PEROMYSCUS NEWSLETTER

NUMBER NINETEEN

PEROMYSCUS GENETIC STOCK CENTER
UNIVERSITY OF SOUTH CAROLINA

MARCH 1995

Cover: Entrance to the *Peromyscus* Genetic Stock Center, University of South Carolina, in springtime array. (See page 7)

TEN YEARS !!!

April 1st marks the **10th Anniversary of the** *Peromyscus* **Genetic Stock Center** as an NSF-supported facility at the University of South Carolina. Therefore, we are including in *PN* Issue #19 an account of the history of the Stock Center and its origins from a dozen cages and about 75 animals in 1962 to five animal rooms and nearly 3000 *Peromyscus* at the present time (See page 7).

We are pleased to announce that we finally are on the Internet after numerous delays in getting a fiber optics cable to our building. By the time you receive this, our Stock Center home page will be available on the net. *HOW TO FIND IT*:

http://www.scarolina.edu/peromyscus.html

We also expect to soon have several genetic databases for *Peromyscus*. The first of these will be the formal **Gene Registry and Catalog**. Included in the catalog will be 1.) gene nomenclature, including synonomies of names and symbols, 2.) linkage group and/or chromosome assignment, 3.) mode of inheritance, 4.) complete phenotype description, 5.) recombination reported, 6.) known interactions, 7.) alleles and recurrences, 8.) initial source and evidence of identity-by-descent, and 9.) original and additional literature citations.

Several other data bases (Linkage and mapping; formal listing genetic loci and alleles; lists of allozyme variants in natural populations; comparative map data) will be added and accessible through Internet. Most of these are already maintained by the Stock Center, but will be modified for network access.

Of course, it will also be possible to transmit your future entries to *PEROMYSCUS NEWSLETTER* by E-mail (**peromyscus@stkctr.biol.scarolina.edu**), as well as by FAX, FedEx or old-fashioned USMail.

Deadline for Issue #20 is September 20th.

PEROMYSCUS NEWSLETTER is produced by the

Peromyscus Genetic Stock Center
Department of Biological Sciences and
Institute of Biological Research and Technology
University of South Carolina
Columbia SC 29208
E-mail: peromyscus@stkctr.biol.scarolina.edu

with support, in part, from
National Science Foundation Grant # BIR-9302181.

Wallace D. Dawson, Editor
Department of Biological Sciences
University of South Carolina
Columbia SC 29208
(803) 777-3107
FAX (803) 777-4002

Oscar G. Ward, Co-editor
Department of Ecology and
Evolutionary Biology
University of Arizona
Tucson AZ 85721
(520) 621-7520

Janet Crossland, Staff Assistant
and Colony Manager
Peromyscus Stock Center
University of South Carolina
Columbia SC 29208
(803) 777-3107

C O N T E N T S

* * *

NEWS, COMMENT and ANNOUNCEMENTS

Max King, in his recent book *SPECIES EVOLUTION* (1993), presents a concise, but informative, summary of chromosomal evolution in the *Peromyscus maniculatus* complex. There are also several other references to *Peromyscus* in the volume.

::

IS ANYONE DOING, OR KNOW OF ANYONE WHO HAS DONE, ELECTRON MICROSCOPY ON *PEROMYSCUS* LIVER??? IF SO, PLEASE CONTACT, DR. **JOANNE ELLZEY** AT UNIV. TEXAS AT EL PASO. DR. ELLZEY WORKS WITH ALCOHOL DEHYDROGENASE IN *PEROMYSCUS.* (See page 14)

<><><><><><><><><><><><><><><><><><><><>

We were saddened to learn recently of the death of Dr. **Bernard Pirofsky** of the University of Oregon Health Science Center at Portland. Dr. Pirofsky maintained stocks of cataract-webbed and spherocytosis deer mice which originally came from the R.R. Huestis colony.

*** *** *** *** ***

Dr. **Bruce Brewer** of the Chicago's Brookfield Zoo is seeking *P. gossypinus*, preferably lab-bred. If anyone has *P. gossypinus* available and is willing to share, please contact Dr. Brewer at (708) 485-0263 ext. 445.

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

The first issue of **RAT GENOME,** *the successor to RAT NEWS LETTER, has just been published. RAT GENOME is the official publication of the International Rat Genetic Nomenclature Committee. Individual subscriptions are $ 20 for two issues annually. Please contact* **Heinz Kunz, Editor,** *University of Pittsburgh School of Medicine, for additional information.*

~~~~~~

The *Peromyscus* Genetic Stock Center is now on-line. Please see our home page on the Internet: **http://www.scarolina.edu/peromyscus.html**
Our E-mail address is:

peromyscus@stkctr.biol.scarolina.edu

Please contact us if we can help you!

~~~~~~

NOTICE

There will be an unspecified number of *P. californicus* available in June of 1995 at the University of Wisconsin. These animals have been hantavirus tested. The investigator must disperse the colony. Please inquire at (608) 265-5581 or E-mail: lisakh@rarc.wisc.edu.

????????????? QUERY ?????????????

"I am intiating an immunological project for which *Peromyscus leucopus* would be useful. I would like to know if anybody has reagents that recognize peromyscus immunoglobins, B cells or T cells. I do know that a goat anti-peromyscus Ig is commercially available. I would like to come in contact with immunologists who use, or have used, *Peromyscus* sp as an experimental animal."

Please contact:

Mariangela Segre
Department of Pathology
College of Veterinary Medicine
University of Illinois
2001 South Lincoln Avenue
Urbana, IL 61801

Susan Dawes sends us an E-mail message that she currently is using Peromyscus leucopus as a feral rodent model for male reproductive toxicology exposure studies. She is building a database of reproductive organ weights, spermatid head counts, as well as sperm motility endpoints using CASA, in P. leucopus. **Anyone with shared interests may want to contact her c/o: dawes.susan@epamail.epa.gov**

HANTAVIRUS UPDATE

It is now nearly two years since the outbreak of hantaviral pulmonary syndrome (HPS) in the western U.S. and identification of *Peromyscus maniculatus* as its principal natural carrier. The incidence of the disease in the human population appears to have abated, with new cases being reported only sporadically. As of January 1995 a total of 102 cases had been confirmed in the U.S. with 7 more in Canada. Overall mortality at this point is about 40%, indicating that medical intervention has been more effective since the condition has been publicised and its etiology more precisely defined. So, should those of us who collect small mammals return to business as usual? Isn't the risk minimal?

