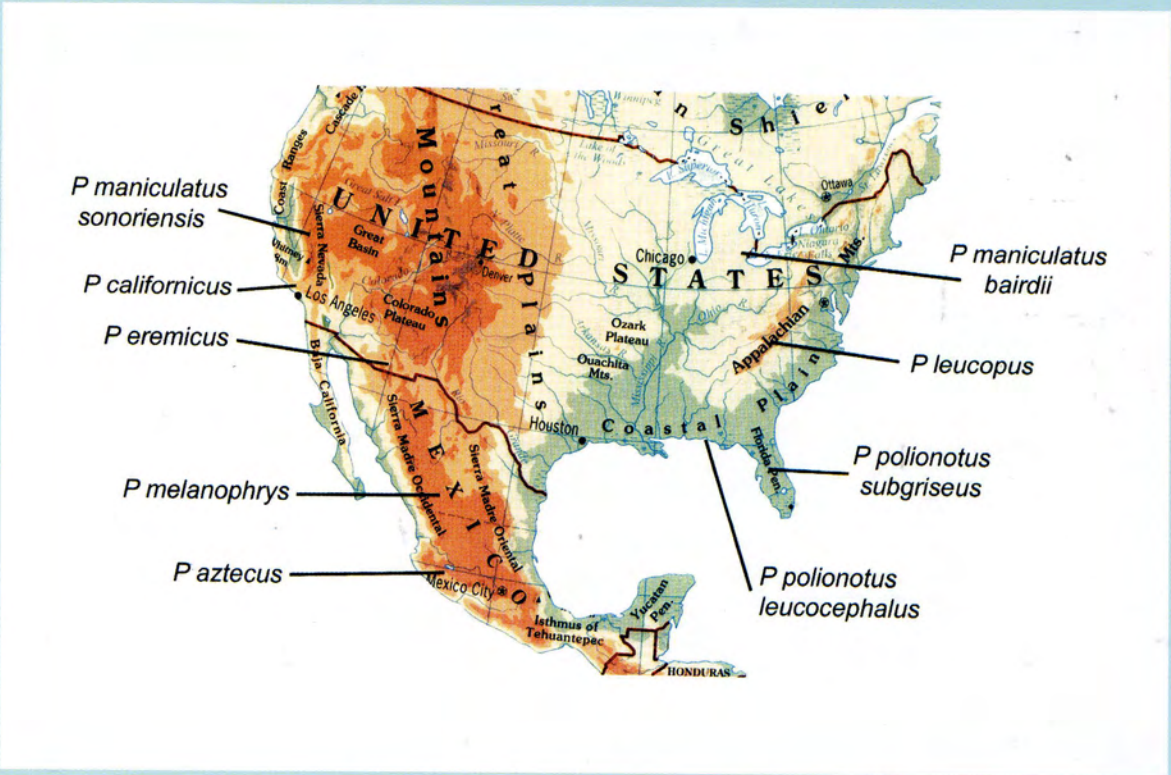
# PEROMYSCUS NEWSLETTER

## NUMBER THIRTY-FOUR




**SEPTEMBER 2002**

Cover: Locales of the founder populations of the wild-type stocks in the Peromyscus Genetic Stock Center. (M.J. Dewey) See p.10

***PN*** ISSUE 34 ---

*PEROMYSCUS NEWSLETTER* is dedicated to sharing information among those interested in deer mice, white-footed mice and other peromyscine rodents whether that interest is professional or amateur. The primary purpose of *PN* is to serve as an informal means of communication among biologists using peromyscus in research and education. Our list of "Recent Publications" is widely used as a quick overview of current peromyscine research.

We also encourage use of ***Pero*Base** : http://wotan.cse.sc.edu/perobase/ that includes the searchable Bruce Buttler Bibliography listing thousands of articles and other references to *Peromyscus* . ***Pero*Base** now has links to many of the American Society of Mammalogists *MAMMALIAN SPECIES* accounts. While there is a certain amount of redundancy between *PN* and ***Pero*Base**, one does not replace the other.

On the cover of this issue is a map showing the locations of the ancestral populations of the various wild-type *Peromyscus* species maintained by the Peromyscus Genetic Stock Center. These nine stocks sample locations that are broadly distributed in the United States and Mexico and represent a diversity of environments and ecosystems. This permits comparison of adaptive traits of closely related species in a variety of ecological settings. See page 8 for more information.

**How to submit an entry to *PN*:** Simply write one or more paragraphs (single spaced, 10-11 size font) describing your project and results. The entry is limited to two printed pages to include not more than one figure or graph. We always encourage grad students as well as others, if they are working with *Peromyscus,* to share their preliminary findings with our readers. Electronic submission to dawson@biol.sc.edu

We welcome and look forward to your research contributions to *PN*, your reports of any news and relevant comments. There is no charge to subscribe. **Deadline** for receipt of entries in the next issue is **15 Mar 03**.

**PEROMYSCUS NEWSLETTER** is produced by the

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## *NEWS, COMMENT and ANNOUNCEMENTS*

Twenty-one papers and posters presented at the annual meeting of the American Society of Mammalogists were devoted to peromyscine rodents. The meeting was held at McNeese State University, Lake Charles, Louisiana.

