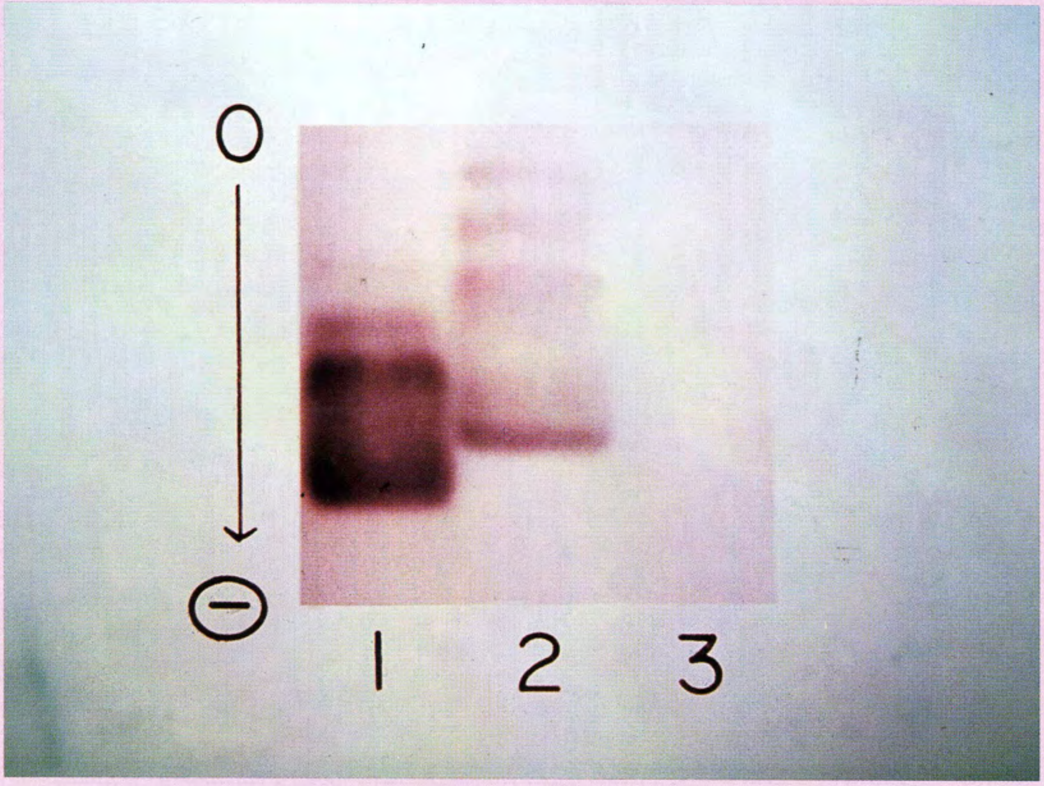
PEROMYSCUS NEWSLETTER

NUMBER TWENTY-FIVE



MARCH 1998

Cover: Starch gel showing alcohol dehydrogenase
electrophoretic phenotypes in *Peromyscus*
corresponding to genotypes:
(1) Adh^F/Adh^F (2) Adh^S/Adh^S (3) Adh^N/Adh^N
See page 13*ff* this issue.
Photograph courtesy M.R. Felder.

Hello Readers -

As we come up on Issue #25, I think we need to consider where we have been and where we are going with *Peromyscus Newsletter*. Because *PN* is primarily for your use, we need input from you, our readers. Therefore, please let us have your opinions and suggestions.

Where have we been? *PN* was originally modelled on the old *Mouse News Letter*. Its origin coincided with establishment of the *Peromyscus* Genetic Stock Center in 1985. We believed that a newsletter would help us publicize the Stock Center and make known the various stocks, mutants and other resources of the Center. We also felt that a newsletter would promote informal communications among persons interested in deer mice and related species. We wanted to include periodic updates on genetics of *Peromyscus*, particularly the formally described mutant loci, the linkage map, and the genetic variants in natural populations. We further believed that occasional personality sketches of prominent *Peromyscus* researchers would prove interesting to some readers. We thought that a chatty "News and Comment" section would be useful. All of these things were done in the 24 semi-annual issues to date.

There has been a significant increase in our mailing list from 175 for the initial issue to 720 currently. Less expensive production methods made it possible to go from a dot matrix-office photocopy version for our early issues to a high quality professionally printed publication seen in recent issues. This was accomplished without a major increase in per issue costs.

But this is not 1985 and the research landscape has changed. These are some of our concerns:

1. **Despite soliciting entries by first class mail, the number of contributed entries has declined over the past five years.** The entries we do receive are frequently from a "faithful few". Some groups actively using *Peromyscus* in research have been reluctant to submit contributions. Is this because of an increased reliance on the Internet for exchange of research information? Are there other problems, *e.g.* reluctance to report informally to prevent premature release of information? Are investigators too busy to bother to write a paragraph or two - or perhaps even to peruse their most recent copy of *PN*? All of these factors, no doubt, enter in.

2. **Additions of traditional genetic information, particularly that generated from allozyme or morphological data, has diminished in recent years making frequent updates less necessary.** On the other hand molecular sequence data has greatly increased. The latter is more conveniently accessed from computer databases such as GenBank.

3. **Only about 25% of research with *Peromyscus* is "genetic" in the broad sense.** At present, much *Peromyscus* research involves toxicology and epidemiology. Two other areas of considerable interests are community ecology and behavior. Most use of the Stock Center relates to these kinds of research rather than to genetics. For example, about 90% of the utilization of the resources of the Stock Center involves wild-type stocks of four species (*P. maniculatus, P. leucopus, P. polionotus* and *P. californicus*), not specialized genetic stocks.

4. **We are currently constructing an on-line *Peromyscus* database (*Pero*Base). Do we need a newsletter, too?.** Maybe not or maybe one with a different focus.

SO WHAT TO DO?? That's why we need your input.

Among the things being considered are ...

*** Change the publication frequency to one annual issue.

*** Summarize all of the genetic information in one issue to be published every two or three years. Use *Pero*Base for more frequent genetic updates. Change the focus of the intervening issues to ecology, reproduction, behavior *etc.*

*** Produce an on-line version of *PN.*

*** Discontinue publication altogether.

In any event, we are planning #26, as scheduled, for September 1998. Your contributed entries for that issue are due **20 September 1998.**

Wally Dawson
wdawson@stkctr.biol.sc.edu

P.S. **PLEASE LET US HEAR FROM YOU.**

C O N T E N T S

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NEWS, COMMENT and ANNOUNCEMENTS

A white-footed mouse (*P. leucopus*) made the cover of the Feb. 13 issue of *SCIENCE* as part of a collage with tick, deer, acorns and gypsy moth emblematic of the ecology of Lyme disease. This highlights an article by **Clive Jones** and co-workers on the effects of removing the mice from a study site (*Science* 279:1023ff). The photo in the collage was originally made by **Jerry Wolff.**

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Peromyscus species are being implicated in still another disease, human granulocytic erlichiosis (HGE). The pathogen produces ulcers in humans. About 68% of 136 seropositive sigmodontine rodents sampled from 13 states were *P. leucopus* according to a paper by Nicholson *et al.* (*J. Clin. Microbiol.* 36:695*ff*).

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Greg Glass and coworkers (Am. Trop. Med. Hyg. 56:359ff) found that almost 59% of rural housing in three national parks surveyed (Yosemite, Sequoia/Kings Canyon, and Shenandoah) harbored rodents and about 91% of these were Peromyscus spp. Methods to rodent-proof houses are discussed.

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Dr. **David Worley** of the Montana State University Veterinary Molecular Biology Lab writes that he has retired and closed his *Peromyscus* colony, but retains his interest in deer mice. He utilized deer mice to maintain *Trichinella* isolated from wild carnivores.

X-X-X-X-X-X-X-X

In our last issue we noted that **Newman Bradshaw** had retired from West Virginia University. He informs us that he left WVU in 1976, and was subsequently employed by Stearns-Roger, an engineering firm in Denver that eventually became Raytheon Engineers and Constructors. Newman retired from there in December 1993. Nevertheless, for *Peromyscus* geneticists he will be remembered for his pioneer G-banded karyotypes.

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BACK ISSUES. Unfortunately our supply of original back issues of *PEROMYSCUS NEWSLETTER* is becoming depleted. The only issues we still have in adequate supply are Numbers 8, 13, 14, 17, 18, 19, 20, 21, 23 and 24. For others there are either no available copies or fewer than 5 on hand. We have good photocopies of scarce back issues (with covers in the original colors) that can be supplied for $ 5 each. A complete set of *PN* (Numbers 1 thru 25), including some as the photocopied version, will be provided for $ 50 including postage.
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PEROMYSCUS MAKES THE NBC EVENING NEWS !!!

A feature segment on the NBC Evening News with Tom Brocaw (10 March 98) considered the possibility that El Nino might produce another hantavirus outbreak in the southwest. Live *Peromyscus* were shown being removed from Sherman traps. **Terry Yates** (Univerity of New Mexico) was featured in the segment.

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Calling your attention to "*Peromyscus* Porter" beer brewed by **Mark Coleman** and associates at the University of Wisconsin (See his entry on page 29). Interesting, but probably not a serious challenge to Miller Genuine Draft!

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We thank **Gloria Salavarria** of Middlebury Indiana, for the monetary donation she recently made to the Peromyscus Stock Center.

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Common names:

Is *Peromyscus maniculatus* "deer mouse", "deer-mouse" or "deermouse". Notice that the alcohol dehydrogenase researchers (page 13) generally use the single word deermouse (or deermice). Lee Dice promoted the use of a single word designation. A one-word designation might prevent dyslexic confusion with mouse deer (*Tragulus*) or, on the other hand, create confusion with "dormouse". However, most of the time in *PN* we use "deer mouse", per Hall and Kelson's *MAMMALS OF NORTH AMERICA.* We made an exception for the ADH essay.

Some subspecies of *P. polionotus* are "beachmice" (note one word - should that be "beach mice"?) other subpecies are "oldfield mice". There are varied versions of how the oldfield mouse received its common name. One version has it that it was named for the 19th century naturalist, W.A. Oldfield. Another version says that it was so named because it is an early succession species that resides in old fields. That's reasonable. A third version, that well may be true, claims that a yankee mammalogist went collecting in southern Alabama and, when a mouse was turned up while plowing, inquired of a rural resident "What kind of mouse is that?" In her typical dixieland dialect, she replied "Why that's jest a lit'l ol' field mouse". Hence its name.

However, most southerners rarely use the word "mouse". All murid rodents are "rats" and there are only two kinds, "big ol' rats" and "lit'l ol' rats!"

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Check out the "mock up" of *Pero*Base, the *Peromyscus* database now under construction, but don't expect anything near a finished product. We are experimenting with a "look" of the web site. Thus, it contains only samples of data, some not correct.
http://stkctr.biol.sc.edu/pbasehom.htm

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AUTHORS NEEDED FOR *MAMMALIAN SPECIES*

Would you like to write an account of your favorite species of *Peromyscus* for *Mammalian Species*? The American Society of Mammalogists, which publishes *Mammalian Species*, is looking for authors (we prefer those familiar with the species they are writing on.) We have only published accounts of twelve species of *Peromyscus*, and 28 species are available -- waiting for authors (with ca. 11 now in preparation).

A *Mammalian Species* account is a summary of all that has been published on the species -- from the first naming of the species to the most recent research. Below is a list of topics included in each account.)

But don't start writing yet! Species are assigned exclusively to authors so there will not be a duplication of effort. Check with the managing editor to see if the species you are interested in are still available. (Contact her at bblake@bennett1.bennett.edu fax 336 230-0942.) If it is available, she will assign it to you.

