

PEROMYSCUS NEWSLETTER

NUMBER TWENTY-TWO



SEPTEMBER 1996

Cover: Three high-expression ashy deer mice posing nicely.
See Teed *et al.* (*J. Hered.* 81:309ff).

*** WELCOME TO ISSUE NUMBER 22 ***

In this issue we feature an update of the *Peromyscus* genetic map together with other new information on deer mouse genetics. At the Peromyscus Stock Center we are in the process of developing a comprehensive database on many aspects of peromyscine biology which will be accessible through the Internet. On page 14 is a description of this project and a report on its progress.

In addition to the Peromyscus genetic map, it is time to publish our bi-annual list of genes formally described for *Peromyscus*.

The *Peromyscus* Stock Center has set some new records lately. See page 7 for details. And our diligent animal care staff is pictured on page 8.

As always, we need your entries for the "Contributions" section of *PN*. The principal objective of the newsletter is to keep the Peromyscus research community informed of current activities involving these animals. Brief informal accounts of on-going projects are especially welcome. Our constraints are few: Please limit to two single-spaced word processed pages and one figure or table. Information for our "News and Comment" section is likewise solicited. We are always glad to learn about the world of *Peromyscus*!

No, the deer mouse pictured on our www homepage is not the same animal as that shown on the cover of the last Newsletter, although both are *P. maniculatus*. The pose is similar in both cases.

The URL for the Stock Center is: <http://www.sc.edu/mouse/peromyscus.html>
Our e-mail address is: peromyscus@stkctr.biol.sc.edu

Deadline for contributions to *Peromyscus Newsletter #23* is **20 Feb 1997**.

WDD

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NEWS, COMMENT and ANNOUNCEMENTS

Here are some web sites that may interest some of our readers:

Sevillita Wildlife Refuge: <http://sevilleta.unm.edu/animal/mammal-home.html>
This site contains detailed descriptions of six species of *Peromyscus* and three of *Onychomys* that occur on the refuge, complete with downloadable photos of some and range maps.

Smithsonian Natural History Museum: <http://nrmnhwww.si.edu/departments/vert.html> and search the gopher. This site gives the holdings of *Peromyscus* specimens in the museum. Skin and skull specimens of each species are listed by state or province. Also see "*Mammals of the World*" at this same site.

Again we remind you of the Auburn University beach mouse site maintained by **Mike Wooten**. The URL is <http://www.ag.auburn.edu/~mwooten/main.html>

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Outback Editions, Inc has produced a series of limited edition art prints depicting different species of mice in their natural environs. *Peromyscus* is included. Interested individuals may contact Outback at 1-800-801-2761 or address 492 Wythe Creek Road, Poquoson, VA 23662.

* * * * *

Sergey Morzunov has returned to Nevada. His new address is Fleischmann Agricultural Building, Mail Stop 200, UNV-Reno, Reno NV 89557. He will continue to collaborate with CDC. Sergey has been sequencing *Peromyscus* and associated hantaviruses.

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

The American Society of Mammalogists held their annual meeting at the University of North Dakota at Grand Forks. As usual, many papers and posters on Peromyscus were presented - nineteen altogether. Other presentations included Peromyscus among other species.

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The July 8th issue of *The Scientist* has an in depth review of the current status of Lyme disease research. Among the matters discussed is the question as to why Lyme disease didn't surface in North America before the 1970s, since museum specimens of *P. leucopus* collected in the 1800s harbored *Borelia burgdorferii* the causative spirochaete. Was the disease present and simply unrecognized? These and other questions are examined in a new book by **Alan Barbour**, *Lyme Disease: The Cause, The Cure, The Controversy* (Johns Hopkins Press). Similar questions were raised a couple of years ago about hantaviral pulmonary syndrome, another infectious human disease in which *Peromyscus* is implicated.

Bob Rose, Old Dominion University, sends his regards and encouragement. Bob has returned from a year of leave in Australia.

-X-X-X-X-X-

CDC has announced funds for a cooperative study on "*Ecology of the Deer Mouse (Peromyscus maniculatus) in Peridomestic Settings*". The deadline for submission of applications was 20 August 96, so presumably some of our readers have heeded this RFP.

HERE IS SOME INFORMATION ABOUT UTILIZATION OF PEROMYSCUS IN RESEARCH THAT MAY BE OF INTEREST TO OUR READERS -----

HOW IS PEROMYSCUS USED IN RESEARCH ?

An analysis of research use based on 207 articles in the 1993 - 1995 scientific literature:

Discipline	Number of articles (% of total)
Molecular biology and cell/organism genetics ¹	12 (5.8%)
Reproduction, growth, development and aging	10 (4.8%)
Physiology and metabolism	24 (11.6%)
Behavior and social organization	21 (10.2%)
Systematics, population genetics and evolution ²	22 (10.6%)
Community ecology, species interaction and natural history	53 (25.6%)
Applied ecology, toxicology and environmental monitoring	18 (8.7%)
Parasitology and infectious disease	47 (22.7%)

¹Does not include molecular systematics or population genetics.

²includes molecular systematics.

WHO USES MATERIALS FROM THE PEROMYSCUS STOCK CENTER ?

Requests were supplied¹ for animals or other materials from the Stock Center to the following types of organizations:

Organization	Orders filled (% of total)
Academic departments (Universities)	115 (45.6)
Medical and allied health schools	40 (15.9)
Government agencies ²	39 (15.5)
Two - four year colleges	24 (9.5)
Veterinary schools	19 (7.5)
Private sector ³	15 (6.0)
Agriculture colleges	1 (0.4)

¹Based on 252 individual requests filled 1990 - Sept. 1996.

²CDC=12, F&W=8, EPA=7, NIH=6, USArmy=3, state and foreign=3

³Includes private museums, individuals and for profit organizations.

WHAT KINDS OF RESEARCH ARE ANIMALS AND MATERIALS FROM THE STOCK CENTER USED FOR ?

An analysis based on requests¹ from 1990 to 1996:

Area of interest	Number requests ² (% of total)
Infectious diseases and parasitology	54 (21.4)
Genetics and cytogenetics	49 (19.4)
Toxicology and environmental monitoring	43 (17.1)
Biochemistry, physiology and pharmacology	31 (12.3)
Behavior and neurobiology	30 (11.9)
Instructional and educational functions	16 (6.4)
Evolution and systematics ²	8 (3.2)
Developmental biology and aging	5 (1.9)
Miscellaneous and undetermined	16 (6.4)

¹Based on 252 individual orders filled 1990 - Sept 1996

²Includes molecular.

SOME INTERESTING OBSERVATIONS ABOUT UTILIZATION OF THE PEROMYSCUS STOCK CENTER:

*** Orders to the Center have originated from 33 states, the District of Columbia and 6 foreign countries.

*** The greatest number of individual orders (40) originated in **Maryland**. Texas was second with 27.

*** There are 5 native species of *Peromyscus* (*sensu lato*) in the 27 states of the U.S. east of the Mississippi River and 13 species in the 23 western states, but two-thirds of Stock Center requests originate in the eastern states (including DC).

*** The 10 institutions which have most often utilized the Stock Center, in order, are:

Johns Hopkins University (Baltimore) - 20
 University of California at Davis - 14
 Benedict College (Columbia SC) - 13
 Centers for Disease Control (Atlanta) - 11
 Truman [formerly Northeast Missouri] State University (Kirksville) - 11
 University of Pennsylvania New Bolton Center (Kennett Square) - 11
 Texas A&M University (College Station) - 10
 U.S. F&W Patuxent Research Center (Laurel MD) - 9
 Princeton University (NJ) - 8
 Clemson Institute of Wildlife Toxicology (Pendleton SC) - 7

*** Most surprising: No orders have ever been received by the Stock Center from MICHIGAN, where L.R. Dice, Jack King and many others conducted pioneering laboratory studies with *Peromyscus*.

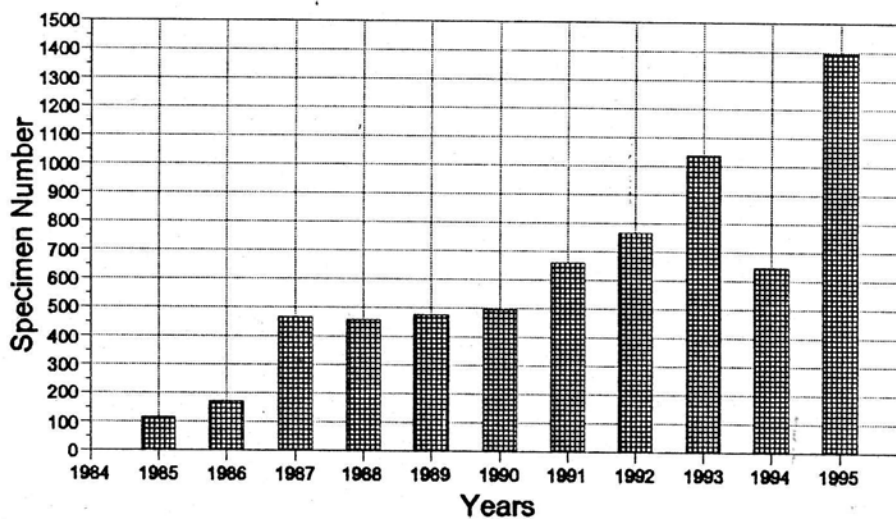
*** Most intriguing order (in 1993): for 18 *P. leucopus* for the **Sweet Dreams Rabbitry**, Grand Prairie TX.

1995 WAS A VERY GOOD YEAR FOR THE *PEROMYSCUS* GENETIC STOCK CENTER

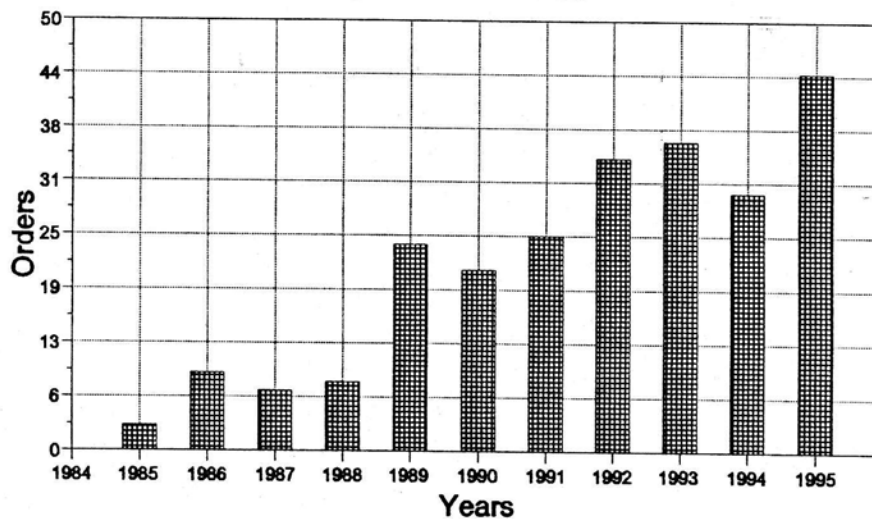
1995 was the best year yet for the Stock Center both in terms of the number of orders filled and number of animals and other specimens supplied to external users (See graphs below). Furthermore, for 1996 to date (September), the number of orders filled already surpasses 1995. There is obviously a need for lab-reared deer mice and other *Peromyscus* species. We supplied our 7000th animal recently.

The Stock Center was initiated in 1985. In that first year we had three requests. One for 20 deer mice, another for 24 white-footed mice, and one for 72 vials of *P. leucopus* serum. The slump in Stock Center utilization in 1994 apparently was due to concern about hantavirus. Many animal care technicians were under the mistaken impression that lab-bred peromyscus were high-risk for harboring the virus. Numerous tests of our animals show them to be hantavirus-free. No animals from the wild are permitted into the colony. Animals from other laboratories are admitted to the colony only after prolonged quarantine and tests of every individual animal for hantavirus. Our animal rooms are also routinely monitored for 14 murine viruses, as well as ectoparasites.

PEROMYSCUS STOCK CENTER SPECIMENS SUPPLIED



ORDERS FILLED





THE STOCK CENTER ANIMAL CARE STAFF

Left to right: Derrick Thompson, Laboratory Animal Technician;
Charlotte Joyner, Laboratory Animal Technologist and Supervisor;
Alliene Lawson, Laboratory Animal Technician

PEROMYSCUS STOCK CENTER

What is the Stock Center? The deer mouse colony at the University of South Carolina has been designated a genetic stock center under a grant from the Special Projects Program of the National Science Foundation. The major function of the Stock Center is to provide genetically characterized types of *Peromyscus* in limited quantities to scientific investigators. Continuation of the center is dependent upon significant external utilization, therefore potential **users are encouraged to take advantage of this resource**. Sufficient animals of the mutant types generally can be provided to initiate a breeding stock. Somewhat larger numbers, up to about 50 animals, can be provided from the wild-type stocks.

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

Stocks Available in the Peromyscus Stock Center

WILD TYPES

ORIGIN

P. maniculatus bairdii
(BW Stock)

Closed colony bred in captivity since 1948.
Descended from 40 ancestors wild-caught
near Ann Arbor MI

P. polionotus subgriseus
(PO Stock)

Closed colony since 1952.
Derived from 21 ancestors wild-caught in
Ocala Nat'l. Forest FL. High inbreeding coefficient.

P. polionotus leucocephalus
(LS Stock)

Derived from beachmice wild-caught on
Santa Rosa I., FL. and bred by R. Lacy.
Seventh to tenth generation in captivity.

P. leucopus
(LL Stock)

Derived from 38 wild ancestors captured
between 1982 and 85 near Linville NC.
Eighteenth to twenty-fourth generation in captivity.

P. californicus insignis
(IS Stock)

Derived from about 60 ancestors collected
between 1979 and 87 in Santa Monica Mts. CA.
Tenth to twelfth generation in captivity.

P. aztecus
(AM Stock)

Derived from animals collected on Sierra Chincua,
Michoacan, Mexico in 1986
Seventh to tenth generation in captivity.

P. maniculatus X *P. polionotus*
F₁ Hybrids

Sometimes available.