To reply to these questions, in our view, is to use common sense. A knowledge of the natural history and evolution of the virus and its rodent hosts is relevant. Brian Hjelle (1995, www server for virology) notes that each of three general categories of hantaviruses seem to infect rodents of a different subfamily. The prototypical hantaviruses (Hantaan, *etc.*) agents which cause hemorrhagic fever with renal syndrome (HFRS) are carried by murine rodents, partcularly *Apodemus* and *Rattus*. Voles (*Microtis* and *Clethrionomys*), subfamily Arvicolinae, appear to be the principal hosts for hantaviruses of the Prospect Hill and Tula type. These either are non-pathogenic to humans or produce a milder renal syndrome. Finally, Four Corners virus (a.k.a. Muerto Canyon virus; Sin Nombre virus, *etc.*) is a member of a group associated with sigmodontine rodents, especially, but not exclusively, *Peromyscus*. This last group produces HPS in humans. The phylogeny of the hantaviruses, based on serology and sequence data, correponds to the rodent phylogeny. This is strong evidence that hantaviruses are endemic to, and likely co-evolved with, their respective rodent hosts. The ancestral hantavirus, perhaps, emerged prior to the divergence of major murid taxa (~25mybp). The earliest confirmed case of HPS dates to 1959 and there are other documented cases pre-dating the recent Four Corners outbreak. In short, these viruses are not new, but likely have been around for a long time.

Then why the 1993 outbreak? As previously noted by CDC and others, the focus of the outbreak occurred in a region where, because of high precipitation in the previous years and heavy seed set, deer mouse populations were locally as much as twenty times the normal. The normal incidence of hantaviral positives in natural *Peromyscus* populations is below 5%, but in 1993 at Four Corners approximated 30%. **What is our message to field biologists? Collect, if necessary, but do so with caution.** Disinfect traps after each use with chlorine bleach solution. Handle wild rodents and carcasses with gloves. Avoid breathing dust associated with rodents. Live rodents brought into captivity should be tested for hantaviral exposure, and care taken not to expose other animals. **Do not collect when populations are dense or unusually expanded**, since transinfection among to rodents is apt to be greater, as in the Four Corners example.

HISTORY OF THE PEROMYSCUS GENETIC STOCK CENTER

The University of South Carolina *Peromyscus* colony originated in 1962 when I joined the faculty of the Biology Department bringing about 75 animals with me from Ohio State University where I had completed graduate work with William B. McIntosh. McIntosh maintained an extensive colony which included wild-type *P. maniculatus* (BW stock) and *P. polionotus* (PO stock) and many of the deer mouse coat color mutants which he, in turn, had brought to Ohio State about 1956 from Lee R. Dice's University of Michigan colony. The initial animals in the South Carolina colony consisted of the two wild-type stocks (which are still maintained) and the gray (*g/g*), wide-band agouti ($A^{Nb}/+$), platinum (*plt/plt*), ivory (*i/i*) and dominant spot (*S/+*) mutants.

Through the subsequent years additional stocks and mutants were assimilated as my research interests and those of my students expanded. The addition in 1966 and 1967 of several mutant stocks from Ralph R. Huestis, University of Oregon, represented a major increment. Huestis' deer mice originated from mutants he and his students had identified and those from F.B. Sumner's stocks at LaJolla, where Huestis himself had trained. Unfortunately, Huestis did not maintain separate lines of individual mutants, but rather had mixed his stocks to find interactions. Thus, these stocks had to be sorted and selected to establish pure lines on an otherwise wild-type background. Other major increments were stocks received in the early 1970s from Harold Egoscue, Dugway Proving Ground, Utah. These included several coat color variants he had described. We also maintained for several years a *P. polionotus* mutant, colorless hairtip (*ctp/ctp*), donated, along with subspecific *P. polionotus* stocks, by Wilfred Bowen of Dartmouth Museum. Exchanges both to and from the University of Michigan colony were made during the 1970's and early 1980's. Suellen Van Ooteghem was instrumental in these exchanges. In addition to coat variants, hemoglobin, amylase, and several skeletal and metabolic variants in *Peromyscus* were absorbed into the colony. During the mid-1970's Michael Felder of the University of South Carolina isolated pure-breeding lines of negative and positive variants of liver alcohol dehydrogenase (*Adh-1*) from the BW stock of *P. maniculatus*. The negative variant is the only known mammalian example of absence of liver ADH activity. This proved to be a very useful model system which engendered research at several laboratories around the world.

Until 1977 the *Peromyscus* colony was maintained using part-time student help, and equipment and supplies provided from the Biology Department budget or grants for specific research projects. The colony had grown to about 600 cages by then and the costs were still manageable, but animal care suffered because of the lack of permanent professional caretakers. The University established a Medical School in 1976 and the need for campus-wide lab animal maintenance and approval by the American Association for Accreditation of Laboratory Animal Care (AAALAC) was evident. Thus, the Medical School assumed responsibility for all laboratory animals on campus instituting a system of *per diem* charges back to the individual departments. In 1978 animal facilities in the Science Annex Building were improved to meet AAALAC standards, but the cost of maintaining the deer mouse colony increased dramatically, entailing a marked reduction in animal inventory. The average cage count declined to 250. However, animal husbandry markedly improved. During this period several mutant types were discontinued (but later most were replenished from elsewhere) and one, colorless hairtip, was lost despite desperate efforts to salvage it.

The South Carolina deer mouse colony gradually developed a reputation as a resource for these animals, and was listed as such in various animal directories. Meanwhile, several of the then-existing *Peromyscus* colonies holding genetic variants at other universities were being closed. The increasing costs and discontinuance of colonies, together with specialized research interests of most *Peromyscus* biologists, threatened continuation of large general purpose colonies. During the late 1970's and early 1980's, initial proposals for external support were made to funding agencies, but were unsuccessful. In 1979 the concept of a consortium of *Peromyscus* colonies was proposed consisting of those at Michigan State University (John A. King), University of Michigan (Morris Foster) and South Carolina. Each institution would specialize in certain stocks, *e.g.* Michigan State would maintain wild-type stocks and South Carolina would be the principal holder of mutants. After some preliminary discussions and a draft proposal, the corsortium plan was abandoned as unfeasible.

Once again application was made to the National Science Foundation in 1984. By this time the philosophy at NSF Biological Research Resources concerning living stock collections was changing, and the requirement for sustained support for was becoming evident. A 5-year NSF award, matched with funds from the University, permitted the establishment of the *Peromyscus* Genetic Stock Center beginning 1 April 1985. NSF funding continued with renewals in 1990 and 1993. In September 1985 Janet Crossland joined the staff as Colony Manager and institutued numerous positive changes.