AVAILABLE

Peromyscus bullatus
Peromyscus difficilis
Peromyscus eva
Peromyscus grandis
Peromyscus gratus
Peromyscus guardia
Peromyscus guatemalensis
Peromyscus gymnotis
Peromyscus hooperi
Peromyscus interparietalis
Peromyscus levipes
Peromyscus madrensis
Peromyscus maniculatus
Peromyscus mayensis
Peromyscus megalops
Peromyscus mekisturus
Peromyscus melanophrys
Peromyscus melanotis
Peromyscus melanurus
Peromyscus merriami
Peromyscus mexicanus
Peromyscus nasutus
Peromyscus ochraventer
Peromyscus pembertoni
Peromyscus polionotus
Peromyscus polius
Peromyscus sitkensis
Peromyscus winkelmanni

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PREVIOUSLY PUBLISHED

Peromyscus attwateri (# 48)
Peromyscus californicus (# 85)
Peromyscus crinitus (# 287)
Peromyscus eremicus (# 118)
Peromyscus gossypinus (# 70)
Peromyscus leucopus (# 242)
Peromyscus melanocarpus (# 241)
Peromyscus pectoralis (# 49)
Peromyscus stirtoni (# 361)
Peromyscus truei (# 161)
Peromyscus yucatanicus (# 196)
Peromyscus zarhynchus (# 562)

[See next page]

(*Mammalian Species* Cont.)

A BRIEF OVERVIEW OF *MAMMALIAN SPECIES* ACCOUNTS

The objective of *Mammalian Species* is to provide critically compiled, accurate, and concise summaries of the present state of our biological knowledge (and ignorance) of species of mammals in a standard format that allows easy reference to specific information. Accounts should present specific information and useful summaries.

Accounts will include the following sections: Synonymy, Context and Content, Diagnosis, General Characters, Distribution, Fossil Record, Form, Function, Ontogeny and Reproduction, Ecology, Behavior, Genetics, Conservation Status, Remarks, and Literature Cited. Each account includes four views of the skull, a distribution map and, if possible, a photograph of the mammal. Accounts are to be ≤42 pages typed double spaced (ca. 10,000 words maximum).

More information is available in two documents -- INSTRUCTIONS FOR CONTRIBUTORS TO *MAMMALIAN SPECIES* and GUIDELINES FOR MANUSCRIPTS FOR PUBLICATIONS OF THE AMERICAN SOCIETY OF MAMMALOGISTS (a guide to style for all ASM publications. The guidelines are available on the website for the American Society of Mammalogists, *wkuweb1.edu/~asm* . The managing editor can send either document to you as attachments to e-mail or as paper copies.

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Bennett College, Box 53
900 E. Washington St.
Greensboro, NC 27401-3239, USA

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This just in:

***P. leucopus* makes another journal cover! This time the March 1st issue of *VIROLOGY* (v. 242, #1).**

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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 **$17.50 per wild-type animal** and **$ 20 per mutant or special stock animal** is charged. 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 TYPE SPECIES	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. Approximately ten generations in captivity.
P. leucopus (LL Stock)	Derived from 38 wild ancestors captured between 1982 and 85 near Linville NC. Approximately 20 generations in captivity.
P. californicus insignis (IS Stock)	Derived from about 60 ancestors collected between 1979 and 87 in Santa Monica Mts. CA. Approximately twelve generations in captivity.
P. aztecus (AM Stock)	Derived from animals collected on Sierra Chincua, Michoacan, Mexico in 1986 Approximately ten generations in captivity.
P. melanophrys	Originated from a group of animals collected at Zacatecas Mexico during the 1970's. Formerly maintained by R.W. Hill at Mich. State Univ.
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)
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)
[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 *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 *yel/yel*	Sumner's original mutant (Sumner, 1917)

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)
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)
[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)
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] 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.

OTHER RESOURCES OF THE *PEROMYSCUS* GENETIC STOCK CENTER:

* * *

NOW. Highly inbred *P. leucopus* (I_{20}+) are available in limited numbers as live animals or as frozen tissues. Several lines developed by George Smith (UCLA) are currently maintained by the Stock Center.

* * *

Limited numbers of other stocks, species, mutants, inbreds and variants are on hand, or under development, but are not available for distribution. Currently we can supply up to 10 each of the species *P. eremicus* and *P. melanophrys*.

Preserved or frozen specimens of types given in tables above.

Tissues, whole blood or serum of types given in tables 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 of individual articles can be photcopied and mailed. Please limit requests to five articles at any given time. There will be a charge of 5 cents per photocopied page after the initial 20 pages.

Materials are 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.)

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 or peromyscus@stkctr.biol.sc.edu

PLEASE CALL WITH INQUIRIES.

Peromyscus Genetic Stock Center
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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, tail, other[3]	*P. maniculatus*	Stk. Ctr.	A
S-02	subgriseus (PO)	liver, tail, other	*P. polionotus*	Stk. Ctr.	A
S-03	leucopus (LL)	liver, tail, other	*P. leucopus*	Stk. Ctr.	A
S-04	wild-caught SC	liver, other	*P. gossypinus*	-	A
S-05	aztecus (AM)	liver, tail, other	*P. aztecus*	J. Glendinning	A
S-06	insignis (IS)	liver, tail, 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

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

[2] Not currently available.

[3] kidney, spleen, testis, carcass.

THE ADH-NEGATIVE DEERMOUSE - A "NATURAL KNOCKOUT"

For more than two decades the ADH-negative deermouse has been widely used in studies of alcohol metabolism. Here we present a brief history of the discovery and utilization of this model.

In January 1972 Michael Felder left a postdoctoral position at Michigan State University, where he had worked with genetic variation and developmental expression of alcohol dehydrogenase (ADH) in maize, to join the University of South Carolina Biology Department faculty. Mike recognized the importance of using mammalian models both from the pragmatic standpoint of obtaining NIH funding and because of the potential biomedical applications that could be derived. He was aware of ADH isozyme variation reported by Selander *et al.* (1969) in wild European house mouse populations, and, knowing that a deermouse colony, now the Peromyscus Genetic Stock Center, existed at his new institution, wondered whether ADH variants could be detected in *Peromyscus*.

By 1974, after more than a year of typing stocks of *Peromyscus* for ADH electrophoretic polymorphisms, Mike had identified and established pure-breeding lines of three variants. Two of the variants were ADH-active but differed in electrophoretic mobility. However, Mike was unable to detect activity in the third line. He recognized immediately the potential value of the "null" strain for alcohol metabolism research. Although ADH-negative *Drosophila* strains were known, there were no known laboratory rodent models. Mike described the ADH-negative deermouse in an initial report (Felder 1975) and subsequently reported in more detail with his student Karen Burnett (Burnett and Felder 1978a, 1978b). In the latter study no cross-reacting material was detected with anti-ADH antiserum in liver tissue where the enzyme is normally present, indicating that no inactive polypeptide was produced. Eventually, Mike and his students Jeff Ceci and Yao-Wu Zheng demonstrated absense of a mRNA transcript in liver tissue of ADH-negative *Peromyscus* (Zheng, *et al.* 1993). Southern blot analysis suggested that most or all of the *Adh1* sequence is deleted in negative animals. The lack of ethanol dehydrogenase activity in livers of ADH-negative deermice was also supported in studies by Haseba *et al.* (1995).

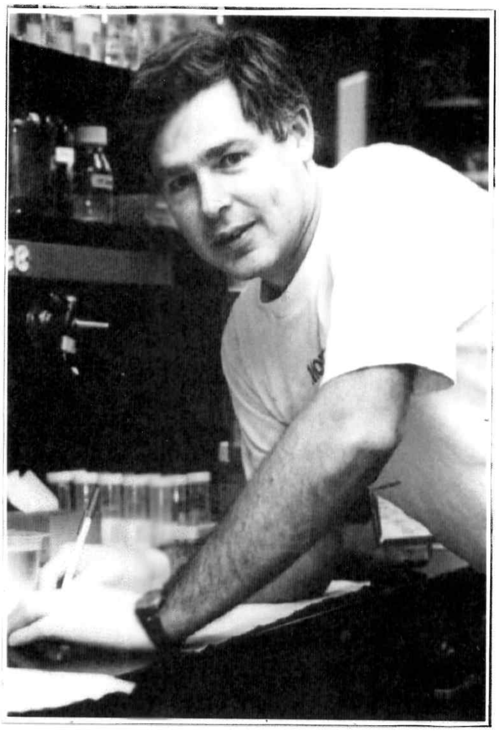
Since Mike Felder's primary research focus is gene regulation, after 1978 he turned increasingly to laboratory mouse (*Mus*) as a model, where other problems of interest were addressed. Nevertheless, he continued to intereact with investigators who used ADH-negative deermice to explore alternative metabolic pathways of alcohol metabolism. Principal among these were the group headed by Charles Lieber at Bronx (NY) VA Medical Center and Ronald Thurman and his associates at the University of North Carolina Pharmacology Department.

Both the Bronx VA group and the UNC Pharmacology group extensively investigated alternative pathways of ethanol metabolism (see references listed below). The two groups used a variety of strategies to detect the preferred alternative pathway utilized by ADH-deficient deermice. Lieber's group concluded that the microsomal ethanol-oxidizing system (MEOS), a cytochrome p450-based mechanism, was the major alternative pathway. On the other hand, the Thurman group produced data supporting oxidation via catalase as the principal secondary pathway. The issue remains controversial.

Alcohol dehydrogenase in *Peromyscus*, as in other species, is a dimer. Heterozygous fast/slow (*Adh1*^{F}/*Adh1*^{S}) express three cathodially-migrating bands on starch electophoretic gels run at *p*H 8.3 in tris glycine buffer (Burnett and Felder 1978a, 1978b), but animals heterozygous for the negative allele express only a single band. In ADH-positive deermice *Adh1* mRNA occurs at high levels in liver, kidney and adrenal glands. The *Adh1* cDNA sequence is known and shares 94% homology with *Mus Adh1*. A second faintly hybridizing ADH is attributed to a second locus, *Adh2*. *Adh2* mRNA also occurs in liver, but unlike *Adh1,* has little expression in kidney (Zheng *et al.* 1993). *Adh2* cDNA, which also has been sequenced, is about 400 bases longer than that of the *Adh1* sequence. *Adh2* is expressed in both ADH1-positive and negative deermice, but, apparently, is not a major factor in ethanol oxidation.

When given a narcotic dose of ethanol, ADH-negative deermice have about double the sleep time as the homozygous ADH-positive counterparts. This corresponds well with the blood ethanol elimination rate (Felder and Burnett 1983). Metabolism of butanol (Cronholm *et al.* 1992), retinoic acid (Posch and Napoli 1992) and *p*-nitrosophenol (Dudley and Winston 1995) have been examined in ADH-negative deermice, further demonstrating effects independent of ADH1-mediated ethanol reactions.

Pure breeding ADH-negative (*Adh1*^{N}/*Adh1*^{N}) and ADH-positive (*Adh*$^+$/*Adh1*$^+$) deermice (*Peromyscus maniculatus bairdii*) derived from the BW Stock are available in limited numbers from the Peromyscus Genetic Stock Center.



Michael R. Felder

References pertaining to ADH-negative deermice:

Alderman J.A., S. Kato and C.S. Lieber. 1989. Characteristics of butanol metabolism in alcohol dehydrogenase-deficient deermice. *Biochem. J.* 257:615-617.

Alderman J., T. Takagi, and C.S. Lieber. 1987. Ethanol-metabolizing pathways in deermice. *J. Biol. Chem.* 262:7497-7503.

Alderman J., S. Kato, and C.S. Lieber. 1989. The microsomal ethanol oxidizing system mediates metabolic tolerance to ethanol in deermice lacking alcohol dehydrogenase. *Arch. Biochem. Biophy.* 271:33-39.

Belinsky S.A., B.U. Bradford, D.T. Forman, E.B. Glassman, M.R Felder and R.G. Thurman. 1985. Hepatotoxicity due to allyl alcohol in deermice depends on alcohol dehydrogenase. *Hepatology* 5:1179-1182.