**Serena Reeder** of Texas Tech University in collaboration with **R.D. Bradley** presented a paper titled "Molecular systematics of neotomine-peromyscine rodents based on the dentin matrix protein 1 gene, and **Quinn Shurtliff, Duke Rogers** and **David McClelland** had a poster "Phylogenetic relationships among sigmodontine rodents based on mitochondrial b DNA sequence data. These and similar studies will hasten a "consensus" phylogenetic tree for peromyscine rodents (See p.8)

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We were recently notified of the death of **Dr. W. B. QUAY** of the Bio-Research Lab, New Bloomfield, MO.

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The February 2002 issue of the PEA News from Princeton University includes the article "Oldfield Mice, Theoretical Biology and the Search for True Love" by **S. Helen Labun**, assisted by **Tatjana Good**. This is a lighthearted discussion of the monogamous habits of *Peromyscus polionotus*, and the evolutionary mechanisms that promote this behavior. The article can be viewed from

*http://www.princeton.edu~pea/feb2002/mice.html*

Our most recently designated "Pioneer", **Don Hoffmeister**, emeritus Professor of Zoology at the University of Illinois, recently mailed us some cartoons of himself that former grad students and colleagues had rendered. One of these, "*Hoffmyscus truei*", is shown on page 6.

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**Janet Crossland**, Colony Manager and Staff Assistant of the *Peromyscus Stock Center,* presented a poster at the 53rd annual meeting of the American Association for Laboratory Animal Science, held in San Antonio TX (October 27-31,2002). The presentation was to introduce deer mice and other *Peromyscus* species to individuals more accustomed to mouse (*Mus*) and rat (*Rattus*) as lab animal species.

*We were saddened to learn of the September 26th death of*

***Charles "Charlie" W. Foreman***

*Dr. Foreman was a professor emeritus at the University of the South (Sewanee) where he taught biology for thirty years (1963-1993). At Sewanee he served a term as department chair and subsequently held the William Henderson Professor of Biology endowed chair. Prior to his appointment at Sewanee, he held faculty positions at Wofford College, University of Maryland and Pfeiffer College. Charlie was a native of Georgia.*

*Charles Foreman was designated a* ***Peromyscus Pioneer*** *by Peromyscus Newsletter in 1994 in recognition of his early contribution to the biochemical genetics of Peromyscus. Charlie was among the very first to utilize electrophoresis of blood proteins to demonstrate biochemical polymorphisms within and between species of Peromyscus. In 1960 Charlie spent a summer research associateship at Oak Ridge National Lab working with Ray Popp who at the time was utilizing electrophoresis to determine the genetics of mouse (Mus) hemoglobin. Charlie applied Popp's methodology to Peromyscus and discovered inherited discrete polymorphisms. This was the first study in Peromyscus, and one of the first in any organism, to demonstrate the mendelian inheritance of a specific protein polymorphism.*

*On a personal note, Charlie was a generous and likeable individual. He was immensely helpful in sharing his expertise with several of my grad students during the 1960s and' 70s. He was dedicated to high quality undergraduate teaching, and thus eventually had to abandon his research program but continued to follow advances in Peromyscus genetics. Charlie is survived by his wife, Elisabeth, three children, Charles, Millicent and Rachel, and two grandsons. He will be missed.*

*A full account of Charlie Foreman's role in establishing the field of biochemical genetics of Peromyscus is given in PN #18 pp.9-12.*

*WD*

**Matthew Camoaioni, Jason Botten, Brian Hjelle and Sabine Loew** in a letter in the May-June 2001 issue of *CDC Emerging Infectious Diseses* describe hantavirus seroconversion of wild-caught *Peromyscus* during quarantine. A portion of the letter is extracted:

"We describe two cases of seroconversion in Peromyscus spp. that were undergoing [a 5-week-long outdoor] quarantine. The results support the use of a quarantine period in combination with hantavirus antibody testing to clear mice for indoor use.

"We collected 132 white-footed mice from one southern and two northern areas of Illinois that have not previously been examined for presence of hantavirus. The average seroprevalence among these mice was 1.5%. Forty-six of these mice were quarantined for 5 weeks, and one underwent seroconversion as detected by strip immunoblot assay. The presence of viral RNA in this mouse was confirmed by [RT-PCR] from lung tissue. In addition, we collected 69 deer mice from an area of New Mexico that had an over all seroprevalence of 20% placed them in quarantine.

One deer mouse delivered four pups while in quarantine and seroconverted 19 days after delivery. While all four pups were seropositive, viral RNA was detected in the dam by using RT-PCR from lung tissue and immunochemistry for heart, lung and liver tissue. Infectiousness of the virus from this mouse was demonstrated by successful passage through uninfected deer mice. The fact that the New Mexico pups had not become infected when they were euthanized at 21 days supports other epidemiological data that suggest that deer mice do not transmit the virus vertically. These results strongly support the recommendations promulgated by Mills et al. and CDC that wild rodents be used as colony founders only if they remain seronegative for hantavirus after a 5-week quarantine period."

