i>	U. Michigan <i>P. m. artemisiae</i> stock (Dice, 1935)
<sup>5</sup> Flexed-tail <i>ff</i>	Probably derived from Huestis flexed-tail (Huestis and Barto, 1936)
Hairless-1 <i>hr-1/hr-1</i>	Sumner's hairless mutant (Sumner, 1924)
Hairless-2 <i>hr-2/hr-2</i>	Egoscue's hairless mutant (Egoscue, 1962)
Juvenile ataxia <i>ja/ja</i>	U. Michigan stock (Van Ooteghem, 1983)
Enzyme variants	Wild type stocks provide a reservoir of variants (Dawson, 1983)

<sup>1</sup> "Random bred" without deliberate selection, sib-sib matings avoided. <sup>2</sup> Inbred lines bred by sib-sib and/or parent-offspring mating for 21 generations or more. <sup>3</sup> Unless otherwise noted, mutations are in *P. maniculatus*. <sup>4</sup> Available only as silver/brown double recessive. <sup>5</sup> Available only as pink-eye dilution/flexed tail double recessive.

## Other Resources of the *Peromyscus* Stock Center

Highly inbred *P. leucopus* (I<sub>30+</sub>) are available as live animals or as frozen tissues.

Two lines developed by George Smith (UCLA) are currently maintained by the Stock Center.

Limited numbers of other stocks are on hand, but not currently available. Inquire.

Preserved or frozen specimens of types given in the above tables.

Flat skins of mutant or wild-type coat colors of any of the stocks listed above.

Reference library of more than 2500 reprints of research papers, articles and reports on *Peromyscus*. Single copies of individual articles can be photocopied and mailed. Please limit requests to not more than five articles at any given time. There will be a charge of 10 cents per photocopied page after the initial 20 pages.

Photocopies of back issues of *Peromyscus* Newsletter (\$5 ea.) or single original back copies, when still available, without charge.

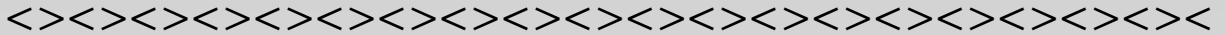
Materials are available through the *Peromyscus* Molecular Bank of the Stock Center. Allow two weeks for delivery. Included is purified DNA or frozen tissues of any of the stocks listed above. Several genomic libraries and a variety of molecular probes are available. (Inquire for more information)

*For additional information or details about any of these mutants, stocks or other materials contact: Janet Crossland, Colony Manager, Peromyscus Stock Center, (803) 777-3107, e-mail [crosslan@biol.sc.edu](mailto:crosslan@biol.sc.edu)*

PLEASE CALL WITH INQUIRIES

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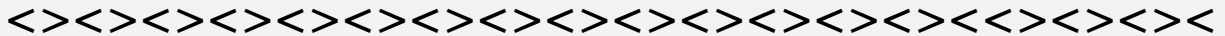
***NOTICE***

**PEROMYSCUS NEWSLETTER IS NOT A FORMAL SCIENTIFIC PUBLICATION.**

**THEREFORE...**

**INFORMATION AND DATA IN THE CONTRIBUTIONS SECTION SHOULD NOT BE CITED OR USED WITHOUT PERMISSION OF THE CONTRIBUTOR.**

**THANK YOU!**



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### **Rapid evolution of host specificity in *Trichinella spiralis***

Rapid evolution is the evolution of a species on a contemporary time scale, in as little as a few years or decades (Stockwell and Ashley, 2004). Rapid evolution of parasites and their hosts in fragmented habitats is a potential problem that could cause epidemic level outbreaks of parasites (Altizer *et al.*, 2003). One parasite attribute that has received little attention with respect to rapid evolution is host specificity. Host specificity is a measure of the number of hosts a parasite species can exploit successfully (Poulin and Mouillot, 2003). It can range from low (many hosts) to high (few hosts). For generalist parasites with low host specificity, repeated generations of selection in a single host species (serial passages) can increase adaptation to the host (Ebert, 1998) which could lead to increased parasite reproduction and harm to the host.

We tested for increased host specificity in *Trichinella spiralis* by measuring its reproductive output (number of juveniles produced per adult worm) in *Peromyscus leucopus* during a serial passage experiment. *Trichinella spiralis* is a generalist nematode parasite that infects meat-eating mammals. The host used in this experiment, *P. leucopus*, has been found infected with *T. spiralis* in nature (Holliman and Meade, 1980), but is a new host for this parasite strain. If *T. spiralis* shows increased adaptation to *P. leucopus* then it will have a higher reproductive rate after serial passage.

*Trichinella spiralis* was obtained from the USDA, where it is cultured in lab rats. We conducted 5 serial passages of *T. spiralis* in *P. leucopus*. Each group of mice consisted of at least ten males of approximately the same age infected with approximately 100 *T. spiralis* juveniles. A group of ten lab rats were simultaneously infected as a control group. The hosts were killed after at least two months. Juvenile *T. spiralis* were isolated from muscle using pepsin-hydrochloric acid digestion and then counted (Meagher and Dudek, 2002).

We found a significant increase in *T. spiralis* reproductive output over the course of this experiment (Figure 1). This increased adaptation by *T. spiralis* also likely increased its virulence since higher numbers of juvenile worms cause greater harm to the host (Meagher and Dudek, 2002). If this rapid evolution of host specificity is common in nature, it may be a concern to conservationists because it could lead to increased harmfulness to endangered species.

### **LITERATURE CITED**

- Altizer, S., D. Harvell and E. Friedle. 2003. Rapid evolutionary dynamics and disease threats to biodiversity. *Trends in Ecology and Evolution*. 18(11): 589-596.  
Ebert, D. 1998. Experimental evolution of parasites. *Science* 282: 1432-1435.

- Holliman, R. B. and B. J. Meade. 1980. Native trichinosis in wild rodents in Henrico County, Virginia. *The Journal of Wildlife Diseases* 16: 205-207.
- Meagher, S. and S. N. Dudek. 2002. Effects of *Trichinella spiralis* on survival, total mass, and organ mass of oldfield mice (*Peromyscus polionotus*). *Journal of Parasitology* 88(5): 833-838.
- Poulin, R. and D. Mouillot. 2003. Parasite specialization from a phylogenetic perspective: a new index of host specificity. *Parasitology* 126: 473-480.
- Sax, D. F. and S. D. Gaines. 2003. Species diversity: from global decreases to local increases. *Trends in Ecology and Evolution*. 18(11): 561-566.
- Stockwell, C. A. and M. V. Ashley, 2004. Rapid adaptation and conservation. *Conservation Biology* 18(1): 272-273.

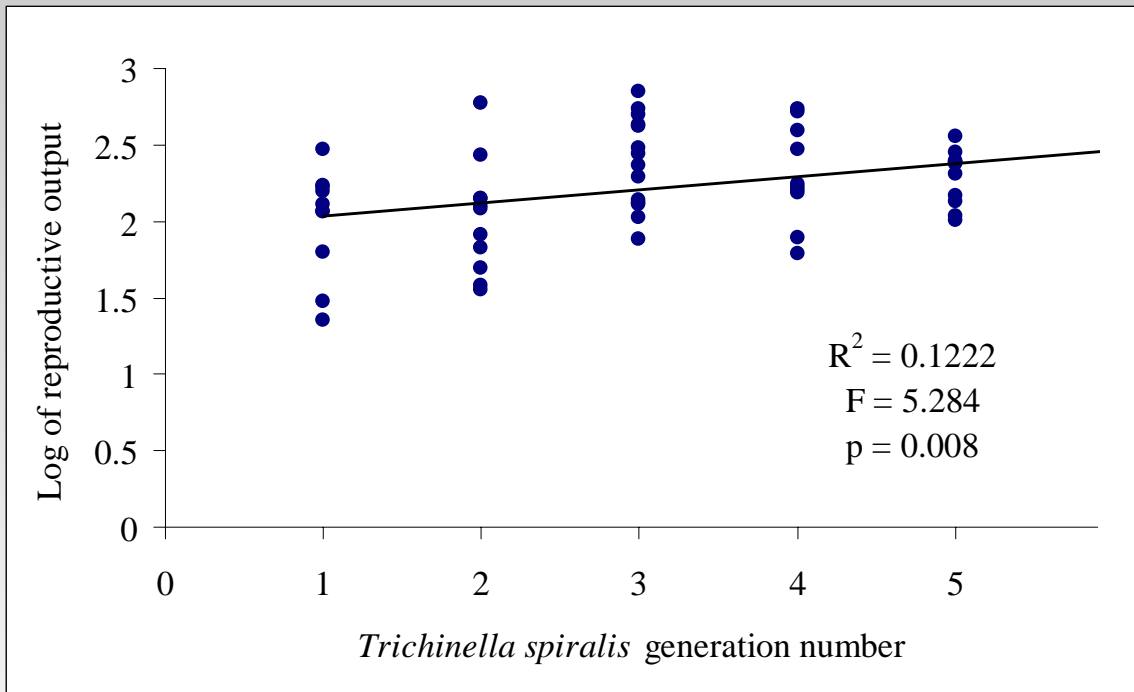


Figure 1. Increase in reproductive output of *Trichinella spiralis* after 5 generations in *Peromyscus leucopus*.



