PEROMYSCUS NEWSLETTER

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COVER: Composite photo of white-footed mice (*Peromyscus leucopus*) of the LL Stock (see p. 7). Several animals were situated in a terrarium simulating a natural habitat. As the mice became more familiar with the setting, one or more would appear and be photographed. The photographs were then cleverly merged using the PhotoShop computer graphics program to give the appearance that there are five separate animals. In the photo some individuals may appear twice or more often, while others that were in the terrarium may not be represented. The background terrarium was constructed by Janet Crossland, and the photography and compositional editing were accomplished by Clint Cook, our in-house photographer and computer graphics specialist.

Welcome to Peromyscus Newsletter Number 35

* * * As *PN* enters its 18th year we are introducing a new feature. Beginning with this issue and in each issue thereafter we will showcase one of the stocks maintained by the Peromyscus Genetic Stock Center. The idea is to familiarize our readers with the particular types of research for which the selected stock may be especially useful. Inasmuch as *Peromyscus* is often viewed as genus of "wild" mice, wherever suitable we will direct the reader to specific research areas for which that stock may be ideal to examine natural behaviors, evolutionary processes and other phenomena in a lab setting amenable to experimental modification. The initial stock we are highlighting is the white-footed mouse, *Peromyscus leucopus,* represented in our Center by the LL ("*leucopus* Linville") Stock (p. 7).

* * * Also in this issue we have our annual update of peromyscine DNA sequences entered in GenBank during the preceding 12 months . Recall that at three year intervals *PN* publishes a "Genetics and Genome" issue at which time a catalog of all DNA sequences for peromyscines, as well as other genetic information, is updated. The most recent "G and G" issue was March 2001, and the next will be March 2004.

* * * As always, we invite researchers, including graduate students, to submit entries for *PN* describing on-going research and preliminary results. These are limited to two pages and no more than one figure or table. Entries will be treated as informal publications not subject to review, and not to be referenced by others without permission of the author. See recent issues of *PN* for examples. Entries may be mailed, e-mailed or FAXed.

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DEADLINE FOR ENTRIES FOR *PN#36* : 26 SEPTEMBER 03

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CONTENTS

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NEWS, COMMENT and ANNOUNCEMENTS

!!!!!!!! We are immensely pleased to announce that our very own **Janet Crossland** was recently recognized by the University of South Carolina College of Science and Mathematics as **Employee of the Year** from among several hundred non-faculty employees. **!!!!!!!**

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Two noteworthy recent papers should be of particular interest:

*** A new species of peromyscine, ***Habromys delicatulus***, was recently described by **Michael Carleton, Oscar Sanchez** and **Guillermina Urbano Vidales** in the Proceedings of the Biological Society of Washington (115:488-533. 2002). With the description of this new species and the elevation of *H. ixtlani* from subspecifc to specific status, the Genus *Habromys*, as now defined, contains six species. The paper discusses *Habromys* in relation to climatology and topography of southern Mexico, and further promotes the concept of southern Mexico as an incubator of peromyscine species.

*** The historical and phylogenetic implications of modern-day distributions of the sister species ***Peromyscus maniculatus* and *P. keeni* in the Pacific Northwest** are considered in a recent paper in *Molecular Ecology* authored by **Xiaoguang Zheng, Brian Arbogast** and **G. J. Kenagy** (Molecular Ecology,12:711-724. 2003). The study attempts to resolve historical scenarios of the differentiation of the two species. The species *P keeni,* representing a group of several *P. maniculatus*-like subspecies, formerly characterized as the "*oreas* complex", has been assumed to have been a late Pleistocene derivitive of *P. maniculatus*, but the historical chain of events and patterns of isolating glaciation have been an enigma. The authors' data suggests that the current sympatry in Washington state and British Columbia is likely the result of post-Pleistocene migration from the north by both species, but the southward migration P. maniculatus may represent a more recent, and secondary, extension of an overall northeastward migration. The species status of *P. sitkensis* is relevant to the question.

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We have received notices of two more retirements of peromyscine biologists. **Kevin A. Fox** has retired from the faculty of SUNY College-Fredonia NY and **John G. Vandenbergh** is soon retiring from the North Carolina State University faculty.

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The Peromyscus Genetic Stock Center since its inception in 1985 has supplied Peromyscus specimens to researchers in 42 US states, DC and PR. Animals and tissues have also been supplied to eight nations located on four continents (North America, Europe, Asia and Africa). We have provided about **14,900 Peromyscus specimens to date**, not including those used in-house. It is interesting to note in retrospect that, when we first submitted proposals to NSF and NIH, reviewers said there would be very little demand for lab-bred Peromyscus.

* * * * * *

Among those who have utilized the Peromyscus Stock Center and consistently supported its mission is **Dr. Randy Nelson**. Randy was recently named **Fellow of the American Association for the Advancement of Science**. Since 2000 he has been Distinguished Professor of Social and Behavioral Science at Ohio State University where he was the recipient of the 2001 Fred Brown Research Award.

Dr. Leah Pyter is seeking aged Peromyscus, preferably older than two years. Sex and subspecies are not important. Anyone who can help should contact her at pyter.1@osu.edu .

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We want to express our **THANKS !** to **John Lepri** for arranging for the Peromyscus Stock Center to obtain some donated cages and lids in a size appropriate for our needs. Altogether, 170 cage bottoms and 25 lids were obtained. John is a colleague of **Dr. Barbara Blake** who also has been most supportive of the Stock Center, particularly with our efforts to obtain *Mammalian Species* (Amer. Soc. Mammalogists) accounts for inclusion in ***Pero*Base.**

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*Pero*Base Needs a Tree

One objective of the ***Pero*Base** team from early on has been to present an easily understood consensus phylogenetic tree with all peromyscine species represented. Such a tree would incorporate molecular, cytogenetic and morphological data sets. Inasmuch as it would use data from various studies, some of which are not necessarily quantifiable, but utilize the best information available, the proposed tree might not be based entirely on statistical algorithms. Such a tree is envisioned as dynamic and would incorporate new information as it became available, hence would be frequently updated. The principal benefactors would be those biologists working with deer mice and allied species who are **not** primarily concerned with systematics or taxonomy, but who require an up-to-date systematic framework to interpret their findings. The consensus tree should be comprehensible to informed lay persons as well as biologists. **We welcome professional opinions and knowledgeable volunteers to help with this project.**
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Species Descriptions Online

Detailed descriptions of the following 18 species are now accessible through ***Pero*Base** as pdf files of *Mammalian Species* accounts courtesy of the American Society of Mammalogists and Allen Press. Brief summary species descriptions are also available in ***Pero*Base** for 15 of these species. (*http://wotan.cse.sc.edu/perobase/species.htm*)

Peromyscus (=Neotomodon) alstoni **- Mouse**

Peromyscus attwateri **- Texas Mouse**

Peromyscus californicus **- California Mouse**

Peromyscus caniceps **- Monserrat Island Canyon Mouse**

Peromyscus crinitus **- Canyon Mouse**

Peromyscus eremicus **- Cactus Mouse**

Peromyscus gossypinus **- Cotton Mouse**

Peromyscus leucopus **- White-footed Mouse**

Peromyscus melanocarpus **- Black-wristed Deer Mouse**

Peromyscus pectoralis **- White-ankled Mouse**

Peromyscus pseudocrinitus **- Coronados Island Canyon Mouse**

Peromyscus spicilegus **– Gleaning Mouse**

Peromyscus stirtoni **- Stirton's Deer Mouse**

Peromyscus truei **- Pinyon Mouse**

Peromyscus yucatanicus **- Yucatan Deer Mouse**

Peromyscus zarhynchus **- Long-nosed Mouse**

Onychomys leucogaster **- Northern Grasshopper Mouse**

Onychomys torridus **- Southern Grasshopper Mouse**

LL Stock of *Peromyscus leucopus* (White-footed Mouse)

(This is the first of a series featuring a particular stock of *Peromyscus* maintained by the Peromyscus Genetic Stock Center. These accounts will describe the origin and history of the various stocks and the types of research projects for which the featured stock may prove useful. Basic references will be cited, and, where appropriate, references to the *Mammalian Species* [American Society of Mammalogists] or the *Peromyscus* Gene Catalog account in ***Pero*Base** will be provided. The primary purpose is to promote the utilization of the resources of the Stock Center.)