Bradford B.U., D.T. Forman and R.G. Thurman. 1993. 4-methyl pyrazole inhibits fatty acyl synthetase and diminishes catalase-dependent alcohol metabolism: Has the contribution of alcohol dehydrogenase to alcohol metabolism been previously overestimated? *Mol. Pharmacol.* 43:115-119.

Bradford B.U., J.A. Handler, C.B. Seed, D.T. Forman and R.G. Thurman. 1991. Inhibition of ethanol metabolism by fructose in alcohol dehydrogenase-deficient deer mice *in vivo*. *Arch. Biochem. Biophy.* 288:435-439.

Bradford B.U., C.B. Seed, J.A. Handler, D.T. Forman and R.G. Thurman. 1993. Evidence that catalase is a major pathway of ethanol oxidation *In Vivo*: Dose-response studies in deer mice using methanol as a selective substrate. *Arch. Biochem. Biophys.* 303:172-176.

Burnett K.G. and M.R. Felder. 1978a. Genetic regulation of liver alcohol dehydrogenase in *Peromyscus*. *Biochem. Genet.* 16:443-454.

Burnett K.G. and M.R. Felder. 1978b. *Peromyscus* alcohol dehydrogenase: Lack of cross-reacting material in enzyme-negative animals. *Biochem. Genet.* 16:1093-1106.

Burnett K.G. and M.R. Felder. 1980. Ethanol metabolism in *Peromyscus* genetically deficient in alcohol dehydrogenase. *Biochem. Pharmacol.* 29:125-130.

Cronholm T., C. Norsten-Hoog, G. Ekstrom, J.A. Handler, R.G. Thurman and M. Ingelman-Sundberg. 1992. Oxidoreduction of butanol in deermice (*Peromyscus maniculatus*) lacking hepatic cytosolic alcohol dehydrogenase. *Eur. J. Biochem.* 204:353-357.

Dawson W.D., L.L. Huang, M.R. Felder and J.B. Shaffer. 1983. Linkage relationships among eleven biochemical loci in *Peromyscus*. *Biochem. Genet.* 21:1101-1114.

Dudley 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.

Ekstrom G., T. Cronholm, C. Norsten-Hoog and M. Ingelman-Sundberg. 1993. Dehydrogenase-dependent metabolism of alcohols in gastric mucosa of deer mice lacking hepatic alcohol dehydrogenase. *Biochem. Pharmacol.* 45:1989-1994.

Felder M.R. 1975. Tissue distribution and genetics of alcohol dehydrogenase isozymes in *Peromyscus*. In: Markert CL (ed) *Isozymes* 3:455-471.

Felder M.R. and K.G. Burnett. 1983. Some observations on ethanol metabolism in alcohol dehydrogenase negative deermice. In: Lieber C.S. (ed) *Biological Approach to Alcoholism*. Res. Mongr. 11 NIAAA. pp 268-273.

Gellert J., J. Alderman and C.S. Lieber. 1986. Interaction between ethanol metabolism and mixed-function oxidation in alcohol dehydrogenase positive and negative deermice. *Biochem. Pharmacol.* 35:1037-1041.

Glassman E.B., G.A. McLaughlin, D.T. Forman, M.R. Felder and R.G. Thurman. 1985. Role of alcohol dehydrogenase in the swift increase in alcohol metabolism (SIAM). Studies with deermice deficient in alcohol dehydrogenase. *Biochem. Pharmacol.* 34:3523-3526.

Handler J.A., B.U. Bradford, E.G. Glassman, J.K. Ladine, and R.G. Thurman. 1986. Catalase-dependent ethanol metabolism *in vivo* in deermice lacking alcohol dehydrogenase. *Biochem. Pharmacol.* 35:4487-4492.

Handler J.A., G.U. Bradford, E.B. Glassman, D.T. Forman, and R.G. Thurman. 1987. Inhibition of catalase-dependent ethanol metabolism in alcohol dehydrogenase-deficient deermice by fructose. *Biochem. J.* 248:415-421.

Handler J.A., D.R. Koop, M.J. Coon, Y. Takei, and R.G. Thurman. 1988. Identification of P-450_{ALC} in microsomes from alcohol dehydrogenase-deficient deermice: Contribution to ethanol elimination in vivo. *Arch. Biochem. Biophys.* 264:114-124.

Haseba T., I. Yamamoto, H. Kamii, Y. Ohno and T. Watanabe. 1995. Alcohol dehydrogenase (ADH) isozymes in the Adh^N/Adh^N strain of *Peromyscus maniculatus* (ADH^- Deermouse) and a possible role of class III ADH in alcohol metabolism. *Biochem. Genet.* 33:349-363.

Inatomi N., D. Ito and C.S. Lieber. 1990. Ethanol oxidation by deermice mitochondria under physiologic conditions. *Alc: Clin. Exp. Res.* 14:130-133.

Ito D. and C.S. Lieber. 1993. Ethanol metabolism in deermice: Role of extrahepatic alcohol dehydrogenase. *Alc. Clin. Exp. Res.* 17:919-925.

Kato S., J. Alderman and C.S. Lieber. 1987. Respective roles of the microsomal ethanol oxidizidng system and catalase in ethanol metabolism by deermice lacking alcohol dehydrogenase. *Arch. Biochem. Biophys.* 254:586-591.

Kato S., J. Alderman, C.S. Lieber. 1988. In vivo role of the microsomal ethanol-oxidizing system in ethanol metabolism by deermice lacking alcohol dehydrogenase. *Biochem. Pharmacol.* 37:2706-2708.

Knecht K.T., B.U. Blair, R.P. Mason and R.G. Thurman. 1990. *In vivo* formation of a free radical metabolite of ethanol. *Mol. Pharmacol.* 38:26-30.

Knecht K.T., R.G. Thurman, and R.P. Mason. 1993. Role of superoxide and trace transition metals in the production of a-hydroxyethyl radical from ethanol by microsomes from alcohol dehydrogenase-deficient deermice. *Arch. Biochem. Biophys.* 303:339-348.

Lebsack M.E., M.R. Felder and C.S. Lieber. 1982. Hepatic aldehyde dehydrogenase activity in *Peromyscus* genetically deficient in alcohol dehydrogenase. *Comp. Biochem. Physiol.* 72B:517-519.

Leo M.A. and C.S. Lieber. 1984. Normal testicular structure and reproductive function in deermice lacking retinol and alcohol dehydrogenase activity. *J. Clin. Invest.* 73:593-596.

Leo M.A., C. Kim, and C.S. Lieber. 1987. NAD^+-Dependent retinol dehydrogenase in liver microsomes. *Arch. Biochem. Biophys.* 259:241-249.

Norsten C., T. Cronholm, G. Ekstrom, J.A. Handler, R.G. Thurman, and M. Ingelman-Sundberg. 1989. Dehydrogenase-dependent ethanol metabolism in deer mice (*Peromyscus maniculatus*) lacking cytosolic alcohol dehydrogenase. *J. Biol. Chem.* 264:5593-5597.

Posch K.C. and J.L. Napoli. 1992. Multiple retinoid dehydrogenases in testes cytosol from alcohol dehydrogenase negative or positive deermice. *Biochem. Pharmacol.* 43:2296-2298.

Shigeta Y., F. Nomura, M.A. Leo, S. Iida, M.R. Felder and C.S. Lieber. 1983. Alcohol dehydrogenase (ADH) independent ethanolmetabolism in deermice lacking ADH. *Pharmacol. Biochem. Behav.* 18:195-199.

Shigeta Y., F. Nomura, S. Iida, M.A. Leo, M.R. Felder and C.S. Lieber. 1984. Ethanol metabolism *in vivo* by the microsomal ethanol oxidizing system in deermice lacking alcohol dehydrogenase (ADH). *Biochem. Pharmacol.* 33:807-814.

Sjoval J., S.H.G. Andersson, and C.S. Lieber. 1985. Bile acids in deermice lacking liver alcohol dehydrogenase. *Biochim. Biophys. Acta* 836:8-13.

Takagi T., J. Alderman, J. Gellert and C.S. Lieber. 1986. Assessment of the role of non-AADH ethanol oxidation *in vivo* and in hepatocytes from deermice. *Biochem. Pharmacol.* 35:3601-3606.

Zheng Y-W., M. Bey, H. Liu and M.R. Felder. 1993. Molecular basis of the alcohol dehydrogenase-negative deermouse: Evidence for deletion of the gene for class I enzyme and identification of a possible new enzyme class. *J. Biol. Chem.* 268:24933-24939.

Peromyscus Nucleic Acid Sequences

Numerous nucleic acid sequences from *Peromyscus* are registered in GenBank. The sequences are annually indexed in the March issue of *PEROMYSCUS NEWSLETTER.* As a service, the *Peromyscus* Genetic Stock Center will furnish a printout of the full GenBank sequence, citations *etc.* Please request by GenBank accession number given in parentheses. Limit requests to no more than five at any given time. Include FAX number and it will be transmitted via FAX if less than 8 pages. A hard copy by mail will also be furnished, if requested. Call (803) 777-3107 or e-mail peromyscus@stkctr.biol.sc.edu

Sequences in this index are listed under major categories: (1) Nuclear genes (2) Nuclear elements and repeats, (3) Mitochondrial genes, and (4) other. Abbreviated locus designations.

NUCLEAR GENES

Alcohol dehydrogenase *(Adh-1, 2)*

[ADH1B] *P. maniculatus* alcohol dehydrogenase 1 (*Adh-1*) mRNA, complete cds. **(L15703)**

[ADH2A] *P. maniculatus* alcohol dehydrogenase 2 (*Adh-2*) mRNA, complete cds. **(L15704)**

Hemoglobin beta chain *(Hbb)*

[HBB1BA] *P. maniculatus* (deer mouse) beta-1-globin (*Hbb-b1*) DNA, 5' region. **(M15292)**

[HBB1BB] *P. maniculatus* (deer mouse) beta-1-globin (*Hbb-b1*) DNA, 5' region. **(M15289)**

[HBB1BC] *P. maniculatus* (deer mouse) beta-1-globin (*Hbb-b1*) DNA, second coding-block region, partial cds. **(M15294)**

[HBB1BD] *P. maniculatus* (deer mouse) beta-1-globin (*Hbb-b1*) DNA, 3' region. **(M15297)**

[HBB2BA] *P. maniculatus* (deer mouse) beta-2-globin (*Hbb-b2*) DNA, 5' region. **(M15293)**

[HBB2BB] *P. maniculatus* (deer mouse) beta-2-globin (*Hbb-b2*) DNA, 5' region. **(M15290)**

[HBB2BC] *P. maniculatus* (deer mouse) beta-2-globin (*Hbb-b2*) DNA, second coding-block region, partial cds. **(M15295)**

[HBB2BD] *P. maniculatus* (deer mouse) beta-2-globin (*Hbb-b2*) DNA, 3' region. **(M15298)**

[HBB3BA] *P. maniculatus* (deer mouse) beta-3-globin (*Hbb-b3*) DNA, 5' region. **(M15291)**

[HBB3BB] *P. maniculatus* (deer mouse) beta-3-globin (*Hbb-b3*) DNA, second coding-block region, partial cds. **(M15296)**

[HBB3BC] *P. maniculatus* (deer mouse) beta-3-globin (*Hbb-b3*) DNA, 3' region. **(M15299)**

Major Histocompatibility Complex - CLASS I *(MHC I)*

[MHCIM42] *P. leucopus* MHC class I *PeleM4* gene, exons 4 and 5 and partial cds. **(U21212)**

[MHCIa3] *P. leucopus* MHC class I antigen *alpha3* domain gene, partial cds. **(U37435)**

[MHCIM4] *P. leucopus* MHC class I *PeleM4* gene, exons 1, 2 and 3. **(U21213)**

[MHCIA11B] (*P. leucopus* group) Mouse MHC class I antigen (*Pele-A11b*) gene, exon 5. **(M59218)**