MUTATIONS AVAILABLE FROM THE STOCK CENTER¹

<u>Coat Colors</u>	<u>ORIGINAL SOURCE</u>
Albino <i>c/c</i>	Sumner's albino deer mice (Sumner, 1922)
Ashy <i>ahy/ahy</i>	Wild-caught in Oregon ~ 1960 (Teed <i>et al.</i> , 1990)
Black (Non-agouti) <i>a/a</i>	Horner's black mutant (Horner <i>et al.</i> , 1980)
Blonde <i>bln/bln</i>	Mich. State U. colony (Pratt and Robbins, 1982)
² Brown <i>b/b</i>	Huestis stocks (Huestis and Barto, 1934)
Dominant spotting <i>S/+</i>	Wild caught in Illinois (Feldman, 1936)
Golden nugget <i>b^{gn}/b^{gn}</i> [in <i>P. leucopus</i>]	Wild caught in Massachusetts (Horner and Dawson, 1993)
Gray <i>g/g</i>	Natural polymorphism From Dice stocks (Dice, 1933)
Ivory <i>i/i</i>	Wild caught in Oregon (Huestis, 1938)
³ Pink-eyed dilution <i>p/p</i>	Sumner's "pallid" deer mice (Sumner, 1917)
Platinum <i>plt/plt</i>	Barto stock at U. Mich. (Dodson <i>et al.</i> , 1987)
² Silver <i>sil/sil</i>	Huestis stock (Huestis and Barto, 1934)
Tan streak <i>tns/tns</i>	Clemson U. stock from N.C. (Wang <i>et al.</i> 1993)
Variable white <i>Vw/+</i>	Michigan State U. colony (Cowling <i>et al.</i> 1994)
White-belly non-agouti <i>a^w/a^w</i>	Egoscue's "non-agouti" (Egoscue, 1971)
Wide-band agouti <i>A^{Nb}/a</i>	Natural polymorphism. U. Michigan stock (McIntosh, 1954)
Yellowish <i>yel/yel</i>	Sumner's original mutant (Sumner, 1917)

MUTATIONS AVAILABLE FROM THE STOCK CENTER¹ (continued)

Other Mutations and Variants

ORIGIN

Alcohol dehydrogenase negative
Adh^o/Adh^o

South Carolina BW stock
(Felder, 1975)

Alcohol dehydrogenase positive
Adh^f/Adh^f

South Carolina BW stock
(Felder, 1975)

⁴Boggler *bg/bg*

Blair's *P. m. blandus* stock
(Barto, 1955)

Cataract-webbed *cwb/cwb*

From Huestis stocks.
(Anderson and Burns, 1979)

⁴Epilepsy *ep/ep*

U. Michigan *artemisiae* stock
(Dice, 1935)

³Flexed-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)

⁴Juvenile ataxia *ja/ja*

U. Michigan stock
(Van Ooteghem, 1983)

Enzyme variants. Wild type stocks given above provide a reservoir for several enzyme and other protein variants. See Dawson *et al.* (1983). For origin references see *PN* this issue p.22ff.

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

²Available only as silver/brown double recessive.

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

⁴Available from Behavior Mutant Center

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

OTHER RESOURCES OF THE *PEROMYSCUS* GENETIC STOCK CENTER:

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

Preserved or frozen specimens of types given above.

Tissues, whole blood or serum of types given above.

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

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

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

PLEASE CALL WITH INQUIRIES.

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



Materials on Deposit in the *Peromyscus* Molecular Bank

Accession Number	Item	Description	Species	Donor	Location ¹
Probes and Clones:					
Pr-01	LINE1	pDK62	<i>P. maniculatus</i>	D. Kass	C
Pr-02	LINE1	pDK55	<i>P. maniculatus</i>	D. Kass	C
Pr-03	ADH1	pADH F72	<i>P. maniculatus</i>	M. Felder	B
Pr-04 ²	Mys		<i>P. leucopus</i>	(Requested)	
Pr-05 ²	SAT		<i>P. leucopus</i>	(Requested)	
Pr-06	6PGD	pB5 clones	<i>P. californicus</i>	S. Hoffman	A
Pr-07	MHC <i>PeleI</i>	38dp2	<i>P. leucopus</i>	M. Crew	A
Pr-08	MHC <i>PeleI</i>	52ap6	<i>P. leucopus</i>	M. Crew	A
Pr-09	MHC <i>PeleI</i>	40Bg1	<i>P. leucopus</i>	M. Crew	A
Pr-10	MHC <i>PeleI</i>	53Pv1	<i>P. leucopus</i>	M. Crew	A
Pr-11	MHC <i>PeleI</i>	37B2	<i>P. leucopus</i>	M. Crew	A
Pr-12	MHC <i>PeleI</i>	37B4	<i>P. leucopus</i>	M. Crew	A
Pr-13	MHC <i>PeleII</i>	α 3E23	<i>P. leucopus</i>	M. Crew	A
Pr-14	MHC <i>PeleIII</i>	17E2	<i>P. leucopus</i>	M. Crew	A
Pr-15	MHC <i>PemaI</i>	pr44	<i>P. maniculatus</i>	M. Crew	A
Libraries:					
Lb-01	lambda genomic	liver (ADH+)	<i>P. maniculatus</i>	M. Felder	B
Lb-02	lambda cDNA	liver	<i>P. maniculatus</i>	M. Felder	B
Lb-03	lambda genomic	testis	<i>P. leucopus</i>	M. Crew	A
Lb-04	cosmid genomic	testis	<i>P. leucopus</i>	R. Baker	A
Lb-05	lambda genomic	liver	<i>P. californicus</i>	S. Hoffman	A
Frozen Tissue for DNA:					
S-01	bairdii (BW)	liver, tail, other ³	<i>P. maniculatus</i>	Stk. Ctr.	A
S-02	subgriseus (PO)	liver, tail, other	<i>P. polionotus</i>	Stk. Ctr.	A
S-03	leucopus (LL)	liver, tail, other	<i>P. leucopus</i>	Stk. Ctr.	A
S-04	wild-caught SC	liver, other	<i>P. gossypinus</i>		A
S-05	aztecus (AM)	liver, tail, other	<i>P. aztecus</i>	J. Glendinning	A
S-06	insignis (IS)	liver, tail, other	<i>P. californicus</i>	S. Hoffman	A
S-07	inbred PmH1A	liver, other	<i>P. maniculatus</i>	Jackson Lab	A
S-08	inbred PmH8	liver, other	<i>P. maniculatus</i>	Jackson Lab	A

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

²Not currently available.

³kidney, spleen, testis, carcass.

Plans for a *Peromyscus* Information Database On-line

The *Peromyscus* Genetic Stock Center, in collaboration with the University of South Carolina's Division of Libraries and Computer Services, and Department of Computer Science, is formulating a comprehensive database to be available on the World Wide Web. At this time plans are in a preliminary stage, but a broad perspective of what is intended can be described.

Why is a database needed? Deer mice and about 55 allied species of the genus *Peromyscus* are arguably the most widespread and abundant mammals in North America. Peromyscines range from Alaska to Panama, from Newfoundland to Florida, and from Atlantic to Pacific. They occur in virtually every terrestrial habitat in the contiguous United States. Peromyscines feed on seeds and insects and serve as an important food source for small predators. As such, these animals represent a major link in the ecosystem.

Among mammals the genus is the largest, in terms of number of species, in the Western Hemisphere. The multitude of species and subspecies within *Peromyscus* are adapted to a broad array of climates and ecological settings. Varying degrees of phylogenetic relationship exist within the genus. Hence, *Peromyscus* has long been studied by systematists and evolutionists. Taxonomically it is among the best known groups of mammals.

Deer mice and other peromyscines are widely utilized in studies of ecology, behavior, genetics, reproduction, endocrinology, toxicology, parasitology, metabolism, epidemiology and other areas as documented by more than 3000 published research articles. Both field and lab-based studies are common. Currently, there are more than 700 subscribers to *Peromyscus Newsletter*, of which about half are estimated to be actively involved with some aspect of peromyscus research.

Two comprehensive volumes, *Biology Of Peromyscus* (King, 1968) and *Advances in the Study of Peromyscus* (Kirkland and Layne, 1989), summarize much basic information known for the genus until the time of their publication. However, such volumes rapidly become outdated when information continually accrues. Thus, an electronic database that can be regularly expanded and updated is ideally suited for a group of organisms that are actively being investigated, such as *Peromyscus*.

There currently are no other comprehensive electronic databases for *Peromyscus* accessible through the Internet. The Gene Catalog for the deer mouse is available only through FTP in ASCII. Smithsonian Institution has entries for each of the species with primarily taxonomic references. No detail descriptions of the animals accompany the entries. Other databases, e.g. Sevilleta Wildlife Refuge Mammal Database, have excellent descriptions and color photographs of a very limited number of species. Auburn University has a small database limited to a single species, *P. polionotus*. Links among these limited databases are extremely few. There exists a clear need for an readily accessible, flexible interconnected information base for *Peromyscus* in view of the importance of these animals and the growing research interest in them.

General Plan. The proposed database will comprise a broad range of information on the biology of *Peromyscus* reflecting the research interests of those utilizing these animals. We expect to organize the database into about 10 units, each centered on a major aspect of *Peromyscus* biology. In addition, there will be a comprehensive bibliography encompassing all article length publications, books and monographs treating the genus. Abstracts, brief unrefereed notes, theses and dissertations will not be included in the bibliography.

The database will include photographic, graphical, tabular and textual information for each of the species wherever such information is obtainable. Links will be developed throughout the database to other files in the database. Links will also be developed to other relevant databases, e.g. genome databases for mouse, rat, human and other mammals, GenBank, museums with *Peromyscus* collections, etc.. Query files and data entry files will be accommodated.

The 10 components will be developed individually, probably beginning with a section on systematics and evolution, and another on genetics. Eventually, reproduction and development, behavior, metabolism, ecology, parasites and disease, and laboratory stocks and husbandry will be developed and integrated into the database. One of the initial projects will be to construct the bibliography.

Implementation. Implementation of the database will be accomplished over a span of five years. We expect the initial components to be on-line within two years. Currently, we have a number of word-processed files, including the *Peromyscus* Gene Catalog, which will be converted to appropriate formats for inclusion in the overall database.

Possible automation concepts for managing the database are in the exploratory phase. Likely a commercially available object oriented relational database (OORDB) will be used with a UNIX platform. Java will be useful for availability on the World Wide Web. We will use Java to provide an intuitive interface, allowing users to query the *Peromyscus* database without using SQL. Java will support the full power of an OORDB and is supported by Windows 95, Windows NT, MAC OS, Solaris 2.x and other operational systems. Netscape has licensed Java for inclusion in Netscape Navigator 2.x which will interface across Windows, Macintosh and UNIX. Numerous URL-addressable files will be accessible through the database.

We will be seeking both funding support and consultants to assist us in establishing the *Peromyscus* database. As the plan proceeds, **any suggestions, recommendations, cautions or other input from our readership will be welcome.**

GENETIC LOCI IN THE DEER MOUSE

(*Peromyscus maniculatus* and allied species)

Table I. lists recognized genetic loci described in *Peromyscus maniculatus* or other species of the *maniculatus*-group. Table II. lists loci formally described in the *P. leucopus* species group, and Table III. those of other species of *Peromyscus*. These lists are limited to loci for which formal Mendelian analysis has been conducted and appropriately reported in the published scientific literature, and/or for which nucleic acid sequences have been published. Additional genetic traits are known, some of which have been cited in abstracts, casual reports, newsletters, grant proposals, papers presented at meetings *etc.* The latter are not included, since the descriptions and genetics are generally insufficient to formally define the loci. Presumptive loci described from natural polymorphisms in the absence of formal genetic analysis are not listed here. Protein electrophoretic and other biochemical or immunological variants known in natural populations are listed elsewhere (See *PN* # 16 pp. 13-27 and # 21 pp. 16-26).

Standardization of genetic nomenclature for *Peromyscus* is a function of the Genetic Advisory Committee for the genus. The following guidelines are applied:

1. To the maximum extent feasible, *Peromyscus* genetic nomenclature and conventions will be consistent with those used for other mammalian species, particularly mouse (*Mus*). Where homology is evident or very likely, the same locus name and symbol is employed. Because homology among alleles is more difficult to ascertain, allelic symbols (superscripts) do not necessarily correspond to those of other species.

2. Dominant and incompletely dominant variant or mutant genes are designated with the first letter of the symbol capitalized. Recessive variant or mutant genes are indicated in lower case letters. The wild-type (normal or standard) allele for morphological, pelage color and behavioral traits, when recognized, is symbolized with a "+" sign. Electrophoretic allelic variants of proteins or subunits are indicated by superscripts in alphabetical sequence, except for null alleles which are designated, with an "o" superscript; or, in some cases, by relative mobility with reference to a standard mobility "100". Restriction fragment length variant alleles are designated by a numerical sequence or size in kilobases. Distinct loci with similar phenotypic effects may be indicated in a hyphenated numerical or alphabetical series.

3. Symbols published by the original investigator are given priority, unless there is clear homology with *Mus* loci, except for certain loci for which the original symbol was retained under the "grandfather" principle and because of prior use in the literature. If an original symbol is in conflict with an established one for *Mus*, the equivalent *Mus* symbol is given preference. In cases where the original symbols have been superseded by subsequent common usage, the latter has been adopted. If a variant is shown to be allelic with a previously reported gene, the locus symbol is reduced to an allelic symbol. Where two authors have used the identical symbol for different loci in *Peromyscus*, priority is given to the first reported, and an alternate designation is devised for the other. (In Table 1 previously published obsolete names and symbols are listed in parentheses.)

4. Presumed loci described solely on the basis of variation observed among individuals in the absence of convincing Mendelian or molecular analysis are not considered to be formally established and are not included in these tables.

5. Linkage assignments are subject to updates of the *Peromyscus* linkage map.

Table 1
Genetic Loci Formally Described in the *Peromyscus maniculatus* Species Group:
A. Coat and Eye Pigmentation and Pattern Variants.

Name of locus and allelic variants	Symbol	Mode of inheritance	Linkage group	Definitive description and analysis	Collateral descriptions, interactions and recurrences	Recombination reported
AGOUTI			III			
Wide-band agouti	A^{Nb}	dominant		McIntosh (1956a)	Blair (1947) as "buff"	Clark (1938) as "buff"
White-belly non-agouti	a^w	recessive		Egoscue (1971)		
Non-agouti (Black)	a	recessive		Homer <i>et al.</i> (1980)		
ASHINESS	ahy	recessive		Teed <i>et al.</i> (1990)		
BROWN	$b = brn$	recessive	II	Huestis and Barto (1934)	Blair (1947), McIntosh (1956a), Dawson <i>et al.</i> (1969)	Huestis and Barto (1934) Blair (1947), Barto (1955, 1956), McIntosh (1956a)
Orange-tan	b^{ot}	recessive		Egoscue and Day (1958)		
BLONDE ²	bln (bl)	recessive		Pratt and Robbins (1982)		
ALBINO	c	recessive	I	Sumner (1922)	Clark (1938)	Sumner (1922), Clark (1936, 1938), Feldman (1937), Barto (1942a), Huestis and Lindstedt (1946), Huestis (1946)
CALIFORNIA BLONDE	cfb	recessive		Roth and Dawson (1996)		Roth and Dawson (1996)
COLORLESS HAIR TIP*	ctp	recessive		Bowen and Dawson (1969)	Bowen (1968)	
DILUTE*	$d = dit$	recessive	II	Dice (1933)		Clark (1938), Barto (1942a, 1956), McIntosh (1956a)
GRAY	g	recessive		Dice (1933)	Clark (1938), Blair (1947), McIntosh (1956a)	Blair (1944, 1947)
IVORY	i	recessive		Huestis (1938)	Clark (1938)	Barto (1942a, 1956), McIntosh (1956a)
PINK-EYED DILUTION	p	recessive	I	Sumner (1917) as "pallid"	Clark (1938), Barto (1942b)	Sumner (1922), Clark (1936, 1938), Feldman (1937), Snyder (1980a)
PLATINUM ²	plt (pt)	recessive		Dodson <i>et al.</i> (1987)		Dodson <i>et al.</i> (1987)
RED EYE ² (Heterochromia)	rde (r)	recessive		Huestis and Willoughby (1950)		
DOMINANT SPOT (Whiteface)	S	dominant		Feldman (1936)		Feldman (1937)
SILVER	sil (sl, sl)	recessive	I	Huestis and Barto (1934)		Huestis and Barto (1934), Huestis and Plestrak (1942), Huestis and Lindstedt (1946), Barto (1956)

(Table Continued)

Table 1A. Coat and Eye Color Variants (Continued)

Name of locus and allelic variants	Symbol	Mode of inheritance	Linkage group	Definitive description and analysis	Collateral descriptions, interactions and recurrences	Recombination reported
TAN STREAK	<i>tns</i>	recessive		Wang <i>et al.</i> (1993)		
VARIABLE WHITE	<i>Vw</i>	semi-dominant lethal		Cowling <i>et al.</i> (1994)		Cowling <i>et al.</i> (1994)
WHITE CHEEK ²	<i>Wck</i> (<i>Wc</i>)	dominant		Blair (1944)	Bowen and Dawson (1977)	Blair (1944)
WHITESIDE ²	<i>ws</i> (<i>wh</i>)	recessive		McIntosh (1956b)		
YELLOWING ² (Yellow)	<i>y = yel</i>	recessive		Sumner (1917)	Sumner and Collins (1922), Clark (1938), McIntosh (1956a)	Sumner (1922), Feldman (1937), Barto (1956), McIntosh (1956a)
Complexly inherited coat pattern traits:						
Minor white spotting (Star, splash, etc.)	<i>p-1, p-2</i>	recessive incompletely penetrant		Feldman (1936)	Sumner (1932), Barto and Huestis (1933)	
Grizzled ²	* <i>Gr</i> (<i>G</i>)	*complex dominant*		Sumner (1928, 1932)		
Coat pattern in <i>P. polionotus</i>				Bowen and Dawson (1977)	Bowen (1968)	Bowen and Dawson (1977)
Pointed A ₂ ²	<i>Pt-A (P_A)</i>	dominant	VII			
Pointed B ²	<i>Pt-B (P_B^A)</i>	dominant	VII			
Tapered ²	<i>Tpt (Tp)</i>	dominant				
Coat pattern modifiers				Bowen and Dawson (1977)		
Squared modifier ²	<i>Msq (Rs)</i>	incompletely dominant				
Tapered modifier ²	<i>Mtp (Rt)</i>	dominant				

¹Autosomal unless otherwise stated.