**Authors: Camaioni and Loew (Illinois State University, Normal IL), Botton and Hjelle (University of New Mexico, Albuquerque NM)**

**Re: Hantavirus and *Peromyscus* - *THIS JUST IN:***

The November issue of **BioScience** features a comprehensive overview of the *Peromyscus* - hantavirus story. A multi-authored article **"The Ecology and Evolutionary History of an Emergent Disease: Hantavirus Pulmonary Syndrome"** (Yates *et al.* BioScience 52(11):989-998 ) presents the story of hantavirus epidemiology, evolution of the New World hantaviruses, and the association of hantaviral pulmonary syndrome with rodents, and specifically in North America with *Peromyscus.* The article features graphs, maps, tables and photographs and the overlapping phylogenetic diagrams of viruses and rodents. A comprehensive bibliography of forty references documents the account. **The cover** of the November *BioScience* highlights the this feature article with **an up-close view of two deer mice**

## *Pero*Base Needs a Tree

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

THANKS AGAIN TO **ELIZABETH HORNER**! Betty has donated yet additional items for the Peromyscus Genetic Stock Center archives. Her most recent deposition includes correspondence with Elizabeth (Betty) Barto, including a copy of Barto's Ph.D. dissertation describing the boggler mutation in *Peromyscus.* Dr. Horner also donated a set of the *Contributions of the Laboratory of Vertebrate Biology.* The Stock Center has and extensive collection of research materials, including some unpublished data, relevant to *Peromyscus* that are available to researchers. Interested persons should contact the Stock Center for more information.

# Species Descriptions Online

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

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

***Peromyscus attwateri*** **- Texas Mouse**

***Peromyscus californicus*** **- California Mouse**

***Peromyscus caniceps*** **- Monserrat Island Canyon Mouse**

***Peromyscus crinitus*** **- Canyon Mouse**

***Peromyscus eremicus*** **- Cactus Mouse**

***Peromyscus gossypinus*** **- Cotton Mouse**

***Peromyscus leucopus*** **- White-footed Mouse**

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

***Peromyscus pectoralis*** **- White-ankled Mouse**

***Peromyscus pseudocrinitus*** **- Coronados Island Canyon Mouse**

***Peromyscus spicilegus*** **- Gleaning Mouse**

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

***Peromyscus truei*** **- Pinyon Mouse**

***Peromyscus yucatanicus*** **- Yucatan Deer Mouse**

***Peromyscus zarhynchus*** **- Long-nosed Mouse**

***Onychomys leucogaster*** **- Northern Grasshopper Mouse**

***Onychomys torridus*** **- Southern Grasshopper Mouse**

# THE PEROMYSCUS GENETIC STOCK CENTER

## General

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

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

## Policies and Procedures.

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

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

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

## Orders and Pricing.

A user fee of **$17.50 is charged per wild-type stock animal. ($22.50 for corporate users). Coat color and other mutants, as well as special stock animals are currently available for $25 per animal.** User assumes the cost of air shipment. Animals lost in transit are replaced without charge. Tissues, blood, skins, *etc.* are supplied at a modest fee that includes technician time. Arrangements for special orders will be negotiated. Billing will be submitted upon satisfactory delivery. **Write or call for details**.

## Stocks Available

| WILD TYPE STOCKS | ORIGIN |
|---|---|
| *P. maniculatus bairdii*<br>(BW Stock)<br>Deer Mouse | Closed colony bred in captivity since 1948.<br>Descended from 40 ancestors wild-caught near Ann Arbor MI. |
| *P. maniculatus sonoriensis*<br>(SM2 Stock)<br>Sonoran Deer Mouse | Derived from about 50 animals wild-caught by Jack Hayes in 1995 near White Mountain Research Station , CA |
| *P. polionotus subgriseus*<br>(PO Stock)<br>Oldfield Mouse | Closed colony since 1952. Derived from 21 ancestors wild-caught in Ocala Nat'l. Forest FL. High inbreeding coefficient. |
| *P. polionotus leucocephalus*<br>(LS Stock)<br>Beach Mouse | Derived from beach mice wild-caught on Santa Rosa Island FL and bred by R. Lacy. |
| *P. leucopus*<br>(LL Stock)<br>White-footed Mouse | Derived from 38 wild ancestors captured between 1982 and 1985 near Linville NC |
| *P. californicus insignis*<br>(IS Stock)<br>California Mouse | Derived from about 60 ancestors collected between 1979 and 1987 in Santa Monica Mts. CA |
| *P. aztecus*<br>(AM Stock)<br>Aztec Mouse | Derived from animals collected on Sierra Chincua Michoacan, Mexico in 1986. |
| *P. melanophrys*<br>(XZ Stock)<br>Plateau Mouse | Derived from animals collected between 1970 and 1978 from Zacatecas, Mexico and bred by R. Hill. |
| *P. eremicus*<br>(EP Stock)<br>Cactus Mouse | Originated from 10-12 animals collected at Tucson, AZ in 1993. |
| **INTERSPECIFIC HYBRIDS** | |
| *P. maniculatus X P. polionotus*<br>$F_1$ Hybrids | Bred by special order. |
| *P. leucopus X P. gossypinus*<br>$F_1$ Hybrids | Sometimes available by request. |

## MUTATIONS AVAILABLE FROM THE STOCK CENTER[3]

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

**OTHER MUTATIONS AND VARIANTS**

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

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

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

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

[4]Available only as silver/brown double recessive

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

## Other Resources of the Peromyscus Stock Center

Highly inbred *P. leucopus* ($I_{30+}$) are available as live animals or as frozen tissues. Two lines developed by George Smith (UCLA) are currently maintained by the Stock Center.

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

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

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

Reference library of more than 2500 reprints of research papers, articles and reports on *Peromyscus*. Single copies of individual articles can be photocopied and mailed. Please limit requests to five articles at any given time. There will be a charge of 10 cents per photocopied page after the initial 20 pages.