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### **The link between environmental productivity and energetics in *Peromyscus***

In the Fall of 2006, I taught an upper division Environmental Physiology course at University of St. Thomas, in St. Paul Minnesota. Eight senior undergraduate students were enrolled in the course, and their biology background was diverse. Some had taken several previous anatomy and physiology courses, though some students had never taken a physiology course. One student was a chemistry major, some had concentrated in cell and molecular biology, and others in ecology. The goals for the course included understanding how biotic and abiotic factors affect physiological systems through natural selection.

As a model for a semester long laboratory study, we chose to study the relationship between environmental productivity and basal metabolic rate (BMR) for five *Peromyscus* species. The basis for the study was work done by Mueller and Diamond (2001; PNAS, 98:12550-12554), which reported that *Peromyscus* species that evolved in areas of low net primary productivity (NPP) had lower BMRs than species that evolved in areas of high primary productivity.

The students used that result as a launching point for several other questions. First, however, they repeated Mueller and Diamond's (2001) study of the BMR - NPP relationship. Next, groups of students asked the following questions:

- 1) Does maximal metabolic rate (MMR) correlate with BMR?
- 2) What is the relationship between the NPP that a species evolved in and its MMR?
- 3) What is the relationship between activity and BMR?
- 4) What is the relationship between T4 thyroxine and NPP?
- 5) What is the relationship between organ mass and BMR?

The students were completely responsible for experimental design, data collection and analysis, and data interpretation. In addition, they were responsible for animal care and maintenance.

We had 20 females of each of the following species: *Peromyscus californicus*, *P. eremicus*, *P. leucopus*, *P. maniculatus*, and *P. melanophrys*.

We measured O<sub>2</sub> consumption of post-absorptive mice at 26°C for 24 hours using closed system respirometry, and then calculated BMR. We then measured O<sub>2</sub> consumption of post-absorptive mice at 5°C for 12 hours and calculated MMR. We quantified activity using recorded wheel activity for 48 hours. We then sacrificed the mice, removed a blood sample from the heart, and removed the liver, kidneys, and

small intestine. Organs were dried at 60°C for 48 hours to determine dry mass. We determined free plasma T4 levels using ELISA. Statistical analyses were performed using JMP.

Here we report preliminary results. Least square means of BMRs (ANCOVA, with body mass as a covariate) for each species increased with NPP (linear regression,  $R^2 = 0.75$ ;  $p = 0.05$ ). As NPP increased, MMR increased ( $p = 0.03$ ), but there was no relationship between BMR and MMR ( $p = 0.17$ ). Activity levels decreased with increasing body mass for the five species ( $p < 0.0001$ ), but there was no significant relationship between BMR and activity ( $p = 0.57$ ) or between MMR and activity ( $p = 0.57$ ). Dry liver mass and dry kidney mass increased with BMR ( $p = 0.0012$  and  $0.0007$ , respectively), but there was no relationship between dry small intestine mass and BMR ( $p = 0.18$ ). Finally, there was no relationship between free plasma thyroxine and BMR ( $p=0.5655$ ).

In general, results from question 1 support the findings of Mueller and Diamond (2001) – species that evolved in low NPP environments have low BMRs, and thus are adapted to run lean. However, MMR did not correlate with BMR, a result that adds to a growing body of equivocal results. While there was no relationship between BMR and activity, body size may have affected the results because the larger mice species may have been constrained by the size of the running wheel. Experiments are underway using alternative measures of activity. Finally, while organ mass did, in general, correlate with BMR, free plasma thyroxine did not. The cause and effect relationship between organ mass is not clear – do larger organs (whether from a genetic or developmental etiology) result in a high BMR to maintain those organs, or does a higher BMR (whether from a genetic or developmental etiology) require larger organs to fuel the higher BMR? Thyroxine has been found to correlate with BMR in some species, and so the lack of relationship between thyroxine and BMR in this study may suggest that organ mass drives BMR, rather than the opposite.

In general, use of a *Peromyscus* model was an excellent opportunity for the students in the course. The model is very well suited for asking questions about adaptations and biotic and abiotic factors affecting physiological and morphological traits. In addition, the animals are relatively easy to handle, easy to maintain and care for, and offer a variety of potential study questions. Finally, there exists a strong body of literature on *Peromyscus* physiology and behavior, thus making many published resources available to students.





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### **Error in measuring *Peromyscus* skulls**

As part of a project comparing genetic and morphological traits of California Channel Islands mice, we wished to estimate the error between different people measuring the same cranial traits. This would help us determine whether variation found between mice was meaningful. Specimens were from four endemic *Peromyscus maniculatus* subspecies: *P. m. anacapae*, *P. m. santacruzae*, *P. m. santarosae*, and *P. m. streatori*. There were 51 specimens total. We spent three days during August 2005 at Chicago's Field Museum measuring these *Peromyscus* skulls with digital calipers. As we wanted to estimate error between different people using different instruments, we each measured the same mice using different calipers. ORWP used Brown & Sharpe DigiMatic digital calipers, RAP used Whitworth digital calipers. Cranial traits were standard except for those further described: breadth of rostrum (BR), zygomatic breadth (ZB), occipital nasal length (LSN, measured as the least distance from the supraorbital notch to the tip of the nasals), greatest length of skull (GL), intermeatus breadth (IB), length of incisive foramen (LIF), length of palate plus nasals, (LPI, measured as the greatest distance from the anterior edge of the alveoli of the incisors to the mesopterygoid fossa), depth of braincase (DBC), and alimentary tooth row (AL)(Fig. 1). Thus there were 9 measures x 2 people x 51 mice = 918 data points. We converted differences between measurements made by ORWP and RAP of the same mice to percentages of total measurements to compensate for size. We then graphed the mean error of each trait (Fig. 2). The graph shows that LIF is the least accurate measurement and GL is the most accurate measurement. It is not surprising that LIF was least accurate: this measurement was made with inside calipers, and clearance for the caliper tips was highly variable. It was surprising that AL was not among the most accurate measurements: while performing the measurement it seemed the most unambiguous. However, all mean errors were less than the variation subsequently found between mice (5-14%).

Fig. 1.