²Symbol or name changed to avoid confusion with designations in *Mus*. Obsolete published names and symbols in parentheses.

*No longer known to be in existence

B. Integumentary, Skeletal and Pathological Variants.

Name of locus and allelic variants	Symbol	Mode of inheritance ¹	Linkage group	Definitive description and analysis	Collateral descriptions, interactions and recurrences	Recombination reported
CATARACT-WEBBED ² (Syndactyly)	<i>cwb</i> (<i>cw</i>)	recessive		Anderson and Burns (1979)	Burns and Feeney (1975)	
FLEXED TAIL	<i>f</i>	recessive	I	Huestis and Barto (1936a)		Huestis and Barto (1936a), Huestis and Piestrak (1942), Huestis and Lindstedt (1946), Huestis <i>et al.</i> (1956), Barto (1956)
HAIRLESS-1	<i>hr-1</i>	recessive		Sumner (1924)		Sumner (1924, 1932), Feldman (1937), Clark (1938), Barto (1942a, 1955, 1956), McIntosh (1956a)
HAIRLESS-2	<i>hr-2</i>	recessive		Egoscue (1962)	Knapp and Dawson (1991)	
NUDE* ² (Post-juvenile nude)	<i>nd</i> (<i>n</i>)	recessive		Clark (1938)	Barto (1942a)	
SPHEROCYTOSIS (Inherited jaundice)	<i>sph</i>	recessive		Huestis and Anderson (1954)	Huestis <i>et al.</i> (1956), Motulsky <i>et al.</i> (1956)	Huestis <i>et al.</i> (1956)

¹Autosomal unless otherwise stated.

²Name or symbol changed to avoid confusion with designations in *Mus*. Obsolete published names and symbols in parentheses.

*No longer known to be in existence.

C. Behavior and Neurological Variants.

Name of locus and allelic variants	Symbol	Mode of inheritance ¹	Linkage group	Definitive description and analysis	Collateral descriptions, interactions and recurrences	Recombination reported
BOGLER ²	<i>bgl</i> (<i>bg</i>)	recessive		Barto (1955)	Vandermeer and Barto (1969)	Barto (1955)
EPILEPSY ² (EP; waltzing in <i>artemisiae</i>)	<i>ep</i> (* <i>e</i> , <i>ep</i> , <i>v</i> ₂)	recessive		Dice (1935)	Clark (1938), Watson (1939), Chance and Yaxley (1950), Barto (1954, 1956)	Watson (1939), Barto (1956)
JUVENILE ATAXIA ²	<i>jtx</i> (<i>ja</i>)	recessive		Van Ooteghem (1983)		
SPINNER* ² (Waltzing in <i>rhoads</i>)	<i>spn</i> (<i>sp</i> , <i>v</i> ₃)	recessive		Watson (1939)	Barto (1954)	
TREMOR*	<i>tr</i>	recessive		Huestis and Barto (1936b)		
WALTZER* (Waltzing in <i>bairdii</i>)	<i>v</i> (<i>w</i>)	recessive	III	Dice (1935)	Clark (1938), Watson (1939), Dice <i>et al.</i> (1963)	Barto (1942a, 1954, 1956), McIntosh (1956a)

¹Autosomal unless otherwise stated.

²Name or symbol changed to avoid confusion with designations in *Mus*. Obsolete published names and symbols in parentheses.

*No longer known to be in existence

D. Biochemical and Immunological Variants.

Name of locus ¹	Allelic designation	Linkage group	Definitive description and formal analysis	Recombination reported
ALCOHOL DEHYDROGENASE-1 (liver)	<i>Adh-1^f</i> <i>Adh-1^s</i> <i>Adh-1^o</i>	VI	Felder (1975), Burnett and Felder (1978a, 1978b)	Dawson <i>et al.</i> (1983) Cowling <i>et al.</i> (1994)
ALCOHOL DEHYDROGENASE-2	<i>Adh-2</i>		Zheng <i>et al.</i> (1993)	
ALBUMIN (serum)	<i>Alb¹⁰⁰</i> <i>Alb₉₆</i> <i>Alb₈₆</i> <i>Alb</i>	VI	Brown and Weiser (1968), Jensen and Rasmussen (1971)	Dawson (1982), Dawson <i>et al.</i> (1983) Cowling <i>et al.</i> (1994) Roth and Dawson (1996)
AMYLASE (salivary)	<i>Amy-1^a</i> <i>Amy-1^b</i> <i>Amy-1^c</i> <i>Amy-1</i>	VI	Evans <i>et al.</i> (1977)	Dawson <i>et al.</i> (1983)
ERYTHROCYTIC ANTIGEN	<i>Ea_B^A</i> = (<i>Pm_B^A</i>) <i>Ea_C^A</i> = (<i>Pm_C^A</i>) <i>Ea</i> = (<i>Pm</i>)	IV	Rasmussen (1961), Savage and Cameron (1971)	Randerson (1973)
ESTERASE (erythrocytic) ²	<i>Es-3^o</i> (<i>Es-1</i>) <i>Es-3^a</i> <i>Es-3^b</i> etc.	IV	Randerson (1965), Van Deusen and Kaufman (1978)	Randerson (1973)
ESTERASES (tissue and serum)	<i>Es-1</i> through <i>Es-7</i> (Symbols not standardized)	VIII	Rasmussen and Jensen (1971), Dawson (1982), Gill (1976), Baccus <i>et al.</i> (1980)	Dawson (1982)
GLYCEROL-3-PHOSPHATE DEHYDROGENASE ² (tissue)	<i>Gdc-1^a</i> (<i>Gpd-1</i>) <i>Gdc-1^b</i>		Gill (1976)	
GLUTAMATE OXALOACETATE TRANSAMINASE (soluble) (ASPARTATE AMINO TRANSFERASE)	<i>Got-1^a</i> = <i>Aat-1</i> <i>Got-1^b</i> <i>Got-1^c</i> <i>Got-1</i>		Gill (1976)	Dawson <i>et al.</i> (1983)
GLUCOSE-6-PHOSPHATE (AUTOSOMAL HEXOSE-6-P) DEHYDROGENASE ² (soluble)	<i>Gpd-1^a</i> (<i>G6pd-1</i>) <i>Gpd-1^b</i>		Shaw and Barto (1965), Shaw (1966)	
HEMOGLOBIN - ALPHA TYPE GLOBINS (Duplicated locus)	<i>Hba₂¹</i> = (<i>Hb^f</i>) = (<i>Hbl^a</i>) <i>Hba₁^o</i> <i>Hbc₁^o</i> = (<i>Hb^o</i>) = (<i>Hbl^o</i>) <i>Hbc₂^f</i> <i>Hbc^f</i>		Thompson <i>et al.</i> (1966), Rasmussen <i>et al.</i> (1968), Jensen <i>et al.</i> (1976), Maybank and Dawson (1976), Snyder (1978, 1980b)	
HEMOGLOBIN - BETA TYPE GLOBINS (triplicated locus)	<i>Hbb¹</i> <i>Hbd^o</i> <i>Hbb-b1</i> <i>Hbd^o</i> or <i>Hbb-b2</i> <i>Hbe₁</i> <i>Hbb-b3</i> <i>Hbe</i>	I	Snyder (1978, 1980b), Padgett <i>et al.</i> (1987)	Snyder (1980a)
HAPTOGLOBIN (serum) ²	<i>Hp₂¹</i> (<i>Hpt</i>) <i>Hp</i>		Rasmussen (1968), Griswold and Dawson (1971)	
IMMUNOGLOBIN (7Sy ₁)	<i>Ig_s^f</i> <i>Ig</i>		Coe (1972)	
LEUCINE AMINOPEPTIDASE (serum)	<i>Lap-1^a</i> <i>Lap-1^b</i>	V	Dawson (1982)	Dawson (1982), Dawson <i>et al.</i> (1983)
LACTATE DEHYDROGENASE ² A SUBUNIT (tissue)	<i>Ldh-1^a</i> (<i>Ldh-A</i>) <i>Ldh-1^b</i>		Cattanach and Perz (1969)	

(Table continued)

Table 1D. Biochemical and Immunological Variants. (Continued)

Name of locus	Allelic designation	Linkage group	Definitive description and formal analysis	Recombination reported
LACTATE DEHYDROGENASE ² B SUBUNIT (tissue)	<i>Ldh-2</i> ^f (<i>Ldh-B</i>) <i>Ldh-2</i> ^s		Shaw and Barto (1963)	
MAJOR HISTOCOMPATIBILITY COMPLEX	<i>Mhc</i> (Class I)		Crew <i>et al.</i> (1994, 1996)	
6-PHOSPHOGLUCONATE DEHYDROGENASE (tissue)	<i>Pgd-1</i> ^a <i>Pgd-1</i> ^b		Gill (1976)	Dawson <i>et al.</i> (1983)
PHOSPHOGLUCOMUTASE-1 (tissue)	<i>Pgm-1</i> ^a <i>Pgm-1</i> ^b		Gill (1976)	
PHOSPHOGLUCOMUTASE-4 (tissue)	<i>Pgm-4</i> ^a <i>Pgm-4</i> ^b <i>Pgm-4</i> ^c		Gill (1976)	
SUPEROXIDE DISMUTASE	<i>Sod-1</i> ^J _P = (<i>Ng</i>) <i>Sod-1</i> ^m <i>Sod-1</i> ^m		Birdsall <i>et al.</i> (1970)	
TRANSFERRIN (serum)	<i>Trf</i> ^a _b = (<i>Trf</i> ^J) <i>Trf</i> ^c <i>Trf</i> ^e <i>Trf</i> ^m = (<i>Trf</i> ^M)	V	Rasmussen and Koehn (1966), Biggers and Dawson (1971), Griswold and Dawson (1971), Canham <i>et al.</i> (1970)	Dawson (1982), Dawson <i>et al.</i> (1983) Roth and Dawson (1996)

²Symbols changed to avoid confusion with those in laboratory mouse (*Mus*). Obsolete published symbols shown in parentheses.

Table 2
Genetic Loci Formally Described in the *Peromyscus leucopus* Species Group

Name of locus and allelic variants	Symbol	Mode of inheritance ¹	Definitive description and analysis	Collateral descriptions, interactions and recurrences	Recombination reported
GOLDEN NUGGET	<i>b</i> ^{gn}	recessive	Homer and Dawson (1993)		
ALBINO	<i>c</i>	recessive	Castle (1912)		
CARBONIC ANHYDRASE	<i>Ca</i> ^f _s <i>Ca</i>	co-dominance	Wilmot and Underhill (1972)		
CATALASE	<i>Cs</i> ^a _b <i>Cs</i>	co-dominance	Jensen (1969)		
ESTERASE-3 (Esterase-1) ² (erythrocytic)	<i>Es-3</i> ⁰ _b (<i>Es-1</i> ^a) <i>Es-3</i>	semi-dominant	Wilmot and Underhill (1973)		
ESTERASE-2 (serum)	<i>Es-2</i> ⁰ _b (<i>Es-2</i> ^a) <i>Es-2</i>	semi-dominant	Wilmot and Underhill (1973)		
HEMOGLOBIN	<i>Hb</i> _B ^A (in <i>P. gossypinus</i>) <i>Hb</i> _C (in <i>P. gossypinus</i>) <i>Hb</i> _D (in <i>P. gossypinus</i>) <i>Hb</i> (in <i>P. leucopus</i>)	co-dominance	Foreman (1966)		
MAJOR HISTOCOMPATIBILITY COMPLEX	<i>Mhc</i> (Classes I, II; multiple haplotypes)		Crew <i>et al.</i> (1989, 1990)		

¹ All are autosomal.

² Name and symbol changed to correspond to *Mus*. Obsolete names and symbols in parentheses.