Since its recognition as an NSF living stock collection, the *Peromyscus* Stock Center has increased its service to the biological research and educational community. The principal function is to provide live animals and other biological materials for research. As of March 1995 more than 5,000 specimens had been provided to external users in 30 states and three foreign countries. The Center has added several additional species and mutants to its collection. A *Peromyscus* Molecular Bank was established in 1991. The *Peromyscus* Behavior Mutant Center at the University's Aiken Campus, spun off in 1991 from the center on the Columbia Campus. The Center also functions to maintain genetic databases for the genus, and publishes *PEROMYSCUS NEWSLETTER*.

The Stock Center currently maintains 37 distinct genetic coat color, morphological and behavioral variants, seven wild-type stocks of six species and various special stocks. Animal inventory levels vary between 2000 and 3000 animals. Addition of two more species (*P. boylii* and *P. truei*) is projected. Service in the information area is also expected to become more efficient with assistance provided through the Internet and other improvements. A reference reprint collection with more than 2,500 journal articles on *Peromyscus* is maintained. We are also looking forward to a new building where the Stock Center will be located. This is in the planning stages, and should become a reality by 1998.

W. Dawson
Peromyscus Stock Center Director

PEROMYSCUS STOCK CENTER

What is the Stock Center? The deer mouse colony at the University of South Carolina has been designated a genetic stock center under a grant from the Special Projects Program of the National Science Foundation. The major function of the Stock Center is to provide genetically characterized types of *Peromyscus* in limited quantities to scientific investigators. Continuation of the center is dependent upon significant external utilization, therefore potential **users are encouraged to take advantage of this resource.** 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.

A user fee of **$10 per animal** is charged and the user assumes the cost of air shipment. Animals lost in transit are replaced without charge. Tissues, blood, skins, *etc.* can also be supplied at a modest fee. Arrangements for special orders will be negotiated. Write or call for details.

Stocks Available in the Peromyscus Stock Center:

WILD TYPES	ORIGIN
P. maniculatus bairdii (BW Stock)	Closed colony bred in captivity since 1948. Descended from 40 ancestors wild-caught near Ann Arbor MI
P. polionotus subgriseus (PO Stock)	Closed colony since 1952. Derived from 21 ancestors wild-caught in Ocala Nat'l. Forest FL. High inbreeding coefficient.
P. polionotus leucocephalus (LS Stock)	Derived from beachmice wild-caught on Santa Rosa I., FL. and bred by R. Lacy. Seventh to tenth generation in captivity.
P. leucopus (LL Stock)	Derived from 38 wild ancestors captured between 1982 and 85 near Linville NC. Eighteenth to twenty-fourth generation in captivity.
P. californicus insignis (IS Stock)	Derived from about 60 ancestors collected between 1979 and 87 in Santa Monica Mts. CA. Tenth to twelfth generation in captivity.
P. aztecus	Derived from animals collected on Sierra Chincua, Michoacan, Mexico in 1986 Seventh to tenth generation in captivity.
P. maniculatus X *P. polionotus* F_1 Hybrids	Sometimes available.

MUTATIONS AVAILABLE FROM THE STOCK CENTER[1]

Coat Colors	**ORIGINAL 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)
[2]Brown *b/b*	Huestis stocks (Huestis and Barto, 1934)
Dominant spotting *S/+*	Wild caught in Illinois (Feldman, 1936)
Golden nugget b^{gn}/b^{gn} [in *P. leucopus*]	Wild caught in Massachusetts (Horner and Dawson, 1993)
Gray *g/g*	Natural polymorphism From Dice stocks (Dice, 1933)
Ivory *i/i*	Wild caught in Oregon (Huestis, 1938)
[3]Pink-eyed dilution *p/p*	Sumner's "pallid" deer mice (Sumner, 1917)
Platinum *plt/plt*	Barto stock at U. Mich. (Dodson *et al.*, 1987)
[2]Silver *si/si*	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. Michigan stock (McIntosh, 1954)
Yellow *y/y*	Sumner's original mutant (Sumner, 1917)

MUTATIONS AVAILABLE FROM THE STOCK CENTER[1] (continued)

Other Mutations and Variants	**ORIGIN**
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)
[4]Boggler *bg/bg*	Blair's *P. m. blandus* stock (Barto, 1955)
Cataract-webbed *cwb/cwb*	From Huestis stocks. (Anderson and Burns, 1979)
[4]Epilepsy *ep/ep*	U. Michigan *artemisiae* stock (Dice, 1935)
[3]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)
[4]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. See Dawson *et al.* (1983). For origin references see *PN* #18, pp.25-26.

---

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

[2]Available only as silver/brown double recessive.

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

[4]Available from Behavior Mutant Center

Note: Some of the mutations are immediately available only in combination with others. For example, silver and brown are maintained as a single "silver-brown" double recessive stock. Write the Stock Center or call (803) 777-3107 for details.

OTHER RESOURCES OF THE *PEROMYSCUS* GENETIC STOCK CENTER:

Limited numbers of other stocks, species, mutants, inbreds and variants are on hand, or under development, but are not currently available for distribution. For additional information or details about any of these mutants or stocks contact: Janet Crossland, Colony Manager, Peromyscus Stock Center, (803) 777-3107.

Preserved or frozen specimens of types given above.

Tissues, whole blood or serum of types given above.

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

Reference library of more than 2400 reprints of research articles and reports on *Peromyscus*.
Copies can be xeroxed and mailed.

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

PLEASE CALL WITH INQUIRIES.

Peromyscus Genetic Stock Center
University of South Carolina
Columbia SC 29208
(803) 777-3107
peromyscus@stkctr.biol.scarolina.edu

