PEROMYSCUS
NEWSLETTER

NUMBER   SIX

SEPTEMBER 1988

Cover: Hairless-2 Mutant in
        Peromyscus maniculatus.

        (Egoscue, H.J. 1962.
         J. Hered., 53:192-194)

        Photo by Clint Cook

ABOUT THIS ISSUE

This is our first issue to be largely laser printed. We hope the new style will be more readable. The transition to a different printer has delayed us a few weeks, but we hope by the next issue to be back on schedule.

In PN #7 Oscar Ward gives us an update on progress toward revising the standard karyotype - see **"Cytogenetics"**, page 17. A number of individuals have been actively working on this project and it should reach fruition in the near future.

Also in this issue we highlight **Emmet T. Hooper** as our "Peromyscus Pioneer". Hooper's many contributions to the systematics of peromyscine rodents are well known. Probably no individual since Wilfred Osgood has influenced the systematics of *Peromyscus* and related taxa to the extent that Hooper and his students have. We wish to thank **Jim Brown, Mike Carleton, Charles O. Handley, Tim Lawlor, Guy Musser,** and **Phil Myers** for providing information. Dr. Hooper's brother, **Dr. Frank F. Hooper,** kindly supplied missing details. We also express our appreciation to Dr. William Dawson and Patty Wolfe of the University of Michigan Department of Zoology for their assistance in providing biographical data.

On page 15 we summarize information about various "hairless" mutants of *Peromyscus.* In a coming issue we plan to have a similar summary of behavioral mutants in the genus.

PLEASE NOTE. Contributed entries are down. We need reports about your *Peromyscus* research. Nothing fancy....just a general description of what's happening in your lab or field project. Keep those entries coming!

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C O N T E N T S

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NEWS and COMMENT

A new *ad hoc* **Committee to Standardize Peromyscus Cytogenetic Nomenclature** and to develop a revised standard karyotype has been formed. **Ira Greenbaum** and **Scott Gunn** have a tentative standard which they are now refining and circulating to the committee members for comment. The new standard incorporates several features which improve upon the original 1977 standard. On page 17 of this issue of PN **Oscar Ward** describes the progress which has been made to date.

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Laura McClellan and Kim Nelson have completed their dissertation research, at Kansas State and Harvard, respectively, and are changing to other pursuits. Laura will be working with *Crocidura,* and Kim has taken a position at Harvard Medical School. Kim presented a featured paper, **"MtDNA evolution in *Peromyscus leucopus*: Genetic structure in populations within a hybrid zone"**, at the annual meeting of the American Society of Mammalogists in June. Altogether thirty-two papers and posters on *Peromyscus* were presented at the ASM meeting held this year at Clemson University.

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Bill Timberlake informs us that the *P. californicus* colony at Indiana University has been disbanded.

John Glendenning has moved to Florida State University and is establishing a breeding stock of *P. melanotis* there.

Rodney Honeycutt will be moving to Texas A&M University in January. **Holly Wichman** also has moved from University of Missouri at Kansas City to the University of Idaho.

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A recent paper by Daniel Pine, Eric Bourekas and Steven Potter (*Nucleic Acids Research*, **16:**3359) describes transgenic mice (*Mus*) into which *Peromyscus* mys elements have been introduced. The mys element, which appears to be specific to New World cricetines and is not detectable in *Mus,* was transcribed only in testes and heart of *Mus,* whereas it is transcribed in a wide array of tissues in *P. leucopus.*

Mark Chappell and Jack Hayes of U.C.-Riverside recently published two interesting papers in *Evolution* (**42:**681-688; 689-697) demonstrating functional correlation between genetic hemoglobin variants and altitude in *P. maniculatus.*

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"Hairless" deer mice are the subject of research sponsored by Upjohn Corporation on treating baldness. A grant to **Loren Knapp** at the University of South Carolina utilizes the hairless-2 mutant, originally described by Harold Egoscue. **Lisa Kwarsick** and **Joanne Hoppenhauer** have been involved in this work.

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Peromyscus truei available. Elizabeth Horner is phasing out some of her animal stocks. The *P. truei* colony numbers approximately 20 young and still-breeding older animals. These are all laboratory-bred, the progenitors having been trapped several years ago in Esmeralda County, Nevada. Entire stock available immediately, for cost of shipping, from Elizabeth Horner, Department of Biological Sciences, Smith College, Northhampton, MA 01063.

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Lisa Bronsro of the Zoology Department at the University of British Columbia, Vancouver, is working with photoperiodic response of *P. maniculatus* under very short and very long day cycles. She has noticed that some of her wild-caught animals appear to have a color change, with an extensive white band around the mid-section. The pattern begins on the ventrum and gradually extends until it forms a broad belt around the animal. In one case the posterior of the animal is very nearly white and the anterior is fully pigmented, a condition reminisent of "half color" in swine.