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

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

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

PLEASE CALL WITH INQUIRIES

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# Mexico: "The Center of Peromyscine Diversity"[1]

Mexico is one of the world's richest sources of mammalian biodiversity, and this was reflected in the numerous papers and posters recently presented at the Mexican Mammal Society in Oaxaca (VI Congreso Nacional de Mastozoologia) which I attended. Much of the research is directed at documenting, cataloguing, classifying, and, above all, preserving such diversity.

This was no less true for mice of the genus *Peromyscus*. In the North American continent the peromyscines are easily the most abundant and speciose of the rodents, and it is in Mexico where the vast majority of species are found. This was reflected in the presentations of local scientists at the meeting. Over a dozen presentations focused specifically on *Peromyscus* reproductive physiology, speciation, taxonomy and biogeography. Also peromyscines were abundantly represented in the species surveys carried out in various locales throughout the Republic. In my presentation[2] I emphasized the potential that *Peromyscus* offers for studying the genetics of habitat adaptation and speciation, and that Mexican peromyscines are very likely a rich and untapped source of useful genetic variation. Such would include genes controlling protective coloration, physiological accommodation to environmental extremes, and adaptive behaviors.

In recent millennia the extensive diversity of Mexican peromyscines is likely to have exerted a strong influence on its northern relatives in the United States and Canada. In a recent monograph, Wally Dawson has outlined his views on the role of Mexican peromyscines as a source of novel *Peromyscus* species populating, and repopulating North America with the successive cycles of glacial advances and retreats throughout the Pleistocene. Mexico is envisaged as a "species incubator", and the cyclic glaciations as "speciation pumps."

Mike Dewey
Peromyscus Stock Center Director

[1] Dawson WD (2002) Peromyscine Biogeography, Mexican Topography and Pleistocene Climatology. In: *Contribuciones Mastozoologicas en Homenaje a Bernardo Villa*. Eds. Sanchez-Cordero V, Medellin RA. (Copies available on request.)

[2] Dewey MJ (2002) Entre el Campo y el Laboratorio: El Centro Genetico de *Peromyscus*. *VI Congreso Nacional de Mastozoologia*, Oaxaca

*NOTICE*

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

**Therefore ...**

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

**THANK YOU!**

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**Systematics and Phylogeography of the White-Footed Mouse, *Peromyscus leucopus*: Variation Among Populations Along The Terminal Moraine of New England and Long Island, New York**

Three subspecies are recognized along the southern New England coastline: *P. l. noveboracensis*, the mainland form, also occurs on and the Elizabeth Islands, Massachusetts; Block Island, Rhode Island; and Long Island, New York; *P. l. fusus* occurs on Martha's Vineyard and Nantucket Islands, Massachusetts; and *P. l. ammodytes* on Monomoy Island, Massachusetts (Hall, 1981; Whitaker and Hamilton, 1998).

The Massachusetts island endemics, *P. l. fusus* and *P. l. ammodytes*, are thought to have been derived from a post-Wisconsinan, ice age, coastal-plain population created during northward colonization of the main southern *P. leucopus* population (Waters, 1960, 1969). Portions of the coastal plain population were isolated on islands and peninsulas when sea levels rose, while the main body of the southern source population colonized the mainland to the east and west of the Appalachian chain (Waters, 1960). Genetic divergence of some of those island forms was proposed to be a result of about 6,000 years of geographic isolation (Waters, 1960).

An alternative interpretation asserts that floral and faunal components pushed south by the glaciers may have persisted on the then exposed continental shelf in coastal plain refugia during the Wisconsinan ice age (Fernald, 1911; Kesner, 1972; Lindroth, 1963; Ogden, 1958; Starrett, 1958; Youngman, 1967). As the ice sheet retreated, these refugial populations would have been able to immediately follow the retreating ice sheets in advance of the main southern population. This enabled them to become established along the northeast coast prior to the southern population's arrival. Portions of the refugial populations were then isolated on newly formed islands as glacial melting caused sea levels to rise, thus establishing the relict forms presently occurring on the islands (Kesner, 1972; Starrett, 1958).

I am currently investigating the systematics and phylogeography among insular, peninsular, and mainland populations of *P. leucopus* along the terminal moraine of Massachusetts, Rhode Island, and Long Island, New York. Cranial morphometric and sequence analysis of the mitochondrial replication control region (D-Loop) are being utilized to characterize geographic variation among and within populations, and to determine the taxonomic status of the subspecies and the evolutionary and geographic origin of the various populations.

The hypothesis being tested is that the insular populations are genetically distinct relicts, originating from pre-Wisconsinan northern populations in coastal refugia, that colonized the newly formed coastal islands off of southern New England prior to island isolation by rising sea levels. These populations are genetically distinct from mainland populations, whose origins were from southern sources that moved northward along the coast after sea levels rose.

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## Zoogeography of *Peromyscus maniculatus* in Massachusetts

Although *Peromyscus* is one of the most studied mice in the United States, the eastern range limits of *Peromyscus maniculatus* in Massachusetts are not known. Habitat characterization and population sampling in Massachusetts is needed in order to define the range and habitat preferences. *Peromyscus maniculatus* is similar in appearance to *P. leucopus* through much of its range in North America. When they occur sympatrically, they are often difficult to distinguish morphologically. Both external (pelage coloration, tail/ear/body length, tail penciling and tail bicoloration) and internal (cranial measurements) characteristics are often necessary to correctly identify individuals. In combination with morphology, salivary amylase provides 100% accurate identification. The goal of this study is to elucidate the habitat preferences and geographical distribution of this mouse in Massachusetts. (Fieldwork is in progress.)