Table 3
Formally Described Genetic Loci in Miscellaneous *Peromyscus* Species

Species	Locus	Symbol and alleles	Mode of inheritance	Reference
<i>P. truei</i>	ESTERASE-1	<i>Es-1</i> ¹⁰⁰ <i>Es-1</i> ⁹³	co-dominance	Zimmerman and Kilpatrick (1975)
<i>P. eremicus</i>	PECTORAL SPOT	<i>psp</i>	recessive	Huestis (1925) Clark (1938)
<i>P. californicus</i>	HAIRLESSNESS	<i>hm</i>	recessive ?	Packchanian and Louis (1984)

References:

- Anderson RS and RP Burns. 1979. *J. Hered.* 70:27-30.
 Baccus R, J Joule and WS Kimberling. 1980. *J. Mamm.* 61:423-435.
 Barto E. 1942a. *Pprs. Mich. Acad. Sci. Arts Let.* 27:195-213.
 Barto E. 1942b. *Am Nat.* 76:634-636.
 Barto E. 1954. *Contr. Lab. Vert. Biol.* 66:1-16.
 Barto E. 1955. *Contr. Lab. Vert. Biol.* 71:1-26.
 Barto E. 1956. *Contr. Lab. Vert. Biol.* 74:1-16.
 Barto E and RR Huestis. 1933. *J. Hered.* 24:245-248.
 Biggers CJ and WD Dawson. 1971. *J. Mamm.* 52:376-378.
 Birdsall DA, JA Redfield and DG Cameron. 1970. *Biochem. Genet.* 4:655-658.
 Blair WF. 1944. *Contr. Lab. Vert. Biol.* 25:1-7.
 Blair WF. 1947. *Contr. Lab. Vert. Biol.* 35:1-18.
 Bowen WW. 1968. *Bull. Fla. State Mus.* 12:1-91.
 Bowen WW and WD Dawson. 1969. *J. Hered.* 60:170-172.
 Bowen WW and WD Dawson. 1977. *J. Mamm.* 58:521-530.
 Brown JH and CF Welser. 1968. *J. Mamm.* 49:420-426.
 Burnett KG and MR Felder. 1978a. *Biochem. Genet.* 16:443-454.
 Burnett KG and MR Felder. 1978b. *Biochem. Genet.* 16:1093-1106.
 Burns RP and L Feeney. 1975. *Am. J. Ophthalmol.* 80:370-378.
 Canham RP, DA Birdsall and DG Cameron. *Genet. Res.* 16:355-357.
 Castle WE. 1912. *Science* 35:346-348.
 Cattanauch BM and JN Perz. 1969. *Biochem. Genet.* 3:499-506.
 Chance MR and DC Yaxley. 1949. *Behavior* 2:96-105.
 Chappell MA, JP Hayes and LRG Snyder. 1988. *Evolution* 42:681-688.
 Clark FH. 1936. *J. Hered.* 27:259-260.
 Clark FH. 1938. *Contr. Lab. Vert. Genet.* 7:1-11.
 Clark FH. 1938. *J. Hered.* 29:79-80.
 Coe JE. 1972. *J. Immunol.* 108:907-912.
 Cowling K, RJ Robbins, GR Haigh, SK Teed and WD Dawson. 1994. *J. Hered.* 85:48-52.
 Crew MD, GS Smith, EC Zeller and RL Walford. 1989. *Immunogenetics* 30:214-217.
 Crew MD, ME Filipowsky, EC Zeller, GS Smith and RL Walford. 1990. *Immunogenetics* 32:371-379.
 Crew MD, CA Douglass and KA Brorson. 1994. *Immunogenetics* 39:412-417.
 Crew MD, LM Bates, CA Douglass and JL York. 1996. *Immunogenetics* 44:177-185.
 Dawson WD. 1982. *Acta Theriol.* 27:213-230.
 Dawson WD, MH Smith and JL Carmon. 1969. *J. Hered.* 60:286-288.
 Dawson WD, LL Huang, MR Felder and JB Shaffer. 1983. *Biochem. Genet.* 21:1101-1114.
 Dice LR. 1933. *Am. Nat.* 67:571-574.
 Dice LR. 1935. *J. Mamm.* 16:25-35.
 Dice LR, E Barto and PJ Clark. 1963. *An. Behav.* 11:40-50.
 Dodson KM, WD Dawson, SA VanOoteghem, BS Cushing and GR Haigh. 1987. *J. Hered.* 78: 183-186.
 Egoscue HJ. 1962. *J. Hered.* 53:192-194.
 Egoscue HJ. 1971. *J. Hered.* 62:372.
 Egoscue HJ and BN Day. 1958. *J. Hered.* 49:189-192.
 Evans MG, LL Huang and WD Dawson. 1977. *J. Hered.* 68:313-316.
 Felder MR. 1975. In: Markert CL (ed) *Isozymes* 3:455-471
 Feldman HW. 1936. *J. Hered.* 27:300-304.
 Feldman HW. 1937. *Am. Nat.* 71:426-429.
 Foreman CW. 1966. *Genetics* 54:1007-1012.
 Gill AE. 1976. *Biochem. Genet.* 14:835-848.
 Griswold KE and WD Dawson. 1971. *J. Hered.* 62:339-341.
 Horner BE and WD Dawson. 1993. *J. Hered.* 84:306-311.
 Horner BE, GL Potter and SA VanOoteghem. 1980. *J. Hered.* 71:49-51.
 Huestis RR. 1925. *J. Exp. Zool.* 9:429-470.
 Huestis RR. 1938. *J. Hered.* 29:235-237.
 Huestis RR. 1946. *Genetics* 31:219.
 Huestis RR and RS Anderson. 1954. *Science* 120:852-853.
 Huestis RR and E Barto. 1934. *J. Hered.* 25:219-223.
 Huestis RR and E Barto. 1936a. *J. Hered.* 27:73-75.
 Huestis RR and E Barto. 1936b. *J. Hered.* 27:436-438.
 Huestis RR and G Lindstedt. 1946. *Am. Nat.* 80:85-91.
 Huestis RR and R Willoughby. 1950. *J. Hered.* 41:287-290.

References (Continued)

- Huestlis RR and V Plestrak. 1942. *J. Hered.* 33:289-291.
Huestlis RR, RS Anderson and AG Motulsky. 1956. *J. Hered.* 47:225-228.
Jensen JN and DI Rasmussen. 1971. *J. Mamm.* 52:508-514.
Jensen JN, JR Merke and DI Rasmussen. 1976. *Biochem. Genet.* 14:541-545.
Jensen JT. 1969. *Am. Zool.* 9:1129.
Knapp LW and WD Dawson. 1991. *J. Hered.* 82:185-192.
Maybank KM and WD Dawson. 1976. *Biochem. Genet.* 14:389-400.
McIntosh WB. 1956a. *Contr. Lab. Vert. Biol.* 73:1-27.
McIntosh WB. 1956b. *J. Hered.* 47:28-32.
Motulsky AG, RR Huestlis and RS Anderson. 1956. *Acta Genet. Stat. Med.* 6:240-245.
Packchianian A and EE Louis. 1984. *J. Hered.* 75:229-230.
Padgett RW, DD Loeb, LRG Snyder, MH Edgell and CA Hutchison III. 1987. *Mol. Biol. Evol.* 4:30-400.
Pratt BM and RJ Robbins. 1982. *J. Hered.* 73:69-70.
Randerson S. 1965. *Genetics* 52:999-1005.
Randerson S. 1973. *J. Hered.* 64:371-372.
Rasmussen DI. 1961. *Genet. Res.* 2:449-455.
Rasmussen DI. 1968. In: King JA (ed.) *Am. Soc. Mamm. Spec. Pub.* 2:340-372.
Rasmussen DI and JN Jensen. 1971. *Comp. Biochem. Physiol.* 39B:19-24.
Rasmussen DI, JN Jensen and RK Koehn. 1968. *Biochem. Genet.* 2:87-92.
Rasmussen DI and RK Koehn. 1966. *Genetics* 54:1353-1357.
Roth VL and WD Dawson. 1996. *J. Hered.* 87:403-406.
Savage E and DG Cameron. 1971. *An. Blood Groups Biochem. Genet.* 2:23-29.
Shaw CR. 1966. *Science* 153:1013-1015.
Shaw CR and E Barto. 1963. *Proc. Nat. Acad. Sci.* 50:211-214.
Shaw CR and E Barto. 1965. *Science* 148:1099-1100.
Snyder LRG. 1978. *Genetics* 89:511-530.
Snyder LRG. 1980a. *Biochem. Genet.* 18:209-220.
Snyder LRG. 1980b. *Evolution* 34:1077-1098.
Sumner FB. 1917. *Genetics* 2:291-300.
Sumner FB. 1922. *Am. Nat.* 56:412-417.
Sumner FB. 1924. *J. Hered.* 15:475-481.
Sumner FB. 1928. *Am. Nat.* 62:193-206.
Sumner FB. 1932. *Biblio. Genetica* 9:1-106.
Sumner FB and HH Collins. 1922. *J. Exp. Zool.* 36:289-321.
Teed SK, JP Crossland and WD Dawson. 1990. *J. Hered.* 81:309-313.
Thompson RB, HB Hewett, SS Kilgore, AP Shepherd and WM Bell. 1966. *Nature* 210:1063-1064.
Vandermeer J and E Barto. *J. Neuro. Path. Exp. Neurol.* 28:257-266.
VanOoteghem SA. 1983. *J. Hered.* 74:201-202.
Wang LRK, JP Crossland and WD Dawson. 1993. *J. Hered.* 84:304-306.
Watson ML. 1939. *Contr. Lab. Vert. Genet.* 11:1-24.
Wilmot PL and DK Underhill. 1972. *Genetics* 71:315-318.
Wilmot PL and DK Underhill. 1973. *J. Hered.* 64:43-44.
Zheng YW, M Bey, H Liu and MR Felder. 1993. *J. Biol. Chem.* 268:24933-24939.
Zimmerman EG and CW Kilpatrick. 1975. *Experientia* 31:420-421.

GENETIC LINKAGE IN *PEROMYSCUS*. 1996 UPDATE.

Most linkage data for *Peromyscus* to date has been generated by formal recombination genetics. However, partial banding homology between Chromosome 1 of *Rattus* and Chromosome 1 of *Peromyscus* (14) suggests that Linkage Group (LG) I is probably located on Chromosome 1 in deer mouse, as is the homologous group in rat (7). Two loci, *Tk-1* and *Tp53*, have been assigned to Chromosome 13 by fluorescence in situ hybridization (FISH) (21). The diploid chromosome number of all *Peromyscus* species is $2N = 48$ (6). The standard karyotype was recently revised (11).

Linkage data for the deer mouse (*P. maniculatus*) collected before 1972 are summarized by Robinson (17, 18). The system of assigning linkage groups on the basis of a single marker employed during the 1940s and 50s (2, 15) is no longer used. "Group IV" in the earlier system is now Group II, and old Groups "II" and "III" have been abandoned. In the interim since Robinson's review several additional linkages have been added (3, 8, 10, 19). The current status of the linkage map for the deer mouse and its sibling species, *P. polionotus*, is represented in the accompanying figure. Eight linkage groups are now established by formal genetics and another is tentative.

The order of loci in LG I, reported informally by R.R. Huestis and K. Silliman in an unpublished communication (17, 9), has been recently revised from previously unpublished data of W.B. McIntosh and K. Dodson. Linkage of *Trf* and *Lap* is tentative (8), but is homologous with a similar linkage in *Mus*. The *Pep-2* locus is provisionally assigned to LG VI proximal to *Alb*, but has not been mapped further (10).

Positive, but not significant, lod scores suggesting possible linkage between the gene pairs *Adh* - *Pgd*, *Adh* - *Got-1*, *Adh* - *Idh*, *Alb* - *Pept-1*, *Alb* - *Sdh* and *Est-4* - *Sdh*, respectively, were reported by Baccus *et al.* (1). Subsequent information indicates that *Adh-1* and *Got-1* are independent, as are the *Alb* and *Sdh-1* loci (10).

The *Hbe* locus is part of the triplicated beta globin site (*Hbb*), according to Snyder (19). Unpublished data from Snyder maps the position of the *Gpi-1* and *Hbe* loci relative to the albino (*c*) and pink-eyed dilution (*p*) loci. Silliman (unpub.) proposed that there is a duplication, *f'*, closely linked to the *f* locus. The Pm blood group locus, formerly designated "*Pm*", is redesignated *Ea_{Pm}*. Linkage of the agouti locus to waltzing (*v*) was tested using the dominant wide-band agouti allele *A^{Nb}* (15).

Two significant markers on the *Peromyscus* linkage map, *d* and *v*, are now extinct in laboratory stocks of deermice. The "flexed tail" trait which occurs in a laboratory stock may not be identical by descent with the original trait used in early linkage studies, but it maps to the same location in LG I.

The *c*, *p*, *a* and *b* coat color loci are phenotypically essentially identical to their counterparts in *Mus* and *Rattus*, and are assumed to be homologous. Enzyme and other protein loci are assumed to be homologous to counterparts in *Mus*, human and other mammals. Specific homologies between esterases and peptidases are not firm, but two clusters of common esterases in *Peromyscus* LG VIII are probably homologous to the esterase clusters on *Mus* Chromosome 8 and *Rattus* LG V. Erythrocytic esterase (*Es-3*, formerly "*Es-1*") of *Peromyscus* is very likely homologous with *Es-3* of *Mus* and is now known to be independent of the esterase loci in LG 8 (D.L. Covington *et al.*, unpub.)

Several non-specific DNA markers (RAPDs and microsatellites) have been provisionally mapped by McClellan and collaborators (unpub.)

MAPPED LOCI IN THE DEER MOUSE (*PEROMYSCUS*). 1996.

Arranged by linkage group. Probable mouse and human homologies indicated.

Locus	Name	<i>Peromyscus</i> Linkage Group	Mouse (<i>Mus</i>) Chromosome	Human Chromosome
<i>c</i>	albino (tyrosinase?)	I	7	11q
<i>f</i>	flexed tail	I	-	-
<i>Gpi-1</i>	glucophosphoisomerase-1	I	7	19q
<i>Hbb</i>	betaglobin complex	I	7	11p
<i>p</i>	pink-eyed dilution	I	7	-
<i>sb</i>	snub nose	I ¹	-	-
<i>sil</i>	silver	I	-	-
<i>brn</i>	brown	II	4	-
<i>dlt</i>	dilute	II	-	-
<i>a</i>	agouti	III	2	-
<i>v</i>	waltzing	III	-	-
<i>Ea_{Pm}</i>	erythrocytic antigen (Pm blood group)	IV	-	-
<i>Es-3</i>	major erythrocytic esterase (formerly <i>Es-1</i>)	IV	11	-
<i>Lap-1</i>	leucine amino peptidase (serum)	V ¹	9?	11q?
<i>Trf</i>	transferrin	V	9	3q

(Continued)

Peromyscus Linkage (Continued):