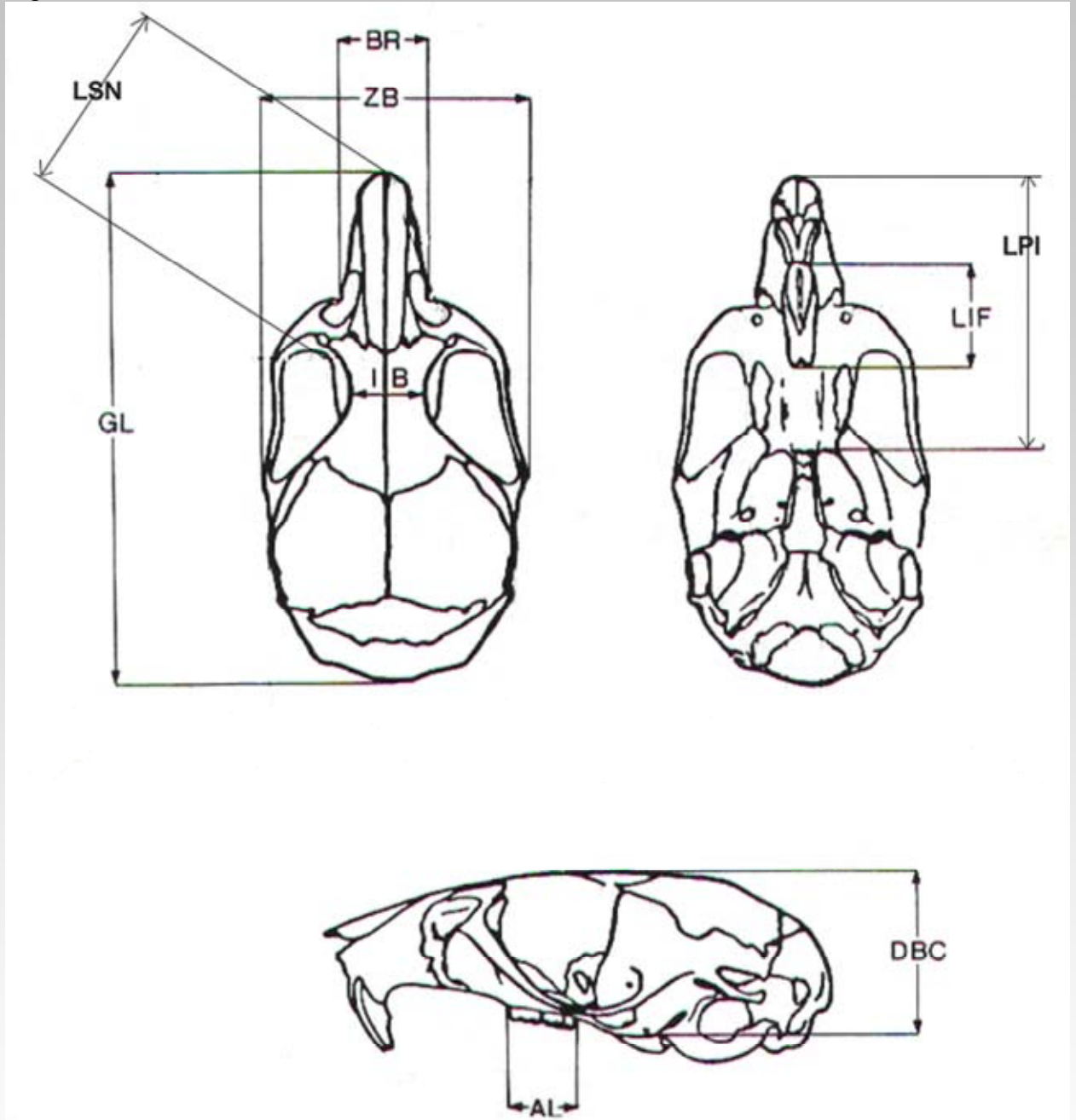
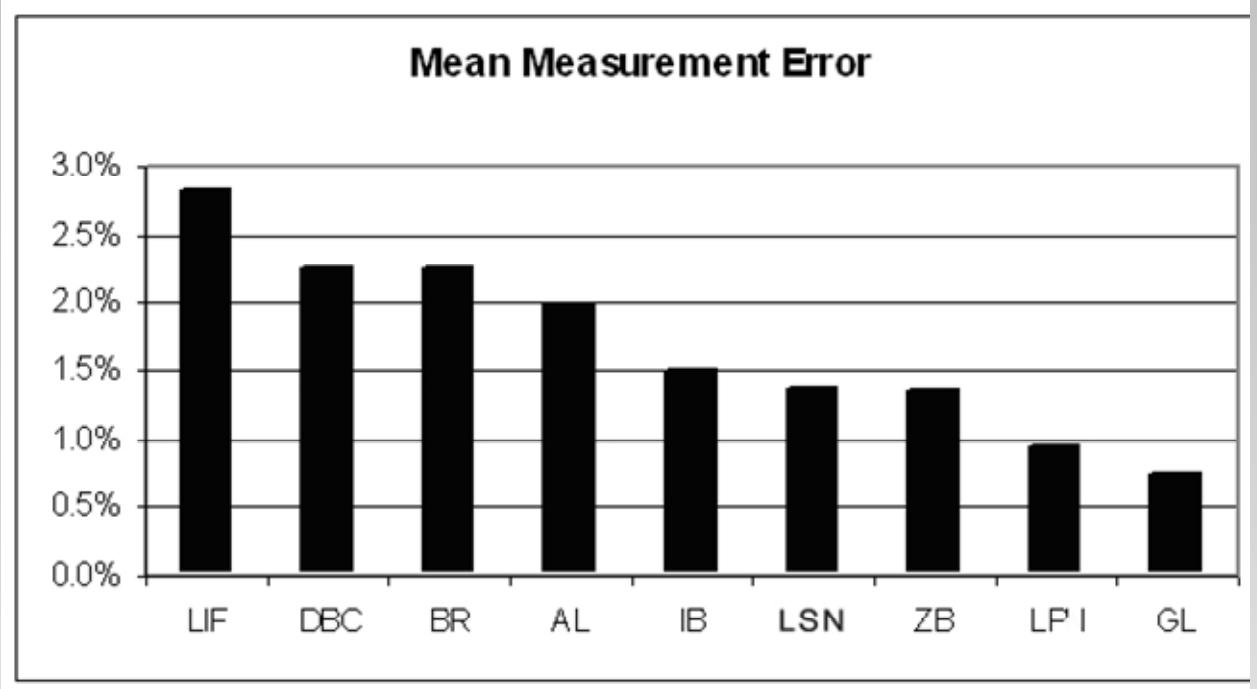


Fig. 2.



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### **Effects of livestock grazing on movement of deer mice into buildings: a description of ongoing research**

Grazing by livestock obviously changes the habitat experienced by small rodents. Livestock thin out vegetation, competing with rodents for plant food sources and reducing cover which would otherwise protect small rodents from predators. Additionally, livestock will trample the ground, hardening it, collapsing underlying burrows and making new ones difficult to form. Examining the effect on grazing on deer mice abundance has gleaned varying results (Rosenstock 1996, Hayward et al 1997, Matlack et al 2001), but no study has looked at how grazing disturbance affects the movement of mice into man-made shelters.

This latter study could be crucial to understanding how and when humans are exposed to Sin nombre virus, the causative agent of Hantavirus pulmonary syndrome. Humans are generally exposed to the virus when mice invade, and subsequently defecate, in buildings (Armstrong et al 1995). What factors drive deer mice into buildings could aid in protection of humans, knowing when we should be most vigilant as to the risk of exposure. Currently, we at Montana Tech University are conducting experiments to investigate such movement in response to grazing.

We hypothesize that deer mice enter buildings more frequently when their habitat experiences grazing. We tested this hypothesis by setting up two sets of 1 hectare plots on ranchland approximately 12 miles outside Butte, MT. Each plot is equipped with 2 “houses” (118.5 cm wide, 244 cm long and 126 cm high) on each plot. One house on each plot contains ample amounts of food (oats) and all houses are equipped with a pit tag reader to monitor movement of previously tagged mice in and out of the houses over night. Readers are activated before sunset and deactivated after sunrise.

One plot serves as an ungrazed control on which no horses were kept. The experimental plot is bordered by an electric fence and for three days 5-6 horses are kept on the plot. Movements of mice are monitored in each of the houses for three days preceding the introduction of the horses on the experimental plot, for the three days horses were on the plot, and for three subsequent days.

Following the successful completion of 9 days of monitoring, the experimental houses are moved to a new location and the experiment will repeat to allow for a new trial. Our goal is to achieve three trials each in both winter and spring over several years to explore the effects seasonality in addition to grazing has on deer mice movement.

## LITERATURE CITED

- Armstrong, L.R., S.R. Zaki, M.J. Goldoft, R.L. Todd, A.S. Khan, R.F. Khabbaz, T.G. Ksiazek and C.J. Peters. 1995. Hantavirus pulmonary syndrome associated with entering or cleaning rarely used rodent-infested structures. *Journal of Infectious Diseases* 172:1166.
- Hayward, B., E.J. Heske and C.W. Painter. 1997. Effects of livestock grazing on small mammals at a desert cienega. *J. Wildl. Manage.* 61:123-129.
- Matlack, R.S., D.W. Kaufman and G.A. Kaufman. 2001. Influence of grazing by bison and cattle on deer mice in burned tallgrass prairie. *Am. Midl. Nat.* 146:361-368.
- Rosenstock, S.S. 1996. Shrub-grassland small mammal and vegetation responses to rest from grazing. *J. Range Manage.* 49:199-203.



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## Evolutionary genetics and genomics of *Peromyscus*

In my lab at the University of Nebraska we are currently conducting a number of population genetic studies of *Peromyscus* species, with a primary emphasis on *P. maniculatus*. One of our main projects involves a study of hemoglobin genes that contribute to adaptive variation in blood biochemistry and aerobic metabolism of mice that are native to high altitude. Specifically, we are analyzing DNA sequence variation in the alpha- and beta-globin genes in populations of *P. maniculatus* that are distributed across steep altitudinal gradients across western North America. Using a breeding colony of *P. maniculatus sonoriensis* maintained by Kim Hammond at UC Riverside, we are creating congenic strains of mice with different alpha- and beta-globin genotypes that we can use for biochemical and physiological experiments. In conjunction with the surveys of DNA polymorphism in natural populations, these experiments should allow us to identify the specific mutations that are responsible for adaptive modifications of the oxygen transport system. In addition to the studies of hemoglobin polymorphism in *P. maniculatus*, we are also studying the molecular evolution of these same globin genes in a number of other *Peromyscus* species that have different altitudinal range limits. To do this we are characterizing the genomic structure of the alpha- and beta-globin gene families in *Peromyscus*, thereby paving the way for a comparative genomics study of gene family evolution in *Peromyscus*, *Mus*, rat, human, and other mammals.

In addition to the study of variation in the globin genes of *P. maniculatus*, we are also studying DNA sequence variation in a number of other candidate genes for physiological adaptation, such as aspartate aminotransferase (AAT), a cytosolic enzyme that plays an important role in protein synthesis and energy metabolism. The AAT gene appears to be subject to strong balancing selection across the species' range in North America.