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**Entrainment Impaired, Masking Spared: An Apparent Genetic Abnormality that Prevents Circadian Rhythm Entrainment to 24-Hour Lighting Cycles in California Mice**

Daily recurring (or circadian) rhythms of behavior and physiology are traits common to virtually all living organisms. All organisms synchronize (entrain) their internally generated circadian rhythms to the day-night cycle by various means, but the light intensity changes associated with this cycle are probably critical for most species. Light can affect daily activity rhythms in at least two ways: by entrainment of the endogenous circadian pacemaker that normally drives this rhythm, and by directly affecting the expression of activity itself. The latter effect is referred to as 'masking' because light (or another environmental factor) masks or obscures the influence of the endogenous pacemaker, which will again exert control when the masking event ends, without altering the pacemaker's rhythmicity. The masking effects of light are not exerted on the pacemaker, but affect behavior directly, for example, by suppressing locomotor activity in nocturnal rodents. Light entrains the daily activity rhythms of mammals by altering the period of an endogenously rhythmic pacemaker, housed in the hypothalamic suprachiasmatic nucleus (SCN), to match the period of the external light-dark (LD) cycle. In general, the endogenous period is close to, but different from, 24 h, and daily light exposure acts to set the pacemaker's period to 24 h and to stabilize its phase relation to the LD cycle. In other words, daily light exposure controls activity rhythms by some combination of modulating the period and resetting the phase of a neural pacemaker that drives these rhythms.

In the course of a study of circadian rhythms of California mice (*Peromyscus californicus*) that routinely entrained to standard LD 12:12 cycles (12 h of light daily), we identified one male mouse (CM558) that failed completely to entrain to this cycle. This mouse expressed a high-amplitude, free-running (unentrained) circadian rhythm, as a blind mouse would, but also showed robust masking in response to light exposure confirming that light information was reaching the brain of this animal although it failed to synchronize his SCN pacemaker (Fig. 1). On behavioral testing, CM558 responded to visual stimuli and showed normal pupillary constriction in response to ophthalmascopic illumination. The circadian phenotype of this animal appears to have genetic components, since we observed a similar behavioral abnormality in the progeny of selective crosses. The inheritance pattern is likely autosomal recessive, since none of the F1 animals showed the behavioral abnormality themselves, and the abnormality occurred in both male and female F2 animals. These mice are described further in a recent publication (*Neurosci Lett*, 2002, 327(3), 203-7).

Subsequent research presented at a recent scientific meeting (Society for Research on Biological Rhythms, 2002) has shown that the retinohypothalamic tract that transmits light information to the SCN in affected animals is intact, and that exposure to a discrete light pulse results in an upregulation of immediate-early gene expression in the SCN, indicating that although light information reaches the SCN, the pacemaker does not respond appropriately to it. The affected mice are the first example in any species of animals expressing an apparently normal circadian rhythm that is not entrained by light, but that still show potent masking responses to light exposure. Our serendipitous discovery of an apparently heritable defect in the entrainment mechanism is of special interest since, although a great deal is known about the molecular and genetic components of the circadian clock, very little is known about the ways in which light modifies the functioning of these components. Since the abnormality appears to be genetically transmitted, the potential exists for developing a line of California mice in which entrainment is lost selectively, thereby permitting a detailed physiological analysis of the mechanisms involved directly in photic entrainment.