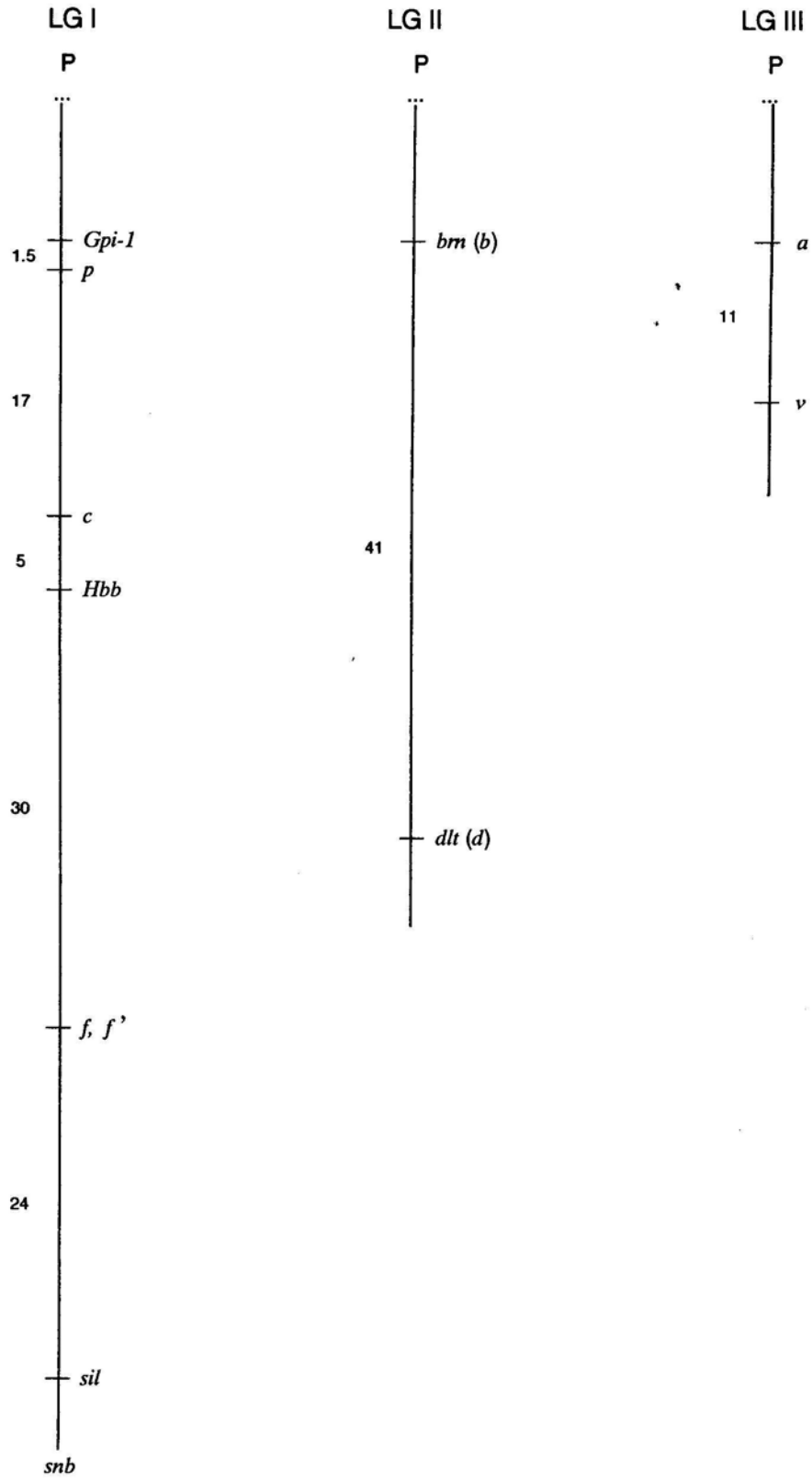
Locus	Name	<i>Peromyscus</i> Linkage Group	Mouse (<i>Mus</i>) Chromosome	Human Chromosome
<i>Alb</i>	albumin	VI	5	4q
<i>Adh-1</i>	alcohol dehydrogenase-1	VI	3	4q
<i>Amy-1</i>	salivary amylase	VI	3	1p
<i>Pep-2</i>	peptidase-2	VI ¹	10	12q
<i>P_A</i>	<i>polionotus</i> rump pattern A	VII	-	-
<i>P_B</i>	<i>polionotus</i> rump pattern B	VII	-	-
<i>Es-4,5</i>	esterase 4,5 cluster	VIII	8	16?
<i>Es-1,6</i>	esterase 1,6 cluster	VIII	8	-

¹ Provisional assignment.

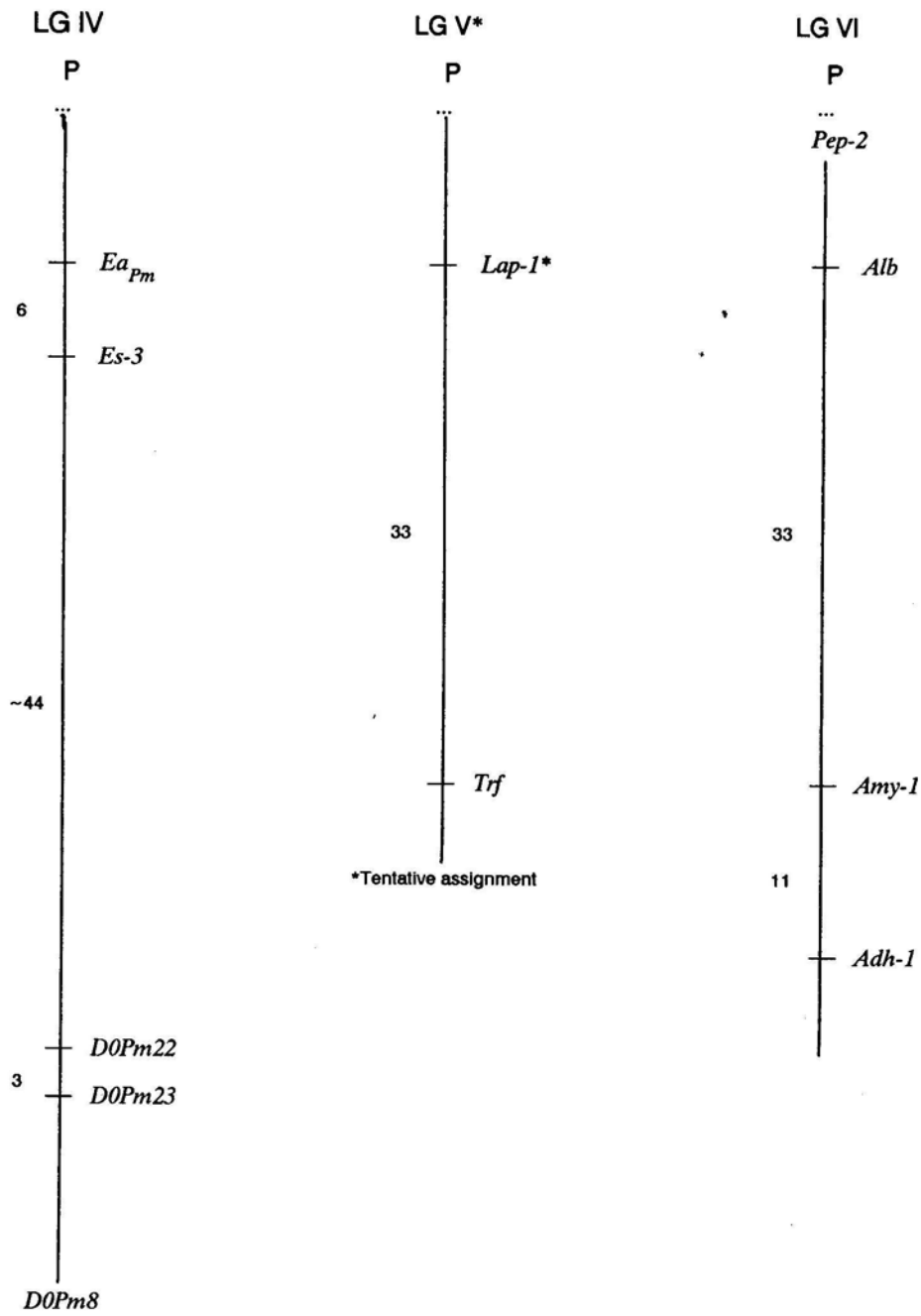
References

- Baccus, R., J. Joule and W.J. Kimberling. (1980). *J. Mamm.*, 61:423-435.
- Barto, E. (1942). *Papers Mich. Acad. Sci., Arts. Lets.* 27:195-213
- Bowen, W.W. and W. D. Dawson. (1977). *J. Mamm.*, 58:521-530.
- Clark, F.H. (1936). *J. Hered.*, 27:259-260.
- Clark, F.H. (1938). *Contrib. Lab. Vert. Genet.*, 7:1-11.
- Committee. (1977). *Cytogenetics*, 19:38-43.
- Cramer, D.V. (1988). *Rat News Letter*, 20:15-20
- Dawson, W.D. (1982). *Acta Theriol.*, 27:213-230.
- Dawson, W.D. and D.S. Rogers (1993). In O'Brien, S.J. (ed.) *Genetic Maps*, pp. 4.232-4.235.
- Dawson, W.D., L.L. Huang, M.R. Felder and J.B. Shaffer (1983). *Biochem. Genet.*, 21:1101-1114.
- Greenbaum, I.F., S.J. Gunn, S.A. Smith, B.F. McAllister, D.W. Hale, R.J. Baker, M.D. Engstrom, M.J. Hamilton, W.S. Modi, L.W. Robbins, D.S. Rogers, O.G. Ward, W.D. Dawson, F.F.B. Elder, M.R. Lee, S. Pathak and F.B. Stangle Jr. (1994) *Cell Genet. Cytogenet.* 66:181-195.
- Huestis, R.R. and V. Piestrak (1942). *J. Hered.*, 33:289-291.
- Huestis, R.R. and G. Lindstedt (1946). *Am. Nat.*, 80:85-91.
- Koop, B.F., R.J. Baker, M.W. Haiduk and M.D. Engstrom. (1984) *Genetica*, 64:199-208.
- McIntosh, W.B. (1956). *Contrib. Lab. Vert. Biol.*, 73:1-27.
- Randerson, S. (1973). *J. Hered.*, 64:371-372.
- Robinson, R. (1964). *Heredity*, 19:701-709.
- Robinson, R. (1972). *Gene Mapping in Laboratory Mammals*, pp.431-441.
- Snyder, L.R.G. (1980). *Biochem. Genet.*, 18:209-220.
- Sumner, F.B. (1922). *Am. Nat.*, 56:412-417.
- Wang, Z., S.R. Young, L. Liu and W.D. Dawson. (1995) *Cell Genet. Cytogenet.*, 69:97-100.

PEROMYSCUS LINKAGE MAP 1996.

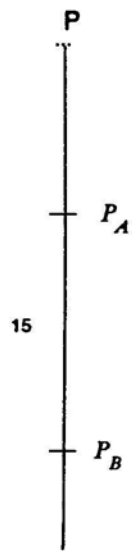


Peromyscus Linkage Map (Continued).

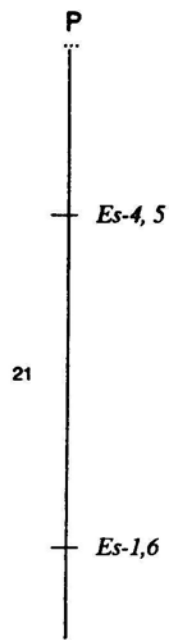


Peromyscus Linkage Map (Continued).

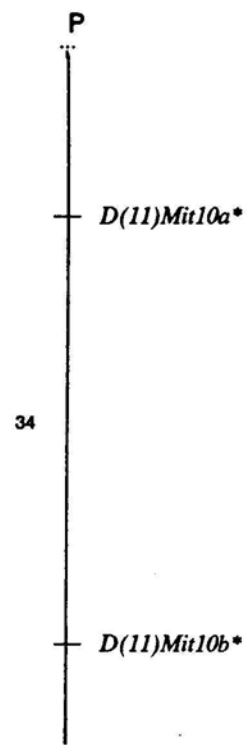
LG VII



LG VIII



LG IX



**Mus* Chm 11 primers

CHM 13



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THANK YOU !

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CURRENT SITUATION OF ENDEMIC *PEROMYSCUS* IN SOME ISLANDS OF THE SEA OF CORTEZ OF BAJA CALIFORNIA SUR, MEXICO

There are 11 species and 23 subspecies of mammals endemic to islands in the Gulf of California of the State of Baja California Sur, Mexico (Hall, 1981). However, there has been little study of these taxa beyond their original taxonomic descriptions. Unfortunately, these islands are no longer in a pristine state; cats, rats, and dogs have been introduced to some of these islands, and several endemics are now considered extinct or endangered. As an effort to see what conservation action may be necessary, we surveyed the population status of *Peromyscus* on the islands in the Gulf of California off the State of Baja California Sur.

The survey was conducted in October 1995 by the Centro de Investigaciones Biologicas del Noroeste, S. C. (CIB) in collaboration with the Mexican Navy, using the oceanographic ship "Altair". The islands visited were: San Jose, San Diego, Santa Cruz, Montserrat, Santa Catalina, Carmen, Tortuga, San Francisco, Danzante and San Marcos. Cerralvo and Coronados islands also have species of *Peromyscus*, but were not visited because previous surveys showed that those populations were in good condition. All specimens were collected with Sherman traps. Frozen tissues, material to make karyotypes and voucher specimens, are in the CIB mammal collection.

We found species of *Peromyscus* on San Jose, San Diego, Santa Cruz, Montserrat, Santa Catalina, Carmen, and Tortuga islands. Trapping success ranged from 1% on Montserrat for *P. caniceps*, to 58% on San Diego for *P. sejugis*.

Species that have lower density or are risk from habitat change are: *P. slevini* (Santa Catalina), *P. caniceps* (Montserrat) and *P. dickeyi* (Tortuga). Each species is endemic to the island.

Domestic cats are present on Santa Catalina island, and we think that this is the factor that is affecting the low population density of *Peromyscus slevini*. For Montserrat we are not sure of the presence of the cats, but we think that is very probable because the endemic *Chaetodipus baileyi* was not collected.

We have now three years experience working with mammals on the islands in the Sea of Cortez in a series of studies on the endemic fauna of these islands.

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MORPHOMETRIC ANALYSIS OF ORGANELLES WITHIN ALCOHOL DEHYDROGENASE POSITIVE AND NEGATIVE *PEROMYSCUS MANICULATUS*

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

Currently we are studying peroxisomes, mitochondria, smooth endoplasmic reticulum and lipids of ADH-negative mice (n=8) and ADH-positive mice (n=8). They are being analyzed for differences in stereological parameters with OPTIMAS image analysis software (Bioscan).

Publications

- Borunda, D., J. T. Ellzey, and T. L. Stevens. 1995. Ultrastructure of *Peromyscus maniculatus* hepatocytes. *Texas Soc. of Electron Microscopy J.*, 26:50-53.
- Ellzey, J. T., D. Borunda, B. P. Stewart. 1996. "An ultrastructural comparison of hepatocytes from ADH-positive and ADH-negative *Peromyscus maniculatus*." *Microscopy and Microanalysis '96, the Annual Meeting of the Microscopy Society of America, the Microbeam Analysis Society and the Microscopical Society of Canada.* August 11-15, 1996.

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PHYSICAL AND BEHAVIORAL DIFFERENCES BETWEEN AGOUTI AND NONAGOUTI *PEROMYSCUS*: SPECULATION ON THE FUNCTIONAL SIGNIFICANCE OF THE AGOUTI LOCUS

Examination of the pelage, behavior, neuroanatomy, and neurochemistry of two allelomorphs of deer mice, *Peromyscus maniculatus*, suggests that the agouti coat-color locus has multiple and diverse pleiotropic effects. Generally, nonagouti animals have a morphology and physiology which exaggerates seasonal differences observed in wild type animals. In short, nonagoutis appear to exhibit an extreme 'summer' phenotype.

Body and Organ Mass:

Body mass was assessed in a single day for 244 captive bred agouti and nonagouti deer mice housed under both short-and long-day photoperiods. Males and nonpregnant females between 3 and 70 months of age were weighed.

Covariance analysis suggests that all independent variables affect body mass: sex (males heavier, $p = 0.009$), daylength (short day heavier ($p = 0.046$), age (older heavier, $p = 0.002$), and color morph (nonagouti heavier $p = 0.021$). However, the heaviest animals were obese (up to 44 g) nonagouti females and the color morph effect disappears when only animals under 25 g are used. Nonagouti females may tend towards obesity.

The gain-of-function agouti mutant 'yellow' (in *Mus*) is known to have pleiotropic effects on fat metabolism. As the loss-of-function mutation, nonagouti, may also alter fat metabolism suggests that appropriate concentrations of the agouti protein are necessary for normal fat metabolism.

In a separate study organ weight were obtained from 40 animals between 4 and 40 months of age. Only data from animals under 25 g were analyzed. Spleens of 3 of the 5 animals over 2 years old were very large. Thus analysis of spleen mass was conducted only on younger animals.

Using body mass as a covariate, both liver and kidney weights were higher for females but exhibit no day length, color-morph, or age effects. Sex and age also have no effect on brain weight but light and color-morph do. Spleen mass was significantly altered by sex and color morph but not influenced by day length.