[MHCIA24A] (*P. leucopus* group) Mouse MHC class I antigen (*Pele-A24*) gene, exon 5. **(M59220)**

[MHCIA34C] (*P. leucopus* group) Mouse MHC class I antigen (*Pele-A34c*) gene, exon 5. **(M59221)**

[MHCIA37A] (*P. leucopus* group) Mouse MHC class I antigen (*Pele-A37*) gene, exon 5. **(M59222)**

[MHCIA38B] (*P. leucopus* group) Mouse MHC class I antigne (*Pele-A38B*) gene, exon 5. **(M59223)**

[MHCIA42B] (*P. leucopus* group) Mouse MHC class I antigen (*Pele-A42b*) gene, exon 5. **(M59224)**

[MHCIA42C] (*P. leucopus* group) Mouse MHC class I antigen (*Pele-A42c*) gene, exon 5. **(M59225)**

[MHCA48C] (*P. leucopus* group) Mouse MHC class I antigen (*Pele-A48c*) gene, exon 5. **(M59226)**

[MHCIA6B] (*P. leucopus* group) Mouse MHC class I antigen (*Pele-A6b*) gene, exon 5. **(M59219)**

[MHCIA4] *P. leucopus* MHC class I gene, exon 5. **(M60612, M33984)**

[MHCIA5] *P. leucopus* MHC class I gene, exon 5. **(M60611, M33983)**

[MHCLAA] *P. leucopus* MHC class I gene, exon 5. **(M60613, M33985)**

[MHCIT24A] *P. maniculatus* nonclassical class I antigen (*PemaT24*) mRNA, complete cds. **(U03104)**

[MHCI11A] *P. maniculatus* major histocompatibility complex class I antigen mRNA, clone *Pema11*, partial cds. **(U16846)**

[MHCIA13A] *P. maniculatus* major histocompatibility complex class I antigen mRNA, complete cds. **(U12822)**

[MHCIA41A] *P. maniculatus* clone *Pema41* major histocompatibility complex class I antigen mRNA, complete cds. **(U12885)**

[MHCIA52A] *P. maniculatus* clone *Pema52* major histocompatibility complex class I antigen mRNA, complete cds. **(U12886)**

[MHCIA53A] *P. maniculatus* major histocompatibility complex class I antigen mRNA, clone *Pema53*, complete cds. **(U16847)**

[MHCIA62A] *P. maniculatus* clone *Pema62* major histocompatibility complex class I antigen mRNA, complete cds. **(U12887)**

Major Histocompatibility Complex - CLASS II *(MHC II)*

[MHCIIAa] *P. leucopus* MHC class II protein alpha-chain *PeleAa (MhcPeleAa)* gene, partial cds. **(U34805)**

Tumor Necrosis Factor *(Tnf)*

[TNF] *P. leucopus* tumor necrosis factor (*P1TNF* gene) gene sequence, cds 5' end. **(M59233)**

NUCLEAR ELEMENTS

LINE-1 *(L1)*

[L1RT-ps] *P. californicus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70828)**

[L1RT-ps] *P. californicus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70829)**

[L1RT-ps] *P. californicus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70830)**

[L1RT-ps] *P. californicus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70831)**

[L1RT-ps] *P. californicus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70832)**

[L1RT-ps] *P. californicus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70833)**

[L1RT-ps] *P. californicus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70834)**

[L1RT-ps] *P. californicus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70835)**

[L1RT-ps] *P. californicus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70836)**

[L1RT-ps] *P. californicus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70837)**

[L1RT-ps] *P. californicus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70838)**

[L1RT-ps] *P. californicus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70839)**

[L1RT-ps] *P. californicus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70840)**

[L1RT-ps] *P. leucopus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70925)**

[L1RT-ps] *P. leucopus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70926)**

[L1RT-ps] *P. leucopus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70927)**

[L1RT-ps] *P. leucopus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70928)**

[L1RT-ps] *P. leucopus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70931)**

[L1RT-ps] *P. leucopus* LINE-1 repetitive element reverse transcriptase gene, partial cds. **(U43365, U70932)**

[L1PM55X] (*P. maniculatus* group) Deer mouse (*L1Pm55*) gene. **(M97518)**

[L1PM62X] (*P. maniculatus* group) Deer mouse (*L1Pm62*) gene. **(M97517)**

[L1RT] *P. maniculatus* LINE-1 repetitive element reverse transcriptase gene, partial cds. **(U43360)**

[L1RT-ps] *P. maniculatus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U43362)**

[L1RT-ps] *P. maniculatus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U43361, U70924)**

[L1RT-ps] *P. maniculatus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70929)**

[L1RT-ps] *P. maniculatus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70930)**

[L1RT-ps] *P. maniculatus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U70933)**

[L1RT-ps] *P. maniculatus* LINE-1 repetitive element reverse transcriptase pseudogene, partial cds. **(U43363, U70934)**

[L1RT] *P. maniculatus* LINE-1 repetitive element reverse transcriptase gene, partial cds. **(U43364, U70935)**

MYS-1, MYS-2 *(Mys)*

[MYS1PL] *P. leucopus* retrovirus-like transposable element *mys-1*. **(X02855)**

[MYS21PER] Mouse (*P. leucopus*) retrovirus-like transposable element *mys-2*, left flank. **(M13343)**

[MYS22PER] Mouse (*P. leucopus*) retrovirus-like transposable element *mys-2*, right flank. **(M13344)**

ID Repeat *(ID)*

[IDPMA2] *P. maniculatus* clone *Pma2* ID repeat element. **(U33854)**

[IDPMA3] *P. maniculatus* clone *Pma3* ID repeat element. **(U33855)**

[IDPMF0] *P. maniculatus* clone *Pmf0* ID repeat element. **(U33856)**

[IDPMG1] *P. maniculatus* clone *Pmg1* ID repeat element. **(U33857)**

[IDPMG2] *P. maniculatus* clone *Pmg2* ID repeat element. **(U33858)**

[IDPMG3] *P. maniculatus* clone *Pmg3* ID repeat element. **(U33859)**

[IDPMG4] *P. maniculatus* clone *Pmg4* ID repeat element. **(U33860)**

[IDPMG5] *P. maniculatus* clone *Pmg5* ID repeat element. **(U33861)**

[IDPMH1] *P. maniculatus* clone *Pmh1* ID repeat element. **(U33862)**

[IDPMH3] *P. maniculatus* clone *Pmh3* ID repeat element. **(U33863)**

[IDPMH5] *P. maniculatus* clone *Pmh5* ID repeat element. **(U33865)**

MITOCHONDRIAL GENES

Cytochrome B *(mtcytB)*

[MTCYTB] *P. leucopus* mitochondrial DNA for *cyt b* gene. **(X89790)**

[MTCYTB] (*P. leucopus* group) *P. gossypinus* mitochondrial DNA for *cyt b* gene. **(X89786)**

[MTCYTB] (*P. maniculatus* group) *P. keeni* mitochondrial DNA for *cyt b* gene. **(X89787)**

[MTCYTB] (*P. maniculatus* group) *P. melanotis* mitochondrial DNA for *cyt b* gene. **(X89791)**

[MTCYTB] (*P. maniculatus* group) *P. polionotus* mitochondrial DNA for *cyt b* gene. **(X89792)**

[MTCYTB] *P. eremicus* mitochondrial DNA for *cy b* gene. **(X89799)**

NADH dehydrogenase and transfer RNAs (*NADHDH* and *tRNA*s)

[MTNADHDH/tRNAs] *P. boylii* ND3 and ND4 genes, complete cds., tRNA-Arg complete seq., ND4 partial cds. **(U83864)**

[MTNADHDH/tRNAs] *P. eremicus* ND3 and ND4 genes, complete cds., tRNA-Arg complete seq., ND4 partial cds. **(U83861)**

[MTNADHDH/tRNAs] *P. gossypinus* ND3 and ND4L genes, complete cds., tRNA-Arg) gene, complete seq., tRNA-Gly gene, partial seq, and ND4 gene partial cds. **(U40246)**

[MTtRNA-Phe] *P. gossypinus* pg6262ga mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031757)**

NADH dehydrogenase and transfer RNAs (*NADHDH* and *tRNA*s) Continued.

[MTtRNA-Phe] *P. gossypinus* pg9510ga mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031758**)

[MTtRNA-Pro] *P. gossypinus* pg6262ga mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031806**)

[MTtRNA-Pro] *P. gossypinus* pg9510ga mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031807**)

[MTtRNA-Phe] *P. leucopus* pl8899nd mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031710**)

[MTtRNA-Phe] *P. leucopus* pl9010ri mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031711**)

[MTtRNA-Phe] *P. leucopus* pl9011ri mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031712**)

[MTtRNA-Phe] *P. leucopus* pl9007ri mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031713**)

[MTtRNA-Phe] *P. leucopus* pl9006ri mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031714**)

[MTtRNA-Phe] *P. leucopus* pl9008ri mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031715**)

[MTtRNA-Phe] *P. leucopus* pl9009ri mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031716**)

[MTtRNA-Phe] *P. leucopus* pl2198mo mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031717**)

[MTtRNA-Phe] *P. leucopus* pl1221mo mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031718**)

[MTtRNA-Phe] *P. leucopus* pl1666ks mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031719**)

[MTtRNA-Phe] *P. leucopus* pl1700ks mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031720**)

[MTtRNA-Phe] *P. leucopus* pl9174ar mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031721**)

[MTtRNA-Phe] *P. leucopus* pl9178ar mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031722**)

[MTtRNA-Phe] *P. leucopus* pl9552tn mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031723**)

[MTtRNA-Phe] *P. leucopus* pl9551tn mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031724**)

[MTtRNA-Phe] *P. leucopus* pl9511yn mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031725**)

[MTtRNA-Phe] *P. leucopus* pl9516tn mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (**AF031726**)

NADH dehydrogenase and transfer RNAs (*NADHDH* and *tRNA*s) Continued.

[MTtRNA-Phe] *P. leucopus* pl4020md mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031727)

[MTtRNA-Phe] *P. leucopus* pl4019md mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031728)

[MTtRNA-Phe] *P. leucopus* pl4557ok mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031729)

[MTtRNA-Phe] *P. leucopus* pl4687tx mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031730)

[MTtRNA-Phe] *P. leucopus* pl4084wi mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031731)

[MTtRNA-Phe] *P. leucopus* pl4067wi mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031732)

[MTtRNA-Phe] *P. leucopus* pl2222il mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031733)

[MTtRNA-Phe] *P. leucopus* pl3455ia mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031734)

[MTtRNA-Phe] *P. leucopus* pl3375ia mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031735)

[MTtRNA-Phe] *P. leucopus* pl9135ky mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031736)

[MTtRNA-Phe] *P. leucopus* pl0530wv mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031737)

[MTtRNA-Phe] *P. leucopus* pl0522wv mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031738)

[MTtRNA-Phe] *P. leucopus* pl0511wv mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031739)

[MTtRNA-Phe] *P. leucopus* pl0512wv mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031740)

[MTtRNA-Phe] *P. leucopus* pl2773wv mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031741)

[MTtRNA-Phe] *P. leucopus* pl9769va mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031742)

[MTtRNA-Phe] *P. leucopus* pl9771va mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031743)

[MTtRNA-Phe] *P. leucopus* pl4574ma mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031744)

[MTtRNA-Phe] *P. leucopus* pl4690sc mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031745)

[MTtRNA-Phe] *P. leucopus* pl4700sc mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031746)

NADH dehydrogenase and transfer RNAs (*NADHDH* **and** *tRNAs*) **Continued.**

[MTtRNA-Phe] *P. leucopus* pl0000ny mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031747)

[MTtRNA-Phe] *P. leucopus* pl4590dc mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031748)

[MTtRNA-Phe] *P. leucopus* pl9711pa mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031749)

[MTtRNA-Phe] *P. leucopus* pl6336ga mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031750)

[MTtRNA-Phe] *P. leucopus* pl14644me mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031751)

[MTtRNA-Phe] *P. leucopus* pl6374in mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031752)

[MTtRNA-Phe] *P. leucopus* pl6368in mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031753)

[MTtRNA-Phe] *P. leucopus* pl5337nc mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031754)

[MTtRNA-Phe] *P. leucopus* pl6021nc mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031756)

[MTtRNA-Pro] *P. leucopus* pl8899nd mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031759)

[MTtRNA-Pro] *P. leucopus* pl2198mo mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031760)

[MTtRNA-Pro] *P. leucopus* pl2218mo mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031761)

[MTtRNA-Pro] *P. leucopus* pl4084wi mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031762)

[MTtRNA- Pro] *P. leucopus* pl4067wi mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031763)

[MTtRNA-Pro] *P. leucopus* pl1666ks mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031764)

[MTtRNA-Pro] *P. leucopus* pl3455ia mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031765)

[MTtRNA-Pro] *P. leucopus* pl3375ia mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031766)

[MTtRNA-Pro] *P. leucopus* pl2222il mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031767)

[MTtRNA-Pro] *P. leucopus* pl9174ar mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031768)

[MTtRNA-Pro] *P. leucopus* pl9178ar mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. (AF031769)

NADH dehydrogenase and transfer RNAs (*NADHDH* and *tRNAs*) Continued.