Materials on Deposit in the *Peromyscus* Molecular Bank

Accession Number	Item	Description	Species	Donor	Location[1]
Probes and Clones:					
Pr-01	LINE1	pDK62	*P. maniculatus*	D. Kass	C
Pr-02	LINE1	pDK55	*P. maniculatus*	D. Kass	C
Pr-03	ADH1	pADH F72	*P. maniculatus*	M. Felder	B
Pr-04[2]	Mys		*P. leucopus*	(Requested)	
Pr-05[2]	SAT		*P. leucopus*	(Requested)	
Pr-06	6PGD	pB5 clones	*P. californicus*	S. Hoffman	A
Pr-07	MHC *Pele*I	38dp2	*P. leucopus*	M. Crew	A
Pr-08	MHC *Pele*I	52ap6	*P. leucopus*	M. Crew	A
Pr-09	MHC *Pele*I	40Bgl	*P. leucopus*	M. Crew	A
Pr-10	MHC *Pele*I	53Pv1	*P. leucopus*	M. Crew	A
Pr-11	MHC *Pele*I	37B2	*P. leucopus*	M. Crew	A
Pr-12	MHC *Pele*I	37B4	*P. leucopus*	M. Crew	A
Pr-13	MHC *Pele*II	α3E23	*P. leucopus*	M. Crew	A
Pr-14	MHC *Pele*III	17E2	*P. leucopus*	M. Crew	A
Pr-15	MHC *Pema*I	pr44	*P. maniculatus*	M. Crew	A
Libraries:					
Lb-01	lambda genomic	liver (ADH+)	*P. maniculatus*	M. Felder	B
Lb-02	lambda cDNA	liver	*P. maniculatus*	M. Felder	B
Lb-03	lambda genomic	testis	*P. leucopus*	M. Crew	A
Lb-04	cosmid genomic	testis	*P. leucopus*	R. Baker	A
Lb-05	lambda genomic	liver	*P. californicus*	S. Hoffman	A
Frozen Tissue for DNA:					
S-01	bairdii (BW)	liver, other[3]	*P. maniculatus*	Stk. Ctr.	A
S-02	subgriseus (PO)	liver, other	*P. polionotus*	Stk. Ctr.	A
S-03	leucopus (LL)	liver, other	*P. leucopus*	Stk. Ctr.	A
S-04	wild-caught SC	liver, other	*P. gossypinus*		A
S-05	aztecus	liver, other	*P. aztecus*	J. Glendinning	A
S-06	insignis (IS)	liver, other	*P. californicus*	S. Hoffman	A
S-07	inbred PmH1A	liver, other	*P. maniculatus*	Jackson Lab	A
S-08	inbred PmH8	liver, other	*P. maniculatus*	Jackson Lab	A

[1]Location code: **A** = USoCar SAI 01; **B** = USoCar CLS 603; **C** = USoCar CLS 707

[2]Not currently available.

[3]kidney, spleen, testis, carcass.

<><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>

<><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>

C O N T R I B U T I O N S

Joanne Tontz ELLZEY, PhD.
Biological Sciences
The University of Texas at El Paso
El Paso, TX 79968-0519
(915) 747-6880
FAX: (915) 747-5808
E-mail: JX04%UTEP@UTEPVM.EP.UTEXAS.EDU

Co-workers:
Daniel Borunda
Tamara Stevens

MORPHOMETRIC ANALYSIS OF PEROXISOMES AND MITOCHONDRIA WITHIN ALCOHOL DEHYDROGENASE POSITIVE AND NEGATIVE *PEROMYSCUS MANICULATUS*.

A morphometric analysis of the volume density, surface density and numerical density of peroxisomes and mitochondria within the livers of alcohol dehydrogenase positive and alcohol dehydrogenase negative *Peromyscus maniculatus* showed no significant differences between these two groups of deer mice.

Seventy-five micrographs of ADH-negative mice (n=5) were compared with 75 micrographs of ADH-positive mice (n=5). They were analyzed with OPTIMAS image analysis software (Bioscan). A Student t-test showed no significant differences in volume density, surface density, or numerical density of peroxisomes or mitochondria. The peroxisomes had an unusual football-shape with dense inclusions.

Future studies will morphometrically analyze similar parameters in the presence of toxic drugs including ethanol.

* * *

Taye TEFERI and D. J. GUBERNICK
Hastings Natural History Reservation
38601 E. Carmel Valley Road
Carmel Valley, CA 93924
(408) 659-7430
E-mail: tteferi@uclink2.berkeley.edu

Co-workers:
Siri Ibarguen
Charles Land

TESTING THE MALE CARE HYPOTHESIS

Our field work on *Peromyscus californicus*, here at Hastings is continuing despite minor interruptions due to unprecedented floods in January and March. In this field research we are particularly interested in testing the Male Care Hypothesis for the evolutionary maintenance of monogamy. In order to determine whether or not male parental care is critical for the successful raising of young, we are using a combination of radiotelemetry and intensive live-trapping. In the process we are attempting to determine the fitness effects of paternal care on maternal investment strategies by removing the father and measuring maternal time budget, infant growth & survivorship; maternal body weight, inter-birth interval & survivorship.

We look forward to an even better field season starting this coming fall. Because of the intensity of the field work, we will be expanding our roster of assistants. Prospective field assistants that can start in September should contact me at the above address.

* * *

Elizabeth K. HARPER
Department of Biology
Moorhead State University
Moorhead, MN 56563

Co-workers:
Denise E. W. Canfield
Donna M. B. Stockrahm

OCCURRENCE OF SMALL MAMMAL SPECIES IN AREAS INHABITED BY THE NORTHERN GRASSHOPPER MOUSE (*ONYCHOMYS LEUCOGASTER*)

During the summer of 1993, 6 study sites in Clay County, Minnesota, were live-trapped to determine the distribution and habitat affinities of the northern grasshopper mouse (*Onychomys leucogaster*). Northern grasshopper mice were captured at 2 of these sites. Several species of small mammals were trapped on at least 1 of the 2 study sites inhabited by northern grasshopper mice. These species included deer mice (*Peromyscus maniculatus*) (n=50), meadow voles (*Microtus pennsylvanicus*) (n=18), and prairie voles (*M. ochrogaster*) (n=9). One additional animal, identified as a white-footed mouse (*P. leucopus*), was trapped at 1 site. However, this identification was based only on tail and coloration characteristics noted in the field and not on skull characteristics. Deer mice and meadow voles were captured at both study sites where the northern grasshopper mice were captured. Furthermore, we captured deer mice in the same traps where northern grasshopper mice had recently been captured. We found this noteworthy because northern grasshopper mice have been reported to kill and eat other rodent species (Egoscue, H. J. 1960. J. Mammalogy 41:99-110). Apparently, the scent of the northern grasshopper mice, their urine, and their feces did not deter the deer mice from entering the traps.