A second area of research involves a study of morphological differentiation in populations of *P. maniculatus* that are distributed across forest-grassland ecotones in different parts of North America. We are studying genetically based variation in cranial and skeletal shape between distinct morphological types that appear to be adapted to contrasting environments. Across the species range, intergrade zones between forest and grassland forms are characterized by varying degrees of morphological differentiation and varying degrees of reproductive isolation.



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### **Development of a deer mouse whole genome radiation hybrid panel and comparative mapping of *Mus* chromosome 11 loci**

A 5000 rad whole-genome radiation hybrid cell panel (BW5000) was developed for mapping the deer mouse (*Peromyscus maniculatus bairdii*) genome. The panel consists of 103 cell lines and has an estimated marker retention frequency of 63.9% (range 28 - 88%) based on PCR typing of 30 Type I (coding gene) and 25 Type II (microsatellite) markers. Using the composite *Mus* map, Type I markers were selected from six *Mus* chromosomes, 22 of which are on *Mus* Chr 11. Fifteen of the *Mus* Chr 11 markers were simultaneously mapped on an interspecific (*P. maniculatus* x *P. polionotus*) backcross panel to test the utility of the radiation hybrid panel, create a framework map, and help establish gene order. The radiation hybrids have effectively detected linkage in the deer mouse genome between markers as far apart as 6.7 cM and resolved markers that are, in the *Mus* genome, as close as 0.2 Mb. Combined results from both panels have indicated a high degree of gene order conservation of the telomeric 64 cM of *Mus* Chr 11 in the deer mouse genome. The remaining centromeric portion also shows gene order conservation with the deer mouse but as a separate linkage group. This indicates a translocation of that portion of *Mus* Chr 11 in *P. maniculatus* and is consistent with rearrangement breakpoints observed between *Mus* and other mammalian genomes, including rat and human. Furthermore, this separate linkage group is likely to reside in a chromosomal region of inversion polymorphism between *P. maniculatus* and *P. polionotus*.

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### **Circling behavior by a wild mouse (*Peromyscus* sp.) in a natural environment**

On 9 June 2005, in McKean County of north-central Pennsylvania, a white-footed (*Peromyscus leucopus*) or deer mouse (*P. maniculatus*) was observed at 2230 h eating a Junebug (*Phyllophaga* sp.) in a woodland habitat. After eating the insect, the mouse began to circle counter-clockwise as though chasing its tail. The mouse would circle for several minutes, fall on its side for several seconds, and then resume circling. A Junebug was thrown to the mouse at about midnight. It stopped circling, ate the insect, and then resumed circling. It was still circling at about 0230 h when we left the site. Digital photographs and a movie clip of the behavior are available upon request (movie inserted on last page).

There is some normal level of circling by *Peromyscus* (Glick and Cox 1978; Turner 2002, 2003). The *Peromyscus* Genetic Stock Center, University of South Carolina web page (<http://stkctr.biol.sc.edu/index.html>) states “. . . they exhibit many activities and routines of circling, jumping, climbing, etc.” However, based on our experience, and that of other field biologists, this behavior was atypical. We believe the behavior was detrimental to the individual, making it susceptible to predation. However, Stephen Vessey (Bowling Green State Univ., pers. comm.) indicated he has occasionally seen white-footed mice circle upon release from live-traps. He described one mouse that circled for several minutes before gaining cover, and this mouse was recaptured and appeared normal the following night. Herein, we list some possible causes of the circling behavior we observed and its' most likely cause.

First, there are the "dancing mice" (*Mus musculus*) with inner ear abnormalities. Circling by these mice is a well-established phenomenon, and a strain has been bred that exhibits this specific behavior. One or more genetic mutations can cause this behavior. Wimstead (2000) chronicles 60 years of studies of a strain developed from a single mouse in 1938 (Grüneberg et al. 1941). This single point mutation causes hair cells in the inner ear to send false signals to the brain telling the animal it is falling or circling, and the animal compensates by circling in the opposite direction (Zheng et al. 2000). Circling may also be caused by defects in the lateral semicircular canal (Cyns et al. 2004).

Hypothyroidism sometimes causes circling behavior. A single point mutation results in a defective thyroid-stimulating hormone receptor, and thus a non-functional thyroid gland. About 25% of animals homozygous for this trait exhibit circling behavior (Kincaid 2001). However, the most severely affected circled only 6 times in 5 minutes.



Third, damage or lesions to parts of the brain (cerebellar, vestibular, cortical, superior collicular systems, and probably others) can result in circling behavior in mice. Glick and Cox (1978) found that lesions to the nigrostriatal areas temporarily increased turning activity.

Another cause suggested to us was acute toxicity, from substances ingested, absorbed, or inhaled, either natural or as environmental contaminants. However, we could not find published accounts where circling behavior was attributed to such exposure.

Finally, disease or pathogens are possible causes for the observed behavior. Although there are many possibilities, Lyme disease and infection from raccoon roundworm (*Baylisascaris procyonis*) larva are likely causes. Lyme disease, caused by a spirochete bacterium, *Borrelia burgdorferi*, is transmitted through the bite of infected ticks. The white-footed mouse is an important reservoir of the bacterium. However, Brian Underwood (State Univ. NY, pers. comm.) indicated Lyme disease is asymptomatic in white-footed mice. In contrast, infection with the raccoon roundworm is not. Kristen Page (Wheaton College, pers. comm.) indicated the behavior we observed is similar to symptoms caused by raccoon roundworm infection in *Peromyscus* and other vertebrates. Specifically, as the roundworm larvae moves through the brain, a mouse will start circling in one direction but will switch direction as the larvae enters the other hemisphere. Symptoms start with a head tilt, then walking or running in a circle, and finally circling with the mouse on its side. During this time, the animal can still feed. It is possible that brain damage caused by the larva is similar to the types of brain damage noted earlier.

Infection with raccoon roundworm larvae seems like the most plausible explanation for the behavior of the mouse we observed. Sheppard and Kazacos (1997) reported that the white-footed mouse was susceptible to infection (57% of test individuals), although at a rate lower than the house mouse (93%). This parasite is implicated in population declines of the Allegheny woodrat (*Neotoma magister*) in portions of its range in the eastern United States (Logiudice 2004). In Indiana, where woodrat populations are reduced from historic levels, an infected female was found in the field (Scott Johnson, Indiana Dep. Nat. Resour., pers. commun.). We suggest cautious concern for problems this parasite can cause, and that field researchers search for additional cases of circling animals. If encountered, animals should be collected using proper safety precautions and tested for raccoon roundworm larvae.

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## LITERATURE CITED

- Cyns, K., A. M. Van Alphen, M. P. Van Spaendonck, P. H. Van De Heyning, J. Timmermans, C. I. De Zeeuw, and G. Van Camp. 2004. Circling behavior in the *Ecl* mouse is caused by lateral semicircular canal defects. *The Journal of Comparative Neurology* 468:587-595.
- Glick, S. D., and R. D. Cox. 1978. Nocturnal rotation in normal rats: correlation with amphetamine-induced rotation and effect of nigrostriatal lesions. *Brain Research* 150:149-161.
- Grüneberg, H., J. B. Burnett, and G. D. Snell. 1941. The origin of jerker, a new gene mutation of the house mouse, and linkage studies made with it. *Proceedings of the National Academy of Science* 27:562-565.
- Kincaid, A. E. 2001. Spontaneous circling behavior and dopamine neuron loss in a genetically hypothyroid mouse. *Neuroscience* 4:8981-898.
- Logiudice, K. 2004. Trophically transmitted parasites and the conservation of small populations: raccoon roundworm and the imperiled Allegheny woodrat. *Conservation Biology* 17:258-266.
- Sheppard, C. H., and K. R. Kazacos. 1997. Susceptibility of *Peromyscus leucopus* and *Mus musculus* to infection with *Baylisascaris procyonis*. *Journal of Parasitology* 83:1104-1111.
- Turner, C. A., M. H. Lewis, and M. A. King. 2003. Environmental enrichment: effects of stereotyped behavior and dendritic morphology. *Developmental Psychobiology* 43:20-27.
- Turner, C. A., M. C. Yang, and M. H. Lewis. 2002. Environmental enrichment: effects of stereotyped behavior and regional neuronal metabolic activity. *Brain Research* 938:15-21.
- Wimstead, W. R. 2000. Why dervishes whirl. *Genome News Network*, J. Craig Venter Institute on-line publication [www.genomenewsnetwork.org/articles/08\\_00/dervishes\\_whirl.shtml](http://www.genomenewsnetwork.org/articles/08_00/dervishes_whirl.shtml).
- Zheng, L., G. Sekerkova, K. Vranich, L. G. Tilney, E. Mugnaini, and J. R. Bartles. 2000. The deaf jerker mouse has a mutation in the gene encoding the espin actin-bundling proteins of hair cell stereocilia and lacks espins. *Cell* 102:377-385.