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Several papers and posters dealing with *Peromyscus* were presented at the AIBS meeting at Davis, California, in August. John Porter (U. Va.), William Vickery (U. Montreal), John Glendinning (U. Fla.) and Glennis and Don Kaufman were among those who made presentations.

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Bill Kilpatrick, University of Vermont, is involved in DNA/DNA hybridization studies, as a method to ascertain the affinities among taxa of peromyscine rodents. He is collaborating with Charles Sibley in this effort.

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Bruce Buttler (Canadian Union College, Alberta) has analyzed recent literature on *Peromyscus*. About half of the published papers are ecologically or environmentally oriented, and about 20% are physiological. The remainder deal with parasitology, genetics, behavior and systematics in that order.

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PEROMYSCUS STOCK CENTER

What is the Stock Center? The deer mouse colony at the University of South Carolina has been designated a genetic stock center under a grant from the Biological Resources 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 $5 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 charge. Write or call for details.

Stocks Available in the 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. leucopus (LL Stock)	Derived from 38 wild ancestors captured between 1982 and 85 near Linville NC. Third to fifth generations in captivity.
P. maniculatus X P. polionotus F_1 Hybrids	Sometimes available.

MUTATIONS IN THE SOUTH CAROLINA STOCK CENTER:

Coat Colors	ORIGINAL SOURCE
Albino **c/c**	Sumner's albino deer mice (Sumner, 1922)
Black (Non-agouti) **a/a**	Horner's black mutant (Horner et al., 1980)
Blonde **bl/bl**	Mich. State colony (Pratt and Robbins, 1982)
Brown **b/b**	Huestis stocks (Huestis and Barto, 1934)
Dominant spotting **S/-**	Wild caught in Illinois (Feldman, 1936)
Gray **g/g**	Natural polymorphism. From Dice stocks (Dice, 1933)
Ivory **i/i**	Wild caught in Oregon. (Huestis, 1938)
Pink-eyed dilution **p/p**	Sumner's "pallid" deer mice. (Sumner, 1917)
Platinum **pt/pt**	Barto stock at U. Mich. (Dodson et al., 1987)
Silver **si/si**	Huestis stock. (Huestis and Barto, 1934)
White-belly non-agouti **a^w/a^w**	Egoscue's "non-agouti" (Egoscue, 1971)
Wide-band agouti **A^{Nb}/-**	Natural polymorphism. Univ. Michigan stock (McIntosh, 1954)
Yellow **y/y**	Sumner's original mutant. (Sumner, 1917)

Note: Some of the coat color 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 Mutants and Variants	ORIGIN
Alcohol dehydrogenase negative **Adh°/Adh°**	South Carolina BW stock. (Felder, 1975)
Alcohol dehydrogenase positive **Adh'/Adh'**	South Carolina BW stock. (Felder, 1975)
Epilepsy **ep/ep**	U. Michigan **artemisiae** stock. (Dice, 1935)
Flexed-tail* **f/f**	Probably derived from Huestis flexed-tail (Huestis and Barto, 1936)
Hairless-2 **hre/hre****	Egoscue's hairless (Egoscue, 1962)
Juvenile ataxia **ja/ja**	U. Michigan stock. (VanOoteghem, 1983)

Enzyme variants. Wild type stocks given above provide a reservoir for several enzyme and other protein variants. See Dawson, et al. (1983).

*Available only on pink-eye dilution background.
**Temporarily unavailable.

Limited numbers of other stocks, species, mutants 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:

> W. D. Dawson
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> Department of Biology
> University of South Carolina
> Columbia SC 29208
> (803) 777-3107

The Advisory Committee for the Peromyscus Stock Center:

John C. Avise (University of Georgia)
Ira F. Greenbaum (Texas A and M University)
Clement L. Markert (North Carolina State University)
Joseph H. Nadeau (Jackson Laboratory)
Suellen Van Ooteghem (Westinghouse Corporation)
Wallace D. Dawson (University of South Carolina)

EMMET T. HOOPER

A major figure in the development of *Peromyscus* systematics is Emmet Thurman Hooper Jr. No individual since Wilfred Osgood influenced the classification of the genus to the extent that Hooper has. His comprehensive review **"Classification"** in *Biology of Peromyscus* (1968. J.A. King, Ed.), and his papers **"The male phallus in mice of the Genus Peromyscus"** (1958. *Misc. Publ. Mus. Zool.* Univ. Mich. **105**:1-24) and **"Notes on classification of the rodent genus *Peromyscus*"** (1964. With G.G. Musser. *Occ. Pap. Mus. Zool.* Univ. Mich., **635**:1-13) are central works in the systematics of the genus. Hooper also was the first to critically assess the relationships of *Peromyscus* to other peromyscine and neotomine rodents. He and his students have largely defined our present taxonomic concept of this murid complex.