The LL ("leucopus Linville") stock originated from 38 white-footed mice captured near Linville Falls, NC between 1982 and 1985. All founders were collected from a single site less than 0.5 hectares in area, most near a single large brush-pile. Deer mice (*P. maniculatus nubiterrae*) were collected at the same site, but in substantially fewer numbers. No animals were collected that were intermediate or suggested that hybridization was occurring between these species. Other studies of these two species in Appalachia suggest that they share, rather split, a niche (Hawkins and Cranford 1992; Wolff 1996; Barry *et al.* 1984). One interpretation is that *P. leucopus* are gradually displacing *P. maniculatus* in the Appalachians as a post-Pleistocene process.

Nearly all of the originally captured animals were fertile in inter-se crosses and 38 founders contributed to the gene pool of the laboratory stock. The stock has been closed since 1985. In the laboratory sib-sib mating is avoided and the mice are otherwise mated essentially at random. Currently (2003) the stock is about 20 generations into captivity, with some overlap among generations. Fertility is excellent.

Morphologically, the LL animals are typical for the species. We do not classify them to subspecies, inasmuch the boundary between *P. l. leucopus* and *P. l. noveboracensis* occurs essentially at Linville NC (Hall 1981) with no discrete morphological discontinuity apparent. Adult weights range from 18 – 24 g. The dorsal coat of the adult animal is a rich brown and the underside is uniformly white. The dorsal pattern is sharply delineated from the underside. The eyes are slightly more protruding than those of deer mice and more narrowly set. The tail is bi-colored but the dorsal stripe is not distinctly defined. (See Cover)

As a species, *P. leucopus* is distributed mostly in upland hardwood forests from Yucatan northward to New England in the eastern half of North America. It also occurs in wooded river valleys in the Great Plains. Seventeen subspecies are recognized. White-footed mice are among the most common native rodents in the eastern United States.

Behaviorally, *P. leucopus* are agile and capable of jumping 20 inches or more. Despite their agility and propensity to escape, they are not aggressive and can be handled without gloves, and when properly handled, rarely bite. Horner (1955), Foster (1959) and others have noted differences between forest and field *Peromyscus* in a number of behaviors. **The utility of the LL *P. leucopus* stock of forest origin contrasted with an open field type such as *P. maniculatus bairdii* (prairie deer mouse) *e.g.* our BW stock or *P. polionotus* (old-field mice) *e.g.* our PO stock, presents itself as a area for**

analysis of the influence of habitat on inborn behaviors. White-footed mice are much more arboreal than prairie deer mice and usually nest in stumps or tree hollows, whereas prairie deer mice nest in shallow burrows, presenting another area for comparative behavioral analysis. **Another relatively unexplored area involves vocalization.** In the LL stock the young are more vocal than we observe in *P. maniculatus bairdi* or *P. polionotus* that are open field animals. Forest animals in general are typically more vocal than related open-habitat forms. Our casual observations in the animal facility indicate that this is this is true of pre-weanling *P. leucopus*, contrasted with *P. maniculatus bairdi*.

Laboratory research use of white-footed mice is primarily in the areas of behavioral biology, epidemiology, toxicology and ecology. Also of interest is the ecological and genetic relationship between *P. leucopus* and its slightly larger sister species, the cotton mouse, *P. gossypinus*. The cotton mouse occurs in lowland, often marshy, woods and swamps of the southeastern U.S. The two species will interbreed and produce fertile progeny when caged together captivity (Dice 1937), but rarely hybridize in nature even where they co-occur (Dice 1940). A few exceptional instances of natural hybridization are known in southern Illinois (Feldhamer 2002) and Louisiana (McCarley 1954). The failure to find hybrids in nature is generally attributed to different ecological preferences. The two species differ in several allozyme alleles that allow for detection of greater genetic variability than might be found in a single species (Robbins *et al.* 1985).

A possible research project: *P. leucopus* X *P. gossypinus* hybrids have been produced in the laboratory by Foreman (1966) and Flinchum (unpub.) to analyze the mendelian genetics of hemoglobin and esterase variation, respecively. **A potential research use of *P. leucopus* X *P. gossypinus* hybrids would be to study fluctuating asymmetry**, and the theory that extreme inbreeding or outbreeding disrupts normal (stable) development. **The Stock Center also maintains two highly inbred strains of *P. leucopus* that could be contrasted with the captive outbred stock and/or with lab-produced interspecific *P. leucopus* X *P. gossypinus*** hybrids. The Stock Center is open to collaboration on such a project. While the Stock Center does not currently maintain a stock of *P. gossypinus*, it is readily obtainable by Stock Center biologists from South Carolina's nearby lowland forests.

White-footed mice presumably are the most common carriers of the larval stage of the tick (*Ixodes*) that transmits Lyme disease (*Borellia burgdorferi*) and, therefore, is of considerable public health interest (Ostfeld *et al.* 1996). Laboratory-reared LL animals from the Stock Center have been used extensively in Lyme Disease research. Other vector-transmitted diseases are harbored by parasites of *P. leucopus*, as well. **The LL stock is available for lab-based studies involving these parasites and vectors.** .

Cited references can be found in ***Pero*Base:** Buttler Bibliography. Search under last name of the lead author.

http://wotan.cse.sc.edu:8080/perobase-bibliography/literature.referenceSearch.action

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 disease free, 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[1] "wild-type" stocks of seven species of *Peromyscus*. 2.) Two highly inbred[2] 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 ***Pero*Base**, 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 of **$17.50 is charged per wild-type stock animal. ($22.50 for corporate users). Coat color and other mutants, as well as special stock animals are currently available for $25 per animal.** User assumes the cost of air 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. **For details contact Janet Crossland (803-777-3107; or crosslan@biol.sc.edu).**

Stocks Available

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

INTERSPECIFIC HYBRIDS

P. maniculatus X P. polionotus F_1 Hybrids	Bred by special order.
P. leucopus X P. gossypinus F_1 Hybrids	Sometimes available by request.

MUTATIONS AVAILABLE FROM THE STOCK CENTER[3]

COAT COLORS	ORGINAL SOURCE
Albino *c/c*	Sumner's albino deer mice (Sumner, 1922)
Ashy *ahy/ahy*	Wild-caught in Oregon ~ 1960 (Teed et al., 1990)
Black (Non-agouti) *a/a*	Horner's black mutant (Horner et al., 1980)
Blonde *bln/bln*	Mich. State U. colony (Pratt and Robbins, 1982)
[4]Brown *b/b*	Huestis stocks (Huestis and Barto, 1934)
California blonde *cfb/cfb*	Santa Cruz I., Calif., stock (Roth and Dawson, 1996)
Dominant spotting *S/+*	Wild caught in Illinois (Feldman, 1936)
Golden nugget b^{gn}/b^{gn} [in *P. leucopus*]	Wild caught in Mass. (Horner and Dawson, 1993)
Gray *g/g*	Natural polymorphism. From Dice stocks (Dice, 1933)
Ivory *i/i*	Wild caught in Oregon (Huestis, 1938)
[5]Pink-eyed dilution *p/p*	Sumner's "pallid" deer mice (Sumner, 1917)
Platinum *plt/plt*	Barto stock at U. Mich. (Dodson et al., 1987)
[4]Silver *sil/sil*	Huestis stock (Huestis and Barto, 1934)
Tan streak *tns/tns*	Clemson U. stock from N.C. (Wang et al., 1993)
Variable white *Vw/+*	Michigan State U. colony (Cowling et al., 1994)
White-belly non-agouti a^w/a^w	Egoscue's "non-agouti" (Egoscue, 1971)
Wide-band agouti A^{Nb}/a	Natural polymorphism. U. Mich. (McIntosh, 1954)
Yellowish *y/y*	Sumner's original mutant (Sumner, 1917)

OTHER MUTATIONS AND VARIANTS

Alcohol dehydrogenase negative *Adh^o/Adh^o*	South Carolina BW stock (Felder, 1975)
Alcohol dehydrogenase positive *Adh^f/Adh^f*	South Carolina BW stock (Felder, 1975)
Boggler *bg/bg*	Blair's P. m. blandus stock (Barto, 1955)
Cataract-webbed *cwb/cwb*	From Huestis stocks (Anderson and Burns, 1979)
Epilepsy *ep/ep*	U. Michigan artemisiae stock (Dice, 1935)
[5]Flexed-tail *f/f*	Probably derived from Huestis flexed-tail (Huestis and Barto, 1936)
Hairless-1 *hr-1/hr-1*	Sumner's hairless mutant (Sumner, 1924)
Hairless-2 *hr-2/hr-2*	Egoscue's hairless mutant (Egoscue, 1962)
Juvenile ataxia *ja/ja*	U. Michigan stock (Van Ooteghem, 1983)
Enzyme variants	Wild type stocks given above provide a reservoir for several enzyme and other protein variants. (Dawson *et al.*, 1983)

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[1]"Random-bred" stocks are mated without deliberate selection, and sib-sib mating is avoided.