## **ADDENDUM: Circling Mouse Video**

Click on the video to start.

Video may not be viewable without QuickTime installed.

To download a free copy of QuickTime visit

<http://www.apple.com/quicktime/download/standalone.html>.



## RECENT PUBLICATIONS

- Anthony, N. M., C. A. Ribic, R. Bautz, and T. Garland. 2005. Comparative effectiveness of Longworth and Sherman live traps. *Wildlife Soc. Bull.*, 33:1018-1026.
- Arjo, W. M., K. K. Wagner, D. L. Nolte, R. S. Stahl, and J. J. Johnston. 2006. Rotential non-target risks from strychnine-containing rodent carcasses. *Crop. Protect.*, 25:183-187.
- Artacho, P., L. E. Castaneda, and R. F. Nespolo. 2005. The role of quantitative genetic studies in animal physiological ecology. *Rev. Chilena de Hist. Nat.*, 78:161-167.
- Avigdor, M., S. D. Sullivan, and P. D. Heideman. 2005. Response to selection for photoperiod responsiveness on the density and location of mature GnRH-releasing neurons. *Am. J. Physiol.-Reg. Integrative Comp. Physiol.*, 288:R1226-R1236.
- Baumgardner, D. J., R. Summerbell, S. Krajdien, I. Alexopoulou, B. Agrawal, M. Bergeson, M. Fuksa, C. Bemis, and M. A. Baumgardner. 2005. Attempted isolation of *Blastomyces dermatitidis* from native shrews in northern Wisconsin, USA. *Med. Mycol.*, 43:413-416.
- Bender, D. J. and L. Fahrig. 2005. Matrix structure obscures the relationship between interpatch movement and patch size and isolation. *Ecology*, 86:1023-1033.
- Bennett, R. S., I. C. Dewhurst, A. Fairbrother, A. D. M. Hart, M. J. Hooper, A. Leopold, P. Mineau, S. R. Mortensen, R. F. Shore, and T. A. Springer. 2005. A new interpretation of avian mammalian reproduction toxicity test data in ecological risk assessment. *Ecotoxicology*, 14:801-815.
- Bester-Meredith, J. K., P. A. Martin, and C. A. Marler. 2005. Manipulations of vasopressin alter aggression differently across testing condition in monogamous and nonmonogamous *Peromyscus* mice. *Aggressive Behav.*, 31:189-199.
- Block, W. M., J. L. Ganey, P. E. Scott, and R. King. 2005. Prey ecology of Mexican spotted owls in pine-oak forests of northern Arizona. *J. Wildlife Manage.*, 69:618-629.
- Brannon, M. P. 2005. Distribution and microhabitat of the woodland jumping mouse, *Napaeozapus insignis*, and the white-footed mouse, *Peromyscus leucopus*, in the Southern Appalachians. *Southeast Nat.*, 4:479-486.
- Bravo-Vinaja, M. G., L. A. Tarango-Arambula, F. Clemente-Sanchez, and G. D. Mendoza-Martinez. 2005. Mexican spotted owls (*Strix occidentalis lucida*) diet composition and variation at Valparaiso, Zacatecas, Mexico. *Agrociencia*, 39:509-515.

- Brinkerhoff, R. J., N. M. Haddad, and J. L. Orrock. 2005. Corridors and olfactory predator cues affect small mammal behavior. *J. Mammal.*, 86:662-669.
- Brittan, C. M., G. J. Forbes, and J. Bowman. 2005. Significance of *Blarina brevicauda* as a predator and source of trap-capture bias on small mammals. *J. Mammal.*, 86:606-609.
- Bunikis, J. and A. G. Barbour. 2005. Third *Borrelia* species in white-footed mice. *Emerg. Infect. Dis.*, 11:1150-1151.
- Burns, C. E. 2005. Behavioral ecology of disturbed landscapes: the response of territorial animals to relocation. *Behav. Ecol.*, 16:898-905.
- Burns, C. E., B. J. Goodwin, and R. S. Ostfeld. 2005. A prescription for longer life? Bot fly parasitism of the white-footed mouse. *Ecology*, 86:753-761.
- Calisher, C. H., J. N. Mills, W. P. Sweeney, J. J. Root, S. A. Reeder, E. S. Jentes, K. Wagoner, and B. J. Beaty. 2005. Population dynamics of a diverse rodent assemblage in mixed grass-shrub habitat, southeastern Colorado, 1995-2000. *J. Wildl. Dis.*, 41:12-28.
- Calisher, C. H., J. J. Root, J. N. Mills, J. E. Rowe, S. A. Reeder, E. S. Jentes, K. Wagoner, and B. J. Beaty. 2005. Epizootiology of Sin Nombre and El Moro Canyon hantaviruses, southeastern Colorado, 1995-2000. *J. Wildl. Dis.*, 41:1-11.
- Cantrell, M. A., M. M. Ederer, I. K. Erickson, V. J. Swier, R. J. Baker, and H. A. Wichman. 2005. MysTR: an endogenous retrovirus family in mammals that is undergoing recent amplifications to unprecedented copy numbers. *J. Virol.*, 79:14698-14707.
- Caporale, D. A., C. M. Johnson, and B. J. Millard. 2005. Presence of *Borrelia burgdorferi* (Spirochaetales: spirochaetaceae) in southern Kettle Moraine State Forest, Wisconsin, and characterization of strain W97F51. *J. Med. Entomol.*, 42:457-472.
- Carleton, M. D. and T. E. Lawlor. 2005. *Peromyscus* from Santa Catalina Island, Sea of Cortez, Mexico: taxonomic identities and biogeographic implications. *J. Mammal.*, 86:814-825.
- Caro, T. 2005. The adaptive significance of coloration in mammals. *Bioscience*, 55:125-136.
- Chelini, M. O. M., N. L. Souza, A. M. Rocha, E. C. G. Felipe, and C. A. Oliveira. 2005. Quantification of fecal estradiol and progesterone metabolites in Syrian hamsters (*Mesocricetus auratus*). *Braz. J. Med. Biol. Res.*, 38:1711-1717.

- Chirhart, S. E., R. L. Honeycutt, and I. F. Greenbaum. 2005. Microsatellite variation and evolution in the *Peromyscus maniculatus* species group. *Mol. Phylogene. Evol.*, 34:408-415.
- Christopher, Cory C. and G. W. Barrett. 2006. Coexistence of white-footed mice (*Peromyscus leucopus*) and golden mice (*Ochrotomys nuttalli*) in a southeastern forest. *J. Mamm.* 87:102-107.
- Christova, I. and T. Gladnishka. 2005. Prevalence of infection with *Francisella tularensis*, *Borrelia burgdorferi* sensu lato and *Anaplasma phagocytophilum* in rodents from an endemic focus of tularemia in Bulgaria. *Ann. Ag. Environ. Med.*, 12:149-152.
- Clark, J. E., E. C. Hellgren, J. L. Parsons, E. E. Jorgensen, D. M. Engle, and D. M. Leslie. 2005. Nitrogen outputs from fecal and urine deposition of small mammals: implications for nitrogen cycling. *Oecologia*, 144:447-455.
- Cole, J. S., M. Sabol-Jones, B. Karolewski, and T. Byford. 2005. *Ornithonyssus bacoti* infestation and elimination from a mouse colony. *Contemp. Topics Lab. Anim. Sci.*, 44:27-30.
- Coleman, J. L., D. LeVine, C. Thill, C. Kuhlow, and J. L. Benach. 2005. *Babesia microti* and *Borrelia burgdorferi* follow independent courses of infection in mice. *J. Infect. Dis.*, 192:1634-1641.
- Connors, M. J., E. M. Schaubert, A. Forbes, C. G. Jones, B. J. Goodwin, and R. S. Ostfeld. 2005. Use of track plates to quantify predation risk at small spatial scales. *J. Mammal.*, 86:991-996.
- Constantine, N. L., T. A. Campbell, W. M. Baughman, T. B. Harrington, B. R. Chapman, and K. V. Miller. 2005. Small mammal distributions relative to corridor edges within intensively managed southern pine plantations. *South. J. Applied For.*, 29:148-151.
- Derting, T. L. and M. K. Virk. 2005. Positive effects of testosterone and immunochallenge on energy allocation to reproductive organs. *J. Comp. Physiol. B-Biochem. System. Environ. Physiol.*, 175:543-556.
- Deyde, V., A. Rizvanov, E. Otteson, S. Brandt, M. Bego, G. Pari, T. Kozel, and S. St. Jeor. 2005. Identification of a monoclonal antibody from *Peromyscus maniculatus* (deer mouse) cytomegalovirus (PCMV) which binds to a protein with homology to the human CMV matrix protein HCMV pp71. *J. Virol. Methods*, 123:9-15.
- Duselis, A. R., C. D. Wiley, M. J. O'Neill, and P. B. Vrana. 2005. Genetic evidence for a maternal effect locus controlling genomic imprinting and growth. *Genesis*, 43:155-165.