Emmet Hooper was born in Phoenix, Arizona, August 19, 1911, the older of two children. His father, a warehouseman, had come to Arizona from Mississippi. Emmet spent his childhood in Phoenix, but the family moved to San Diego by the time he was in high school. Enthusiasm for the outdoors and hunting during his youth led to an interest in mammals, and his ultimate choice of a career. Hooper accomplished most of his undergraduate work at San Diego State College, but subsequently transferred to the University of California at Berkeley, where he received the bachelors degree in 1933. While at Berkeley he worked part time as an assistant with US Fisheries Bureau. He remained at Berkeley for his graduate work at the Museum of Zoology, receiving the MA degree in 1936 and the Ph.D. in 1939. His dissertation, directed by Joseph Grinnell, treated the geographic variation in woodrats in the San Francisco Bay area. Hooper was among the last of Grinnell's many illustrious students. At Berkeley he also came into association with E. Raymond Hall, another prominent mammalogist. While in graduate school, Hooper met and married Helen Bacon, and their two sons, Alan and Kim, were born in the ensuing years.

In 1939 Hooper published his first paper dealing specifically with *Peromyscus* (*J. Mamm.*, **20**:257), a brief discussion of sparsity of deer mice in marsh habitats on the California coast.

In 1938 Hooper accepted a position as Curator of Mammals at the University of Michigan Museum of Zoology, where two other former Grinnell students, William Burt and Lee Dice, had previously situated. Hooper held this post until his retirement forty-one years later. During World War II he served in the Army Air Corps stationed in Idaho as a physiologist. In 1946 he joined the Zoology faculty as an Assistant Professor and advanced to the rank of Professor by 1958. Emmet Hooper and William Burt, his colleague at the museum for many years, helped established the reputation of the University of Michigan as a premier institution for the study of mammalogy.

Hooper travelled to Mexico and Central America on several occasions where collections of *Reithrodontomys*, *Baiomys*, *Nelsonia* and other genera stimulated expanded studies of peromyscines and neotomines. A comprehensive comparative study of dentition of *Peromyscus* was published in 1957 (*Misc. Pub. Mus. Zool.* Univ. Mich., **99**:1-59). About this time Hooper recognized the value of the elaborate structures of rodent male genitalia as taxonomic criteria, and in 1958 published his well known study, cited above, on *Peromyscus* phallic morphology. He extended description of the glans penis to other species and eventually arrived at a phylogenetic scheme of relationships among New World cricetines. One of his students, Guy G. Musser, was closely associated with these studies, and collaborated with Hooper on his 1964 rearrangement of *Peromyscus* systematics cited earlier. Other of his associates and students conducted parallel studies. George C. Rinker, described the comparative

myology of *Peromyscus* and related taxa, and Michael Carleton analyzed stomach morphology of New World cricetines. Hooper pioneered in utilization of soft anatomy in mammalian taxonomy. It became a hallmark of his work and is one of his major contrbutions to his field.

The classification of *Peromyscus* published by Osgood in 1909 had remained essentially intact for fifty years, the only significant change had been the elevation of *Baiomys* (pygmy mice) from subgeneric back to full generic rank by Miller (1912). The Hooper-Musser treatment departed from the Osgood classification in several repects. The golden mouse (*Ochrotomys nuttalli*) was removed from the genus. *P. crinitus* was removed from subgenus *Haplomylomys* and included in the *P. crinitus* species group within subgenus *Peromyscus*. The *P. megalops* species group was submerged into the *P. mexicanus* species group. Subgenera *Osgoodomys*, *Habromys* and *Isthmomys* were erected to include atypical species from Mexico and Central America. Among genera closely allied to *Peromyscus* were *Reithrodontomys* (harvest mice) and *Neotomodon* (volcano mouse). The Hooper-Musser system was reiterated in Hooper's previously mentioned 1968 review in *Biology of Peromyscus.* Nevertheless, these changes represented a relatively conservative modification of Osgood's original scheme.[1]

Hooper's bibliography includes some eighty-five titles. While only eight of his papers specifically treat *Peromyscus*, numerous others involve *Peromyscus* and related genera in the context of more general studies. Most of his work is published in either the *Occasional Papers* or *Miscellaneous Publications of the University of Michigan Museum of Zoology*. However, he was also a frequent contributor to *Journal of Mammalogy*. Hooper trained about a dozen Ph.D. students, many of whom worked with *Peromyscus*. His students include James Brown, Michael Carleton, Ted Flemming, Charles Handley, David Huckaby, David Klingener, James Alden Lackey, Timothy Lawlor, Guy Musser, Wilbur Quay, Joan Williamson and John Winklesmann, many of whom have made contributions in their own right.