In sum, the nonagouti allele appears to influence brain and spleen size as well as the tendency towards obesity.

Behavioral Comparisons:

In a small sample size study, Ms. Herrloff-Anwar found that when in estrous both agouti and nonagouti females prefer to be near an agouti male rather than a nonagouti male. This result extends

earlier studies done by Dr. Horner and needs additional study as it provides an alternative hypothesis for the rarity of the nonagouti allele in wild populations.

Mr. Rusby investigated nesting behavior of the two morphs under both short and long day conditions and found that agouti animals used more nesting material than nonagoutis. In addition, agouti animals under short-day photoperiod used more nesting material than those under long day lengths. The photoperiodic effect was not consistent in nonagouti animals.

Mr. Beard examined food intake with respect to coat color, sex, and photoperiod. Sex and color morph differences in food intake are only apparent in short day conditions. Under a short photoperiod, agouti males ate less than agouti females but this sex difference is reversed for nonagouti animals. Short-day nonagouti males ate more than females. Thus increased food intake does not explain the tendency towards obesity in nonagouti females. Apparently the altered fat metabolism of nonagouti females does not influence food intake.

Spleen Histology:

Ms. Reardon began a more detailed histological investigation of the spleens in the two color morphs. The percentage of white pulp to red pulp is highly variable. Based on a small sample size, individual nodules of white pulp appear to be of similar size in the two colormorphs and constitute a similar proportion of spleen volume. However, as the spleens of the nonagouti animals are larger the amount of white pulp relative to body size is also larger. More data are needed to confirm these initial observations.

Speculation:

The suite of potential pleiotropic effects associated with the agouti locus at first appears disjoint, but many of the traits have ramifications for the seasonal biology of deermice (pelage, activity, body size, food intake, nest building). Possibly, one function of the agouti locus is to regulate the seasonal physiology of mammals via modulation of proopiomelanotropic hormones. If so, agouti and nonagouti deermice may prove to be an invaluable model system for examining the genetics, biochemistry, and physiology of seasonal changes in mammalian biology.

Bibliography

- Beard, J. 1996. An investigation into the effect of sex, photoperiod and coat colour on food intake in deermice (*Peromyscus maniculatus*). Honours Thesis, University of Nottingham. Sutton Bonington, United Kingdom.
- Hayssen, V. 1996. Organ and body mass in agouti and nonagouti *Peromyscus maniculatus gracilis*. Am. Soc. Mammal., Univ. of North Dakota, Grand Forks, ND [poster presentation]
- Herrloff-Anwar, A. 1996. Mate choice in deer mouse, *Peromyscus maniculatus*. Honors Thesis, University of Nottingham. Sutton Bonington, United Kingdom.
- Reardon, L. 1996. The effects of the agouti protein, daylength and sex on spleen size and composition in *Peromyscus maniculatus*. Honours Thesis, University of Nottingham. Sutton Bonington, United Kingdom.
- Rusby, D. 1996. The effect of photoperiod and sex on the nesting behavior of agouti and non-agouti deermice (*Peromyscus maniculatus*). Honours Thesis, University of Nottingham. Sutton Bonington, United Kingdom.

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SMALL MAMMAL WINTER ABUNDANCE AND DISTRIBUTION IN THE CANADIAN MIXED GRASS PRAIRIES

Small mammals are important in the swift fox (*Vulpes velox*) winter diet, and their abundance and distribution may potentially influence the long term survival of the swift fox. Thus, quantitative analysis was performed on factors likely to influence small mammal populations over the winter. This involved measuring standing vegetation height, litter depth, and per cent vegetation cover during snow-free periods, and snow depth in coulee, roadside, and upland habitats when snow was present. Biological parameters contributing to small mammal population dynamics were also noted. The study was conducted in the mixed grass prairies in three areas (separated by approximately 75-250 km) in southern Alberta and Saskatchewan encompassing core ranges of swift fox populations.

Mark-recapture methods of trapping resulted in a total of 163 animals in an overall 9,000 trap nights in early (November), mid (Jan.-Feb.), and late (March-April) winter during 1995-1996. Deer mice (*Peromyscus maniculatus*) comprised 96.0% of the total catch, while shrews (*Sorex sp.*) constituted the remaining 4.0%. Winter trap mortality of *Peromyscus* was low, with an overall mortality rate of 3.8%.

The male to female ratios of *Peromyscus* remained constant from early to mid-winter, 1:1 but, by late winter, the male to female ratio was 2:1 likely a result of dispersal, and the search for territories and mates. Deer mice did not reproduce from early November to early April. Winter aggregation was also noted. Once winter conditions subsided males exhibited increased activity and distance travelled.

Early winter trapping resulted in highest abundance values while there was a significant decline in small mammal abundance and biomass from early to mid winter, late winter resulting in the overall lowest capture rates. The exception occurred in one area where spring-like conditions were earlier than for other sites probably enhancing dispersal and consequently total catch. Overall decline of capture totals from early to late winter was 91% and 93% at two areas, while at the third area there was an 89% increase.

During the winter, there was a significant difference in snow depths between study areas, habitats, and trapping seasons. With deeper snow, there was a significant decline in small mammal numbers caught over the winter. There was a significant difference in vegetation height and cover between upland and linear habitats, but *Peromyscus* did not appear to exhibit any preference for any particular habitat attribute. Percent vegetation cover, vegetation height and litter depth, a reflection of range condition, differed significantly between study areas and sometimes between habitats. The area with the best range conditions exhibited an increase of small mammal numbers from early to late winter and highest biomass and abundance values by the end of the winter.

Overall, winter severity and snow conditions were more strongly associated with abundance of *Peromyscus* than were habitat characteristics. Distribution of *Peromyscus* in upland versus linear habitats over the winter indicated that unless snow and moisture factors dictated otherwise, there was no strong correlation between habitat type and small mammal abundance. This is consistent with the notion that *Peromyscus* species are classified as "habitat generalists" and will often be found in many habitat types. The few shrews caught were consistently captured in coulee habitat with higher vegetation cover.

Extrapolating from these results, late winter appears to be the most critical for swift fox survival when small mammal prey are the least abundant and foxes already have decreased fat reserves. During this time, swift fox mortality is at its peak and home ranges continuously increase throughout the winter as the foxes are forced to forage greater distances to obtain sufficient amounts of food with higher risks of predation by coyotes (*Canis latrans*) and birds of prey.

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GENETIC IMPRINTING IN THE RODENT GENUS *PEROMYSCUS*

The rodent genus *Peromyscus* (deer mice) is 20+ million years removed from the domestic mouse. Crosses between two species in the genus, *P. maniculatus* (*P.m.*) and *P. polionotus* (*P.p.*) yield interesting parent-of-origin effects. The two species are roughly the same size, but a female *P.m.* crossed with a male *P.p.* yields much smaller offspring than either parent. In the reverse cross, the offspring are oversized to the point of neonatal lethality. This is suggestive of differential genomic imprinting between the two species. The latter phenotype is much like the *Igf2r* (a known imprinted locus) knockout mice. This size effect is particularly pronounced in the placenta, where 6X differences are observed. These *Peromyscus* species are also excellent models for testing Haig's theory of imprinting as parental conflict in that one species (*P.p.*) is monogamous, while *P.m.* is more promiscuous. Haig's theory predicts that maternal and paternal interests in growth rates of embryos are different in non-monogamous species, and lead to genetic imprinting of loci involved in growth control.

We are testing the status of such imprinted genes as *Igf2*, *Igf2r*, *Mash-2*, *Mas* and *p57kip*. It is clear that *Igf2* is tightly imprinted, with the exception of the brain. *Igf2r* appears to be more tightly imprinted in one cross (PxM) than the reciprocal (MxP- the smaller F1's). This relaxation appears most pronounced in the placenta. *H19* on the other hand, appears to be globally relaxed in the oversized F1's (PxM).

We have also initiated a backcross to one parental strain in order to map the genes responsible for the growth phenotypes by a QTL approach. While we will initially scan markers from the known imprinted regions, we will survey the whole genome via southern blotting with conserved loci roughly every 20 cM. The X-linked markers used by Zechner et al. (Nat. Genet. 12:398) to localize a similar effect in *M. spretus/musculus* backcrosses will also be tested.

* * *

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PEROMYSCUS POPULATIONS AT FOUR NATIONAL PARKS IN PENNSYLVANIA

We initiated a long-term project (1992-1996) at four national parks in Pennsylvania, including Valley Forge National Historical Park (VAFO), Gettysburg National Military Park and Eisenhower National Historic Site (GETT-EISE), and Hopewell Furnace National Historic Site (HOFU). The overall goals of this project were to (1) determine the effectiveness of protocols for terrestrial vertebrates in terms of time, labor, cost, and types of data obtained, and (2) predict and document the number of terrestrial vertebrate species within the parks. As part of this project, we live-trapped *Peromyscus* populations in representative habitats of each park. Funding for this study was provided by the National Park Service.

The white-footed mouse (*P. leucopus*) was the most common small mammal species captured at the four parks. At VAFO, we captured 18 white-footed mice during 220 trapnights (12.3 mice/100 trapnights) in old-field sites.

At GETT-EISE, we captured 11 prairie deer mice (*P. maniculatus bairdii*) during 436 trapnights (2.5 mice/100 trapnights) in grassland sites, 17 white-footed mice during 336 trapnights (5.1 mice/100 trapnights) in old-field sites, and 102 white-footed mice during 646 trapnights (15.8 mice/100 trapnights) in forest sites.

At HOFU, we captured 17 white-footed mice during 220 trapnights (12.3 mice/100 trapnights) in old-field sites, 65 white-footed mice during 340 trapnights (19.1 mice/100 trapnights) in lowland-forest sites, and 31 white-footed mice during 340 trapnights (9.1 mice/100 trapnights) in upland-forest sites.

* * *

RECENT PUBLICATIONS

- Belk, M. C. and M. H. Smith. 1996. Pelage coloration in oldfield mice (*Peromyscus polionotus*): Antipredator adaptation? *J. Mammal.* 77:882-890.
- Bohm, U., P. F. Dahm, B. F. McAllister, and I. F. Greenbaum. 1995. Identifying chromosomal fragile sites from individuals: A multinomial statistical model. *Hum. Genet.*, 95:249-256.
- Bradley, R. D., R. D. Owen, and D. J. Schmidly. 1996. Morphological variations in *Peromyscus spicilegus*. *Occas. Papers, The Museum, Texas Tech Univ.*, 159:1-23.
- Brown, E. and S. J. Ropski. 1995. A survey of the mammals of the Wattsburg Fen Natural Area and the Titus Bog Preserve. *J. Penn. Acad. Sci.*, 69:111-114.
- Brown, R. N. and R. S. Lane. 1996. Reservoir competence of four chaparral-dwelling rodents for *Borrelia burgdorferi* in California. *Am. J. Trop. Med. Hygiene*, 54:84-91.
- Brunet, L. R., C. Sellitto, A. Spielman, and S. R. Telford III. 1995. Antibody response of the mouse reservoir of *Borrelia burgdorferi* in nature. *Infect. Immun.*, 63:3030-3036.
- Bruseo, J. A. and R. E. Barry, Jr. 1995. Temporal activity of syntopic *Peromyscus* in the central Appalachians. *J. Mamm.*, 76:78-82.
- Carballal, G. 1996. Emerging or re-emerging viruses? *Medicina*, 56:97-101.
- Carey, A. B. and M. L. Johnson. 1995. Small mammals in managed, naturally young, and old-growth forests. *Ecol. Appl.*, 5:336-352.
- Casavant, N. C., A. N. Sherman, and H. A. Wichman. 1996. Two persistent LINE-1 lineages in *Peromyscus* have unequal rates of evolution. *Genetics*, 142:1289-1298.
- Chable-Santos, J. B., N. R. Van Wynsberghe, S. B. Canto-Lara, and F. J. Andrade-Narvaez. 1995. Isolation of *Leishmania (L.) mexicana* from wild rodents and their possible role in the transmission of localized cutaneous leishmaniasis in the state of Campeche, Mexico. *Amer. J. Trop. Med. Hygiene*, 53:141-145.
- Childs, J. E., J. W. Krebs, T. G. Ksiazek, G. O. Maupin, K. L. Gage, P. E. Rollin, P. S. Zeitz, J. Sarisky, R. E. Enscoe, J. C. Butler, J. E. Cheek, G. E. Glass, and C. J. Peters. 1995. A household-based, case-control study of environmental factors associated with hantavirus pulmonary syndrome in the southwestern United States. *Am. J. Trop. Med. Hyg.*, 52:393-397.
- Childs, J. E., J. N. Mills, and G. E. Glass. 1995. Rodent-borne hemorrhagic fever viruses: A special risk for mammalogists? *J. Mammal.*, 76:664-680.
- Chizhikov, V. E., C. F. Spiropoulou, S. P. Morzunov, M. C. Monroe, C. J. Peters, and S. T. Nichol. 1995. Complete genetic characterization and analysis of isolation of Sin Nombre virus. *J. Virol.*, 69:8132-8136.
- Clough, J. E., J. A. Foster, M. Barnett, and H. A. Wichman. 1996. Computer simulation of transposable element evolution: Random template and strict master models. *J. Mol. Evol.*, 42:52-58.
- Crete, M., B. Drolet, J. Huot, M.-J. Fortin and G. J. Doucet. 1995. Post-fire stages of mammal and bird diversity in the north of Quebecois boreal forest. *Can. J. For. Res.*, 25:1509-1518.