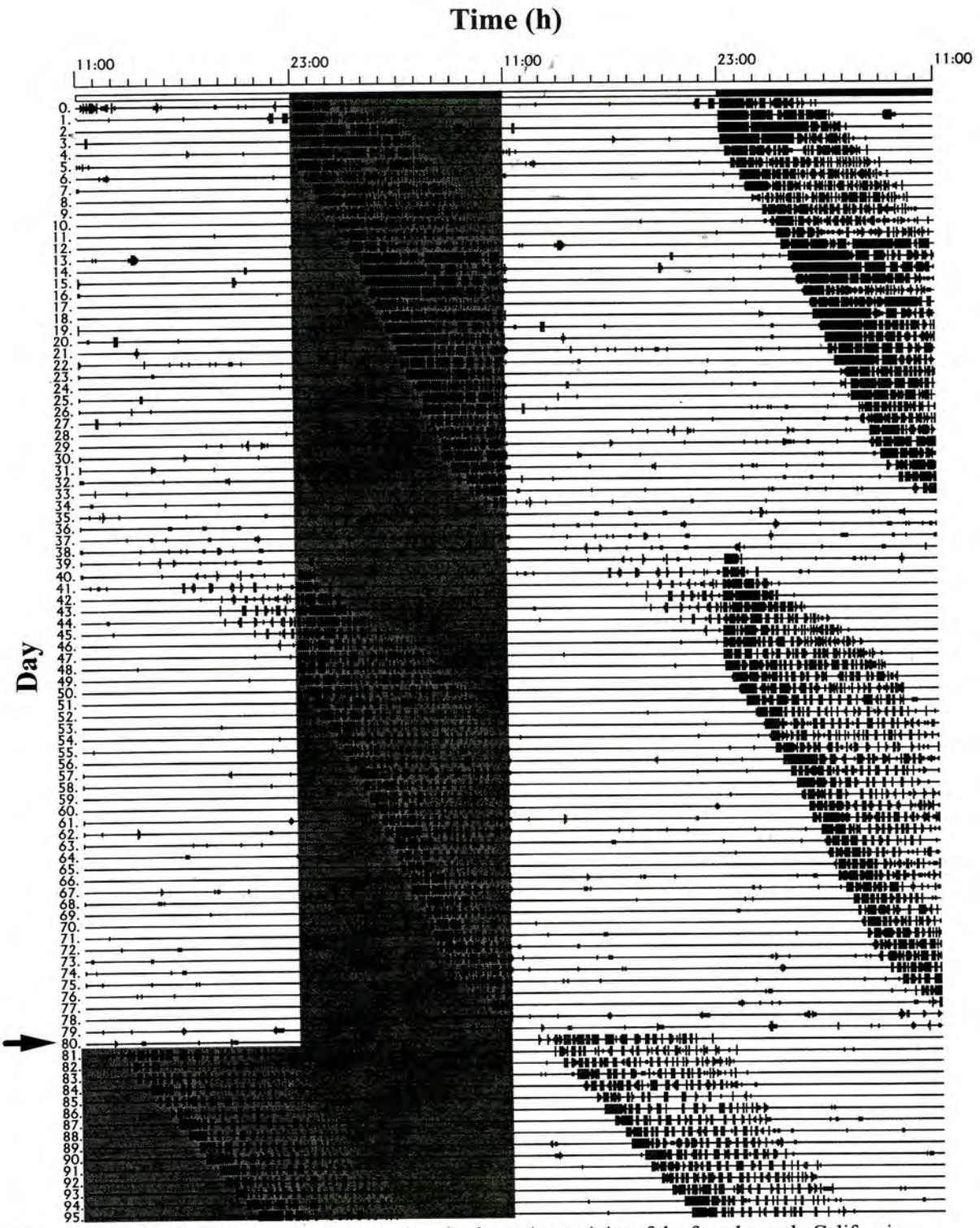


**Figure 1**. Double-plotted actogram showing the wheel-running activity of the founder male California mouse. Horizontal lines are 48 h (shown in time bar across the top), with consecutive days (numbered 0 - 95) plotted along the vertical axis. Vertical deflections along the horizontal lines represent wheel-running activity counts, with the larger deflections indicating higher levels of wheel-running activity. The LD cycle is shown in the bar across the top (open bar = light phase), and the shaded area on the left-hand side shows when the animal was in darkness. The arrow indicates the last day of the LD 12:12 cycle.

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**Behavioral Responses of Cotton Mice (*Peromyscus gossypinus*) to Large Amounts of Coarse Woody Debris**

Coarse woody debris (CWD) is any log, snag, or downed branch >10 cm in diameter. Previous research points to CWD as a critical habitat component for a number of rodents, including cotton mice. As a resource that is amenable to management, it is worthwhile to determine the attributes of CWD that influence the type and extent of use by small mammals. In May 2002 we initiated a field study to examine patterns of space use, movement, and habitat selection of cotton mice in areas with and without large amounts of coarse woody debris with the overall goal of determining the contribution of CWD to habitat quality. This study is being conducted in six 9-ha plots in 50-year old loblolly pine stands on the Savannah River Site in South Carolina. The plots represent three replicates of two treatments: Control and Log Pulse. Trees were felled in the Log Pulse plots to increase log volumes to six times the amount on Control plots. We used radio-telemetry and fluorescent powder tracking to evaluate movement patterns, home range characteristics, and refuge selection relative to CWD and other structural variables. Low trapping success (3 captures/1000 trap nights) limited the number of animals we were able to track to 8 mice with radio-telemetry and 12 mice with fluorescent powder. The movement path data obtained from powder tracking were highly variable. Total path length ranged from 18 to 264 m. We will use regression analysis to determine the relationship between the fractal dimension of the path and measurements of cover provided by logs, shrubs, and herbaceous vegetation. It is noteworthy that although log densities are artificially high in half of the study plots, the mean portion of paths associated with logs (10%) is lower than previously reported values. Through radio-tracking, we identified 63 unique daytime refugia of which the majority were in rotted stumps (70%) and root boles (10%). Patterns of use-intensity for the 'neighborhood' of refuges in stumps suggests that there is an inverse relationship between the amount of herbaceous and low-lying woody ground cover and extent of use. There is also some evidence that use-intensity of stump refuges increased with the stage of decomposition. Relationships between refuge use-intensity and microhabitat variables will be more thoroughly investigated through model development in a polytomous logistic regression framework. The second, and final, field season for this project is scheduled to begin in February or March and run through July 2003.