[2]Inbred lines are bred by sib-sib (or parent-offspring equivalent) mating for 21 generations or more.

[3]Unless otherwise noted, mutations are in *P. maniculatus*

[4]Available only as silver/brown double recessive

[5]Available only as pink-eye dilution/flexed-tail double recessive

Other Resources of the Peromyscus Stock Center

Highly inbred *P. leucopus* (I_{30+}) 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 or wild-types 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 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 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

PLEASE CALL WITH INQUIRIES

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New *Peromyscus* Sequences in GenBank (Mar. 2002 – Mar. 2003)

The following is a list of GenBank accessions for *Peromyscus* and allied genera since our *PN*#33 (Mar 2002) update and *PN*#31 Mar (2001) comprehensive index. Inclusive sequential accession numbers are given in parentheses in bold face type. Loci are shown in bracketed italics.

Nuclear Genes:

CHEMOKINE LIGANDS

[*Ccl2*] CC chemokine ligand 2 (*CCL2*) mRNA, partial cds. *P. maniculatus* **(AY271904, AY271905)**

[*Ccl3*] CC chemokine ligand 3 (*Ccl3*) mRNA, partial cds. *P. maniculatus* **(AY247759)**

[*Ccl4*] CC chemokine ligand 4 (*Ccl3*) mRNA, partial cds. *P. maniculatus* **(AY247758)**

GRANULOCYTE MACROPHAGE STIMULATING FACTOR

[*Gmcsf*] Granulocyte macrophage colony-stimulating factor. mRNA, partial cds. *P. maniculatus* **(AY247762, AY247763)**

INTERLEUKINS

[*IL2*] Interleukin-2 (*Il2*) mRNA, partial cds. *P. maniculatus* **(AY247760)**

[*IL6*] Interleukin-6 (*Il6*) mRNA, partial cds. *P. maniculatus* **(AY256518)**

[*IL10*] Interleukin-10 (*Il10*) gene, complete cds. *P. maniculatus* **(AY251293)**

[*IL12*] Interleukin-12 p35 subunit (*Il12a*) p35 mRNA, partial cds. *P. maniculatus* **(AY247763)**

[*IL21*] Interleukin-21 (*Il21*) mRNA, partial cds. *P. maniculatus* **(AY247760 - AY247762)**

[*IL23*] Interleukin-23a (*I123*) subunit p19 mRNA, partial cds. *P. maniculatus* **(AY247629)**

LYMPHOTOXIN

[*Lta*] Lymphotoxin alpha, (*Lta*) gene, complete cds. *P. maniculatus* **(AY251294)**

TUMOR NECROSIS FACTOR

[*TNF*] Tumor necrosis factor precursor (*Tnf*), partial cds. *P. maniculaus* **(AY249143)**

TRANSCRIPTION FACTORS

[*TFT-bet*] Transcription factor T-bet (*T-bet*) mRNA, partial cds. *P. maniculatus.* **(AY271903)**

Nuclear Elements, Repeats, Microsatellites

[B1 SINE] Pleu retrotransposons. *P. leucopus* **(AY041703 – AY041734)**

[B1 SINE] Pnud retrotransposons. *P. nudipes* **(AY041743 – AY041749)**

[LINE-1] Pleu LINE-1 retrotransposons ORF II. *P. leucopus* **(AY041507 - AY041523)**

[LINE-1] Pnud LINE-1 retrotranposons ORF II. *P. nudipes* **(AY041546 – AY041575)**

Mitochondrial Genes

[*MTCOII*] *P. leucopus* cytochrome C oxidase subunit II gene, partial cds. **(AY266677 – AY266679)**.

[*MTCYTB*] *P. maniculatus* cytochrome b (cytB) gene, partial cds. **(AY184679 – AY184725)**

[*MTCYTB*] *P. maniculatus* cytochrome b (cytB), partial cds. **(AY184551- AY184600)**

[*MTCYTB*] *P. nudipes* cytochrome B (cytB) gene, partial cds. **(AY041200)**

[*MTCR*] *P. maniculatus* mitochondrial control region (mtCR) partial sequence. **(AY184601 - AY184678)**

[*MTCR*] *P. maniculatus* mitochondrial control region (mtCR) partial sequences. **(AY184501 – AY184550)**

Omissions from previous updates:

Mitochondrial Genes:

[*COIII*] *P. merriami* cytochrome oxidase subunit III (COIII), partial cds.
(AY009178 – AY009184)

[*COIII*] *P. eva* cytochrome oxidase subunitIII (COIII), partial cds. **(AF343754)**

[*MTNADHDH/tRNA*] *Isthmomys pirrensis* NADH dehydrogenase subunits 3 (ND), tRNA arginase, complete seq. NADH 4 subunit 4L (ND4L), partial cds.
(U83859)

[*MTNADHDH*] *Onychomys leucogaster* NADH dehydrogenase, subunit 3 (ND3), complete cds, tRNA-Arg, complete seq., NADHDH subunit (ND4L), partial cds.
(U83858)

[*MTNADHDH*] *Habromys lophurus* NADH dehydrogenase, subunit 3 (ND3), complete cds, tRNA-Arg, complete seq., NADHDH subunit (ND4L), partial cds.
(U83863)

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PN Number 37 will include a key to GenBank accessions for all peromyscine rodents.

Also, refer to PeroBase for updates.

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NOTICE

PEROMYSCUS NEWSLETTER IS <u>NOT</u> 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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Effects of testosterone on the mammalian immune system: Immunosuppression or immunoredisribution

Introduction

A negative relationship between immune and reproductive function has been reported for a number of species. One potential contributor to this relationship is an immunosuppressive effect of testosterone on immune function. Recent research suggests, however, that testosterone may cause redistribution of leukocytes rather an actual reduction in leukocyte numbers (Dhahbar 1995). An immunoredistristribution effect of testosterone that enhances immune defense during periods of increased risk of injury, such as the mating season, would be of adaptive value.

Methods

To investigate the effects of testosterone, we tested the null hypothesis that testosterone has no effect on the distribution of leukocytes. We also tested whether testosterone level is positively correlated with corticosterone level because corticosterone is known to cause redistribution of leukocytes (Dhahbar 1995). We established four groups of adult male white-footed mice (*Peromsycus leucopus)*: 1) control (CC), 2) testosterone-treated (CT), 3)immunochallenged (IC), and 4) testosterone-treated and immunochallenged (IT). Testosterone injections were given to mice for 10 days. The immunochallenged mice were treated with sheep red blood cells (SRBC) to challenge the humoral branch of the immune system and phytohemagglutinin (PHA) to challenge the cell-mediated branch. To determine if immunoredistribution occurred blood samples were taken from the heart (core blood) and the retro-orbital sinus (peripheral blood). Hormone assays were performed to determine any relationship between testosterone and corticosterone. White blood cell counts, hemaagluttination titres, and hematocrit were also determined.

Results

White blood cell counts revealed no significant differences between the control group and testosterone treated group (Fig. 1A). There was no significant redistribution of leukocytes in any group of mice. The reaction to PHA was much less, however, in the testosterone-treated mice than the control mice (Fig. 1B). Likewise, the hemagglutination titres of peripheral blood in animals with exogenous testosterone were significantly less than those of control animals (Fig. 1C). Testosterone-treated animals had lower levels of corticosterone compared with controls.