- Crew, M. D. and L. M. Bates. 1996. DNA sequence of the *Peromyscus leucopus* MHC class II gene Aa (*MhcPelaAa*). *Immunogenetics*, 43:323-324.
- Crew, M. C., L. M. Bates, C. A. Douglass, and J. L. York. 1996. Expressed *Peromyscus maniculatus* (*Pema*) MHC class I genes: evolutionary implications and the identification of a gene encoding a *Qa1*-like antigen. *Immunogenetics*, 44:177-185.
- Cunningham, H. N., Jr. 1995. An inventory of the small mammals of Presque Isle State Park Erie County, Pennsylvania. *J. Penn. Acad. Sci.*, 69:105-110.
- Cushing, B. S. and J. M. Cawthorn. 1996. Species differences in activity patterns during oestrus. *Can. J. Zool.*, 74:473-479.
- Daniels, T. J. and D. Fish. 1995. Effect of deer exclusion on the abundance of immature *Ixodes scapularis* (Acari: Ixodidae) parasitizing small and medium-sized mammals. *J. Med. Entomol.*, 32:5-11.
- Defosse, D. L., R. C. Johnson, B. J. Paster, F. E. DeWhirst, and G. J. Fraser. 1995. *Brevinema andersonii* gen. nov., sp. nov., and infections spirochete isolated from the short-tailed shrew (*Blarina brevicauda*) and the white-footed mouse (*Peromyscus leucopus*). *Internat. J. Systematic Bacteriol.*, 45:78-84.
- DeGraaf, R. M. and T. S. Maier. 1996. Effect of egg size on predation by white-footed mice. *Wilson Bull.*, 108:535-.
- Demas, G. E. and R. J. Nelson. 1996. Photoperiod and temperature interact to affect immune parameters in adult deer mice (*Peromyscus maniculatus*). *J. Biol. Rhythms*, 11:94-102.
- Derting, T. L. and E. B. Noakes. 1995. Seasonal changes in gut capacity in the white footed mouse (*Peromyscus leucopus*) and meadow vole (*Microtus pennsylvanicus*). *Can. J. Zool.*, 73:243-252.
- Diffendorfer, J. E., M. S. Gaines, and R. D. Holt. 1995. Habitat fragmentation and movements of three small mammals (*Sigmodon*, *Microtus*, and *Peromyscus*). *Ecology*, 76:827-839.
- Dominguez, A. M., S. A. Smith, and I. F. Greenbaum. 1995. Susceptibility of heterochromatin to aphidicolin-induced chromosomal breakage. *Hum. Genet.*, 96:516-520.
- Dooley, J. L., Jr. and M. A. Bowers. 1996. Influences of patch size and microhabitat on the demography of two old-field rodents. *Oikos*, 75:453-462.
- Dooley, J. L., Jr. and R. D. Dueser. 1996. Experimental tests of nest site competition in two *Peromyscus* species. *Oecologia*, 105:81-86.
- Duddley, B. F. and G. W. Winston. 1995. p-Nitrosophenol reduction by liver cytosol from ADH-positive and -negative deer mice (*Peromyscus maniculatus*). *Arch. Biochem. Biophys.*, 316:879-885.
- Duquette, L. S. and J. S. Millar. 1995. Reproductive response of a tropical mouse, *Peromyscus mexicanus*, to changes in food availability. *J. Mammal.*, 76:596-602.
- Duquette, L. S. and J. S. Millar. 1995. The effect of supplemental food on life-history traits and demography of a tropical mouse *Peromyscus mexicanus*. *J. Anim. Ecol.*, 64:348-360.
- Durden, L. A. 1995. Bot fly (*Cuterebra fontinella fontinella*) parasitism of cotton mice (*Peromyscus gossypinus*) on St. Catherines Island, Georgia. *J. Parasitol.*, 81(5):787-790.
- Duszynski, D. W., and C. T. McAllister. 1995. Coccidian parasites of *Peromyscus attwateri* and *P. pectoralis* in Texas with a description of a new species from *P. pectoralis laceianus*. *Occas. Papers Mus., Texas Tech Univ.*, 156:1-8.

- Elrod, D. A. and M. L. Kennedy. 1995. Microgeographic variation in morphometric characters of the white-footed mouse, *Peromyscus leucopus*. *Southwestern Nat.*, 40:42-49.
- Fa, J. E., V. Sanchez-Cordero and A. Mendez. 1996. Interspecific agonistic behaviour in small mammals in a Mexican high-elevation grassland. *J. Zool.*, 239:396-401.
- Fish, D. 1995. Environmental risk and prevention of Lyme disease. *Amer. J. Med.*, 98:4A-2S-4A-85.
- Fuller, C. A. 1996. Population dynamics of two species of *Eimeria* (Apicomplexa: Eimeriidae) in deer mice (*Peromyscus maniculatus*): Biotic and abiotic factors. *J. Parasitol.*, 82:220-225.
- Fuller, C. A. 1996. Variable levels of immunity to experimental *Eimeria arizonensis* infections in natural, seminatural, and laboratory populations of deer mice (*Peromyscus maniculatus*). *Can. J. Zool.*, 74:750-757.
- Fuller, C. A. and A. R. Blaustein. 1996. Effects of the parasite *Eimeria arizonensis* on survival of deer mice (*Peromyscus maniculatus*). *Ecology*, 77:2196-.
- Fuller, C. A., J. Hefner, and E. Wrosch. 1995. Oocyst output, periodicity, and immunity of two deer mouse (*Peromyscus maniculatus*) eimerians (*Eimeria arizonensis* and *Eimeria delicata*). *J. Parasitol.*, 81:187-194.
- Gage, K. L., R. S. Ostfeld, and J. G. Olson. 1995. Nonviral vector-borne zoonoses associated with mammals in the United States. *J. Mammal.*, 76:695-715.
- Galea, L. A. M., M. Kavaliers, and D. P. Ossenkopp. 1996. Sexually dimorphic spatial learning in meadow voles *Microtus pennsylvanicus* and deer mice *Peromyscus maniculatus*. *J. Exp. Biol.*, 199:195-200.
- Garwood, T. and J. Rose. 1995. Effects of bilateral adrenalectomy on initiation of fur growth cycles in the deer mouse (*Peromyscus maniculatus*). *Lab. Anim. Sci.*, 45:564-566.
- Goetze, J. R., F. D. Yancey, C. Jones, and B. M. Gharaibeh. 1995. Noteworthy records of mammals from the Edwards Plateau of central Texas. *Texas J. Sci.*, 47:3-8.
- Gubernick, D. J., J. T. Winslow, P. Jensen, L. Jeanotte, and J. Bowen. 1995. Oxytocin changes in males over the reproductive cycle in the monogamous, biparental California mouse, *Peromyscus californicus*. *Horm. Behav.*, 29:59-73.
- 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.
- Havelka, M. A. and J. S. Millar. 1996. Multiple nest boxes per station in the study of *Peromyscus leucopus*. *Am. Midl. Nat.*, 135:376-380.
- Hayes, J. P. and J. S. Shonkwiler. 1996. Altitudinal effects on water fluxes of deer mice: A physiological application of structural equation modeling with latent variables. *Physiol. Zool.*, 69:509-531.
- Hazler, K. R. and R. S. Ostfeld. 1995. Larval density and feeding success of *Ixodes scapularis* on two species of *Peromyscus*. *J. Parasitol.*, 81:870-875.
- Henderson, W. W., M. C. Monroe, S. C. St. Jeor, W. P. Thayer, J. E. Rowe, C. J. Peters, and S. T. Nichol. 1996. Naturally occurring Sin Nombre virus genetic reassortants. *Virology*, 214:602-610.
- Hjelle, B. 1995. Evolution and speciation of new world hantaviruses. In: *Hantaviruses, newly emerging viral pathogens* (Monographs in virology series), Eds. S. S. Morse and J. W. LeDuc. 1-38.

- Hjelle, B., B. Anderson, N. Torrez-Martinez, W. Song, W. L. Gannon, and T. L. Yates. 1995. Prevalence and geographic genetic variation of hantaviruses of new world harvest mice (*Reithrodontomys*): Identification of a divergent genotype from a Costa Rican *Reithrodontomys mexicanus*. *Virology*, 207:452-459.
- Hjelle, B., J. Krolkowski, N. Torrez-Martinez, F. Chavez-Giles, C. Vanner, and E. Laposata. 1995. Phylogenetically distinct hantavirus implicated in a case of hantavirus pulmonary syndrome in the northeastern United States. *J. Med. Virol.*, 46:21-27.
- Hjelle, B., S. W. Lee, W. Song, N. Torrez-Martinez, J. W. Song, R. Yanagihara, I. Gavrilovskaya, and E. R. Mackow. 1995. Molecular linkage of hantavirus pulmonary syndrome to the white-footed mouse, *Peromyscus leucopus*: Genetic characterization of the M genome of New York virus. *J. Virol.*, 69:8137-8141.
- Hjelle, B., N. Torrez-Martinez, F. T. Koster. 1996. Hantavirus pulmonary syndrome-related virus from Bolivia. *Lancet*, 347:57.
- Hjelmqvist, L., M. Estonius, and H. Jornvall. 1995. The vertebrate alcohol dehydrogenase system: Variable class II type form elucidates separate stages of enzymogenesis. *PNAS*, 92:10904-10908.
- Hoffman, S. M. G. and W. M. Brown. 1995. The molecular mechanism underlying the "Rare allele phenomenon" in a subspecific hybrid zone of the California field mouse, *Peromyscus californicus*. *J. Mol. Evol.*, 41:1165-1169.
- Hofmeister, E. K. and J. E. Childs. 1995. Analysis of *Borrelia burgdorferi* sequentially isolated from *Peromyscus leucopus* captured at a Lyme disease enzootic site. *J. Infec. Dis.*, 172:462-469.
- Hofmeister, E. K. and J. E. Childs. 1995. Ear biopsy location influences detection of *Borrelia burgdorferi* by PCR, but not by culture in naturally infected *Peromyscus leucopus*. *J. Wildlife Dis.*, 31:345-351.
- Houseal, T. W., J. A. Cook, W. S. Modi, and D. W. Hale. 1995. Identification of highly conserved loci by genome painting. *Chromosome Res.*, 3:175-181.
- Jacquot, J. J. and S. H. Vessey. 1995. Influence of the natal environment on dispersal of white-footed mice. *Behav. Ecol. Sociobiol.*, 37:407-412.
- Jekanoski, R. D. and D. W. Kaufman. 1995. Use of simulated herbaceous canopy by foraging rodents. *Amer. Mid. Nat.*, 133:304-311.
- Kantak, G. E. 1996. Microhabitats of two *Peromyscus* (deer and white-footed mice) species in old fields and prairies of Wisconsin. *Can. Field-Nat.*, 110:322-325.
- Kass, D. H., J. Kim, and P. L. Deininger. 1996. Sporadic amplification of ID elements in rodents. *J. Mol. Evol.*, 42:7-14.
- Katbamna, B., C. Thodi, and J. B. Senturia. 1996. Auditory-evoked brainstem responses in the torpid deermouse. *Physiol. & Behav.*, 59:189-194.
- Kaufman, D. W., G. A. Kaufman, E. J. Finck. 1995. Temporal variation in abundance of *Peromyscus leucopus* in wooded habitats of eastern Kansas. *Am. Midl. Nat.*, 133:7-17.
- Kavaliers, M. and L. A. M. Galea. 1995. Sex differences in the expression and antagonism of swim stress-induced analgesia in deer mice vary with the breeding season. *Pain*, 63:327-334.
- Khan, A. S., C. F. Spiropoulou, S. Morzunov, S. R. Zaki, M. A. Kohn, S. R. Nawas, L. McFarland, and S. T. Nichol. 1995. Fatal illness associated with a new hantavirus in Louisiana. *J. Med. Virol.*, 46:281-286.
- Kirkland, G. L., Jr., H. W. Snoddy, and T. L. Amsler. 1995. Impact of fire on small mammals and amphibians in a central Appalachian deciduous forest. *Am. Midl. Nat.*, 135:253-260.

- Koteja, P. 1996. Limits to the energy budget in a rodent, *Peromyscus maniculatus*: The central limitation hypothesis. *Physiol. Zool.*, 69:981-993.
- Koteja, P. 1996. Limits to the energy budget in a rodent, *Peromyscus maniculatus*: Does gut capacity set the limit? *Physiol. Zool.*, 69:994-1020.
- Larson, O. R., R. G. Schwab, and A. Fairbrother. 1996. Seasonal occurrence of fleas (*Siphonaptera*) on deer mice (*Peromyscus maniculatus*) in northern California. *J. Vector Ecol.*, 21:31-36.
- Laerm, J. and J. L. Boone. 1995. Corrections of records of occurrence of *Peromyscus polionotus* (Wagner) and *P. gossypinus* (Le Conte) (Rodentia: Muridae) in the Blue Ridge Province of Georgia. *Brimleyana*, 0:9-14.
- Larson, O. R., R. G. Schwab, and A. Fairbrother. 1996. Seasonal occurrence of fleas (*Siphonaptera*) on deer mice (*Peromyscus maniculatus*) in northern California. *J. Vector Ecol.*, 21:31-36.
- Laurinoli, M. and L. I. Bendell-Young. 1996. Copper, zinc, and cadmium concentrations in *Peromyscus maniculatus* sampled near an abandoned copper mine. *Arch. Environ. Contamination Toxicol.*, 30:481-486.
- Lee, R. N., J. C. Jaskula, R. A. Van Den Bussche, R. J. Baker, and H. A. Wichman. 1996. Retrotransposon *Mys* was active during evolution of the *Peromyscus leucopus-maniculatus* complex. *J. Mol. Evol.*, 42:44-51.
- Li, D., A. L. Schmaljohn, K. Anderson, and C. S. Schmaljohn. 1995. Complete nucleotide sequences of the *M* and *S* segments of two hantavirus isolates from California: Evidence for reassortment in nature among viruses related to hantavirus pulmonary syndrome. *Virology*, 206:973-983.
- Long, C. A. 1996. Ecological replacement of the deer mouse, *Peromyscus maniculatus* by the white-footed mouse, *P. leucopus*, in the Great Lakes region. *Can. Field-Nat.*, 110:271-277.
- Lyon, S. M., J. D. Edman, and R. G. Van Driesche. 1996. Field estimates of numbers of *Ixodes scapularis* (Acari: Ixodidae) larvae and nymphs per hectare successfully feeding on *Peromyscus leucopus* in Massachusetts. *J. Med. Entomol.*, 33:812-.
- Lyubsky, S., I. Gavrilovskaya, B. Luft, and E. Mackow. 1996. Histopathology of *Peromyscus leucopus* naturally infected with pathogenic NY-1 hantaviruses: Pathologic markers of HPS viral infection in mice. *Lab. Invest.*, 74:627-633.
- Magnarelli, L. A., J. F. Anderson, R. A. Flavell, and E. Fikrig. 1995. Reactivity of white-footed mouse and raccoon sera to whole cell and recombinant antigens of *Borrelia burgdorferi*. *J. Wildlife Dis.*, 31:339-344.
- Magnarelli, L. A., J. F. Anderson, and R. C. Johnson. 1995. Analyses of mammalian sera in enzyme-linked immunosorbent assays with different strains of *Borrelia burgdorferi* sensu lato. *J. Wildlife Dis.*, 31:159-165.
- Magnarelli, L. A. and J. S. Dumler. 1996. Ehrlichioses: Emerging infectious diseases in tick-infested areas. *CMNEEJ*, 18:81-88.
- Magnarelli, L. A., K. C. Stafford, III., T. N. Mather, M.-T. Yeh, K. D. Horn, and J. S. Dumler. 1995. Hemocytic rickettsia-like organisms in ticks: Serologic reactivity with antisera to ehrlichiae and detection of DNA of agent of human granulocytic ehrlichiosis by PCR. *J. Clin. Microbiol.*, 33:2710-2714.
- Marinelli, L. and D. Neal. 1995. The distribution of small mammals on cultivated fields and in rights-of-way. *Can. Field-Nat.*, 109:403-407.
- McCoy, G., M. F. Finlay, A. Rhone, K. James, and G. P. Cobb. 1995. Chronic polychlorinated biphenyls exposure on three generations of oldfield mice (*Peromyscus polionotus*): Effects on reproduction, growth, and body residues. *Arch. Environ. Contam. Toxicol.*, 28:431-435.