It is noteworthy that Hooper, as well as Burt, at the Michigan Museum of Zoology overlapped Lee R. Dice, W. F. Blair, Elizabeth Barto and others at the University Laboratory of Vertebrate Biology who also were actively working with *Peromyscus,* particularly during the 1940's and 50s. Although Dice and Hooper were both students of Grinnell, their approaches to systematics were very different. Dice's interests focused on the genetic variability of individual populations and his work involved laboratory breeding as well as field studies (See **PN #4**). Hooper concentrated on morphological distinctions at the level of species and higher taxa. His materials were preserved specimens which included both the traditional skins and skulls, and also special soft anatomy collections. By the 1960s, when Hooper and his students became enmeshed in peromyscine systematics in a major way, the Dice group had passed its heyday and was declining. The Museum of Zoology and the Vertebrate Biology Laboratory groups worked largely independently during this period, but some interaction occurred. The shared interests of the Laboratory of Vertebrate Biology and the Museum of Zoology in the genus made the University of Michigan *the* national center for *Peromyscus* biology for many years.

Emmet Hooper was honored in many ways. He served as President (1962 - 1964) and Vice President (1958 - 1962) of the American Society of Mammalogists. He was elected to Honorary Membership of this organization in 1976. He also served in numerous other scientific and academic capacities, including Program Director (1964 - 1965) for the Systematics Section at the National Science Foundation. Perhaps the most significant recognition came in 1977 when a newly described species from Mexico, *Peromyscus hooperi*, was named in his honor (1977. Lee and Schmidley. *J. Mamm.*, **58**:263-268; 1985. Schmidley et al. *Occ. Pap. Mus.* Texas Tech Univ., **97**:1-40).

Hooper impresses his colleagues as a congenial, distinguished individual. Although a somewhat reserved and private

person, he interacted with his students and associates in a positive fashion. He held firm ideas about approaches to work both in the field and museum. He commanded the respect of his students, insisted on high standards of performance and conducted a disciplined, structured operation. Hooper would not tolerate slackness, but was always willing to share his expertise on a one-to-one basis with serious graduate students and colleagues. Emmet Hooper's interests extend well beyond the narrow limits of systematics. He is knowledgeable in physiology and ecology, and during his active career was always seeking novel approaches to his discipline. His abiding interest in Latin American culture was well known. Until he accidentally damaged his hand, he frequently entertained his associates with the guitar. His family shared his interest in the biological sciences, his son, Alan, is a biochemist at the University of Minnesota, and his other son, Kim, is involved in primate research. His younger brother, Frank Fincher Hooper, is a fisheries biologist, who is still located at the University of Michigan.

Following the protracted illness and death of his first wife, Hooper retired from his position at Michigan in May 1979. He returned to California, and has since remarried. He and his wife, Lee, reside in Aptos. He holds a consulting position with the Institute of Marine Science at Santa Cruz, where he has been involved in the sea otter recovery program, but continues an active interest in *Peromyscus*. His insight into systematics of *Peromyscus* and other cricetines is among Emmet Hooper's enduring legacies for which he will long be recognized by those of us who continue to work with these animals.

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[1] In 1980, one of Hooper's students, Michael Carleton of Smithsonian, proposed a more radical and controversial departure from Osgood's arrangement.

EMMET T. HOOPER

VARIANT GENETIC LOCI REPORTED IN NATURAL POPULATIONS OF PEROMYSCUS

Numerous allozymic studies of natural populations of *Peromyscus* have revealed protein polymorphisms within populations and species, and well as variation among potentially interbreeding species, e.g. *P. maniculatus* and *P. polionotus*. Variants of a protein are generally assumed to identify a genetic "locus", although formal analysis with mendelian crosses may not have been done.

PEROMYSCUS NEWSLETTER periodically lists in tabular form the known genetic loci in various *Peromyscus* species or species groups.
We distinguish between loci which have been formally demonstrated and presumptive loci, usually biochemical variants identified by electrophoresis, described from natural populations. We publish separate tables for the two categories. In this issue we summarize presumptive loci identified in *P. (=Podomys) floridanus* and *P. (=Megadontomys) thomasi.* Monomorphic loci are not listed.