[MTtRNA-Pro] *P. leucopus* pl1700ks mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031770)**

[MTtRNA-Pro] *P. leucopus* pl4687tx mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031771)**

[MTtRNA-Pro] *P. leucopus* pl4557ok mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031772)**

[MTtRNA-Pro] *P. leucopus* pl9010ri mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031773)**

[MTtRNA-Pro] *P. leucopus* pl9011ri mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031774)**

[MTtRNA-Pro] *P. leucopus* pl9007ri mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031775)**

[MTtRNA-Pro] *P. leucopus* pl9006ri mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031776)**

[MTtRNA-Pro] *P. leucopus* pl9008ri mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031777)**

[MTtRNA-Pro] *P. leucopus* pl9009ri mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031778)**

[MTtRNA-Pro] *P. leucopus* pl9552tn mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031779)**

[MTtRNA-Pro] *P. leucopus* pl9551tn mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031780)**

[MTtRNA-Pro] *P. leucopus* pl9511tn mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031781)**

[MTtRNA-Pro] *P. leucopus* pl9516tn mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031782)**

[MTtRNA-Pro] *P. leucopus* pl4020md mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031783)**

[MTtRNA-Pro] *P. leucopus* pl4019md mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031784)**

[MTtRNA-Pro] *P. leucopus* pl9135ky mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031785)**

[MTtRNA-Pro] *P. leucopus* pl4574ma mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031786)**

[MTtRNA-Pro] *P. leucopus* pl0000ny mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031787)**

[MTtRNA-Pro] *P. leucopus* pl4590dc mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031788)**

[MTtRNA-Pro] *P. leucopus* pl9711pa mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031789)**

NADH dehydrogenase and transfer RNAs (*NADHDH* **and** *tRNA*s) **Continued.**

[MTtRNA-Pro] *P. leucopus* pl6336ga mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031790)**

[MTtRNA-Pro] *P. leucopus* pl6374in mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031791)**

[MTtRNA-Pro] *P. leucopus* pl6368in mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031792)**

[MTtRNA-Pro] *P. leucopus* pl5345in mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031793)**

[MTtRNA-Pro] *P. leucopus* pl9769va mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031794)**

[MTtRNA-Pro] *P. leucopus* pl9771va mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031795)**

[MTtRNA-Pro] *P. leucopus* pl4644me mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031796)**

[MTtRNA-Pro] *P. leucopus* pl0530wv mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031797)**

[MTtRNA-Pro] *P. leucopus* pl0522wv mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031798)**

[MTtRNA-Pro] *P. leucopus* pl0511wv mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031799)**

[MTtRNA-Pro] *P. leucopus* pl0512wv mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031800)**

[MTtRNA-Pro] *P. leucopus* pl2773wv mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031801)**

[MTtRNA-Pro] *P. leucopus* pl4690sc mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031802)**

[MTtRNA-Pro] *P. leucopus* pl4700sc mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031803)**

[MTtRNA-Pro] *P. leucopus* pl5337nc mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031804)**

[MTtRNA-Pro] *P. leucopus* pl602nc mt D-loop, partial seq., and tRNA-Pro gene, partial seq. encoding mt RNA. **(AF031805)**

[MTNADHDH/tRNAs] *P. leucopus* ND3 and ND4L genes, complete cds., tRNA(arg) gene, complete seq., tRNA(gly) gene, partial seq, and ND4 gene partial cds; mtDNA gene products. **(U40252)**

[MTNADHDH/tRNAs] *P. maniculatus oreas* ND3 and ND4L genes, complete cds., tRNA(arg) gene, complete seq., tRNA(gly) gene, partial seq, and ND4 gene partial cds; mtDNA gene products. **(U40062)**

[MTNADHDH/tRNAs] *P. maniculatus interdictus* ND3 and ND4L genes, complete cds., tRNA(arg) gene, complete seq., tRNA(gly) gene, partial seq, and ND4 gene partial cds; mtDNA gene products. **(U40063)**

NADH dehydrogenase and transfer RNAs (*NADHDH* and *tRNAs*) **Continued.**

[MTNADHDH/tRNAs] *P. maniculatus austerus* ND3 and ND4L genes, complete cds., tRNA(arg) gene, complete seq., tRNA(gly) gene, partial seq, and ND4 gene partial cds; mtDNA gene products. (U40249)

[MTNADHDH/tRNAs] *P. maniculatus rufinus* ND3 and ND4L genes, complete cds., tRNA(arg) gene, complete seq., tRNA(gly) gene, partial seq, and ND4 gene partial cds; mtDNA gene products. (U40250)

[MTNADHDH/tRNAs] *P. maniculatus coolidgei* ND3 and ND4L genes, complete cds., tRNA(arg) gene, complete seq., tRNA(gly) gene, partial seq, and ND4 gene partial cds; mtDNA gene products. (U40251)

[MTNADHDH/tRNAs] *P. melanotis* ND3 and ND4L genes, complete cds., tRNA(arg) gene, complete seq., tRNA(gly) gene, partial seq, and ND4 gene partial cds; mtDNA gene products. (U40247)

[MTNADHDH/tRNAs] *P. mexicanus* ND3 and ND4L genes, complete cds., tRNA-Arg complete seq., ND4 partial cds. (U83862)

[MTNADHDH/tRNAs] *P. polionotus* ND3 and ND4L genes, complete cds., tRNA(arg) gene, complete seq., tRNA(gly) gene, partial seq, and ND4 gene partial cds; mtDNA gene products. (U40254)

[MTNADHDH/tRNAs] *P. sejugis* ND3 and ND4L genes, complete cds., tRNA(arg) gene, complete seq., tRNA(gly) gene, partial seq, and ND4 gene partial cds; mtDNA gene products. (U40253)

[MTNADHDH/tRNAs] *P. sejugis* ND3 and ND4L genes, complete cds., tRNA(arg) gene, complete seq., tRNA(gly) gene, partial seq, and ND4 gene partial cds; mtDNA gene products. (U40255)

[MTNADHDH/tRNAs] *P. slevini* ND3 and ND4L genes, complete cds., tRNA(arg) gene, complete seq., tRNA(gly) gene, partial seq, and ND4 gene partial cds; mtDNA gene products. (U40248)

***mtSSU* ribosomal RNA**

[MT12SrRNA] *P. eremicus* mitochondrial DNA for *SSU* ribosomal RNA gene. **(X89784)**

[MT12SrRNA] *P. leucopus* mitochondrial DNA for *12S* ribosomal RNA gene. **(X89797)**

[MT12SrRNA] (*P. leucopus* group) *P. gossypinus* mitochondrial DNA for *SSU* ribosomal RNA gene. **(X89795)**

[MT12SrRNA] *P. leucopus* mitochondrial 12S rRNA gene. **(X99463)**

[MT12SrRNA] (*P. maniculatus* group) *P. keeni* mitochondrial DNA for *SSU* ribosomal RNA gene. **(X89796)**

[MT12SrRNA] (*P. maniculatus* group) *P. melanotis* mitochondrial DNA for *SSU* ribosomal RNA gene. **(X89785)**

[MT12rRNA] (*P. maniculatus* group) *P. polionotus* DNA for *12S* ribosomal RNA gene. **(X89888)**

[MTsnRNA] *P. maniculatus* snRNA (*BC1 RNA*) gene, partial sequence. **(U33851)**

[MTsnRNA] *P. californicus* snRNA (*BC1 RNA*) gene, partial sequence. **(U33850)**

Other Peromyscine Species

MITOCHONDRIAL GENES

Osgoodomys [Peromyscus] banderanus:

[MTCOII] *O. [P.] banderanus* cytochrome c oxidase II gene, mitochondrial gene encoding mitochondrial protein, partial cds. **(U18836, U62572)**

[MT12SrRNA] *O. banderanus* 12S ribosomal RNA gene, mitochondrial gene encoding mitochondrial rRNA, partial sequence. **(U67295)**

[MTNADHDH/tRNA-Arg] *O. banderanus* NADH dehydrogenase subunits ND3, ND4L, and tRNA-Arg complete seqs. ND4 partial cds.

Onychomys sp.

[MT12SrRNA] *O. arenicola* mitochondrial DNA for SSU ribosomal RNA gene. **(X89782)**

[MT12SrRNA] *O. leucogaster* DNA for 12S ribosomal RNA gene. **(X89889)**

[MT12SrRNA] *O. torridus* mitochondrial DNA for SSU ribosomal RNA gene. **(X89783)**

[MTCYTB] *O. arenicola* mitochondrial DNA for cyt B gene. **(X89793)**

[MTCYTB] *O. leucogaster* mitochondrial DNA for cyt B gene. **(X89794)**

[MTCYTB] *O. torridus* mitochondrial DNA for cyt B gene. **(X89798)**

[MTCOIII] *O. arenicola* isolate LVT 614 cytochrome c oxidase subunit III gene, mitochondrial gene encoding mitochondrial product, partial cds. **(U21648)**

[MTCOIII] *O. arenicola* isolate 615 cytochrome c oxidase subunit III gene, mitochondrial gene encoding mitochondrial product, partial cds. **(U21649)**

[MTCOIII] *O. arenicola* isolate LVT 616 cytochrome c oxidase subunit III gene, mitochondrial gene encoding mitochondrial product, partial cds. **(U21650)**

[MTCOIII] *O. leucogaster* isolate LVT 617 cytochrome c oxidase subunit 3 gene, mitochondrial gene encoding mitochondrial product, partial cds. **(U21614)**

[MTCOIII] *O. leucogaster* isolate LVT 618 cytochrome c oxidase subunit 3 gene, mitochondrial gene encoding mitochondrial product, partial cds. **(U21615)**

[MTCOIII] *O. leucogaster* isolate LVT 619 cytochrome c oxidase subunit 3 gene, mitochondrial gene encoding mitochondrial product, partial cds. **(U21616)**

[MTCOIII] *O. torridus* isolate LVT 620 cytochrome c oxidase subunit III gene, mitochondrial gene encoding mitochondrial product, partial cds. **(U21633)**

[MTCOIII] *O. torridus* isolate LVT 621 cytochrome c oxidase subunit III gene, mitochondrial gene encoding mitochondrial product, partial cds. **(U21634)**

[MTCOIII] *O. torridus* isolate LVT 622 cytochrome c oxidase subunit III gene, mitochondrial gene encoding mitochondrial product, partial cds. **(U21635)**

Podomys [Peromyscus] floridanus

[NADHDH/tRNA-Arg] *P. floridanus* NADH dehydrogenase subunits ND3, ND4L, and tRNA-Arg complete sequence. ND4 partial cds. **(U83865)**

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NOTICE

PEROMYSCUS NEWSLETTER IS NOT A FORMAL SCIENTIFIC PUBLICATION.