- Ellis, J. A., A. D. Walter, J. F. Tooker, M. D. Ginzel, P. F. Reagel, E. S. Lacey, A. B. Bennett, E. M. Grossman, and L. M. Hanks. 2005. Conservation biological control in urban landscapes: manipulating parasitoids of bagworm (Lepidoptera: Psychidae) with flowering forbs. *Biol. Control*, 34:99-107.
- Espeland, E. K., T. M. Carlsen, and D. Macqueen. 2005. Fire and dynamics of granivory on a California grassland forb. *Biodiversity Conserv.*, 14:267-280.
- Evans, J. A., J. A. Elliott, and M. R. Gorman. 2005. Circadian entrainment and phase resetting differ markedly under dimly illuminated versus completely dark nights. *Behav. Brain Res.*, 162:116-126.
- Fantz, D. K. and R. B. Renken. 2005. Short-term landscape-scale effects of forest management on *Peromyscus* spp. Mice within Missouri Ozark forests. *Wildlife Soc. Bull.*, 33:293-301.
- Feng, Z. L., R. Swihart, Y. F. Yi, and H. P. Zhu. 2004. Coexistence in a metapopulation model with explicit local dynamics. *Math. Biosci. Engin.*, 1:131-145.
- Fisher, J. T. and L. Wilkinson. 2005. The response of mammals to forest fire and timber harvest in the North American boreal forest. *Mammal. Review*, 35:51-81.
- Geiser, F., B. S. Law, and G. Kortner. 2005. Daily torpor in relation to photoperiod in a subtropical blossom-bat, *Syconycteris australis* (Megachiroptera). *J. Thermal Biol.*, 30:574-579.
- Geluso, K. 2005. Benefits of small-sized cached for scatter-hoarding rodents: influence of cache size, depth, and soil moisture. *J. Mammal.*, 86:1186-1192.
- Ginsberg, H. S., P. A. Buckley, M. G. Balmforth, E. Zhioua, S. Mitra, and F. G. Buckley. 2005. Reservoir competence of native North American birds for the Lyme disease spirochete, *Borrelia burgdorferi*. *J. Med. Entomol.*, 42:445-449.
- Giuggioli, L., G. Abramson, V. M. Kenkre, G. Suzan, E. Marce, and T. L. Yates. 2005. Diffusion and home range parameters from rodent population measurements in Panama. *Bull. Math. Biol.*, 67:1135-1149.
- Glasper, E. R. and A. C. DeVries. 2005. Social structure influences effects of pair-housing on wound healing. *Brain, Behav., Immun.*, 19:61-68.
- Gonzalez-Ruiz, N., S. T. Alvarez-Castaneda, and T. Alvarez. 2005. Distribution, taxonomy, and conservation status of the Perote mouse *Peromyscus bullatus* (Rodentia: Muridae) in Mexico. *Biodiv. Conserva.*, 14:3423-3436.

- Good, T. C., K. K. Harris, and C. A. Ihunnah. 2005. Corticosteroids as potential mechanism regulating variability in reproductive success in monogamous oldfield mice (*Peromyscus polionotus*). *Physiol. Behav.*, 86:96-102.
- Goodwin, B. J., C. G. Jones, E. M. Schaubert, and R. S. Ostfeld. 2005. Limited dispersal and heterogeneous predation risk synergistically enhance persistence of rare prey. *Ecology*, 86:3139-3148.
- Grahn, R. A., T. A. Rinehart, M. A. Cantrell, and H. A. Wichman. 2005. Extinction of LINE-1 activity coincident with a major mammalian radiation in rodents. *Cytogene. Genome Res.*, 110:407-415.
- Haas, J. P. and E. J. Heske. 2005. Experimental study of the effects of mammalian acorn predators on red oak acorn survival and germination. *J. Mammal.*, 86:1015-1021.
- Hahn, M. E. and M. J. Lavooy. 2005. A review of the methods of studies on infant ultrasound production and maternal retrieval in small rodents. *Behav. Gene.*, 35:31-52.
- Hahn, N., R. J. Eisen, L. Eisen, and R. S. Lane. 2005. Ketamine-medetomidine anesthesia with atipamezole reversal: practical anesthesia for rodents under field conditions. *Lab Animal*, 34:48-51.
- Heideman, P. D., M. Rightler, and K. Sharp. 2005. A potential microevolutionary life-history trade-off in white-footed mice (*Peromyscus leucopus*). *Funct. Ecol.*, 19:331-336.
- Homyack, J. A., D. J. Harrison, and W. B. Krohn. 2005. Long-term effects of precommercial thinning on small mammals in northern Maine. *For. Ecol. Manage.*, 205:43-57.
- Hornbostel, V. L., R. S. Ostfeld, and M. A. Benjamin. 2005. Effectiveness of *Metarhizium anisopliae* (Deuteromycetes) against *Ixodes scapularis* (Acari : Ixodidae) engorging on *Peromyscus leucopus*. *J. Vect. Ecol.*, 30:91-101.
- Horncastle, V. J., E. C. Hellgren, P. M. Mayer, A. C. Ganguli, D. M. Engle, and D. M. Leslie. 2005. Implications of invasion by *Juniperus virginiana* on small mammals in the southern Great Plains. *J. Mammal.*, 86:1144-1155.
- Jaffe, G., D. A. Zegers, M. A. Steele, and J. F. Merritt. 2005. Long-term patterns of botfly parasitism in *Peromyscus maniculatus*, *P. leucopus*, and *Tamias striatus*. *J. Mammal* 86:39-45.



- Jonsson, C. B., B. G. Milligan, and J. B. Arterburn. 2005. Potential importance of error catastrophe to the development of antiviral strategies for hantaviruses. *Virus Res.*, 107:195-205.
- Kavaliers, M., D. D. Colwell, and E. Choleris. 2005. Kinship, familiarity and social status modulate social learning about "micropredators" (biting flies) in deer mice. *Behav. Ecol. Sociobiol.*, 58:60-71.
- Kelsey-Wall, A., J. C. Seaman, C. H. Jagoe, C. E. Dallas, and K. F. Gaines. 2005. Rodents as receptor species at a tritium disposal site. *J. Environ. Radioactivity*, 82:95-104.
- Konarzewski, M., A. Ksiazek, and I. B. Lapo. 2005. Artificial selection on metabolic rates and related traits in rodents. *Integrat. Comp. Biol.*, 45:416-425.
- Kramer, D. A. 2005. Commentary: gene-environment interplay in the context of genetics, epigenetics, and gene expression. *J. Am. Acad. Child Adolesc. Psychiatry*, 44:19-27.
- Kramer, K. M., Y. Yamamoto, G. E. Hoffman, and B. S. Cushing. 2005. Estrogen receptor  $\alpha$  and vasopressin in the paraventricular nucleus of the hypothalamus in *Peromyscus*. *Brain Res.*, 1032:154-161.
- Kremen, C. and R. S. Ostfeld. 2005. A call to ecologists: measuring, analyzing, and managing ecosystem services. *Front. Ecol. Environ.*, 3:540-548.
- Kuenzi, A. J., R. J. Douglass, C. W. Bond, C. H. Calisher, and J. N. Mills. 2005. Long-term dynamics of Sin Nombre viral RNA and antibody in deer mice in Montana. *J. Wildlife Dis.*, 41:473-481.
- Liebhold, A. M., K. F. Raffa, and A. L. Diss. 2005. Forest type affects predation on gypsy moth pupae. *Ag. For. Entomol.*, 7:179-185.
- Liu, L. and P. S. F. Yip. 2005. Proportional trapping-removal models with contaminated data. *J. Stat. Plan. Inference*, 127:131-142.
- Mahan, C. G. and T. J. O'Connell. 2005. Small mammal use of suburban and urban parks in central Pennsylvania. *Northeast. Nat.*, 12:307-314.
- Margulis, S. W., M. Nabong, G. Alaks, A. Walsh, and R. C. Lacy. 2005. Effects of early experience on subsequent parental behaviour and reproductive success in oldfield mice, *Peromyscus polionotus*. *Anim. Behav.*, 69:627-634.
- Maul, J. D. P. C. Smiley, Jr. and C. M. Cooper. 2005. Patterns of avian nest predators and a brood parasite among restored riparian habitats in agricultural watersheds. *Environ. Monitoring and Assess.*, 108:133-150.