Most recent previous updated summaries of genetic variants in natural populations of other species or species groups are:

The most recent tables listing loci identified by formal genetics are:

VARIANT GENETIC LOCI REPORTED IN NATURAL POPULATIONS OF PEROMYSCUS (=PODOMYS) FLORIDANUS

Protein	Locus Symbol	References
ESTERASE	**Es-1** **Es-2** **Es-4**	Smith et al. (1973)
GLUTAMATE OXALOACETATE TRANSAMINASE	**Got-1**	Smith et al. (1973)
HEMOGLOBIN	**Hb**	Smith et al. (1973)
HEXOSE 6-PHOSPHATE DEHYDROGENASE	**H6pd-1**	Smith et al. (1973)
ISOCITRATE DEHYDROGENASE	**Idh-1**	Smith et al. (1973)
LACTATE DEHYDROGENASE	**Ldh-1** **Ldh-2** **Ldh-3**	Smith et al. (1973)
MALIC ENZYME	**Mdr-1**	Smith et al. (1973)
PHOSPHOGLUCOMUTASE	**Pgm-1** **Pgm-3**	Smith et al. (1973)
PREALBUMIN	**Pab-1**	Smith et al. (1973)
TRANSFERRIN	**Trf**	Smith et al. (1973)

Reference: Smith, M.H., R.K. Selander and W.E. Johnson. 1973. Biochemical polymorphism and systematics in the Genus *Peromyscus*. III. Variation in the Florida Deer Mouse (*Peromyscus floridanus*). J. Mammal. 54:1-13.

GENETIC VARIANTS REPORTED IN NATURAL POPULATIONS OF
PEROMYSCUS (MEGADONTOMYS) THOMASI

Protein	Locus Symbol	References
ALCOHOL DEHYDROGENASE	**Adh-1**	Werbitsky and Kilpatrick (1987)
ALBUMIN	**Alb**	Werbitsky and Kilpatrick (1987)
AMYLASE	**Amy-1**	Werbitsky and Kilpatrick (1987)
CARBONIC ANHYDRASE	**Car-1**	Werbitsky and Kilpatrick (1987)
GLUTAMATE OXALOACETATE TRANSAMINASE	**Got-1**	Werbitsky and Kilpatrick (1987)
HEMOGLOBIN (Alpha globin)	**Hba**	Werbitsky and Kilpatrick (1987)
PEPTIDASE	**Pep-A** **Pep-D**	Werbitsky and Kilpatrick (1987)
PHOSPHOGLUCOSE ISOMERASE	**Pgi-1**	Werbitsky and Kilpatrick (1987)
TRANSFERRIN	**Trf**	Werbitsky and Kilpatrick (1987)

Reference: Werbitsky, D. and C.W. Kilpatrick. 1987. Genetic variation and genetic differentiation among allopatric populations of *Megadontomys*. J. Mamm., 68:305-312.

"HAIRLESS" MUTANTS OF PEROMYSCUS

Several "hairless", or more correctly hypotrichosis, mutations have been reported in *Peromyscus.* While all involve loss of hair there are distinct differences among them. The potential value of these animals has come into focus recently as the result tests of pharmaceutical products to treat baldness. None of the known hairless mutants in *Peromyscus* are analogous to athymic nude (*n/n*) in the laboratory mouse *Mus domesticus* which is immunologically deficient. All *Peromyscus* hairless mutant phenotypes involve some limited hair development, and thus resemble more the "hairless" mutant (*hr/hr*) laboratory mouse.

The first hairless genetic variant in deer mice (*P. maniculatus*) was reported by F.B. Sumner (1924). This gene is now designated "hairless-1" (*hr-1*). This trait is inherited as a recessive. The animals acquire their juvenile coat, which begins to thin by weaning age. The hair is eventually lost on most of the remainder of the body until by two months of age the animals are virtually naked. The vibrissae persist throughout life and are essentially normal. The claws become much elongated and sometimes twisted. Sumner reported that the animals had reduced viability and fertility. A small number of these animals are maintained at the Peromyscus Stock Center. In the same report, Sumner (1924) described a second hairless line, possibly of the same mutation, which apparently has died out.

Another hairless mutant deer mouse was reported by Egoscue (1962) and was subsequently designated "hairless-2" (*hr-2*). Although this condition initially also appeared to be inherited as an autosomal recessive, Hoppenhauer and Knapp (1988) recently reported that heterozygotes are distinguishable from homozygotes, thus it is an incompletely dominant trait. Hairless-2 deer mice develop a transient first coat which is thin and is mostly lost by weaning age. There may be later sparse hair growth, corresponding to molt periods. Hairless-2 is readily distinguished from hairless-1 in that the vibrissae are represented only as stubble and the claws appear normal. Hair follicles are abnormal and many individual hairs are doubled in a common sheath. The skin is tacky, apparently due to sebaceous secretions in the absense of hair. Females have low fertility and post weaning mortality is high. Heterozygotes are distinguishable in having a "greasy" appearance to the coat, apparently due to abnormal hair formation and/or sebaceous secretions. These animals are maintained at the Peromyscus Stock Center and are currently being used in a research project contracted by Upjohn Corporation.