* * *

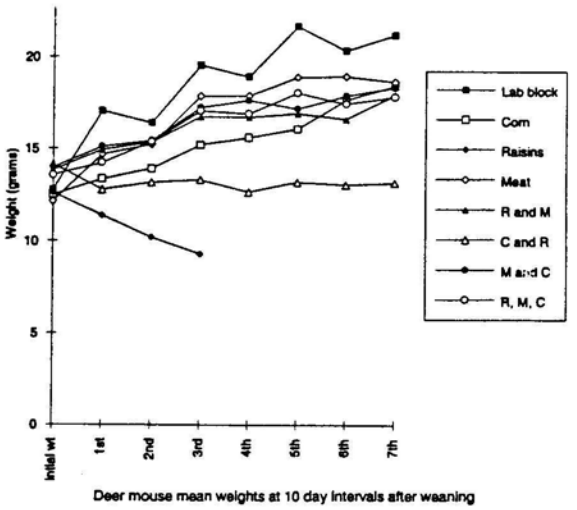
Binh V. PHAM
Department of Biological Sciences
University of South Carolina
Columbia, SC 29208
(803) 777-3107

NUTRIENT VALUE OF SEVERAL NATURAL FOOD SUBSTANCES FOR DEER MICE

Natural food diets were investigated to determine what nutrients are most important to growth and maintenance of deer mice (*Peromyscus maniculatus*). The study was divided into two projects. In Project I, twelve mating pairs of newly weaned *Peromyscus* of similar age and weight, were established and divided into four groups of three with each group being fed a different diet. The diets used were: 1) commercial lab block as a control, 2) desiccated beef pellets (representing the high protein nutrient that deer mice find in the wild in the form of animal carcasses and arthropods), 3) seedless raisins (representing the high sugars in fruits and berries), and 4) dry whole kernel corn (representing high carbohydrate in grains and seeds). The mated pairs were scored for several measures to determine health and development, including individual weight at 10 day intervals. Results from this project provided information on the relative importance of the exclusive diets to the *Peromyscus*.

Project II, examined the effects of feeding combinations of the natural food substances. Twelve matings were established following the same guidelines as the first project except that the four diets used were: 1) raisins and meat, 2) corn and raisins, 3) meat and corn, and 4) raisins, meat, and corn. To avoid preferential feeding by the deer mouse, the diet was alternated every two days for each group forcing the animals to consume the specified nutrient in the combination. The animals were scored using the same criteria from the first project.

Exclusive diets were insufficient in providing nutrition for growth and development of deer mice. A balanced diet with varied nutrients is critical in maintaining proper health. Results also indicated that combination diets containing high protein and carbohydrate favor better growth than other combinations. Lab block was significantly superior to all other diets. Raisins and corn plus raisins, were significantly inferior. All other diets permitted sustenance to varying degrees.



Deer mouse mean weights at 10 day intervals after weaning

Reference: Vickery, W. L., J. Daoust, A. E. Wartiti, and J. Peltier. 1994. The effect of energy and protein content one food choice by deer mice, *Peromyscus maniculatus* (Rodentia). Anim. Behav., 47:55-64.

Albrecht I. SCHULTE-HOSTEDDE and Ronald J. BROOKS
Department of Zoology
University of Guelph
Guelph, Ontario, Canada
(519) 824-4120 ext. 8360

INTERSPECIFIC INTERACTIONS AND HABITAT USE BY *PEROMYSCUS MANICULATUS, CLETHRIONOMYS GAPPERI,* AND *NAPAEOZAPUS INSIGNIS*

As part of a long-term monitoring project (1945-1995) of *Peromyscus* abundance in Algonquin Park, Ontario, we are beginning a short-term investigation of the role of interspecific competition in patterns of habitat selection of a small mammal community. *Peromyscus maniculatus* is sympatric with two other small mammal species, *Clethrionomys gapperi* and *Napaeozapus insignis*, which share similar habitats. Populations of these species are variable among habitats. In particular, habitats occupied by *C. gapperi* often have low numbers of *P. maniculatus*. Previous work investigating interspecific competition *i*) have been conducted under unnatural conditions, *ii*) were not statistically robust, and *iii*) based their interpretations on trapping data which does not give a proper account of spatial or temporal variation.

Our goals are:

1. To investigate whether interspecific competition is responsible for differences in habitat use between species.

2. To determine whether the nature of interspecific competition is behaviourial interactions or mutual avoidance of odour cues.

3. To determine whether results from 1. and 2. are consistent with patterns seen in the long-term data.

Primarily, we hypothesize that interspecific competition is responsible for differences we have observed among species in habitat use. Secondarily, we hypothesize that interspecific competition occurs in the form of behaviourial interference, rather than mutual avoidance of odour cues.

To test these hypotheses, we will construct 3-4 large outdoor enclosures, each containing 3 habitat classes (maple, spruce/pine, and mixed). We will use the spool and thread technique to track individuals in a heterogeneous environment both with and without the presence of a heterospecific (Boonstra and Craine 1986). A small spool of thread is glued to the back of the animal using Krazy Glue, which is similar to glue used as a skin adhesive (Ontario Veterinary College, pers. comm.). As a control, animals will be placed in the enclosure one at a time. Treatments will include putting the animal in the enclosure with an heterospecific (also with a spool), a caged heterospecific, and the faeces and urine of a heterospecific. Ultimately, we hope to clarify the importance of interspecific competition in small mammal communities.

* * *

Jerry O. WOLFF
USEPA
200 SW 35th Street
Corvallis, OR 97333
(503) 754-4377
FAX: (503) 754-4338
E-mail: jerryw@mail.cor.epa.gov

MECHANISMS FOR COEXISTENCE OF WHITE-FOOTED MICE AND DEER MICE

In a 14-year study of white-footed mice (*Peromyscus leucopus noveboracensis*) and cloudland deer mice (*Peromyscus maniculatus nubiterrae*) where they occur sympatrically in the southern Appalachian Mountains of the eastern United States, my colleagues and I have not been able to detect any significant resource partitioning nor totally explain how these species coexist. We did demonstrate that at high densities the two species are interspecifically territorial and thus coexistence could be mediated by equal dominance between the two species. Population densities of both species have fluctuated between 3 and 103 mice/ha from 1980 through 1994. The ratio of *P. leucopus* to *P. maniculatus* ranged from 0.5:1 to 6:1., but varied predictably by season and year. The ratio of *P. leucopus* to *P. maniculatus* was highest when overall densities were >20 mice/ha and(or) during population increases, and lowest when overall densities were <20 mice/ha and(or) populations were declining. High *P. leucopus:P. maniculatus* ratios occurred during high acorn production and(or) mild winters, and low ratios occurred in early spring following autumns of poorest acorn production. During low spring densities, *P. maniculatus* seemed to have a survival advantage, whereas during seasonal or annual periods of population growth, *P. leucopus* populations grew faster than did those of *P. maniculatus*. Environmental conditions seem to fluctuate at a sufficient frequency to give each species a selective advantage often enough such that neither gains a long-term advantage.