- McIntyre, N. E., Y. K. Chu, R. D. Owen, A. Abuzeineh, N. de la Sancha, C. W. Dick, T. Holsomback, R. A. Nisbett, and C. Jonsson. 2005. A longitudinal study of Bayou virus, hosts, and habitat. *Am. J. Trop. Med. Hygiene*, 73:1043-1049.
- Moore, J. E. and R. K. Swihart. 2005. Modeling patch occupancy by forest rodents: incorporating detectability and spatial autocorrelation with hierarchically structured data. *J. Wildlife Manage.*, 69:933-949.
- Morris, D. W. 2005. Paradoxical avoidance of enriched habitats: have we failed to appreciate omnivores? *Ecology*, 86:2568-2577.
- Moser, A. M. and J. T. Ratti. 2005. Value of riverine islands to nongame birds. *Wildlife Soc. Bull.*, 33:273-284.
- Motameni, A-R. T., T. C. Bates, I. J. Juncadella, C. Petty, M. N. Hedrick, and J. Anguita. 2005. Distinct bacterial dissemination and disease outcome in mice subcutaneously infected with *Borrelia burgdorferi* in the midline of the back and the footpad. *FEMS Immunol. And Med. Microbiol.*, 45:279-284.
- Noel, S., B. Angers, and F. J. Lapointe. 2005. *Peromyscus* populations and their *Cuterbra* parasites display congruent phylogeographical structure. *Parasitol.*, 131:237-245.
- Ogden, N. H., A. Maarouf, I. K. Barker, M. Bigras-Poulin, L. R. Lindsay, M. G. Morshed, C. J. O'Callaghan, F. Ramay, D. Waltner-Toews, and D. F. Charron. 2006. Climate change and the potential for range expansion of the Lyme disease vector *Ixodes scapularis* in Canada. *Int. J. Parasitol.*, 36:63-70.
- Orrock, J. L. and B. J. Danielson. 2005. Patch shape, connectivity, and foraging by oldfield mice (*Peromyscus polionotus*). *J. Mammal.*, 86:569-575.
- Ortiz, S., K. A. Hammond, and R. A. Cardullo. 2004. The effects of high altitude on skeletal muscle enzyme capacity in deer mice, *Peromyscus maniculatus*. *Integra. Comp. Biol.*, 44:733.
- Oyegbile, T. O. and C. A. Marler. 2005. Winning fights elevates testosterone levels in California mice and enhances future ability to win fights. *Hormones Behav.*, 48:259-267.
- Padgett, K. A. and W. M. Boyce. 2005. Ants as first intermediate hosts of *Mesocestoides* on San Miguel Island, USA. *J. Helminthol.*, 79:67-73.
- Parnell, P. G., J. P. Crossland, R. M. Beattie, and M. J. Dewey. 2005. Frequent Harderian gland adenocarcinomas in inbred white-footed mice (*Peromyscus leucopus*). *Comp. Med.*, 55:382-386.

- Pauli, B. D. and S. W. Kennedy. 2005. Hepatic porphyria induced by the herbicide *Tralkoxydim* in small mammals is species-specific. *Environ. Toxicol. Chem.*, 24:450-456.
- Pearce, J. and L. Venier. 2005. Small mammals as bioindicators of sustainable boreal forest management. *For. Ecol. Manage.*, 208:153-175.
- Pearson, D. E. and R. M. Callaway. 2005. Indirect nontarget effects of host-specific biological control agents: implications for biological control. *Biol. Control*, 35:288-298.
- Pennisi, E. 2005. Evolution 2005 Meeting: color genes help mice and lizards. *Science*, 309:374-375.
- Pergams, O. R. W. and D. W. Nyberg. 2005. Evaluating the predicted local extinction of a once-common mouse. *Conserve. Biol.*, 19:1312-1317.
- Perry, R. W. and R. E. Thill. 2005. Small-mammal responses to pine regeneration treatments in the Ouachita Mountains of Arkansas and Oklahoma, USA. *For. Ecol. Manage.*, 219:81-94.
- Porcella, S. F., S. J. Raffel, D. E. Anderson, Jr., S. D. Gilk, J. L. Bono, M. E. Schrupf, and T. G. Schwan. 2005. Variable tick protein in two genomic groups of the relapsing fever spirochete *Borrelia hermsii* in western North America. *Infect. And Immunity*, 73:6647-6658.
- Porcher, E. and R. Lande. 2005. Loss of gametophytic self-incompatibility with evolution of inbreeding depression. *Evolution*, 59:46-60.
- Potringer, M. 2005. Hantavirus in Indian country: the first decade in review. *Am. Indian Culture Res. J.*, 29:35-56.
- Prescott, J., C. Y. Ye, G. Sen, and B. Hjelle. 2005. Induction of innate immune response genes by Sin Nombre hantavirus does not require viral replication. *J. Virol.*, 79:15007-15015.
- Presti, M. F. and M. H. Lewis. 2005. Striatal opioid peptide content in an animal model of spontaneous stereotypic behavior. *Behav. Brain Res.*, 157:363-368.
- Pulido-Flores, G., S. Moreno-Flores, and S. Monks. 2005. Helminths of rodents (Rodentia: Muridae) from Metztlán, San Cristobal, and Rancho Santa Elena, Hidalgo, Mexico. *Comp. Parasitol.*, 72:186-192.

- Pyter, L. M., A. K. Hotchkiss, and R. J. Nelson. 2005. Photoperiod-induced differential expression of angiogenesis genes in testes of adult *Peromyscus leucopus*. *Reproduction*, 129:201-209.
- Pyter, L. M., G. N. Neigh, and R. J. Nelson. 2005. Social environment modulates photoperiodic immune and reproductive responses in adult male white-footed mice (*Peromyscus leucopus*). *Am. J. Physiol.-Reg. Integrative Comp. Physiol.*, 288:R891-R896.
- Pyter, L. M. and R. J. Nelson. 2005. Effects of photoperiod on hippocampal neurogenesis in adult *Peromyscus leucopus*. *Hormones Behav.*, 48:121.
- Pyter, L. M., B. F. Reader, and R. J. Nelson. 2005. Short photoperiods impair spatial learning and alter hippocampal dendritic morphology in adult male white-footed mice (*Peromyscus leucopus*). *J. Neurosci.*, 25:4521-4526.
- Pyter, L. M., Z. M. Weil, and R. J. Nelson. 2005. Latitude affects photoperiod-induced changes in immune response in meadow voles (*Microtus pennsylvanicus*). *Can. J. Zool.*, 83:1271-1278.
- Ramsdell, C. M., E. L. Thames, J. L. Weston, and M. J. Dewey. 2006. Development of a deer mouse whole-genome radiation hybrid panel and comparative mapping of *Mus* chromosome 11 loci. *Mammal. Genome*, 17:37-48.
- Randa, L. A. and J. A. Yunger. 2004. The influence of prey availability and vegetation characteristics on scent station visitation rates of coyotes, *Canis latrans*, in a heterogeneous environment. *Can. Field-Nat.*, 118:341-353.
- Rauter, C., M. Mueller, I. Diterich, S. Zeller, D. Hassler, T. Meergans, and T. Hartung. 2005. Critical evaluation of urine-based PCR assay for diagnosis of Lyme borreliosis. *Clin. Diag. Lab. Immunol.*, 12:910-917.
- Reed, A. W., G. A. Kaufman, and D. W. Kaufman. 2005. Rodent seed predation and GUDs: effect of burning and topography. *Can. J. Zool.*, 83:1279-1285.
- Rezende, E. L., F. R. Gomes, C. K. Ghalambor, G. A. Russell, and M. A. Chappell. 2005. An evolutionary frame of work to study physiological adaptation to high altitudes. *Rev. Chilena de Hist. Nat.*, 78:323-336.
- Rinehart, T. A., R. A. Grahn, and H. A. Wichman. 2005. SINE extinction preceded LINE extinction in sigmodontine rodents: implications for retrotranspositional dynamics and mechanisms. *Cytogenet. Genome Res.*, 110:416-425.