The postjuvenile nude mutant (*n*) was reported by Clark (1938) in *P. maniculatus.* It is inherited as an autosomal recessive trait. This condition is caused by faulty keratinization of the hairs of the postjuvenile coat, which break off at or beneath the surface of the skin. The animals acquire an initial juvenile pelage, but the postjuvenile coat is lost, so that the animals are naked by 25 - 35 days of age. The adult coat which develops about 50 - 60 days of age appears normal and is retained, although the tip of the nose and tail may remain bare. This mutation is no longer known to be in existence.

Hairless *Peromyscus californicus* were reported by Packchanian and Louis (1984). The mice develop a juvenile coat and appear normal until 2 - 3 weeks of age, when the hair becomes thinner, particularly in the shoulder area and bare patches appear at various random sites on the body. Some animals by 4 - 6 months become virtually hairless except for vibrissae, which appear normal. The claws are also normal. Some animals, presumably heterozygotes, become only partially hairless, and undergo cyclic regeneration of hair. High expression of the mutant condition was enhanced by selection. Hairless California mice weight one-fourth less than their normal counterparts. The
trait appears to be inherited as an incompletely dominant trait. This stock is maintained at the Department of Microbiology, University of Texas Medical Branch at Galveston.

Hairless *P. leucopus* are known, but we are unaware of any published reports.

No genetic linkage is known for any of the hairless genes. Possible allelism of *hr-1* and *hr-2* is being tested.

References:

Clark, F.H. 1938. Inheritance and linkage relations of mutant characters in the deer mouse, *Peromyscus maniculatus. Contrib. Lab. Vert. Genetics*, 7:1-11.

David, L. T. 1932. The external expression and comparative dermal histology of hereditary hairlessness in mammals. *Zetschr. Zellfarsch. mikrosk. Anat.*, 14:616-719.

Hoppenhauer, J.T. and L.W. Knapp. 1988. Developmental genetics of the hairless-2 mutant deer mouse. *Bull. S.C. Acad. Sci.*, 50:94 (Abstr.)

Huestis, H.J. 1962. A new hairless mutation in deer mice. *J. Hered.*, 53:192-194.

Packchanian, A. and E.E. Louis. 1984. New hairless mutant of the American deer mouse, *Peromyscus californicus insignis. J. Hered.*, 75:229-230.

Sumner, F.B. 1924. Hairless mice. *J. Hered.*, 15:475-481.

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CYTOGENETICS

REDEFINING THE STANDARD.

Ten years ago the Committee for Standardization of Chromosomes of *Peromyscus* published the standardized, G-banded karyotype for the genus (Committee, 1977). The description of the main G-band patterns of the chromosomes provided not only a tool but also a stimulus for numerous studies of *Peromyscus* ranging from molecular genetics to systematics and evolution. Although most of the 24 chromosome pairs can be readily identified by GTG or QM banding, during the past decade discrepancies have arisen between numbering systems applied by different groups of workers. This is not surprising given that the number of similar-sized chromosomes and the observation that apparent chromosome size may differ from cell to cell and from species to species. The later variation also is compounded by the occurrence of inversions and heterochromatic short arms in the different species. We believe that now is the appropriate time to address the common problems of arrangement and interpretation which have evolved, and to present a refined standard which will provide a sufficiently detailed description of patterns-landmarks and band nomenclature -- for the mapping of genes and breakpoints of structural chromosome rearrangements. The assignment of the first linkage group to a *Peromyscus* chromosome may not be far away. Within a decade we may expect the construction of a genetic and physical map of the genome. This would open the door to studies of the comparative genetics of *Mus*, human, and *Peromyscus,* with the latter offering insight into the behavior of genes and their traits in naturally occurring species populations.

During the past two years, Dr. Ira Greenbaum and Dr. Scott Gunn have been revising the 1977 Standard through G-band comparisons with approximately 45 *Peromyscus* species. At the 1988 meeting of the American Society of Mammalogists a second Committee for the Standardization of the Chromosomes of *Peromyscus,* comprised of interested parties, was convened to hear and offer assistance to Greenbaum and Gunn on their revision. This second committee was formally designated as the ad hoc *Peromyscus* Karyotype Standardization Committee by the Advisory Committee of the *Peromyscus* Stock Center at the June 1988 Annual meeting in Columbia, SC (University of South Carolina).

A progress report on the revision is available from Ira Greenbaum, Department of Biology, Texas A&M University, College Station, TX 77843-3258. Further information on the revision will appear in future volumes of the *Peromyscus Newsletter.*

The Committee for Standardization of Chromosomes of *Peromyscus*: Standardized karyotype of deer mice, *Peromyscus* (Rodentia). *Cytogenet. Cell Genet.* 19:38-43 (1977).