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**An Assessment of the Trapping Web for the Density Estimation of Small Mammals**

Abstract:

The trapping web, a distance-sampling method by which the density of small mammal populations may be directly estimated without an accompanying estimate of effective trapping area, has seldom been used or evaluated since its introduction in 1983. Previous assessments, having evaluated simulated and/or limited amounts of empirical data, have generally supported the continued use of the trapping web method; yet, few have evaluated (or described) basic mechanisms integral to its performance. Animal movement on trapping webs must be "stable" (i.e., no directional movement, especially towards web centers); however, traps (especially live-traps) are known to affect the natural movements of many animal species in a complex manner. Our objectives were to assess how the gradient of trap densities that characterize the trapping web design may affect the movement and capture probability of small mammals, and evaluate the implications of these effects on population estimates. We examined the movements of individual white-footed mice (*Peromyscus leucopus*) over a wide range of population densities, using live-trapping data from 24 trials on 12 individual, 3-ha trapping webs located at seven sites throughout central Massachusetts, August-December 1996-98. Our results suggest that the gradient of trap densities intrinsic to the trapping web design may itself mechanistically displace animals toward web centers; such movement potentially exacerbating "edge-effect" in outermost rings (i.e., extending the effect further toward web centers), limiting the duration of trial periods, negating the use of recapture data from trapping webs, and most deleteriously, biasing estimates of population density (exhibited as frequency "spikes" in innermost web rings). Such movement by small mammals on trapping webs may be ameliorated by increasing trap spacing along web radii; in the case of *P. leucopus*, 20-30 m trap spacing may suffice, except at very low densities.

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## Effects of Exotic Plant Invasion and Associated Biological Control Agents on Deer Mouse Populations

Exotic plant invasions threaten natural systems around the world, and biological control, in which exotic insects are introduced to reduce densities of target plant species, is a prevalent management approach. However, few studies have considered effects of exotic plant invasions and associated management practices on native fauna. Previous research conducted in western Montana by Pearson et al. (2000) demonstrated that the foraging ecology of the deer mouse (*Peromyscus maniculatus*) has been dramatically altered by two gall flies (*Urophora affinis* and *U. quadrifasciata*) introduced for the biological control of spotted knapweed (*Centaurea maculosa*), a widespread exotic plant in the western North America. Deer mice inhabiting grasslands invaded by spotted knapweed have become aggressive gall fly predators and can consume hundreds of larvae per mouse per day. Here, we highlight results from a second study conducted in western Montana to examine effects of knapweed invasion and associated gall fly biocontrols on deer mice populations (Ortega et al. unpubl. manuscript). We found that the relative abundance of deer mice was elevated in grassland habitats with moderate densities of spotted knapweed and gall fly food sources, compared to habitats dominated by native vegetation, in 2 of 3 years of the study. Availability of gall fly larvae during the critical overwinter period appeared to reduce overwinter population declines of mice in knapweed-invaded habitats by increasing survival. Conversely, deer mouse breeding productivity was reduced in knapweed-invaded habitats, likely due to the loss of gall fly resources during summer, when adult gall flies emerge from knapweed seedheads and mice are left with native resources diminished by knapweed invasion. Thus, the positive effects of gall fly resources on overwinter survival more than compensated for the negative effects on breeding productivity associated with knapweed invasion and the lack of gall fly resources during summer. These results suggest that insect biocontrol agents can subsidize deer mouse populations. Furthermore, deer mouse populations elevated by gall flies could impact native plants and insects commonly consumed by deer mice, and affect humans through increased hantavirus prevalence. Studies are currently underway to examine these potential consequences.

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## Pharmacotherapy in a mouse model of spontaneous stereotypy

### Introduction

Deermice housed in standard laboratory conditions demonstrate spontaneous stereotypical behaviour, and these have been proposed to represent an animal model of OCD. The aims of this study were to characterize this potential model by determining whether chronic administration of different pharmacological reagents, known to reduce obsessive-compulsive symptoms, also reduces stereotypical behaviour in deermice and to determine whether these treatments have an effect on NMDA receptors in the frontal cortex.

### Materials and Methods

40 Adult deer mice (*Peromyscus maniculatus bairdii*) were randomly divided into 4 groups with 6 females and 4 males in each of the groups. A trial of 9 weeks (one week for baseline and 8 weeks for treatment) were conducted. During treatment, the 4 groups received i.p. injections daily with saline, inositol(metabolic precursor of the phospho-inositide second messenger pathway 1,2 g/kg), citalopram (SSRI 1mg/kg) or risperidone(Dopamine antagonist 0,1 mg/kg). The behaviour of the mice were recorded for 15 minutes/week for 5 minutes at a time, either in the morning before 11am or in the evening after 4pm to ensure high activity levels. Ratings were done by raters that were blind to the medication status of the mice and a 5 second interval scoring system were used in which the absence or presence of stereotypies such as backward somersaults and patterned running were noted. Summed ratings for every week of the trial will be compared across the groups.

After 8 weeks of treatment, the mice were sacrificed by decapitation and the frontal cortex dissected. Radioligand binding studies were performed on NMDA receptors using $^{3H}$ MK-801.

### Results

There were no significant differences in stereotypical behaviour between the groups and weeks.

There is a trend towards higher Bmax values of NMDA receptors in the treatment groups when compared to the control group. Risperidone also decreased the affinity of the NMDA receptors. No significant differences were found.