In the southern Appalachians, *P. leucopus* occurs from sea level to an elevation of about 1400 m and *P. maniculatus* occurs from the highest elevation down to about 800 m. *Peromyscus maniculatus*, having a more boreal distribution than does *P. leucopus* may be better adapted to adverse weather conditions, whereas the more southern *P. leucopus* has an advantage during seasons and years of high productivity or mild weather. Thus, in the zone of range overlap between 800 and 1,400 m, coexistence of these two *Peromyscus* species might be mediated by different responses to seasonal and annual environmental conditions. *Peromyscus leucopus* exhibit rapid population increase during "good" times, but has poor survival value during "bad" times. *Peromyscus maniculatus* do not increase as rapidly as do *P. leucopus* during "good" times, but have higher survival and are able to maintain stable numbers during winters of food shortage. Thus, coexistence can be mediated through different physiological limitations of the two species in a fluctuating environment.

* * *

RECENT PUBLICATIONS

Andersen, D. C. 1994. Demographics of small mammals using anthropogenic desert riparian habitat in Arizona. J. Wildlife Manage., 58:445-454.

Baker, A. E. M. 1994. Stowaway transport rates of house mice (*Mus domesticus*) and deermice (*Peromyscus maniculatus*). Proc. 16th Vertebr. Pest Conf., 16:106-112.

Baker, R. J. and D. H. Kass. 1994. Comparison of chromosomal distribution of a retroposon (LINE) and a retrovirus-like element *mys* in *Peromyscus maniculatus* and *P. leucopus*. Chrom. Res., 2:185-189.

Bellocq, I. and S. M. Smith. 1994. Arthropods preferred as food by *Sorex cinereus* (masked shrew) and *Peromyscus maniculatus* (deer mouse): An experimental approach. Mammalia, 58:391-396.

Beyer, W. N., E. E. Connor, and S. Gerould. 1994. Estimates of soil ingestion by wildlife. J. Wildl. Manage., 58:375-382.

Blank, J. L., A. I. Korytko, D. A. Freeman, and T. P. Ruf. 1994. Role of gonadal steroids and inhibitory photoperiod in regulating body weight and food intake in deer mice (*Peromyscus maniculatus*). Proc. Soc. Exp. Biol. Med., 206:396-403.

Brackett, L. E., J. Rotenberg, and C. B. Sherman. 1994. Hantavirus pulmonary syndrome in New England and Europe. New England J. Med., 331:545-.

Brillhart, D. E. and D. W. Kaufman. 1994. Temporal variation in coyote prey in tallgrass prairie of eastern Kansas. Prairie Nat., 26:93-105.

Brown, R. N. and R. S. Lane. 1994. Natural and experimental *Borrelia burgdorferi* infections in woodrats and deer mice from California. J. Wildlife Dis., 30:389-398.

Bruseo, J. A. and R. E. Barry, Jr. 1995. Temporal activity of syntopic *Peromyscus* in the central appalachians. J. Mamm., 76:78-82.

Budaraju, S., W. E. Stewart, and W. P. Porter. 1994. Prediction of forced ventilation in animal fur from a measured pressure distribution. Proc. R. Soc. Lond. B, 256:41-46.

Burek, K. A., C. A. Rossi, J. W. Ledue, and T. M. Yuill. 1994. Serologic and virologic evidence of a Prospect Hill-like hantavirus in Wisconsin and Minnesota. Am. J. Trop. Med. Hyg., 51:286-294.

Burkey, T. V. and N. C. Stenseth. 1994. Population dynamics of territorial species in seasonal and patchy environments. Oikos, 69:47-53.

Butler, J. C. and C. J. Peters. 1994. Hantaviruses and hantavirus pulmonary syndrome. CID, 19:387-395.

Buttler, B. 1994. Predation and *Peromyscus* (Rodentia): A bibliography. Canadian Union College, College Heights, Alberta CANADA. 1-26.

Childs, J. E., T. G. Ksiazek, C. F. Spiropoulou, J. W. Krebs, S. Morzunov, G. O. Maupin, K. L. Gage, P. E. Rollin, J. Sarisky, R. E. Enscore, J. K. Frey, C. J. Peters, and S. T. Nichol. 1994. Serologic and genetic identification of *Peromyscus maniculatus* as the primary rodent reservoir for a new hantavirus in the southwestern United States. J. Infect. Dis., 169:1271-1280.

Cowling, K., R. J. Robbins, G. R. Haigh, S. K. Teed, and W. D. Dawson. 1994. Coat color genetics of *Peromyscus*: IV. Variable white, a new dominant mutation in the deer mouse. J. Hered., 85:48-52.

Cramer, K. L. 1994. New mammal record for Fremont Island with an updated checklist of mammals on islands in the Great Salt Lake. Great Basin Nat., 54:287-289.

Crew, M. D., C. A. Douglass, and K. A. Brorson. 1994. *H-2T24* and *PemaT24*: orthologous expressed MHC class IB genes from mouse and *Peromyscus maniculatus*. Immunogenetics 39:412-417.

Cummings, J. R. and S. H. Vessey. 1994. Agricultural influences on movement patterns of white-footed mice (*Peromyscus leucopus*). Am. Midl. Nat., 132:209-218.

Daniels, T. J. and D. Fish. 1995. Effect of deer exclusion on the abundance of immature *Ixodes scapularis* (Acari: Ixodidae) parasitizing small and medium-sized mammals. J. Med. Entomol., 32:5-11.

Defosse, D. L., R. C. Johnson, B. J. Paster, F. E. DeWhirst, and G. J. Fraser. 1995. *Brevinema andersonii* gen. nov., sp. nov., and infections spirochete isolated from the short-tailed shrew (*Blarina brevicauda*) and the white-footed mouse (*Peromyscus leucopus*). Internat. J. Systematic Bacteriol., 45:78-.

Duddley, B. F. and G. W. Winston. 1995. p-Nitrosophenol reduction by liver cytosol from ADH-positive and -negative deermice (*Peromyscus maniculatus*). Arch. Biochem. Biophys., 316:879-885.

Fellers, G. M. 1994. Species diversity, selectivity, and habitat associations of small mammals from coastal California. Southwestern Nat., 39:128-136.

French, J. B., Jr. and W. P. Porter. 1994. Energy acquisition and allocation in *Peromyscus maniculatus* exposed to aldicarb and cool temperatures. Environ. Toxicol. Chem., 13:927-933.

Galea, L. A. M., M. Kavaliers, K.-P. Ossenkopp, D. Innes, and E. L. Hargreaves. 1994. Sexually dimorphic spatial learning varies seasonally in two populations of deer mice. Brain Res., 635:18-26.