Oscar G. Ward
Co-Editor

Sequences reported:

I.   INDIVIDUAL COPY STRUCTURAL GENES.

Hbb. β globin complex. Partial sequences of structural adult β globin genes in **P. maniculatus** (Padgett et al., 1987):

Twelve λ clones represent a total of 80 kb in three sections with gaps of undetermined length. Clones isolated using three **Mus Hbb** probes. Sequences given for three regions ([a]110, [b]110 and [c]219 bp, respectively) from each **Hbb-b1** and **Hbb-b2**, and for two regions ([a]110 and [c]219 bp) from **Hbb-b3** adult β globin genes. The second of the three β globin coding blocks is located, except for the initial two codons, in the third sequenced region for each of the three genes. No termination codons are present in the coding sequences. **Hbb-b1** and **b2** have identical coding sequences and match for all but two non-coding bases in regions sequenced. **Hbb-b3** varies from **b1** and **b2** at ten sites in the third region, which contains the second coding block, and at numerous sites in the non-coding first region. Region two was not sequenced for **Hbb-b3**. Homologies with **Mus** and other mammals are discussed together with molecular evolution of the β globin gene.

II.   REPEAT ELEMENTS.

Mys-1 element in **P. leucopus** (Wichman et al. 1985)

Features: 2843 bp. 343 bp terminal repeats (1-343) and (2501-2843). Open reading frame [1] 489 bp (595-1083) and ORF [2] 642 bp (1552-2193) with a single interrupt codon at 1795. ORF [1] translated reveals homologies with other known reverse transcriptase proteins. 20 bp pyrimidine tract (344-364); internal direct repeats 1243-1280, 1281-1318; T A sequences beginning at 1516 and at 2240. Lys tRNA binding site at 2487-2498. **Mys** elements **2 - 8** share common restriction sites. **Mys** probe hybridizes with **P. gossypinus** and other cricetid, but not murid, genomic digests. **Mys** elements probably occur in 500 to 1000 copies per haploid genome in both **P. leucopus** and **P. gossypinus.**

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L1 long interspersed repeat family in **P. maniculatus.**

Features: No sequences reported in **Peromyscus.** Homology with **Mus** and other mammalian **L1** sequences shown by Burton et al. (1986).

DNA Libraries:

P. leucopus. Constructed from **P.l. leucopus** from Georgia.
Dr. H. A. Wichman, School of Basic Life Sciences, Univ. Missouri-Kansas City,
Kansas City MO 64110. (Wichman et al. 1985).

P. maniculatus. Constructed from **P.m. sonoriensis** from California, using lambda
phage Charon 4A vector. (Dr. M. Edgell and associates, Dept. of Bacteriology and
Immunology, Univ. North Carolina, Chapel Hill NC 27514). Several separate
libraries from individual animals. Univ. South Carolina (M. Felder) also has one
of these libraries.

Mitochondrial DNA:

RESTRICTION ENZYME ANALYSIS.

P. polionotus, P. maniculatus and **P. leucopus.** Digest with EcoRI, HindIII,
BstEI, BstEII, HaeIII and PstI. 25 combinational types from 23 populations
indicated. (Avise et al., 1979)

P. maniculatus, P. polionotus, and **P. leucopus.** Digest with HincII, BglII,
HindIII, BstEII, EcoRI, BamHI, Xba and HpaII. 61 combinational types in
P. maniculatus, 22 combinational types in **P. polionotus,** and 12 combinational types
in **P. leucopus.** (Lansman et al., 1983; Avise et al. 1983)

P. maniculatus. Digest with EcoRI, HindIII, BstII, PstI, BglII, AvaI,
AvaII, MboI and HinfI. 26 combinational types from 26 populations from
California Channel Islands and southern California mainland. (Ashley and Wills,
1987)

P. leucopus. Digest with BamHi, BglII, BstEII, EcoRI, HincII, HindIII,
HpaII and XbaI. 7 combinational types from six populations, representing two
cytotypes and a hybrid zone in Oklahoma. (Nelson et al., 1987)

Transgenics.

Four **P. leucopus mys** repeat element (retroposon) clones (1, 2, 4, 7)
microinjected into **Mus domesticus** male pronuclei. Three transgenic **Mus**
recorded. Mys transcripts produced. Consensus target sequence recognized by
mys element 3' deduced: **> ATCC.........TT/GAAGTT.** (Pine et al., 1988)

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CONTRIBUTIONS

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Molecular Nature of the Genetic Defect in ADH-negative Deermice.