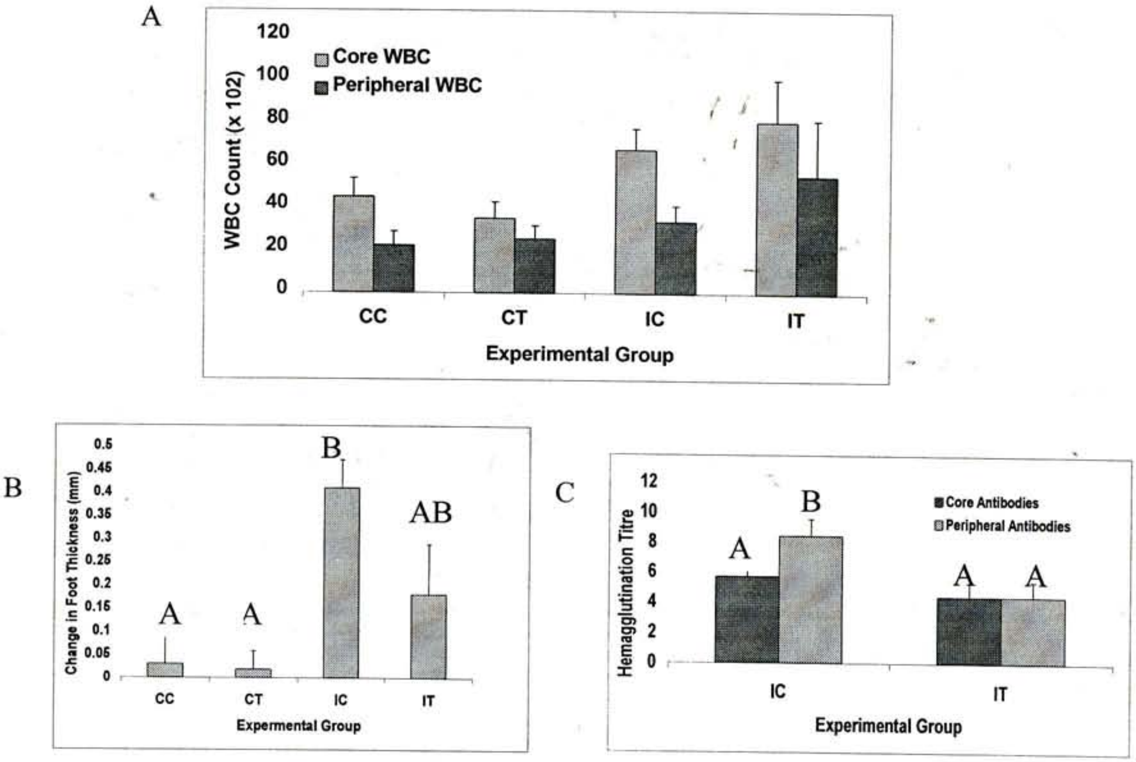

Fig 1. (A) White blood cell (WBC) counts (X ± S.E.) for core and peripheral blood. (B) Dermal hypersensitivity response to PHA. (C) Hemaagluttination titres (X ± S.E.) in response to sheep red blood cells (SRBC). Means with the same letter are not significantly different from each other (ANOVA, $p < 0.05$).

Conclusion

Our results indicated that testosterone had an immunosuppressive effect on the activity of leukocytes (Fig. 1C). In addition, corticosterone levels were lower in the testosterone treated mice so redistribution could not have occurred due to corticosterone. We concluded that testosterone does not raise corticosterone levels and is not related to immunoredistribution. Future experiments will involve the effects of raised testosterone and raised corticosterone on the mammalian immune system. In these experiments the location and types of leukocytes will be observed.

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Digital radiography, a novel non-lethal method of skull analysis

The cotton mouse, *Peromyscus gossypinus,* is known to inhabit undisturbed riparian woodlands and swamps of the southeastern coastal plain, and is sympatric in certain geographical areas with *Peromyscus leucopus* (Hamilton, 1943; McCarley, 1963; Hoffmeister, 1989). An ongoing field study is being conducted at Poinsett State Park, a relatively undisturbed habitat, 30 miles from the University of South Carolina Sumter to determine the habitat preference and geographical distribution that seem to be incomplete for *P. gossypinus* in South Carolina.

Although many species of *Peromyscus* can be distinguished based on pelage characteristics and ratios of their body measurements, cranial measurements that require euthanization are also important in species identification. *P. gossypinus* and *P. leucopus* are particularly difficult to distinguish in the field, so we desired a non-lethal method of assessing cranial characteristics.

Peromyscus species were captured with small Sherman live traps baited with peanut butter. Pelage characteristics and body measurements were noted. Digital radiography (DEXIS, Redwood, CA), was used to analyze skull and mandible characteristics by obtaining full X-rays of dorsal, ventral and left lateral views of skulls and mandibles. The mouse was placed on a sensor, which captures and converts an analog image into a digital X-ray image that is directly transmitted to a computer monitor. Images up to 70k can be stored and processed. This is a novel, non-lethal and quick method of conducting cranial and mandible studies to identify fully adult *Peromyscus* species.

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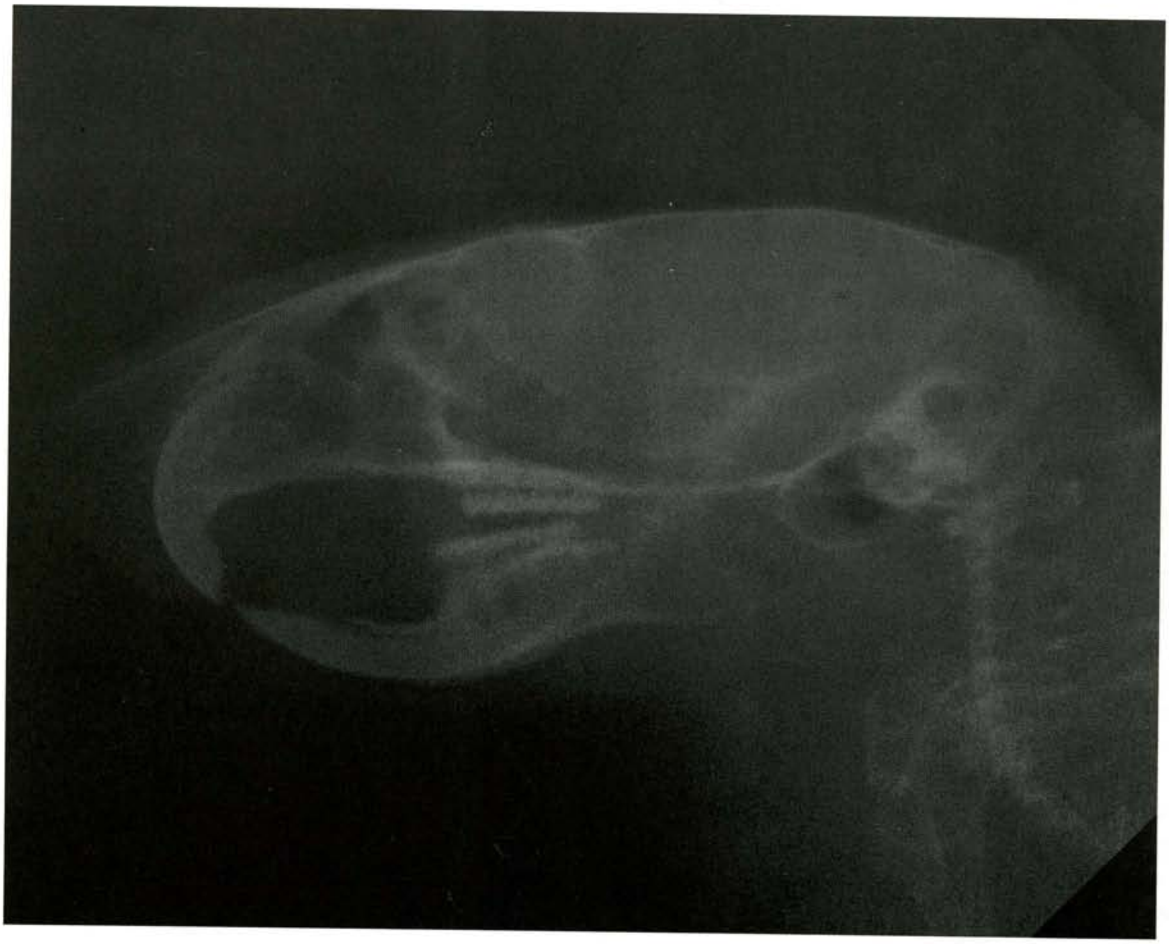
Literature Cited

Hoffmeister, D.F. 1989. Mammals of Illinois. Univ. of Illinois Press, Urbana.