Therefore ...

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

THANK YOU !

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CONTRIBUTIONS

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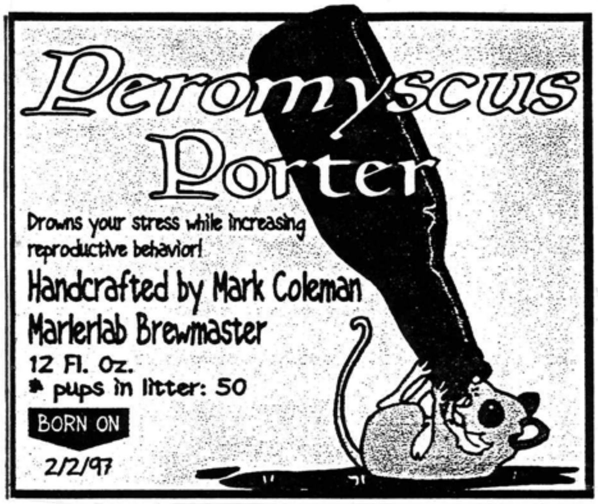
The figure entitled "Peromyscus Porter" we respectfully submit for publication in the Peromyscus Newsletter. A vast amount of time and research went into the making of Peromyscus Porter, which is the result of a collaboration between me (the brewer) and our department artist, William Feeney. I must also give credit to those who helped drink this fine ale at many special occasions, several of which we manufactured for the sole purpose of imbibing the substance. Indeed, several seemingly mundane events became earth shattering spectacles as members of our laboratory, their family, and friends lifted a few bottles of this concoction. My only regret is that there is no more Peromyscus Porter left for others to sample. The only evidence we have of its existence today is a photocopy of a black & white version of the labels we lovingly attached to each bottle. Sadly, this is merely a shadow of the color version.

Credit for it's creation is due Mark A. Coleman, William Feeney, Catherine A. Marler.



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DISCORDANT ROLES OF THE WHITE-FOOTED MOUSE IN THE NATURAL CYCLES OF THE AGENTS OF HUMAN GRANULOCYTIC EHRLICHIOSIS AND LYME DISEASE

The agent of human granulocytic ehrlichiosis (HGE) is transmitted by the tick *Ixodes scapularis* - the same vector that transmits *Borrelia burgdorferi* - the agent of Lyme disease. Both agents are perpetuated in the natural cycles between the tick-vector and vertebrate hosts. The white-footed mouse (*Peromyscus leucopus*) is suspected to be a major reservoir for both pathogens among many vertebrate species that harbor immature *I. scapularis*.

We assessed the relative role of *P. leucopus* in the natural cycles of the HGE agent and *B. burgdorferi* by comparing the prevalence of infection for both pathogens in adult ticks that fed as nymphs upon white-footed mice only to the infection in the general population of adult ticks that fed on the whole community of hosts.

Mice were trapped during the peak of nymphal activity and kept for several days in the laboratory over water to allow naturally attached ticks to feed to repletion and drop off. Serum samples were also collected from all mice and tested by IFA for the presence of antibodies to HGE. Engorged ticks were allowed to molt and were then individually tested for the presence of both pathogens by PCR. A sample of adult ticks from general population was collected in the following fall from the vegetation at the same site where the trapping was done. Overall, we tested 98 ticks derived from the nymphs fed upon 121 mice, and 50 ticks collected from vegetation.

Of 121 sera samples, 46 (38%) had antibodies to HGE. Prevalence of HGE agent was 9.2% in mice-fed ticks and 18% in the general population. Corresponding prevalence of *B. burgdorferi* infection were 64.3% and 56%. Although mice were susceptible to HGE agent and regularly exposed to it in nature, they produced a prevalence of HGE-infection in adult ticks twice as low as that observed in the general population.

Data show that the white-footed mouse plays a minor role in the cycle of HGE compared to other host(s) although it has a major role as a reservoir for *B. burgdorferi*, at least at the site studied. Dissimilarity in prevalence of infection between two pathogens in the general population of ticks and in a sub-population that fed exclusively on white-footed mice suggests that natural cycles of HGE agent and *B. burgdorferi* involve different principal vertebrate reservoirs, although they have the same vector species.

* * *

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CIRCADIAN AND ULTRADIAN RHYTHMS IN ACTIVITY DURING REPRODUCTION IN *PEROMYSCUS MANICULATUS*

I plan to initiate a laboratory study of activity patterns during reproduction in deer mice (*Peromyscus maniculatus*). I expect that circadian (22-26 hour free-running) and ultradian (less than 22 hours free running) rhythms will be altered in reproductive females and that the alteration in rhythms will increase with litter size. There are a number of reasons to expect rhythms to be altered during reproduction. Reproduction involves changes in hormone levels, social stimuli from the nursing young, and changes in metabolic state, all of which have been shown to alter biological rhythms individually (Albers et al., 1981; Goel and Lee, 1997; Wollnik and Schmidt, 1995). The fact that reproduction involves all of these factors suggests that biological rhythms are significantly altered during reproduction.

Alterations in activity rhythms associated with reproduction have implications for behavior of animals living under natural conditions. Changes in activity rhythms could result in increased predation risk not only because of increased duration of activity but in some cases, activity may shift into daylight hours as seen in a study of reproductive mice forced to work for their food (Perrigo, 1987). Diurnal activity will result in exposure to predators not normally encountered.

Alteration in rhythms and resulting changes in predation risk might be factors shaping reproductive investment. Females supporting large litters face higher energetic costs particularly during lactation than females supporting relatively small litters. Deer mice meet these costs primarily through increased ingestion (Millar, 1979). Increased ingestion of food could be accomplished through either increased foraging efficiency or increased foraging time. Increased foraging time must translate to increased predation risk because females are exposed to predators for a longer period of time. An ultimate cost to high reproductive investment (large litters) might be decreased maternal survival to the next breeding season as a result of increased predation.

Currently I am trying to collect some preliminary data using a small number of mice, before beginning a large scale study. I hope to begin in earnest this summer. I am interested in feedback on my idea in information on any similar studies conducted or presently in progress with breeding *Peromyscus*.

REFERENCES

Albers, H.E., A.A. Gerall, and J.F. Axelson. 1981. Effect of reproductive state on circadian periodicity in the rat. Physiol. Behav. 26:21-25.

Goel, N., and T.M. Lee. 1997. Social cues modulate free-running circadian activity rhythms in the diurnal rodent, *Octodon degus*. Am. J. Physiol. 273(2 part 2):R797-R804.

Millar, J.S. 1979. Energetics of lactation in *Peromyscus maniculatus*. Can. J. Zool. 57:1015-1019.

Perrigo, G. 1987. Breeding and feeding strategies in deer mice and house mice when females are challenged to work for their food. Anim. Behav. 35:1298-1316.

Wollnik, F., and B. Schmidt. 1995. Seasonal and daily rhythms of body temperature in the European hamster (*Cricetus cricetus*) under semi-natural conditions. J. Comp. Physiol. B 165:171-182.

* * *

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COMPETITIVE INTERACTION BETWEEN THE AGENTS OF LYME DISEASE AND HUMAN GRANULOCYTIC EHRLICHIOSIS IN A NATURAL RESERVOIR HOST

Agents of Lyme disease (*Borrelia burgdorferi*) and human granulocytic ehrlichiosis (*Ehrlichia phagocytophila*) are perpetuated in the same natural cycle involving blacked-legged tick *I. scapularis* and its vertebrate hosts. Using *I. scapularis* nymphs as an infection challenge, we studied how infection with one pathogen in white-footed mice affects their ability to acquire the other agent and to subsequently infect larvae which would maintain these agents in a natural cycle.

Two groups of mice were infected with either *B. burgdorferi* or *E. phagocytophila*. One week later, *Borrelia*-infected mice were challenged with *Ehrlichia*, and *Ehrlichia*-infected mice were challenged with *Borrelia*. Simultaneously, two control groups of uninfected mice were infested with ticks infected with each agent from the same cohorts used on preinfected mice. Uninfected *I. scapularis* larvae were repeatedly fed on all mice for xenodiagnosis at intervals lasting 56 days. All control and *Ehrlichia*-infected mice acquired *B. burgdorferi*. However, fewer xenodiagnostic larvae acquired *Borrelia* from mice with dual infections compared to mice infected with *Borrelia* only. All 5 control mice acquired *E. phagocytophila*, whereas only 2 out of 5 mice preinfected with *B. burgdorferi* became infected with *Ehrlichia* as well.

Thus, a preexisting infection with either *B. burgdorferi* or *E. phagocytophila* in mice inhibited transmission of the other agent, suggesting a competitive relationship between two agents.

* * *

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CO-SPECIATION OF SIN NOMBRE-LIKE HANTAVIRUSES WITH PHYLOGENETICALLY DISTINCT FORMS OF *PEROMYSCUS MANICULATUS* AND *P. LEUCOPUS*

Hantaviruses are known to have a narrow host range, with each hantavirus species usually being associated with a single species of rodent. To evaluate co-evolutionary relationships among recently identified Sin Nombre-like North American hantaviruses and their rodent hosts *Peromyscus maniculatus* and *Peromyscus leucopus*, phylogenies based on rodent mtDNA sequences and hantavirus RNA sequences (obtained from the same rodent samples) were compared. *P. maniculatus* samples clearly form four phylogenetically distinct groups. The "forest" form occupies much of the Eastern United States and Canada and carries Monongahela virus. The "grassland" form occurs almost everywhere West of the Appalachian Mountains and carries "classic" western SN virus. Two "western mountain" forms inhabit certain mountain areas of the Western US and Canada, Baja California islands and mainland Mexico. *P. leucopus* samples also form four phylogenetically distinct groups, with two of them being associated with two phylogenetically distinct genetic lineages of Blue River virus, and a third one being associated with New York virus. Our data suggest 2 major factors which have let to the current genetic divergence and geographic distribution of SN-like hantaviruses: (i) long-term co-speciation with their specific rodent hosts; (ii) biogeographic factors (such as sympatricity, allopatric migrations, geographic separation and isolation) and geographic domination of certain SN-like hantavirus lineages in some particular areas, which could eventually lead to host-switching events in areas of sympatricity. In particular, it is likely that the current association of NY virus with *P. leucopus* is a result of an historically recent host-switching event.

* * *

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FUNCTIONAL MORPHOMETRIC VARIATION OF *PEROMYSCUS GRATUS* FROM MEXICO

The traditional approach to the study of intrapopulational variation (secondary sexual, ontogenetic, and individual variation) has been to record several measurements of the skull and, by means of univariate and multivariate statistical techniques, define homogeneous groups (e.g. adulthood) for posterior comparisons among populations. This is a useful method for such purposes but considers only comparisons variable by variable. Because no cranial functional units are defined, group differences cannot be examined and discussed from a functional or ecological perspective.

In order to follow a functional approach, we defined in a skull of *Peromyscus gratus* seven functional units (Cranial Functional Components or CFC): one olfactory (volume of rostrum), one auditive (volume of bullae), one ocular (ocular area), one cerebral (volume of braincase), and three masticatories (masticatory area, food storing area, and length of ramus), calculated from 27 common linear variables from the skull and mandible in a sample of 249 *Peromyscus gratus* collected in south Mexico City. We examined the secondary sexual, ontogenetic, and individual variation of this sample in both CFC and traditional data sets. Our data analyses was based on standard univariate and multivariate statistical techniques as well as the procedures of Willig and Hollander (1995).