Garman, S. L., A. F. O'Connell, Jr., and J. H. Connery. 1994. Habitat use and distribution of the mice *Peromyscus leucopus* and *Peromyscus maniculatus* on Mount Desert Island, Maine. Can. Field-Nat., 108:67-71.

Getty, T. and E. A. Capaldi. 1994. Inheritance of rank requires inheritance of social environment. Anim. Behav., 48:982-983.

Greenbaum, I. F., S. J. Gunn, S. A. Smith, B. F. McAllister, D. W. Hale, R. J. Baker, M. D. Engstrom, M. J. Hamilton, W. S. Modi, L. W. Robbins, D. S. Rogers, O. G. Ward, W. D. Dawson, F. F. B. Elder, M. R. Lee, S. Pathak, and F. B. Stangl, Jr. 1994. Cytogenetic nomenclature of deer mice, *Peromyscus* (Rodentia): Revision and review of the standardized karyotype. Cytogenet. Cell Genet., 66:181-195.

Gubernick, D. J. and R. L. Addington. 1994. The stability of female social and mating preferences in the monogamous California mouse, *Peromyscus californicus*. Anim. Behav., 47:559-567.

Gubernick, D. J. and B. Laskin. 1994. Mechanisms influencing sibling care in the monogamous biparental California mouse, *Peromyscus californicus*. Anim. Behav., 48:1235-1237.

Gubernick, D. J., K. A. Schneider, and L. A. Jeannotte. 1994. Individual differences in the mechanisms underlying the onset and maintenance of paternal behavior and the inhibition of infanticide in the monogamouse biparental California mouse, *Peromyscus californicus*. Behav. Ecol. Sociobiol., 34:225-231.

Hayssen, V., S. Gunawardhana, and J. Meyer. 1994. The agouti coat-color locus may influence brain catecholamines: Regional differences in norepinephrine and dopamine in the brains of two color-morphs of deermice (*Peromyscus maniculatus*). Comp. Biochem. Physiol., 107:51-55.

Heske, E. J., J. H. Brown, and S. Mistry. 1994. Long-term experimental study of a Chihuahuan Desert rodent community: 13 years of competition. Ecology, 75:438-445.

Hjelle, B., S. Jenison, N. Torres-Martinex, T. Yamada, K. Nolte, R. Zumwalt, K. Macinnes, and G. Myers. 1994. A novel hantavirus associated with an outbreak of fatal respiratory disease in the southwestern United States: Evolutionary relationships to known hantaviruses. J. Virol., 68:592-596.

Jacquot, J. J. and S. H. Vessey. 1994. Non-offspring nursing in the white-footed mouse *Peromyscus leucopus*. Anim. Behav., 48:1238-.

Jemiolo, B., D. J. Gubernick, M. C. Yoder, and M. Novotny. 1994. Chemical characterization of urinary volatile compounds of *Peromyscus californicus*, a monogamous biparental rodent. J. Chem. Ecol., 20:2489-2500.

Jimenez, J. A., K. A. Hughes, G. Alaks, L. Graham, and R. C. Lacy. 1994. An experimental study of inbreeding depression in a natural habitat. Science, 266:271-273.

Joy, J. E. and N. J. Briscoe. 1994. Parasitic arthropods of white-footed mice at McClintic Wildlife Station, West Virginia. J. Amer. Mosquito Contr. Assoc., 10:108-111.

Kaufman, D. W., G. A. Kaufman, E. J. Finck. 1995. Temporal variation in abundance of *Peromyscus leucopus* in wooded habitats of eastern Kansas. Am. Midl. Nat., 133:7-17.

Kaufman, G. A. and D. W. Kaufman. 1994. Changes in body mass related to capture in the prairie deer mouse (*Peromyscus maniculatus*). J. Mamm., 75:681-691.

Kaufman, G. A., D. W. Kaufman, B. R. Mcmillan, and D. E. Brillhart. 1994. Prevalence of hantavirus antibodies in natural populations of deer mice in north central Kansas. Prairie Nat., 26:209-216.

Lane, R. S., R. N. Brown, J. Piesman, and C. A. Peavy. 1994. Vector competence of *Ixodes pacificus* and *Dermacentor occidentalis* (Acari: Ixodidae) for various isolates of Lyme disease spirochetes. J. Med. Entomol., 31:417-424.

Langley, W. M. 1994. Comparison of predatory behaviors of deer mice (*Peromyscus maniculatus*) and grasshopper mice (*Onychomys leucogaster*). J. Compar. Psychol., 108:394-400.

Layne, J. N. and R. J. Jackson. 1994. Burrow use by the Florida mouse (*Podomys floridanus*) in South-central Florida. Am. Mid. Nat., 131:17-23.

Linkhart, B. D. and R. T. Reynolds. 1994. *Peromyscus* carcass in the rest of a flammulated owl. J. Raptor Res., 28:43-44.

Linzey, A. V. and D. M. Grant. 1994. Characteristics of a white-footed mouse (*Peromyscus leucopus*) population inhabiting a polychlorinated biphenyls contaminated site. Arch. Environ. Contam. Toxicol., 27:521-.

Lord, R. D., V. R. Lord, J. G. Humphreys, and R. G. McLean. 1994. Distribution of *Borrelia burgdorferi* in host mice in Pennsylvania. J. Clin. Microbiol., 32:2501-2504.

Magnarelli, L. A., J. F. Anderson, R. C. Johnson, R. B. Nadelman, and G. P. Wormser. 1994. Comparison of different strains of *Borrelia burgdorferi* sensu lato used as antigens in enzyme-linked immunosorbent assays. J. Clin. Microbiol., 32:1154-1158.

Magnarelli, L. A., J. F. Anderson, and K. C. Stafford, III. 1994. Detection of *Borrelia burgdorferi* in urine of *Peromyscus leucopus* by inhibition enzyme-linked immunosorbent assay. J. Clin. Microbiol., 32:777-782.

Mannelli, A., U. Kitron, C. J. Jones, and T. L. Slachert. 1994. Influence of season and habitat on *Ixodes scapularis* infestation on white-footed mice northwestern Illinois. J. Parasitol., 80:1038-1042.

Marshall, W. F., S. R. Telford, P. N. Refs, B. J. Rutledge, D. Mathiesen, S. E. Malawista, A. Spielman, and D. H. Persing. 1994. Detection of *Borrelia burgdorferi* DNA in museum specimens of *Peromyscus leucopus*. J. Infec. Dis., 170:1027-1032.