Hamilton, W. J., Jr. 1943. Mammals of the eastern United States. Comstock Pull. Co., Ithaca, New York.

McCarley, W. H. 1963. Distributional relationships of sympatric populations of *Peromyscus leucopus* and *P. gossypinus*. Ecology 44:784-788.

Figure 1. Left lateral view of skull and mandible



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As a hobbyist of fancy pet mice, I had questioned whether there was a solution to the problem of male fancy mice having to live alone after being used for breeding. My daughter had bred two fancy mice for a 4H project and had separated the male once it became apparent that the female was, indeed, pregnant. Her male became quite inactive, rarely venturing from his nest and much less social than our other mice that had cage-mates. He looked unhealthy and did not groom himself well. I looked into neutering the male but the cost and possible complications made that option impossible. I had heard from other hobbyists that perhaps putting a female deer mouse in with a male fancy mouse might be possible if they would accept each other as cage-mates without becoming aggressive toward one another. Obviously, they would not breed so, if they could get along, it might be a solution.

I acquired two female *Peromyscus maniculatus bairdii* from the *Peromyscus* Genetic Stock Center at the University of South Carolina. Their birth dates were December 2002, making them approximately three months younger than my male fancy type. Upon introduction, my male was extremely interested and excited but not aggressive. The deer mice were submissive. I did notice that my male was somewhat startled by the movements of the deer mice. He would jump at the movements and, for the first week or so, stayed in his nest when they were the most active. However, he now eats quietly in a corner while they race about their cage playing. And there have been a hand full of times in which I have seen him engaged in play with them. The extreme difference in his demeanor is what is most satisfying. He builds and rebuilds the nest and spends a lot of time carrying small amounts of shavings and packing it around the nest until it is just right. He can be seen bringing food into the nest and is the first to venture out to check noises when I am changing water or filling food bowls. The two *Peromyscus* used one nest and the male fancy another for the first week. They now share the same nest all of the time.

I consider this attempt to be a success as the male fancy mouse is now a part of a mouse colony in which he can engage in behavior and life similar to that of other mouse colonies without the chance of breeding.

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Are there fewer small mammals since the outbreak of West Nile virus? An invitation to more thorough testing.

The first West Nile virus outbreak in the U.S. was recorded in birds in 1999. West Nile virus has been known to affect humans, dogs, cats, horses, bats, a single chipmunk, a single skunk, a single squirrel, and a single domestic rabbit since 2001 (CDC 2003). It is not clear whether West Nile virus affects other small mammals such as mice, voles, and shrews. If West Nile virus is affecting other small mammals, there should be fewer small mammals caught in the same locations now (after West Nile was introduced) than in 1999 (before West Nile was introduced). In 2003, we decided to live-trap for small mammals at two natural areas in the Chicago region: Woodworth Prairie in Glenview, IL and G.A.R. Woods in River Forest, IL. We chose these sites because they had also been trapped in 1999, prior to the outbreak of West Nile virus. We used Sherman model #SNA live traps baited with oats and peanut butter. The traps were laid 15 ft. apart in grids. We combined our trapping results with results from other scientists (Pergams et al. 2003; Pergams and Nyberg *In review*; Pergams et al. *In review*; A. Ruszaj *Unpublished data*) that had trapped in 1999 and 2003 at the same sites using the same methods. The combined results were 44 animals [*Peromyscus leucopus* ($N = 31$), *Microtus pennsylvanicus* (8), *Blarina brevicauda* (2), *Mus musculus* (2), and *Tamias striatus* (1)] in 219 traps in 1999, and 3 animals [*Microtus pennsylvanicus* (2) and *Mus musculus* (1)] in 213 traps in 2003 (Table 1). Trap success at the same locations was 20% before West Nile virus, and 1% after West Nile virus hit the Chicago area especially hard in 2002. Trapping in 2003 was earlier in the season than in 1999, and this may possibly explain a difference this great, but we do not think it likely. Anecodotally, in another area that was a center of West Nile virus in 2002 (the Syracuse, NY area) we observed that *Peromyscus leucopus* have gone from being abundant in woodpiles and bird houses that were checked in spring 2001 and 2002, to being apparently absent from those same sites in spring 2003. We do not, of course, think these results are sufficient to prove West Nile virus is affecting *Peromyscus* or other small mammals. Instead, we offer these results as an invitation to other researchers to perform more thorough trapping, presumably combined with testing for West Nile virus antibodies.

Literature Cited

Center for Disease Control. 2003. West Nile virus: vertebrate ecology. Website accessed 5/26/03 at: http://www.cdc.gov/ncidod/dvbid/westnile/birds&mammals.htm.
Pergams, O. R. W. and D. Nyberg. *In review.* Local disappearance of a once common mouse.
Pergams, O. R. W., W. M. Barnes, and D. Nyberg. *In review.* Rapid evolution of white-footed mouse mitochondrial DNA
Pergams, O. R. W., W. M. Barnes, and D. Nyberg. 2003. Rapid change of mouse mitochondrial DNA. Nature 423:397.

Table 1.
Combined trapping results from 1999 and 2003.

date	location	traps	catches	%
12-Sep-1999	Woodworth	84	24	29%
15-Jun-1999	G.A.R. Woods	135	20	15%
	totals	**219**	**44**	**20%**
27-Mar-2003	Woodworth	48	2	4%
17-Apr-2003	Woodworth	43	0	0%
08-May-2003	G.A.R. Woods	40	0	0%
16-May-2003	Woodworth	82	1	1%
	totals	**213**	**3**	**1%**

RECENT PUBLICATIONS

Abramson, G. and V. M. Kenkre. 2002. Spatiotemporal patterns in the Hantavirus infection. Physical Review, 66:011912.

Abramson, G., V. M. Kenkre, T. L. Yates, and R. R. Parmenter. 2003. Traveling waves of infection in the hantavirus epidemics. Bull. Math. Biol., 65:519-534.

Allan, B. F., F. Keesing, and R. S. Ostfeld. 2003. Effect of forest fragmentation on Lyme disease risk. Conserv. Biol., 17:267-272.

Alvarez-Castaneda, S. T. and A. Ortega-Rubio. 2003. Current status of rodents on islands in the Gulf of California. Biol. Conserv., 109:157-163.

Andreassen, H. P., N. C. Stenseth, and R. A. Ims. 2002. Dispersal behaviour and population dynamics of vertebrates. Dispersal Ecol., :237-256.

Barko, V. A. and G. A. Feldhamer. 2002. Cotton mice (*Peromyscus gossypinus*) in southern Illinois: evidence for hybridization with white-footed mice (*Peromyscus leucopus*). Am. Midl. Nat., 147:109-115.

Berg, S. J. and K. E. Wynne-Edwards. 2002. Salivary hormone concentrations in mothers and fathers becoming parents are not correlated. Hormones Behav., 42:424-436.

Bersot, V. 2003. Small mammal inventory in the Shipstern Nature Reserve (Corozal District, Belize, Central America), a preliminary assessment. Revue Suisse de Zool., 110:207-246.

Bharadwaj, M., K. Mirowsky, C. Ye, J. Botten, B. Masten, J. Yee, C. R. Lyons, and B. Hjelle. 2002. Genetic vaccines protect against Sin Nombre hantavirus challenge in the deer mouse (*Peromyscus maniculatus*). J. Gen. Virol., 83:1745-1751.

Bock, C. E., K. T. Vierling, S. L. Haire, J. D. Boone, and W. W. Merkle. 2002. Patterns of rodent abundance on open-space grasslands in relation to suburban edges. Conserv. Biol., 16:1653-1658.

Bohlman, M. C., S. P. Morzunov, J. Meissner, M. B. Taylor, K. Ishibashi, L. Rowe, S. Levis, D. Enria, and S. C. S. Jeor. 2002. Analysis of hantavirus genetic diversity in Argentina: S segment-derived phylogeny. J. Virol., 76:3765-3773.