Our preliminary results from both the CFC and the traditional data sets showed similar patterns of morphometric differentiation. First, males and females do not differ statistically in any of the five age categories (based on tooth wear) that we recognized. Second, two age groups were differentiated: juveniles, which embrace age categories one to three, and adults, including age classes four and five. The comparison between the variation coefficients of the two groups showed no statistical difference. These results are similar to what Hoffmeister (1952) previously reported for *P. truei* (formerly conspecific with *P. gratus*). Although the traditional data and the CFC data sets share a similar pattern of morphometric variation, the CFC showed a trend where sexual dimorphism appears less, and, on the other hand, juveniles and adults are better identified. In addition, these data showed a higher degree of statistical independence among CFC.

In addition, when we compared the results of the secondary sexual and ontogenetic variation with published reports on population ecology of *Peromyscus*, a correlation between the morphologic patterns of morphometric differentiation and the differential use of resources becomes clear. For instance, there is no difference between the type of food items used by sex classes. In contrast, it is known that juveniles eat more soft food than adults, which eat more hard elements, such as arthropods. The use of the importance index proposed by Willig and Hollander (1995) in the CFC data set supported that mandibular as well as olfactory elements are quite important in the morphometric differentiation between juveniles and adults.

On the other hand, the results of the individual variation analyses in both CFC and traditional data sets do not support the results of other ecological studies, wherein juveniles have been reported to display a larger ecological niche than that of the adults. Our data did not show significant differences between the coefficients of variation of the two large age groups.

Because the results of the study of CFC agree well with those obtained from traditional variables used in systematics, and from population ecology, we propose the use of this type of morphometric studies as a bridge between systematics and ecology. Since CFC allow the identification of homogeneous groups for further taxonomic comparisons that systematics needs, they provide with tools to the ecologists to identify differences between individual groups of the same population.

LITERATURE CITED

Hoffmeister, D.F. 1951. A taxonomic and evolutionary study of the pinon mouse, *Peromyscus truei*. Illinois Biological Monographs, 21:1-104.

Willig, M.R. and R.R. Hollander. 1995. Secondary sexual dimorphism and phylogenetic constraints in bats: a multivariate approach. Journal of Mammalogy, 76:981-992.

* * *

RECENT PUBLICATIONS

Bayne, E. M. and K. A. Hobson. 1998. The effects of habitat fragmentation by forestry and agriculture on the abundance of small mammals in the southern boreal mixedwood forest. Can. J. Zool., 76:62-69.

Brunet, L. R., P. Katavolos, A. Spielman, and S. R. Telford. 1997. Anti-osp A antibody reduces reservoir competence of mice for *Borrelia burgdorferi* the agent of Lyme disease. Med. Vet. Entomol., 11:198-200.

Bunnell, J. E., J. S. Dumler, J. E. Childs, and G. E. Glass. 1998. Retrospective serosurvey for human granulocytic ehrlichiosis agent in urban white-footed mice from Maryland. J. Wildlife Dis., 34:179-181.

Cantoni, D. and R. E. Brown. 1997. Male influence on interbirth interval in the monogamous California mouse when required to forage for food. Annals NY Acad. Sci., 807:486-489.

Cantoni, D. and R. E. Brown. 1997. Paternal investment and reproductive success in the California mouse, *Peromyscus californicus*. Anim. Behav., 54:377-386.

Demas, G. E., A. C. Devries, and R. J. Nelson. 1997. Effects of photoperiod and 2-deoxy-D-glucose-induced metabolic stress on immune function in female deer mice. Amer. J. Physiol., 272:R1762-R1767.

Demas, G. E. and R. J. Nelson. 1998. Social, but not photoperiodic, influences on reproductive function in male *Peromyscus aztecus*. Biol. Reprod., 58:385-389.

Dietrich, N., S. Pruden, T. G. Ksiazek, S. P. Morzunov, and J. W. Camp. 1997. A small-scale survey of hantavirus in mammals from Indiana. J. Wildlife Dis., 33:818-822.

Duffy, P. H., R. J. Feuers, J. L. Pipkin, A. Turturro, and R. W. Hart. 1997. Age and temperature related changes in behavioral and physiological performance in the *Peromyscus leucopus* mouse. Mech. Ageing Dev., 95:43-61.

Ellis, L. M., C. S. Crawford, and M. C. Morales, Jr. 1997. Rodent communities in native and exotic riparian vegetation in the middle Rio Grade Valley of central New Mexico. Southwest Nat., 42:13-19.

Ellis, L. M., M. C. Molles, and C. S. Crawford. 1997. Short-term effects of annual flooding on a population of *Peromyscus leucopus* in a Rio Grande riparian forest of central New Mexico. Am. Midl. Nat., 138:260-267.

Feldhamer, G. A., J. C. Whittaker, and E. M. Charles. 1998. Recent records of the cotton mouse (*Peromyscus gossypinus*) in Illinois. Am. Midl. Nat., 139:178-180.

Fenske-Crawford, T. J. and G. J. Niemi. 1997. Predation of artificial ground nests at two types of edges in a forest-dominated landscape. Condor, 99:14-24.

Galindo-Leal, C. 1997. Infestation of rock mice (*Peromyscus difficilis*) by botflies: Ecological consequences of differences between sexes. J. Mammal., 78:900-907.

Geluso, K., C. S. O'Connor, S. G. Sullivan, and J. P. Hayes. 1997. Elevational records for mammals in the White Mountains of California. Great Basin Nat., 57:83-84.

Glass, G. E., J. S. Johnson, G. A. Hodenbach, C. L. J. Disalvo, C. J. Peters, J. E. Childs, and J. N. Mills. 1997. Experimental evaluation of rodent exclusion methods to reduce hantavirus transmission to humans in rural housing. Am. J. Trop. Med. and Hygiene, 56:359-364.

Graham, T. B. and B. B. Chomel. 1997. Population dynamics of the deer mouse (*Peromyscus maniculatus*) and Sin Nombre virus, California Channel Islands. Emerg. Infect. Dis., 3:367-370.

Hall, L. S. and M. L. Morrison. 1997. Den and relocation site characteristics and home ranges of *Peromyscus truei* in the White Mountains of California. Great Basin Nat., 57:124-130.

Havelka, M. A. and J. S. Millar. 1997. Sex ratio of offspring in *Peromyscus maniculatus borealis*. J. Mammal., 78:626-637.

Hayssen, V. 1997. Effects of the nonagouti coat-color allele on behavior of deer mice (*Peromyscus maniculatus*): A comparison with Norway rats (*Rattus norvegicus*). J. Comp. Psychol., 111:419-423.

Hayssen, V. 1998. Effect of transatlantic transport on reproduction of agouti and nonagouti deer mice, *Peromyscus maniculatus*. Lab. Anim., 32:55-64.

Henein, K., J. Wegner, and G. Merriam. 1998. Population effects of landscape model manipulation on two behaviourally different woodland small mammals. Oikos, 81:168-186.

Hofmeister, E. K., C. P. Kolbert, A. S. Abdulkarim, J. M. H. Magera, M. K. Hopkins, J. R. Uhl, A. Ambyaye, S. R. Telford, F. R. Cockerill, and D. H. Persing. 1998. Cosegregation of a novel Bartonella species with *Borrelia burgdorferi* and *Babesia microti* in *Peromyscus leucopus*. J. Infect. Dis., 177:409-416.

Hogan, K. M., S. K. Davis, and I. F. Greenbaum. 1997. Mitochondrial-DNA analysis of the systematic relationships within the *Peromyscus maniculatus* species group. J. Mammal., 78:733-743.

Holtcamp, W. N., W. E. Grant, and S. B. Vinson. 1997. Patch use under predation hazard: Effect of the red imported fire ant on deer mouse foraging behavior. Ecology, 78:308-317.

Hu, R. J., K. E. Hyland, and D. Markowski. 1997. Effects of *Babesia microti* infection on feeding pattern, engorged body weight, and molting rate of immature *Ixodes scapularis* (Acari: Ixodidae). J. Med. Entomol., 34:559-564.

Jacquot, J. J. and S. H. Vessey. 1998. Recruitment in white-footed mice (*Peromyscus leucopus*) as a function of litter size, rarity, and season. J. Mammal., 79:312-319.

Jay, M., M. S. Ascher, B. B. Chomel, M. Madon, D. Sesline, B. A. Enge, B. Hjelle, T. G. Ksiazek, P. E. Rollin, P. H. Kass, and K. Reilly. 1997. Seroepidemiologic studies of hantavirus infection among wild rodents in California. Emerg. Infect. Dis., 3:183-190.

Jones, C. G., R. S. Ostfeld, M. P. Richard, E. M. Schauber, and J. O. Wolff. 1998. Chain reactions linking acorns to gypsy moth outbreaks and Lyme disease risk. Science, 279:1023-1026.

Kass, D. H., J. Kim, A. Rao, and P. L. Deininger. 1997. Evolution of B2 repeats: The muroid explosion. Genetica, 99:1-13.

Kendall, W. L., J. D. Nichols, and J. E. Hines. 1997. Estimating temporary emigration using capture-recapture data with Pollock's robust design. Ecology, 78:563-578.

Kesner, M. H. and A. V. Linzey. 1997. Modeling population variation in *Peromyscus leucopus*: An exploratory analysis. J. Mammal., 78:643-654.

Kirsch, E. M. 1997. Small mammal community composition in cornfields, roadside ditches, and prairies in eastern Nebraska. Nat. Areas J., 17:204-211.

Klein, S. L. and R. J. Nelson. 1997. Sex differences in immunocompetence differ between two *Peromyscus* species. Am. J. Physiol., 273:R655-R660.

Kollars, T. M., L. A. Druden, and J. H. Oliver. 1997. Fleas and lice parasitizing mammals in Missouri. J. Vect. Ecol., 22:125-132.

Korytko, A. I., D. E. Dluzen, and J. L. Blank. 1997. Photoperiod and steriod-dependent adjustments in hypothalamic gonadotropic hormone-releasing hormone, dopamine, and norepinephrine content in male deer mice. Biol. Reprod., 56:617-624.

Kosoy, M. Y., R. L. Regnery, T. Tzianabos, E. L. Marston, D. C. Jones, D. Green, G. O. Maupin, J. G. Olson, and J. E. Childs. 1997. Distribution, diversity, and host specificity of *Bartonella* in rodents from the southeastern United States. Am. J. Trop. Med. Hyg., 57:578-588.

Krohne, D. T. 1997. Dynamics of metapopulations of small mammals. J. Mammal., 78:1014-1026.

Lacy, R. C. 1997. Importance of genetic variation to the viability of mammalian populations. J. Mammal., 78:320-335.

Levin, M. L. and D. Fish. 1998. Density-dependent factors regulating feeding success of *Ixodes scapularis* larvae (Acari: Ixodidae). J. Parasitol., 84:36-43.

Levin, M., M. Papero, and D. Fish. 1997. Feeding density influences acquisition of *Borrelia burgdorferi* in larval *Ixodes scapularis* (Acari: Ixodidae). J. Med. Entomol. 34:569-572.

Lewellen, R. H. and S. H. Vessey. 1998. Modeling biotic and abiotic influences on population size in small mammals. Oecologia, 113:210-218.

Lindsay, L. R., I. K. Barker, G. A. Surgeoner, S. A. McEwen, and G. D. Campbell. 1997. Duration of *Borrelia burgdorferi* infectivity in white-footed mice for the tick vector *Ixodes scapularis* under laboratory and field conditions in Ontario. J. Wildlife Dis., 33:766-775.

Loxterman, J. L., N. D. Moncrief, R. D. Dueser, C. R. Carlson, and J. F. Pagels. 1998. Dispersal abilities and genetic population structure of insular and mainland *Oryzomys palustris* and *Peromyscus leucopus*. J. Mammal., 79:66-77.