Meyers, S. M. and J. O. Wolff. 1994. Comparative toxicity of azinophos-methyl to house mice, laboratory mice, deer mice, and gray-tailed voles. Arch. Environ. Contam. Toxicol., 26:478-482.

Moody, K. D., G. A. Terwilliger, G. M. Hansen, and S. W. Barthold. 1994. Experimental *Borrelia burgdorferi* infection in *Peromyscus leucopus*. J. Wildlife Dis., 30:155-161.

Munger, J. C. and W. H. Karasov. 1994. Costs of bot fly infection in white-footed mice: Energy and mass flow. Can. J. Zool., 72:166-173.

McMillan, B. R. and D. W. Kaufman. 1994. Differences in use of interspersed woodland and grassland by small mammals in northeastern Kansas. Prairie Nat., 26:107-116.

Nerurkar, V. R.,J. W. Song, K. J. Song, J. W. Nagle, B. Hjelle, S. Jenison, and R. Yanagihara. 1994. Genetic evidence for a hantavirus enzootic in deer mice (*Peromyscus maniculatus*) captured a decade before the recognition of hantavirus pulmonary syndrome. Virology, 204:563-568.

Nichols, L. B. 1994. The effect of bot fly (*Cuterebra*) infestation on cold-night trap mortality in cactus mice (*Peromyscus eremicus*). S. W. Nat., 39:383-386.

Nolte, D. L., J. R. Mason, G. Epple, E. Aronore, and Campbell. 1994. Why are predator urines aversive to prey? J. Chem. Ecol., 20:1505-1516.

O'Farrell, M. J., W. A. Clark, F. H. Emmerson, S. M. Juarez, F. R. Kay, T. M. O'Farrell, and T. Y. Goodlett. 1994. Use of a mesh live trap for small mammals: Are results from Sherman live traps deceptive? J. Mamm., 75:692-699.

Oliver, J. H., Jr. 1994. Review of Howard S. Ginsberg, Ed. Ecol. Environ. Manag. Lyme Dis. Science, 263:544-545.

Pascoe, G. A., R. J. Blanchet, and G. Linder. 1994. Bioavailability of metals and arsenic to small mammals at a mining waste-contaminated wetland. Arch. Environ. Contam. Toxicol., 27:44-50.

Porter, W. P., J. C. Munger, W. E. Stewart, S. Budaraju, and J. Jaeger. 1994. Endotherm energetics: From a scalable individual-based model to ecological applications. J. Zool., 42:125-162.

Qumsiyeh, M. B. 1994. Evolution of number and morphology of mammalian chromosomes. J. Hered., 85:455-465.

Richmond, J. Y. and C. J. Peters. 1995. Laboratory management of agents associated with hantavirus pulmonary syndrome: Interim biosafety guidelines. Lab Anim., 24:41-45.

Ruefenacht, B. and R. L. Knight. 1995. Influences of corridor continuity and width on survival and movement of deermice *Peromyscus maniculatus*. Biol. Conserv., 71:269-.

Saucier, D. M. and M. Kavaliers. 1994. Antagonistic effects of the selective, competitive N-methyl-D-aspartate (NMDA) receptor antagonist, NPC 12626, on kappa opiate-induced analgesia in male deer mice. Brain Res., 637:292-296.

Schwartz, O. A., A. M. Vivas, A. Orris, and C. J. Miller. 1994. Small mammal species associations in three types of roadside habitats in Iowa. Prairie Nat., 26:45-52.

Sietman, B. E., W. B. Fothergill, and E. J. Finck. 1994. Effects of haying and old-field succession on small mammals in tallgrass prairie. Am. Mid. Nat., 131:1-8.

Smith, S. A., I. F. Greenbaum, and D. J. Schmidly. 1994. A problematic specimen of *Peromyscus* with an unusual karyotype. S. West. Nat., 39:289-291.

Song, J., L. Baek, D. C. Gajdusek, R. Yanagihara, I. Gavrilovskaya, B. J. Luft, E. R. Mackow, and B. Hjelle. 1994. Isolation of pathogenic hantavirus from white-footed mouse (*Peromyscus leucopus*). The Lancet, 344:1637.

Stapp, P. J. K., Young, S. VandeWoude, and B. Van Horne. 1994. An evaluation of the pathological effects of fluorescent powder on deer mice (*Peromyscus maniculatus*). J. Mamm., 75:704-709.

Suchecki, D., D. Y. Nelson, H. Van Oers, and S. Levine. 1995. Activation and inhibition of the hypothalamic-pituitary-adrenal axis of the neonatal rat: Effects of maternal deprivation. Psychonsuroendocrinology, 20:169-182.

Tull-Singleton, S., S. Kimball, and K. McBee. 1994. Correlative analysis of heavy metal bioconcentration and genetic damage in white-footed mice (*Peromyscus leucopus*) from a hazardous waste site. Bull. Environ. Contam. Toxicol., 52:667-672.

Valone, T. J., J. H. Brown, and E. J. Heske. 1994. Interactions between rodents and ants in the Chihuahuan Desert: An update. Ecology, 75:252-255.

Vickery, W. L., J. L. Daoust, A. E. Wartiti, and J. Peltier. 1994. The effect of energy and protein content on food choice by deer mice, *Peromyscus maniculatus*. Anim. Behav., 47:55-64.

Wang, Z., S. R. Young, L. Liu, and W. D. Dawson. 1995. Assignment of *Tp53* and *Tk1* to chromosome 13 in *Peromyscus* by fluorescence in situ hybridization. Cytogenet. Cell Genet., 69:97-100.

Williams, C. K., V. A. Witmer, M. Casey, and G. W. Barrett. 1994. Effects of strip cropping on small mammal population dynamics in soybean agroecosystems. Ohio J. Sci., 94:94-98.

Wolff, J. O. 1994. Reproductive success of solitarily and communally nesting white-footed mice and deer mice. Behav. Ecol., 5:206-209.

Yamada, T., B. Hjelle, R. Lanzi, C. Morris, B. Anderson, and S. Jenison. 1995. Antibody responses to four corners hantavirus infections in the deer mouse (*Peromyscus maniculatus*): Identification of an immunodominant region of the viral nucleocapsid protein. J. Virol., 69:1939-1943.

Zimmerling, L. M. and T. P. Sullivan. 1994. Influence of mustelid semiochemicals on population dynamics of the deer mouse (*Peromyscus maniculatus*). J. Chem. Ecol., 20:667-689.

VVVVVVVVVVVVVVVV