Botten, J., K. Mirowsky, C. Ye, K. Gottlieb, M. Saavedra, L. Ponce, and B. Hjelle. 2002. Shedding and intracage transmission of Sin Nombre hantavirus in the deer mouse (*Peromyscus maniculatus*) model. J. Virol., 76:7587-7594.

Botten, J., K. Mirowsky, C. Ye, K. Gottlieb, M. Saavedra, L. Ponce, and B. Hjelle. 2003. Persistent Sin Nombre virus infection in the deer mouse (*Peromyscus maniculatus*) model: sites of replication and strand-specific expression. J. Virol., 77:1540-1550.

Calisher, C. H., J. J. Root, J. N. Mills, and B. J. Beaty. 2002. Assessment of ecologic and biologic factors leading to hantavirus pulmonary syndrome, Colorado, U.S.A. CMJ, 33:330-337.

Carignan, V. and M. A. Villard. 2002. Effects of variations in micro-mammal abundance on artificial nest predation in conifer plantations and adjoining deciduous forests. Forest Ecol. Manage., 157:255-265.

Carleton, M. D., O. Sanchez, and G. U. Vidales. 2002. A new species of *Habromys* (Muridae: Neotominae) from Mexico, with generic review of species definitions and remarks on diversity patterns among Mesoamerican small mammals restricted to himid montane forests. Proc. Biol. Soc. Washington, 115:488-533.

Carraway, L. N. and B. J. Verts. 2002. Geographic variation in pelage color of pinon mice (*Peromyscus truei*) in the northern great basin and environs. West. N. Am. Nat., 62:458-465.

Casher, L., R. Lane, R. Barrett, and L. Eisen. 2002. Relative importance of lizards and mammals as hosts for ixodid ticks in northern California. Exp. Applied Acarol., 26:127-143.

Chappell, M. A., E. L. Rezende, and K. A. Hammond. 2003. Age and aerobic performance in deer mice. J. Exp. Biol., 206:1221-1231.

Cherry, B. A., B. Cadigan, N. Mansourian, C. Nelson, and E. L. Bradley. 2002. Adrenal gland differences associated with puberty and reproductive inhibition in *Peromyscus maniculatus*. Gen. Comp. Endocrinol., 129:104-113.

Clark, K. L. and L. A. Durden. 2002. Parasitic arthropods of small mammals in Mississippi. J. Mammal., 83:1039-1048.

Clark, K. L., J. H. Oliver, A. M. James, L. A. Durden, and C. W. Banks. 2002. Prevalence of *Borrelia burgdorferi* sensu lato infection among rodents and host-seeking ticks in South Carolina. J. Med. Entomol., 39:198-206.

Craft, R. M. 2003. Sex differences in drug- and non-drug-induced analgesia. Life Sci., 72:2675-2688.

Cramer, M. J. and M. R. Willig. 2002. Habitat heterogeneity, habitat associations, and rodent species diversity in a sand-shinnery-oak landscape. J. Mammal., 83:743-753.

Davis, B. K., R. G. Cook, R. R. Rich, and J. R. Rodgers. 2002. Hyperconservation of the putative antigen recognition site of the MHC class I-b molecule TL in the subfamily Murinae: evidence that thymus leukemia antigen is an ancient mammalian gene. J. Immunol., 169:6890-6899.

Davis, I. C., A. J. Zajac, K. B. Nolte, J. Botten, B. Hjelle, and S. Matalon. 2002. Elevated generation of reactive oxygen/nitrogen species in hantavirus cardiopulmonary syndrome. J. Virol., 76:8347-8359.

Demas, G. E. and R. J. Nelson. 2003. Lack of immunological responsiveness to photoperiod in a tropical rodent, *Peromyscus aztecus hylocetes*. J. Comp. Physiol. B-Biochem. Systemic Environ. Physiol., 173:171-176.

Douglass, R. J., A. J. Kuenzi, C. Y. Williams, S. J. Douglass, and J. N. Mills. 2003. Removing deer mice from buildings and the risk for human exposure to Sin Nombre virus. Emerg. Infect. Dis., 9:390-392.

Drazen, D. L., A. M. Jasnow, R. J. Nelson, and G. E. Demas. 2002. Exposure to short days, but not short-term melatonin, enhances humoral immunity of male Syrian hamsters (*Mesocricetus auratus*). J. Pineal Res., 33:118-124.

Elias, A. F., P. E. Stewart, D. Grimm, M. J. Caimano, C. H. Eggers, K. Tilly, J. L Bono, D. R. Akins, J. D. Radolf, T. G. Schwan, and P. Rosa. 2002. Clonal polymorphism of *Borrelia burgdorferi* strain B31 MI: implications for mutagenesis in an infectious strain background. Infect. Immun., 70:2139-2150.

Falck, M. J., K. R. Wilson, and D. C. Andersen. 2003. Small mammals within riparian habitats of a regulated and unregulated aridland river. West. N. Am. Nat., 63:35-42.

Fleming, A. S., C. Corter, J. Stallings, and M. Steiner. 2002. Testosterone and prolactin are associated with emotional responses to infant cries in new fathers. Hormones Behav., 42:399-413.

Fulhorst, C. F., S. G. Bennett, M. L. Milazzo, H. L. Murray, J. P. Webb, M. N. B. Cajimat, and R. D. Bradley. 2002. Bear canyon virus: an arenavirus naturally associated with the California mouse (*Peromyscus californicus*). Emerg. Infect. Diseases, 8:717-721.

Fulhorst, C. F., M. L. Milazzo, G. Duno, and R. A. Salas. 2002. Experimental infection of the *Sigmodon alstoni* cotton rat with Cano Delgadito virus, a South American hantavirus. Am. J. Trop. Med., 67:107-111.

Gauthier, O., P. A. Landry, and F. J. Lapointe. 2003. Missing data in craniometrics: a simulation study. Acta Theriol., 48:25-34.

Gehring, T. M. and R. K. Swihart. 2003. Body size, niche breadth, and ecologically scaled responses to habitat fragmentation: mammalian predators in an agricultural landscape. Biol. Conserv., 109:283-295.

Ginnett, D. A., J. H. Theis, and J. J. Kaneko. 2003. Spontaneous gallstone formation in deer mice: interaction of cholesterol, bile acids, and dietary fiber. J. Wildlife Dis., 39:105-113.

Gitzen, R. A. and S. D. West. 2002. Small mammal response to experimental canopy gaps in the southern Washington Cascades. For. Ecol. Manage., 168:187-199.

Glass, G. E., T. L. Yates, J. B. Fine, T. M. Shields, J. B. Kendall, A. G. Hope, Ca. A. Parmenter, C. J. Peters, T. G. Ksiazek, C. S. Li, J. A. Patz, and J. N. Mills. 2002. Satellite imagery characterizes local animal reservoir populations of Sin Nimbre virus in the southwestern United States. PNAS, 99:16817-16822.

Glennon, M. J., W. F. Porter, and C. L. Demers. 2002. An alternative field technique for estimating diversity of small-mammal populations. J. Mammal., 83:734-742.

De Groot, M. H. M. and B. Rusak. 2002. Entrainment impaired, masking spared: an apparent genetic abnormality that prevents circadian rhythm entrainment to 24-h lighting cycles in California mice. Neurosci. Letters, 327:203-207.

Greenberg, C. H. 2002. Response of white-footed mice (*Peromyscus leucopus*) to coarse woody debris and microsite use in southern Appalachian treefall gaps. For. Ecol. Manage., 164:57-66.

Guerra M., E. Walker, C. Jones, S. Paskewitz, M. R. Cortinas, A. Stancil, L. Beck, M. Bobo, and U. Kitron. 2002. Predicting the risk of Lyme disease: habitat suitability for *Ixodes scapularis* in the north central United States. Emerg. Infect. Dis., 8:289-297.

Hammond, K. A., M. A. Chappell, and D. M. Kristan. 2002. Developmental plasticity in aerobic performance in deer mice (*Peromyscus maniculatus*). Comp. Biochem. Physiol. A-Mol. Integra. Physiol., 133:213-224.