- McMillan, B. R., D. E. Brillhart, G. A. Kaufman, and D. W. Kaufman. 1995. Short-term responses of small mammals to autumn fire in tallgrass prairie. *Prairie Nat.*, 27:158-165.
- McMillan, B. R. and D. W. Kaufman. 1995. Travel path characteristics for free-living white-footed mice (*Peromyscus leucopus*). *Can. J. Zool.*, 73:1474-1478.
- McMurry, S. T., R. L. Lochmiller, J. F. Boggs, D. M. Leslie, Jr., and D. M. Engle. 1996. Demography and condition of populations of white-footed mice (*Peromyscus leucopus*) in late and early successional habitats. *J. Mammal.*, 77:335-345.
- Millar, J. S. 1994. Senescence in a population of small mammals. *Ecoscience*, 1:317-321.
- Mills, J. N., T. L. Yates, J. E. Childs, R. R. Parmenter, T. G. Ksiazek, P. E. Rollin, and C. J. Peters. 1995. Guidelines for working with rodents potentially infected with hantavirus. *J. Mammal.*, 76:716-722.
- Morris, D. W. 1996. State-dependent life histories, Mountford's hypothesis, and the evolution of brood size. *J. Anim. Ecol.*, 65:43-51.
- Morris, D. W. 1996. State-dependent life history and senescence of white-footed mice. *Ecoscience*, 3:1-6.
- Morris, D. W. 1996. Temporal and spatial population dynamics among patches connected by habitat selection. *Oikos*, 75:207-219.
- Morton, M. L., M. L. Morrison, L. S. Hall, and M. E. Pereyra. 1995. Life history parameters in mice exposed to a prolonged drought. *Southwestern Nat.*, 40:18-28.
- Morzunov, S. P., H. Feldmann, C. F. Spiropoulou, V. A. Semenova, P. E. Rollin, T. G. Ksiazek, C. J. Peters, and S. T. Nichol. 1995. A newly recognized virus associated with a fatal case of hantavirus pulmonary syndrome in Louisiana. *J. Virol.*, 69:1980-1983.
- Myers, P., B. L. Lundrigan, B. W. Gillespie, and M. L. Zelditch. 1996. Phenotypic plasticity in skull and dental morphology in the prairie deer mouse (*Peromyscus maniculatus bairdii*). *J. Morphol.*, 229:229-237.
- Nelson, R. J., D. J. Gubernick, and J. M. C. Blom. 1995. Influence of photoperiod, green food, and water availability on reproduction in male California mice (*Peromyscus californicus*). *Physiol. Behav.*, 57:1175-1180.
- Nestler, J. R., G. P. Dieter, and B. G. Kloeid. 1996. Changes in total body fat during daily torpor in deer mice (*Peromyscus maniculatus*). *J. Mammal.*, 77:147-154.
- Nickelson, S. A. and S. D. West. 1996. Renal cadmium concentrations in mice and shrews collected from forest lands treated with biosolids. *J. Environ. Qual.*, 25:86-91.
- Nupp, T. E. and R. K. Swihart. 1996. Effect of forest patch area on population attributes of white-footed mice (*Peromyscus leucopus*) in fragmented landscapes. *Can. J. Zool.*, 74:467-472.
- Ordaz, J. F. and M. De Los Angeles Sanabria Espinoza. 1995. A new species of the genus *Protospirura* (Nemata: Spiruridae), parasite of *Peromyscus difficilis* (Rodentia: Cricetidae) from Hidalgo, Mexico. *Anales del Instituto de Biol. Univ. Nacional Autonoma de Mex. Serie Zool.*, 66:17-26.
- Ostfeld, R. S., O. M. Cepeda, K. R. Hazler, and M. C. Miller. 1995. Ecology of Lyme disease: Habitat associations of ticks (*Ixodes scapularis*) in a rural landscape. *Ecol. App.*, 5:353-361.
- Ostfeld, R. S., M. C. Miller, and K. R. Hazler. 1996. Causes and consequences of tick (*Ixodes scapularis*) burdens on white-footed mice (*Peromyscus leucopus*). *J. Mammal.*, 77:266-273.

- Otteson, E. W., J. Riolo, J. E. Rowe, S. T. Nichol, T. G. Ksiazek, P. E. Rollin, and S. C. St. Jeor. 1996. Occurrence of hantavirus within the rodent population of northeastern California and Nevada. *Am. J. Trop. Med. Hyg.*, 54:127-133.
- Peavey, C. A. and R. S. Lane. 1996. Comparison of infectivities of six tick-derived isolates of *Borrelia burgdorferi* for rodents and ticks. *J. Clin. Microbiol.*, 34:71-75.
- Peavey, C. A. and R. S. Lane. 1995. Transmission of *Borrelia burgdorferi* by *Ixodes pacificus* nymphs and reservoir competence of deer mice (*Peromyscus maniculatus*) infected by tick-bite. *J. Parasitol.*, 81:175-178.
- Pivron, E. B. and A. Nordone. 1996. Brain synaptosomes display a diadenosine tetraphosphate (Ap₄A)-Mediated Ca⁺ influx distinct from ATP-Mediated influx. *J. Neurosci. Res.*, 44:478-489.
- Poirier, S. R., M. E. Rau, and X. Wang. 1995. Diel locomotory activity of deer mice (*Peromyscus maniculatus*) infected with *Trichinella nativa* or *Trichinella pseudospiralis*. *Can. J. Zool.*, 73:1323-1334.
- Regamey, C. 1995. Some newly recognized agents of pneumonia. *Schweizerische Medizinische Wochenschrift*, 125:2171-2177.
- Richmond, J. Y. and C. J. Peters. 1995. Laboratory management of agents associated with hantavirus pulmonary syndrome: Interim biosafety guidelines. *Lab Anim.*, 24:41-45.
- Risley, L. S., S. Gerum, and M. Villamar. 1995. Lyme disease in northern New Jersey: Prevalence of spirochete infection in small mammals. *Bull. NJ Acad. Sci.*, 40:1-3.
- Roth, V. L. and W. D. Dawson. 1996. Coat color genetics of *Peromyscus*: V. California blonde, a new recessive mutation in the deer mouse. *J. Hered.*, 87:403-406.
- Rowe, J. E., S. C. St. Jeor, J. Riolo, E. W. Otteson, M. C. Monroe, W. W. Henderson, T. G. Ksiazek, P. E. Rollin, and S. T. Nichol. 1995. Coexistence of several novel hantaviruses in rodents indigenous to North America. *Virology*, 213:122-130.
- Ruefenacht, B. and R. L. Knight. 1995. Influences of corridor continuity and width on survival and movement of deer mice *Peromyscus maniculatus*. *Biol. Conserv.*, 71:269-274.
- Scheibe, J. S. and M. J. O'Farrell. 1995. Habitat dynamics in *Peromyscus truei*: Eclectic females, density dependence, or reproductive constraints? *J. Mammal.*, 76:368-375.
- Schmaljohn, A. L., D. Li, D. L. Negley, D. S. Bressler, M. J. Turell, G. W. Korch, M. S. Ascher, and C. S. Schmaljohn. 1995. Isolation and initial characterization of a newfound hantavirus from California. *Virology*, 206:963-972.
- Schmidly, D. J. and R. D. Bradley. 1995. Morphological variation in the Sinaloan mouse *Peromyscus simulus*. *Revista Mexicana de Mastozoologia*, 1:44-58.
- Schwarz, T. F., S. R. Zaki, S. Morzunov, C. J. Peters, and S. T. Nichol. 1995. Detection and sequence confirmation of Sin Nombre virus RNA in paraffin-embedded human tissues using one-step RT-PCR. *J. Virol. Methods*, 51:349-356.
- Seamon, J. O. and G. H. Adler. 1996. Population performance of generalist and specialist rodents along habitat gradients. *Can. J. Zool.*, 74:1130-1139.
- Seidel, G. E. and R. C. Whitmore. 1995. Effects of Dimilin application on white-footed mouse populations in a central Appalachian forest. *Environ. Toxicol. Chem.*, 14:793-799.
- Sekgororoane, G. B. and T. G. Dilworth. 1995. Relative abundance, richness, and diversity of small mammals at induced forest edges. *Can. J. Zool.*, 73:1432-1437.

- Sheafor, B. A. and G. K. Snyder. 1996. Energy partitioning in torpor-sensitive and torpor-resistant deer mice (*Peromyscus maniculatus*). *Can. J. Zool.*, 74:1179-1186.
- Shih, C.-M., L.-P. Liu, and A. Spielman. 1995. Differential spirochetal infectivities to vector ticks of mice chronically infected by the agent of Lyme disease. *J. Clin. Microbiol.*, 33:3164-3168.
- Sikes, R. S. 1995. Costs of lactation and optimal litter size in northern grasshopper mice (*Onychomys leucogaster*). *J. Mammal.*, 76:348-357.
- Smith, D. D. and J. K. Frenkel. 1995. Prevalence of antibodies of *Toxoplasma gondii* in wild mammals of Missouri and east central Kansas: Biologic and ecologic considerations of transmission. *J. Wildlife Dis.*, 31:15-21.
- Solberg, V. B., J. Olson, L. R. Boobar, J. R. Burge, and P. G. Lawyer. 1996. Prevalence of *Ehrlichia chaffeensis*, spotted fever group Rickettsia, *Borrelia* spp. infections in ticks and rodents at Fort Bragg, NC. *J. Vector Ecol.*, 21:81-84.
- Song, J. W., L. J. Baek, I. N. Gavrilovskaya, E. R. Mackow, B. Hjelle, and R. Yanagihara. Sequence analysis of the complete S genomic segment of a newly identified hantavirus isolated from the white-footed mouse (*Peromyscus leucopus*): Phylogenetic relationship with other sigmodontine rodent-borne hantaviruses. *Virus Genes*, 12:249-.
- Song, J.-W., L. J. Baek, J. W. Nagle, D. Shlitter, and R. Yanagihara. 1996. Genetic and phylogenetic analyses of hantaviral sequences amplified from archival tissues of deer mice (*Peromyscus maniculatus nubiterrae*) captured in the eastern United States. *Arch. Virol.*, 141:959-967.
- Song, W., N. Torrez-Martinez, W. Irwin, F. J. Harrison, R. Davis, M. Ascher, M. Jay, and B. Hjelle. 1995. Isla vista virus: A genetically novel hantavirus of the California vole *Microtus californicus*. *J. Gen. Virol.*, 76:3195-3199.
- Stafford III, K. C., V. C. Bladen, and L. A. Magnarelli. 1995. Ticks (Acari: Ixodidae) infesting wild birds (Aves) and white-footed mice in Lyme, CT. *J. Med. Entomol.*, 32:453-466.
- Stallman, H. R. and L. B. Best. 1996. Small-mammal use of an experimental strip intercropping system in northeastern Iowa. *Am. Midl. Nat.*, 135:266-273.
- Stancampiano, A. J. and W. Caire. 1995. Food habits of *Peromyscus* and *Reithrodontomys* in the Wichita Mountains Wildlife Refuge, Oklahoma. *Proc. Okla. Acad. Sci.*, 75:45-49.
- Stansley, W. and D. E. Roscoe. 1996. The uptake and effects of lead in small mammals and frogs at a trap and skeet range. *Arch. Environ. Contam. Toxicol.*, 30:220-226.
- Stapp, P. and B. Van Horne. 1996. Do olfactory cues mediate interactions between rodents on northern shortgrass prairie? *Can. J. Zool.*, 74:226-232.
- Suchecky, D., D. Y. Nelson, H. Van Oers, and S. Levine. 1995. Activation and inhibition of the hypothalamic-pituitary-adrenal axis of the neonatal rat: Effects of maternal deprivation. *Psychoneuroendocrinology*, 20:169-182.
- Sullivan, J., K. E. Holsinger, and C. Simon. 1995. Among-site rate variation and phylogenetic analysis of 12S rRNA in sigmodontine rodents. *Mol. Biol. Evol.*, 12:988-1001.
- Sullivan, J., K. E. Holsinger, and C. Simon. 1996. The effect of topology on estimates of among-site rate variation. *J. Mol. Evol.*, 42:308-312.
- Sullivan, T. P. and J. O. Boateng. 1996. Comparison of small-mammal community responses to broadcast burning and herbicide application in cutover forest habitats. *Can. J. Forest Res.*, 26:462-473.
- Swihart, R. K. 1995. Use of woodchuck burrows by small mammals in agricultural habitats. *Am. Midl. Nat.*, 133:360-363.

- Taylor, A. B. and M. I. Siegel. 1995. Modeling differences in biological shape in two species of *Peromyscus*. *J. Mammal.*, 76:828-842.
- Teferi, T. and J. S. Miller. 1994. Effect of supplemental food on the dispersal of young *Peromyscus maniculatus*. *Ecoscience*, 1:115-118.
- Turell, M. J., G. W. Korch, C. A. Rossi, D. Sesline, B. A. Enge, D. V. Dondero, M. Jay, G. V. Ludwig, D. Li, C. S. Schmaljohn, R. J. Jackson, and M. S. Ascher. 1995. Short report: Prevalence of hantavirus infection in rodents associated with two fatal human infections in California. *Amer. J. Trop. Med. Hygiene*, 52:180-182.
- Ubico, S. R., R. G. McLean, and L. M. Cooksey. 1996. Susceptibility of selected rodent species from Colorado to *Borrelia burgdorferi*. *J. Wildlife Dis.*, 32:293-299.
- Vander Wall, S. B. 1995. Salivary water loss during seed husking in deer mice and Great Basin pocket mice. *Physiol. Zool.*, 68:878-886.
- Wager-Page, S. A. and J. R. Mason. 1996. *Ortho*-aminoacetophenone, a non-lethal repellent: The effect of volatile cues vs. direct contact on avoidance behavior by rodents and birds. *Pestic. Sci.*, 46:55-60.
- Walker, E. D., R. G. McLean, T. W. Smith, and S. M. Paskewitz. 1996. *Borrelia burgdorferi*-infected *Ixodes scapularis* (Acari: Ixodidae) and *Peromyscus leucopus* in northeastern Wisconsin. *J. Med. Entomol.*, 33:165-.
- Wall, S. B. V. 1995. Influence of substrate water on the ability of rodents to find buried seeds. *J. Mammal.*, 76:851-856.
- Wang, Z., S. R. Young, L. Liu, and W. D. Dawson. 1995. Assignment of *Tp53* and *Tk1* to chromosome 13 in *Peromyscus* by fluorescence in situ hybridization. *Cytogenet. Cell Genet.*, 69:97-100.
- White, D. J. 1996. Human and rodent hantavirus infection in New York State. *Arch. Intern. Med.*, 156:722-726.
- Wilkins, K. T. 1995. The rodent community and associated vegetation in a tallgrass blackland prairie in Texas. *Tx. J. Sci.*, 47:243-262.
- Wolff, J. O. 1996. Population fluctuations of mast-eating rodents are correlated with production of acorns. *J. Mammal.*, 77:850-856.
- Wrobel, S. 1995. Serendipity, science, and a new hantavirus. *FASEB J.*, 9:1247-1254.
- Yamada, T., B. Hjelle, R. Lanzi, C. Morris, B. Anderson, and S. Jenison. 1995. Antibody responses to four corners hantavirus infections in the deer mouse (*Peromyscus maniculatus*): Identification of an immunodominant region of the viral nucleocapsid protein. *J. Virol.*, 69:1939-1943.
- Yancey, F. D., II, R. W. Manning, and C. Jones. 1996. Distribution, natural history and status of the Palo Duro mouse, *Peromyscus truei comanche*, in Texas. *Tx. J. Sci.*, 48:3-12.
- Zaki, S. R., P. W. Greer, L. M. Coffield, C. S. Goldsmith, K. B. Nolte, K. Foucar, R. M. Feddersen, R. E. Zumwalt, G. L. Miller, A. S. Kahn, P. E. Rollin, T. G. Ksiazek, S. T. Michol, B. W. J. Mahy, and C. J. Peters. 1995. Hantavirus pulmonary syndrome: *Pathogenesis of an emerging infectious disease*. *Amer. J. Pathol.*, 146:552-579.