- Rizvanov, A. A., S. F. Khaiboullina, A. G. M. van Geelen, and S. C. St. Jeor. 2006. Replication and immunoactivity of the recombinant *Peromyscus maniculatus* cytomegalovirus expressing hantavirus G1 glycoprotein in vivo and invitro. *Vaccine*, 24:327-334.
- Romo-Vazquez, E., L. Leon-Paniagua, and O. Sanchez. 2005. A new species of *Habromys* (Rodentia: Neotominae) from Mexico. *Proc. Biol. Soc. WA*, 118:605-618.
- Root, J. J., J. S. Hall, R. G. Mclean, N. L. Marlenee, B. J. Beaty, J. Gansowski, and L. Clark. 2005. Serologic evidence of exposure of wild mammals to flaviviruses in the central and eastern United States. *Am. J. Trop. Med. Hyg.*, 72:622-630.
- Root, J. J., K. R. Wilson, C. H. Calisher, K. D. Wagoner, K. D. Abbott, T. L. Yates, A. J. Kuenzi, M. L. Morrison, J. N. Mills, and B. J. Beaty. 2005. Spatial clustering of murid rodents infected with hantaviruses: implications from meta-analyses. *Ecol. Applica.*, 15:565-574.
- Rosa, P. 2005. Lyme disease agent borrows a practical coat. *Nat. Med.*, 11:831-832.
- Roth, J. K. and S. B. Vander Wall. 2005. Primary and secondary seed dispersal of bush chinquapin (Fagaceae) by scatterhoarding rodents. *Ecology*, 86:2428-2439.
- Rowe, R. K. and A. Pekosz. 2006. Bidirectional virus secretion and nonciliated cell tropism following Andes virus infection of primary airway epithelial cell cultures. *J. Virol.*, 80:1087-1097.
- Russell, G. A., K. A. Hammond, and R. A. Cardullo. 2004. Effects of development at high altitude: aerobic metabolism in the deer mouse, *Peromyscus maniculatus*. *Integra. Comp. Biol.*, 44:633.
- Safronetz, D., R. Lindsay, A. Dibernardo, B. Hjelle, R. B. Xiao, H. Artsob, and M. A. Drebot. 2005. A preliminary study of the patterns of Sin Nombre viral infection and shedding in naturally infected deer mice (*Peromyscus maniculatus*). *Vector-Borne Zoo. Dis.*, 5:127-132.
- Schauber, E. M., R. S. Ostfeld, and A. S. Evans. 2005. What is the best predictor of annual Lyme disease incidence: weather, mice, or acorns? *Ecol. Applica.*, 15:575-586.
- Schmidt, J., H. Meisel, B. Hjelle, D. H. Kruger, and R. Ulrich. 2005. Development and evaluation of serological assays for detection of human hantavirus infections caused by Sin Nombre virus. *J. Clin. Virol.*, 33:247-253.

- Schmidt, J., H. Meisel, S. G. Capria, R. Petraityte, A. Lundkvist, B. Hjelle, P. A. Vial, P. Padula, D. H. Kruger, and R. Ulrich. 2006. Serological assays for the detection of human Andes hantavirus infections based on its yeast-expressed nucleocapsid protein. *Intervirology*, 49:173-184.
- Schmidt, K. A., R. Manson, and D. Lewis. 2005. Voles competing with mice: differentiating exploitative, interference and apparent competition using patch use theory. *Evol. Ecol. Res.*, 7:273-286.
- Schmidt, K. A., L. C. Nelis, N. Briggs, and R. S. Ostfeld. 2005. Invasive shrubs and songbird nesting success: effects of climate variability and predator abundance. *Ecol. Appl.*, 15:258-265.
- Schulze, T. L., R. A. Jordan, and C. J. Schulze. 2005. Host associations of *Ixodes scapularis* (Acari: ixodidae) in residential and natural settings in a Lyme disease-endemic area in New Jersey. *J. Med. Entomol.*, 42:966-973.
- Schulte-Hostedde, A. I., B. Zinner, J. S. Millar, and G. J. Hickling. 2005. Restitution of mass-size residuals: validating body condition indices. *Ecology*, 86:155-163.
- Schwartz, M. K. and L. S. Mills. 2005. Gene flow after inbreeding leads to higher survival in deer mice. *Biol. Conserv.*, 123:413-420.
- Scott, M. E., O. K. Dare, T. Tu, and K. G. Koski. 2005. Mild energy restriction alters mouse-nematode transmission dynamics in free-running indoor arenas. *Can. J. Zool.*, 83:610-619.
- Shi, W., A. Krella, A. Orth, Y. Yu, and R. Fundele. 2005. Widespread disruption of genomic imprinting in adult interspecies mouse (*Mus*) hybrids. *Genesis*, 43:99-107.
- Shipp-Pennock, M. A., W. D. Webster, and D. W. Freshwater. 2005. Systematics of the whit-footed mouse (*Peromyscus leucopus*) in the mid-Atlantic region. *J. Mammal.*, 86:803-813.
- Shupe, J. M., D. M. Kristan, S. N. Austad, and D. L. Stenkamp. 2006. The eye of the laboratory mouse remains anatomically adapted for natural conditions. *Brain Behav. Evol.*, 67:39-52.
- Shurtliff, Q. R., D. E. Pearse, and D. S. Rogers. 2005. Parentage analysis of the canyon mouse (*Peromyscus crinitus*): evidence for multiple paternity. *J. Mammal.*, 86:531-540.
- Silva, M., L. Hartling, and S. B. Opps. 2005. Small mammals in agricultural landscapes of Prince Edward Island (Canada): effects of habitat characteristics at three different spatial scales. *Biol. Conserv.*, 126:556-568.

- Slade, N. A. and S. Crain. 2006. Impact on rodents of mowing strips in old fields of eastern Kansas. *J. Mamm.* 87:97-101.
- Smale, L., P. D. Heideman, and J. A. French. 2005. Behavioral neuroendocrinology in nontraditional species of mammals: things the 'knockout' mouse can't tell us. *Hormones Behav.*, 48:474-483.
- Smith J. N., X. P. Pan, A. Gentles, E. E. Smith, S. B. Cox, and G. E. Cobb. 2006. Reproductive effects of hexahydro-1,3,5-trinitroso-1,3,5-triazine in deer mice (*Peromyscus maniculatus*) during a controlled exposure study. *Environ. Toxicol. Chem.*, 25:446-451.
- Suazo, A. A., A. T. Delong, A. A. Bard, and D. M. Oddy. 2005. Repeated capture of beach mice (*Peromyscus polionotus phasma* and *P. p. niveiventris*) reduces body mass. *J. Mammal.*, 86:520-523.
- Sullivan, T. P., D. S. Sullivan, and E. J. Hogue. 2004. Population dynamics of deer mice, *Peromyscus maniculatus*, and yellow-pine chipmunks, *Tamias amoenus*, in old field and orchard habitats. *Can. Field-Nat.*, 118:299-308.
- Thayer, T. C. and S. B. Vander Wall. 2005. Interactions between Steller's jays and yellow pine chipmunks over scatter-hoarded sugar pine seeds. *J. Anim. Ecol.*, 74:365-374.
- Tischler, N. D., H. Galeno, M. Roseblatt, and P. D. T. Valenzuela. 2005. Human and rodent humoral immune responses to Andes virus structural proteins. *Virology*, 334:319-326.
- Tomback, D. F., A. W. Schoettle, K. E. Chevalier, and C. A. Jones. 2005. Life on the edge for limber pine: seed dispersal within a peripheral population. *Ecoscience*, 12:519-529.
- Trainor, B. C. and R. J. Nelson. 2005. Differential photoperiodic regulation of reproduction and aggression in two species of *Peromyscus*. *Hormon. Behav.*, 48:132.
- Turnbull, C. A., M. D. Dearing, and S. St. Jeor. 2004. Effects of species diversity on dynamics of Sin Nombre hantavirus in deer mice (*Peromyscus maniculatus*). *Integra. Comp. Biol.*, 44:654.
- Vander Wall, S. B., K. M. Kuhn, and J. R. Gworek. 2005. Two-phase seed dispersal: linking the effects of frugivorous birds and seed-caching rodents. *Oecologia*, 145:282-287.

- Vrana, P. B. 2006. Assays to determine allelic usage of gene expression in the placenta. *Method Mol. Med.*, 121:439-450.
- Wakano, J. Y. and Y. Ihara. 2005. Evolution of male parental care and female multiple mating: game-theoretical and two-locus diploid models. *Am. Nat.*, 166:E32-E44.
- Wall, S. B. V., E. C. H. Hager, and K. M. Kuhn. 2005. Pilfering of stored seeds and the relative costs of scatter-hoarding versus larder-hoarding in yellow pine chipmunks. *West. N. Am. Nat.*, 65:248-257.
- Webster, M. D., C. A. Cohrs, J. J. Eisenschenk, D. A. Olson, and A. M. Meuleners. 2004. Acclimation to heat in the cactus mouse, *Peromyscus eremicus*. *Integr. Comp. Biol.*, 44:760.
- Weston, J. L., C. M. Ramsdell, S. C. Napier, R. Bullard-Dillard, C. Braithwaite, H. Exeter, T. C. Glenn, and M. J. Dewey. 2004. Development of *Peromyscus* genomics. *Integr. Comp. Biol.*, 44:664.
- Wilder, S. M., A. M. Abtahi, and D. B. Meikle. 2005. The effects of forest fragmentation on densities of white-footed mice (*Peromyscus leucopus*) during the winter. *Am. Midl. Nat.*, 153:71-79.
- Wilder, S. M. and D. B. Meikle. 2005. Reproduction, foraging and the negative density-area relationship of a generalist rodent. *Oecologia*, 144:391-398.
- Wilder, S. M. and D. B. Meikle. 2006. Variation in effects of fragmentation on the white-footed mouse (*Peromyscus leucopus*) during the breeding season. *J. Mamm.* 87:117-123.
- Zollner, P. A. and S. L. Lima. 2005. Behavioral tradeoffs when dispersing across a patchy landscape. *Oikos*, 108:219-230.