Magnarelli, L. A., J. F. Anderson, K. C. Stafford, and J. S. Dumler. 1997. Antibodies to multiple tick-borne pathogens of babesiosis, ehrlichiosis, and Lyme borreliosis in white-footed mice. J. Wildlife Dis., 33:466-473.

Margulis, S. W. 1998. Differential effects of inbreeding at juvenile and adult life-history stages in *Peromyscus polionotus*. J. Mammal., 79:326-336.

Margulis, S. W. 1997. Inbreeding-based bias in parental responsiveness to litters of oldfield mice. Behav. Ecol. Sociobiol., 41:177-184.

Margulis, S. W. 1998. Relationships among parental inbreeding, parental behaviour and offspring viability in oldfield mice. Anim. Behav., 55:427-438.

Margulis, S. W. and J. Altmann. 1997. Behavioural risk factors in the reproduction of inbred and outbred oldfield mice. Anim. Behav., 54:397-408.

Markowski, D., K. E. Hyland, H. S. Ginsberg, R. J. Hu. 1997. Spatial distribution of larval *Ixodes scapularis* (Acari: Ixodidae) on *Peromyscus leucopus* and *Microtus pennsylvanicus* at two island sites. J. Parasitol., 83:207-211.

McAllister, B. F. and I. F. Greenbaum. 1997. How common are common fragile sites: Variation of aphidicolin-induced chromosomal fragile sites in a population of the deer mouse (*Peromyscus maniculatus*). Hum. Genet., 100:182-188.

McMillan, B. R., G. A. Kaufman, and D. W. Kaufman. 1997. A case of senescence for the white-footed mouse? Southwest. Nat., 42:236-237.

Mills, J. N., T. G. Ksiazek, B. A. Ellis, P. E. Rollin, S. T. Nichol, T. L. Yates, W. L. Gannon, C. E. Levy, D. M. Engelthaler, T. Davis, D. T. Tanda, J. W. Frampton, C. R. Nichols, C. J. Peters, and J. E. Childs. 1997. Patterns of association with host and habitat: Antibody reactive with Sin Nombre virus in small mammals in the major biotic communities of the southwestern United States. Am. J. Trop. Med. Hyg., 56:273-284.

Morris, D. W. 1997. Optimally foraging deer mice in prairie mosaics: A test of habitat theory and absence of landscape effects. Oikos, 80:31-42.

Morzunov, S. P., J. E. Rowe, T. G. Ksiazek, C. J. Peters, S. C. St Jeor, and S. T. Nichol. 1998. Genetic analysis of the diversity and origin of hantaviruses in *Peromyscus leucopus* mice in North America. J. Virol., 72:57-64.

Mount, G. A., D. G. Haile, and E. Daniels. 1997. Simulation of blacklegged tick (Açari: Ixodidae) population dynamics and transmission of *Borrelia burgdorferi*. J. Med. Entomol., 34:461-484.

Nelson, R. J. and G. E. Demas. 1997. Role of melatonin in mediating seasonal energetic and immunologic adaptations. Brain Res. Bull., 44:423-430.

Nelson, R. J., A. C. Marinovic, C. A. Moffatt, L. J. Kriegsfeld, and S. Kim. 1997. The effects of photoperiod and food intake on reproductive development in male deer mice (*Peromyscus maniculatus*). Physiol. & Behav., 62:945-950.

Nestler, J. R., S. J. Peterson, B. D. Smith, R. Brian Heathcock, C. R. Johanson, J. D. Sarthou, and J. C. King. 1997. Glycolytic enzyme binding during entrance to daily torpor in deer mice (*Peromyscus maniculatus*). Physiol. Zool., 70:61-67.

Nicholson, W. L., S. Muir, J. W. Sumner, and J. E. Childs. 1998. Serologic evidence of infection with *Ehrlichia* spp. in wild rodents (Muridae: Sigmodontinae) in the United States. J. Clin. Microbiol., 36:695-700.

O'Connor, C. S., J. P. Hayes, and S. C. St. Jeor. 1997. Sin Nombre virus does not impair respiratory function of wild deer mice. J. Mammal., 78:661-668.

Ostfeld, R. S. 1997. The ecology of Lyme-disease risk. Amer. Sci., 85:338-346.

Ostfeld, R. S., R. H. Manson, and C. O. Canham. 1997. Effects of rodents on survival of tree seeds and seedlings invading old fields. Ecology, 78:1531-1542.

Parmenter, C. A., T. L. Yates, R. R. Parmenter, J. N. Mills, J. E. Childs, M. L. Campbell, J. L. Dunnum, and J. Milner. 1998. Small mammal survival and trapability in mark-recapture monitoring programs for hantavirus. J. Wildlife Dis., 34:1-12.

Patten, M. A. 1997. Reestablishment of a rodent community in restored desert scrub. Restor. Ecol., 5:156-161.

Peavey, C. A., R. S. Lane, and J. E. Kleinjan. 1997. Role of small mammals in the ecology of *Borrelia burgdorferi* in a peri-urban park in north coastal California. Exp. Appl. Acarol., 21:569-584.

Reese, E. O., J. C. Barnard, and T. A. Hanley. 1997. Food preference and *ad libitum* intake of wild-captured Sitka mice, *Peromyscus keeni sitkensis*. Can. Field-Nat., 111:223-226.

Roberts, K. J., F. D. Yancey, Ii, and C. Jones. 1997. Distributional records of small mammals from the Texas panhandle. Tex. J. Sci., 49:57-64.

Robinson, M., C. Gautier, and D. Mouchiroud. 1997. Evolution of isochores in rodents. Mol. Biol. Evol., 14:823-828.

Rodriguez, L. L., J. H. Owens, C. J. Peters, and S. T. Nichol. 1998. Genetic reassortment among viruses causing hantavirus pulmonary syndrome. Virology, 242:99-106.

Ruf, T., A. I. Korytko, A. Stieglitz, K. R. Lavenburg, and J. L. Blank. 1997. Phenotypic variation in seasonal adjustments of testis size, body weight, and food intake in deer mice: Role of pineal function and ambient temperature. J. Comp. Physiol. B-Biochem. Syst. Environ. Physiol., 167:185-192.

Ruhl, M. W. and F. B. Stangl, Jr. 1997. Noteworthy records of mammals from Stonewall County, Texas. Tx. J. Sci., 49:345-348.

Sawby, R. and H. A. Wichman. 1997. Analysis of orthologous retrovirus-like elements in the white-footed mouse, *Peromyscus leucopus*. J. Mol. Evol., 44:74-80.

Schauber, E. M., W. D. Edge, and J. O. Wolff. 1997. Insecticide effects on small mammals: Influence of vegetation structure and diet. Ecol. Appl., 7:143-157.

Schulte-Hostedde, A. I. and R. J. Brooks. 1997. An experimental test of habitat selection by rodents of Algonquin Park. Can. J. Zool., 75:1989-1993.

Seamon, J. and G. Adler. 1997. Factors affecting immigration of adults: Experimental and theoretical observations with rodents. Acta Oecolog., 18:637-655.

Sheppard, C. H. and K. R. Kazacos. 1997. Susceptibility of *Peromyscus leucopus* and *Mus musculus* to infection with *Baylisascaris procyonis*. J. Parasitol., 83:1104-1111.

Songer, M. A., M. V. Lomolino, and D. R. Perault. 1997. Niche dynamics of deer mice in a fragmented, old-growth-forest landscape. J. Mammal., 78:1027-1039.

Stamper, J. L. and J. Dark. 1997. Metabolic fuel availability influences thermoregulation in deer mice (*Peromyscus maniculatus*). Physiol. Behav., 61:521-524.

Stangl, F. B., Jr. and T. J. McDonough. 1997. Noteworthy records of mammals from Fannin County, Texas. Tx. J. Sci., 49:259-261.

Stapp, P. 1997. Community structure of shortgrass-prairie rodents: Competition or risk of intraguild predation? Ecology, 78:1519-1530.

Stapp, P. and B. Van Horne. 1997. Response of deer mice (*Peromyscus maniculatus*) to shrubs in shortgrass prairie: Linking small-scale movements and the spatial distribution of individuals. Funct. Ecol., 11:644-651.

Sternburg, J. E. and G. A. Feldhamer. 1997. Mensural discrimination between sympatric *Peromyscus leucopus* and *P. maniculatus* in southern Illinois. Acta Theriol., 42:1-13.

Sugg, D. W., R. K. Chesser, and J. C. Long. 1997. Assessment of genetic information in morphometric traits: Geographic patterns and evolutionary interpretation. J. Mammal., 78:405-416.

Sullivan, J., J. A. Markert, and C. W. Kilpatrick. 1997. Phylogeography and molecular systematics of the *Peromyscus aztecus* species group (Rodentia: Muridae) inferred using parsimony and likelihood. System. Biol., 46:426-440.

Sullivan, T. P., D. S. Sullivan, R. A. Lautenschlager, and R. G. Wagner. 1997. Long-term influence of glyphosate herbicide on demography and diversity of small mammal communities in coastal coniferous forest. Northwest Sci., 71:6-17.

Swann, D. E., A. J. Kuenzi, M. L. Morrison, and S. DeStefano. 1997. Effects of sampling blood on survival of small mammals. J. Mammal., 78:908-913.

Tannenbaum, M. G., S. L. Seematter, and D. M. Zimmerman. 1998. Endophyte-infected and uninfected fescue seeds suppress white-footed mouse (*Peromyscus leucopus*) reproduction. Am. Midl. Nat., 139:114-124.

Terman, C. R. 1998. Early-summer reproductive curtailment in wild white-footed mice and reproductive recovery in the laboratory. J. Mammal., 79:320-325.

Topping, M. G., J. S. Millar, B. E. Woolfenden. 1997. Unsuccessful colonization of a naturally depopulated area by the deer mouse, *Peromyscus maniculatus*. Can. Field-Nat., 111:466-468.

Vander Wall, S. B. 1997. Dispersal of singleleaf pinon pine (*Pinus monophylla*) by seed-caching rodents. J. Mammal., 78:181-191.

Vander Wall, S. B. 1998. Foraging success of granivorous rodents: Effects of variation in seed and soil water on olfaction. Ecology, 79:233-241.

Wager-Page, S. A., G. Epple, and J. R. Mason. 1997. Variation in avoidance of Siberian pine needle oil by rodent and avian species. J. Wildlife Mgt., 61:235-241.

Walls, J. J., G. Greig, D. F. Neitzel, and J. S. Dumlet. 1997. Natural infection of small mammal species in Minnesota with the agent of human granulocytic ehrlichiosis. J. Clin. Microbiol., 35:853-855.

Walpole, D. K., S. K. Davis, and I. F. Greenbaum. 1997. Variation in mitochondrial DNA in populations of *Peromyscus eremicus* from the Chihuahuan and Sonoran deserts. J. Mammal., 78:397-404.

Wilson, W. D., J. A. Hnida, D. W. Duszynski. 1997. Parasites of mammals on the Sevilleta National Wildlife Refuge, Socorro, New Mexico. *Cuterebra austeni* and *C-neomexicana*- (Diptera: Oestridae) from *Neotoma* and *Peromyscus* (Rodentia: Muridae), 1991-1994. J. Med. Entomol., 34:359-367.

Woolfenden, B. E. and J. S. Millar. 1997. Effects of salt on the growth and timing of reproduction of the deer mouse (*Peromyscus maniculatus borealis*). Can. J. Zool., 75:110-115.

Yao, C., A. K. Prestwood, and R. A. Mcgraw. 1997. *Trichinella spiralis* (T_1) and *Trichinella* T_5: A comparison using animal infectivity and molecular biology techniques. J. Parasitol., 83:89-95.

Zollner, P. A. and S. L. Lima. 1997. Landscape-level perceptual abilities in white-footed mice: Perceptual range and the detection of forested habitat. Oikos, 80:51-60.

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