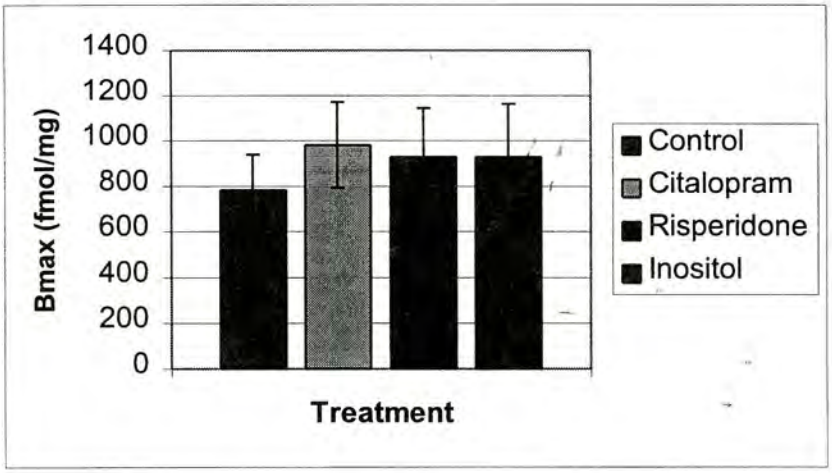


Fig 3: Bmax values ± SEM for NMDA receptors in the frontal cortex. No significant differences were found between treatment groups.

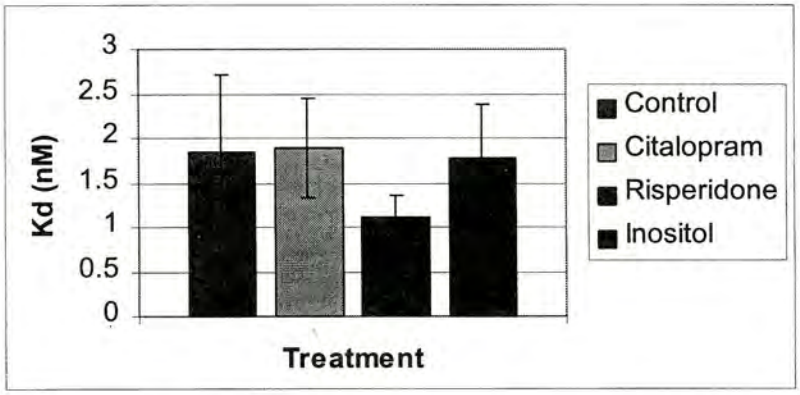


Fig 4: Kd values ± SEM for NMDA receptors in the frontal cortex. No significant differences were found between treatment groups.

## Conclusion

Deermice could be used as a model for OCD. Our results were not significantly different and this could be because of insufficient duration of the treatment and insufficient dosages. We experienced difficulty in handling the mice. We would like to repeat the study with higher dosages to compare the effects of the treatments.

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**Mating System of the Canyon Mouse (*Peromyscus crinitus*) Using Microsatellite DNA Markers**

Within *Peromyscus,* mating systems usually have been inferred from field studies of male and female spatial relationships and from laboratory behavioral studies (Wolff, 1989). The majority of such studies have indicated that multiple paternity seems to be the predominant mating system within this genus. Only 4 species of *Peromyscus*, however, have been analyzed using molecular data to determine the mating system. Of those, two were found to employ a multiple paternity (*P. maniculatus* [Ribble and Millar, 1996], *P. leucopus* [Xia and Millar, 1991]), and two a monogamous system (*P. californicus* [Ribble, 1991], *P. polionotus* [Foltz, 1981].

The Canyon mouse (*P. crinitus*) is endemic to Western North America and occurs in Oregon, California, Idaho, Utah, Wyoming and Colorado, southward to New Mexico, Sonora, and Baja California Norte (Johnson and Armstrong, 1987). Although deer mice have been relatively well studied, *P. crinitus* is less well known and the literature is devoid of conclusive evidence as to the mating system that it employs. Using microsatellite DNA markers, I will test the hypothesis posited by Dewsbury (1981) that *P. crinitus* employs a polygamous mating system.

My study site is located on Stansbury Island – an uninhabited rocky peninsula jutting out into the Great Salt Lake, Tooele Co.,Utah. The "island" rises several hundred feet above the level of the surrounding lake and consists of granite cliffs and ridges that erupt from a predominately cheat grass habitat. Approximately 6,200 trap nights yielded 63 *P. crinitus* (44 males and 18 females) from two disjunct sites. Embryos were extracted from eleven pregnant females as well as from two additional females that were captured at a different Utah local two years ago. The average litter size was 4.0 with a maximum of 5 and minimum of 3 embryos per litter. The location of each animal was marked using a Global Positioning System unit and distances were assayed between animals trapped within 30 m of each other using a 100 m measuring tape.

Heart, liver, kidney and spleen tissues were taken from all individuals for DNA work. I have successfully extracted DNA from all adult *P. crinitus* as well as from the embryos. Currently, I am in the process of optimizing primers that were used for *P. leucopus* microsatellite loci by Schmidt (1999). Thus far, two primer pairs have amplified DNA segments using the Polymerase Chain Reaction (PCR) that show up as strong bands on an agarose gel. These bands correspond to the approximate sizes outlined by Schmidt and I am awaiting results from our DNA sequencing center, which will allow me to determine if the amplified microsatellites are polymorphic.

In the future, I plan to use at least six primer pairs to fingerprint each adult animal and embryo. If the microsatellite data support the hypothesis of Dewsbury (1981), I should find up to 2 different maternal (1 allele for homozygous and 2 for heterozygous females) and >2 paternal alleles. Three or more paternal alleles imply that at least 2 males sired the litter. Several litters resulting in 3 or more paternal alleles will lend support to the hypothesis that *P. crinitus* does employ a multiple paternity mating system in the target population. After paternal markers have been determined within each litter I will attempt to correlate male morphological characteristics and parasitic load to breeding success in an effort to establish an association between morphology and male fitness.

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