Hannon, S. J., C. A. Paszkowski, S. Boutin, J. DeGroot, S. E. Macdonald, M. Wheatley, and B. R. Eaton. 2002. Abundance and species composition of amphibians, small mammals, and songbirds in riparian forest buffer strips of varying widths in the boreal mixedwood of Alberta. Can. J. For. Res., 32:1784-1800.

Hastings, F. L., F. P. Hain, H. R. Smith, S. P. Cook, and J. F. Monahan. 2002. Predation of gypsy moth (Lepidoptera: Lymantriidae) pupae in three ecosystems along the southern edge of infestation. Environ. Entomol., 31:668-675.

Hawes, S. and J. P. Seabolt. 2003. Hantavirus. Clin. Lab. Sci., 16:39-42.

Herbst, M. M., J. Prescott, A. D. Palmer, and T. Schontz. 2002. Sequence and expression analysis of deer mouse interferon-gamma, interleukin-10, tumor necrosis factor, and lymphotoxin-alpha. Cytokine, 17:203-213.

Hodges, K. E., S. Mech, and J. O. Wolff. 2002. Sex and the single vole: effects of social grouping on prairie vole reproductive success. Ethology, 108:871-884.

Hoekstra, H. E. and M. W. Nachman. 2003. Different genes underlie adaptive melanism in different populations of rock pocket mice. Mol. Ecol., 12:1185-1194.

Hotchkiss, A. K. and R. J. Nelson. 2003. Melatonin and immune function: hype or hypothesis? Critical Rev. Immunol., 22:351-371.

Jones, Z. F., C. E. Bock, and J. H. Bock. 2003. Rodent communities in a grazed and ungrazed Arizona grassland, and a model of habitat relationships among rodents in southwestern grass/shrublands. Am. Mid. Nat., 149:384-394.

Kalcounis-Ruppell, M. C., J. S. Millar, and E. J. Herdman. 2002. Beating the odds: effects of weather on a short-season population of deer mice. Can. J. Zool., 80:1594-1601.

Kalcounis-Ruppell, M. C. and J. S. Millar. 2002. Partitioning of space, food, and time by syntopic *Peromyscus boylii* and *P. californicus*. J. Mamm., 83:614-625.

Van Keulen, H., P. T. Macechko, S. Wade, S. Schaaf, P. M. Wallis, and S. L. Erlandsen. 2002. Presence of human giardia in domestic, farm and wild animals, and environmental samples suggests a zoonotic potential for giardiasis. Vet. Parasitol., 108:97-107.

Koch, I., C. Hough, S. Mousseau, K. Mir, A. Rutter, C. Ollson, E. Lee, P. Andrewes, S. Granhichino, B. Cullen, and K. Reimer. 2002. Sample extraction for arsenic speciation. Can. J. Anal. Sci. Spec., 47:109-118.

Kristan, W. B. A. J. Lynam, M. V. Price, and J. T. Rotenberry. 2003. Alternative causes of edge-abundance relationships in birds and small mammals of California coastal sage scrub. Ecography, 26:29-44.

Lapo, I. B., M. Konarzewski, and B. Sadowski. 2003. Differential metabolic capacity of mice selected for magnitude of swim stress-induced analgesia. J. Applied Physiol., 94:677-684.

Lednicky, J. A. 2003. Hantaviruses – A short review. Arch. Pathol. Lab. Med., 127:30-35.

Lee, A. W. and R. E. Brown. 2002. The presence of the male facilitates parturition in California mice (*Peromyscus californicus*). Can. J. Zool., 80:926-933.

Lee, A. W. and R. E. Brown. 2002. Medial preoptic lesions disrupt parental behavior in both male and female California mice (*Peromyscus californicus*). Behav. Neurosci., 116:968-975.

Lee, S. M., W H. Hwang, and L. H. Huang. 2003. Bayes extimation of population size from capture-recapture models with time variation and behavior response. Statistica Sinica, 13:477-494.

Liu, L. P., P. S. F. Yip, and R. K. Watson. 2003. Removal process estimation of population size for a population with a known sex ratio. Environ. Ecol. Statistics, 10:281-292.

LoGiudice, K., R. S. Ostfeld, K. A. Schmidt, and F. Keesing. 2003. The ecology of infectious disease: effects of host diversity and community composition on Lyme disease risk. PNAS, 100:567-571.

Mabry, K. E. and G. W. Barrett. 2002. Effects of corridors on home range sizes and interpatch movements of three small mammal species. Landscape Ecol., 17:629-636.

Mabry, K. E., E. A. Dreelin, and G. W. Barrett. 2003. Influence of landscape elements on population densities and habitat use of three small mammal species. J. Mammal., 84:20-25.

Maier, T. J. 2002. Long-distance movements by female white-footed mice, *Peromyscus leucopus*, in extensive mixed-wood forest. Can. Field-Nat., 116:108-111.

Manning, E. L., J. Crossland, M. J. Dewey, and G. Van Zant. 2002. Influences of inbreeding and genetics on telomere length in mice. Mammal. Genome, 13:234-238.

Margulis, S. W. and A. Walsh. 2002. The effects of inbreeding on testicular sperm concentration in *Peromyscus polionotus*. Reprod. Fert. Develop., 14:63-67.

Massung, R. F. and K. G. Slater. 2003. Comparison of PCR assays for detection of the agent of human granulocytic ehrlichiosis, anaplasma phagocytophilum. J. Clin. Microbiol., 41:717-722.

Meagher, S. and S. N. Dudek. 2002. Effects of *Trichinella spiralis* on survival, total mass, and organ mass of oldfield mice (*Peromyscus polionotus*). J. Parasitol., 88:833-838.

Mech, S. G. and P. A. Zollner. 2002. Using body size to predict perceptual range. OIKOS, 98:47-52.

Mellink, E., G. Ceballos, and J. Luevano. 2002. Population demise and extinction threat of the Angel de la Guarda deer mouse (*Peromyscus guardia*). Biol. Conserv., 108:107-111.

Mengak, M. T. and D. C. Guynn. 2003. Small mammal microhabitat use on young loblolly pine regeneration areas. Forest Ecol. Manage., 173:309-317.

Merritt, J. F. and D. A. Zegers. 2002. Maximizing survivorship in cold: thermogenic profiles of non-hibernating mammals. Acta Theriol., 47:221-234.

Morris, D. W. 2002. Measuring the Allee effect: positive density dependence in small mammals. Ecology, 83:14-20.

Morrison, M. L., A. J. Kuenzi, C. F. Brown, and D. E. Swann. 2002. Habitat use and abundance trends of rodents in southeastern Arizona. Southwest. Nat., 47:519-526.

Morshed, M. G., J. D. Scott, K. Fernando, R. B. Mann, and L. A. Durden. 2003. Lyme disease spirochete, *Borrelia burgdorferi* endemic at epicenter in Rondeau Provincial Park, Ontario. J. Med. Entomol., 40:91-94.

Nelson, R. J. and B. J. Prendergast. 2002. Form over function? J. Biol. Rhythms, 17:406-409.

Olson, R. A. and M. J. Brewer. 2003. Small mammal populations occurring in a diversified winter wheat cropping system. Agricul. Ecosys. Environ., 95:311-319.

Olson, R. A., B. L. Perryman, S. Petersburg, and T. Naumann. 2003. Fire effects on small mammal communities in Dinosaur National Monument. West. N. Am. Nat., 63:50-55.

Pergams, W. R. W., W. M. Barnes, and D. Nyberg. 2003. Rapid change in mouse mitochondrial DNA. Nature, 423:397.

Peters, C. J. 2002. Hurrying toward disaster? Perspect. Health Mag., 7. http://www.paho.org/English/DPI/Number14_article3_1.htm

Powell, F. L. 2003. Functional genomics and the comparative physiology of hypoxia. Ann. Rev. Physiol., 65:203-230.

Plyusnin, A. 2002. Genetics of hantaviruses: implications to taxonomy. Arch. Virol., 147:665-682.

Presti, M. F., H. M. Mikes and M. H. Lewis. Selective blockade of spontaneous motor stereotypy via intrastriatal pharmacological manipulation. Pharmacol. Biochem. Behav., 74:833-839.

Presti, M. F., S. B. Powell, and M. H. Lewis. 2002. Dissociation between spontaneously emitted and apomorphine-induced stereotypy in *Peromyscus maniculatus bairdii*. Physiol. Behav., 75:347-353.

Prince, K. L., T. C. Glenn, and M. J. Dewey. 2002. Cross-species amplification among peromyscines of new microsatellite DNA loci from the oldfield mouse (*Peromyscus polionotus subgriseus*). Mol. Ecol. Notes, 2:133-136.

Punzo, F. 2003. Observations on the diet composition of the gray shrew *Notiosores crawfordi* (insectivora), including interactions with large arthropods. Tx. J. Sci., 55:75-86.

Rausch, R. L. 2003. *Taenia pencei* n. sp from the ringtail, *Bassariscus astutus* (Carnivora: Procyonidae), in Texas, USA. Comp. Parasitol., 70:1-10.

Ribble, D. O., A. E. Wurtz, E. K. McConnell, J. J. Buegge, and K. C. Welch, Jr. 2002. A comparison of home ranges of two species of *Peromyscus* using trapping and radiotelemetry data. J. Mammal., 83:260-266.

Richman, A. D., L. G. Herrera, and D. Nash. 2002. Characterization of *Peromyscus* MHC class II beta sequences by ligation-anchored RT-PCR and denaturing gradient gel electrophoresis. J. Immunogen., 29:213-217.

Ryan, K. K. and R. C. Lacy. 2003. Monogamous male mice bias behaviour towards females according to very small differences in kinship. Anim. Behav., 65:379-384.

Sample, B. E. and G. W. Suter, II. 2002. Screening evaluation of the ecological risks to terrestrial wildlife associated with a coal ash disposal site. Human Ecol. Risk Assess., 8:637-656.

Schauber E. M. and R. S. Ostfeld. 2002. Modeling the effects of reservoir competence decay and demographic turnover in Lyme disease ecology. Ecol. Applica., 12:1142-1162.

Schmidt, K. A. and R. S. Ostfeld. 2003. Songbird populations in fluctuating environments: predator responses to pulsed resources. Ecology, 84:406-415.

Schnurr, J. L., R. S. Ostfeld, and C. D. Canham. 2002. Direct and indirect effects of masting on rodent populations and tree seed survival. Oikos, 96:402-410.

Schwan, T. G., J. M. Battisti, S. F. Porcella, S. J. Raffel, M. E. Schrumpf, E. R. Fischer, J. A. Carroll, P. E. Stewart, P. Rosa, and G. A. Somerville. 2003. Glycerol-3-phosphate acquisition in spirochetes: distribution and biological activity of glycerophosphodiester phosphodiesterase (GlpQ) among *Borrelia* species. J. Bacteriol., 185:1346-1356.

Segre, M., S. M. Arena, E. H. Greeley, M. J. Melancon, D. A. Graham, and J. B. French. 2002. Immunological and physiological effects of chronic exposure of *Peromyscus leucopus* to Aroclor 1254 at a concentration similar to that found at contaminated sites. Toxicology, 174:163-172.

Shaw, M. T., F. Keesing, R. McGrail, and R. S. Ostfeld. 2003. Factors influencing the distribution of larval blacklegged ticks on rodent hosts. Am. J. Trop. Med. Hygiene, 68:447-452.

Stapp, P. and G. A. Polis. 2003. Marine resources subsidize insular rodent populations in the Gulf of California, Mexico. Oecologia, 134:496-504.

Sterner, R. T., B. E. Petersen, S. E. Gaddis, K. L. Tope, and D. J. Poss. 2003. Impacts of small mammals and birds on low-tillage, dryland crops. Crop Prot., 22:595-602.

Steyermark, A. C. and P. J. Mueller. 2002. Cage size affects feeding and energetics of captive rodents. Physiol. Biochem. Zool., 75:209-213.

Stockley, P. 2003. Female multiple mating behaviour, early reproductive failure and litter size variation in mammals. 270:271-278.

Subak, S. 2003. Effects of climate on variability in Lyme disease incidence in the northeastern United States. Am. J. Epidemiol., 157:531-538.

Suzuki, N. and J. P. Hayes. 2003. Effects of thinning on small mammals in Oregon coastal forests. J. Wildlife Manage., 67:352-371.

Swilling, W. R., Jr. and M. C. Wooten. 2002. Subadult dispersal in a monogamous species: the Alabama beach mouse (*Peromyscus polionotus ammobates*). J. Mammal., 83:252-259.

Thuett, K. A. E. H. Roots, L. P. Mitchell, B. A. Gentles, T. A. Anderson, and E. E. Smith. 2002. In utero and lactational exposure to ammonium perchlorate in drinking water: effects on developing deer mice at postnatal day 21. J. Toxicol. Environ. Health, 65:1061-1076.

Thuett, K. A. E. H. Roots, L. P. Mitchell, B. A. Gentles, T. Anderson, R. J. Kendall, and E. E. Smith. 2002. Effects of in utero and lactational ammonium perchlorate exposure on thyroid gland histology and thyroid and sex hormones in developing deer mice (*Peromyscus maniculatus*) through postnatal day 21. J. Toxicol. Environ. Health-Part A, 65:2119-2130.

Tischendorf, L., D. J. Bender, and L. Fahrig. 2003. Evaluation of patch isolation metrics in mosaic landscapes for specialist vs. generalist dispersers. Landscape Ecol., 18:41-50.

Trainor, B. C. and C. A. Marler. 2002. Testosterone promotes paternal behaviour in a monogamous mammal via conversion to oestrogen. Proc. Royal Soc. London Series B-Biol. Sci., 269:823-829.

Turnbull, M. W. and N. J. Fashing. 2002. Efficacy of the ventral abdominal secretion of the cockroach *Eurycotis floridana* (Blattaria: Blattidae) as a defense allomone. J. Insect Behav., 15:369-384.

Vetcha, S., E. Wilkins, T. Yates, and B. Hjelle. 2002. Rapid and sensitive handheld biosensor for detection of hantavirus antibodies in wild mouse blood samples under field conditions. Talanta, 58:517-528.

Vieira, M. L. and R. E. Brown. 2002. Ultrasonic vocalizations and ontogenetic development in California mice (*Peromyscus californicus*). Behav. Process., 59:147-156.

Vieira, M. L. and R. E. Brown. 2003. Effects of the presence of the father on pup development in California mice (*Peromyscus californicus*). Devel. Psychobiol., 42:246-251.

Wang, Y. and P. S. F. Yip. 2002. Estimation of population size for additive-multiplicative models based on continuous-time recapture experiments. Environmetrics, 13:847-857.

Wilkins, J. F. and D. Haig. 2003. What good is genomic imprinting: the function of parent-specific gene expression. Nat. Rev. Gene., 4:359-368.

Wolf, M. and G. O. Batzli. 2002. Effects of forest edge on populations of white-footed mice *Peromyscus leucopus*. Ecography, 25:193-199.

Wolf, M. and G. O. Batzli. 2002. Relationship of previous trap occupancy to capture of white-footed mice (*Peromyscus leucopus*). J. Mammal., 83:728-733.

Woodman, N., E. Schneider, P. Grant, D. Same, K. E. Schmall, and J. T. Curtis. 2002. A new southern distributional limit for the Central American rodent *Peromyscus stirtoni*. Caribbean J. Sci., 38:281-284.

Wright, S. L. and R. E. Brown. 2002. The importance of paternal care on pup survival and pup growth in *Peromyscus californicus* when required to work for food. Behav. Process, 60:41-52.

Yates, T. L., et al. 2002. The ecology and evolutionary history of an emergent disease: hantavirus pulmonary syndrome. Bioscience, 52:989-998.

Yunger, J. A. 2002. Response of two low-density populations of *Peromyscus leucopus* to increased food availability. J. Mammal., 83:267-279.

Zechner, U., M. Hemberger, M. Constancia, A. Orth, I. Dragatsis, A. Luttges, H. Hameister, and R. Fundele. 2002. Proliferation and growth factor expression in abnormally enlarged placentas of mouse interspecific hybrids. Devel. Dynamics, 224:125-134.

Zheng, X. G., B. S. Arbogast, and G. J. Kenagy. 2003. Historical demography and genetic structure of sister species: deermice (*Peromyscus*) in the North American temperate rain forest. Mol. Ecol., 12:711-724.

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