A cDNA library has been prepared from ADH-positive deermice and the *Adh-1* cDNA was isolated from this library using a mouse *Adh-1* cDNA probe. One clone containing a 0.9kb insert was chosen for further analysis and sequenced. It shares about 90% sequence homology with the mouse *Adh-1* cDNA sequence.

DNA isolated from ADH-positive and ADH-negative deermice was digested with *Pst I, Hind III, Bam HI,* and *Eco RI* and the fragments analyzed by Southern blotting techniques using the deermouse cDNA clone as probe. The *Adh-1* gene in ADH-positive deermice seems to occur as a single copy sequence of more than 10- kb. However, no detectable hybridizing sequences were found in ADH-negative mice. The ADH-negative mice also fail to produce *Adh-1* mRNA when analyzed by Northern blotting procedures. These results suggest that a deletion has occured to produce the ADH deficiency.

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Work was begun May 1988 on a local population of *Peromyscus polionotus* to study the population dynamics and gene frequencies. This will be a multi-year study involving live-trapping, marking mice and blood sampling for polymorphic blood proteins. To date 26 mice have been marked and their activities over a nine week period recorded. Electrophoretic work has confirmed the presence of the E allele for transferrin in one individual. Future work will include continued trapping and blood sampling. It is hoped to correlate familial relationships, dispersal data and gene frequencies to determine the prevailant forces controlling the genetic structure of the population. Implications with regards to genetic drift will be considered (Flinchum).

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For my undergraduate thesis project I am analyzing the effects of geographic isolation on insular populations of *Peromyscus* in lower Puget Sound, Washington. The islands in the lower Sound are relatively small (the largest is approximately 12 miles long), and they form three distinct groups separated by narrow passages, inlets, and peninsular land masses. Earlier systematic and distributional accounts of *Peromyscus* in Washington have assumed the deermice of these islands, part of the Puget Sound lowland trough, to be *Peromyscus maniculatus austerus*.

I am presently still in the collection and preparation phase of my project. Preliminary total length/tail length ratios seem to indicate that the Mason County island group is populated by *P. oreas* rather than *P. maniculatus austerus*.

* * * * * *

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Marco Salvioni

I am conducting my dissertation research on *Peromyscus californicus* at the Hastings Natural History Reservation, California. Specifically, I am investigating the interrelationships between mating behavior, social organization, and dispersal patterns.

Previous studies have suggested that *P. californicus* is monogamous and males help care for the young. This past year Marco Salvioni and I conducted a radiotelemetry study that indicated mated pairs have contiguous ranges which are exclusive of neighboring mated pairs. We also intensively monitored nest cohabitation which showed that putative fathers do spend substantial periods of time in the nest presumably caring for the young. This along with other data supports previous suggestions that *P. californicus* is monogamous and exhibits parental care by both sexes.

I will be continuing my studies of the demography, population dynamics, and dispersal this coming year. Results to date indicate that dispersal is female-biased in high density populations. In low density populations both sexes remain philopatric.

Lastly, I have been attempting to ascertain genetic paternity with electromorph data, but unfortunatelly a low level of variation has prevented conclusive decisions of paternity in most cases. In the coming year I will be using DNA fingerprinting techniques to ascertain genetic paternity.

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The current status of efforts to inbreed *P. leucopus* is shown in the follwing line chart. The relationships are indicated for lines which required crosses to maintain their unique(?) genes. Sublines of the various lines are not shown. Preliminary cDNA probe banding patterns obtained by Southern blot with various human and mouse histocompatibility Class II probes are in the fiqure. Mark Crew, Ph.D., a Post Doctoral Fellow in our laboratory, performed the DNA work.

P. leucopus cDNA MHC probes Southern Blot bands

	R	J	SS M	G	C	ST N	P	SU H	E	SV	Q	K	S'L	B	SW	D	A	SX Q	L	F
LINES		10	752	14	7	753	756	16	12		754	109	750	6		8.75	3	8	18	13
		y	xy2	14xy	7xy	xy3	xy6	16xy	12xy		xy4	9y	xy1	6xy		8xy	3xy	8xy	18xy	x

kb — DQ beta / Bgl II

kb	J	M	G	C	N	P	H	E	Q	K	S'L	B	D	A	Q	L	F
6600	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx									
6100	xxx								xxx	xxx	xxx	xxx	xxx				
5800	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx									
5000														xxx			
4800	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
4200															xxx	xxx	xxx
3900	xxx	xxx	xxx	xxx													
3800														xxx			
3600							xxx	xxx	xxx	xxx			xxx				
3500	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx					xxx				
3000	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx					xxx		xxx	xxx	xxx
2500	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx						xxx			
2100	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
2000	xxx								xxx	xxx	xxx	xxx					
1800	xxx								xxx	xxx	xxx	xxx	xxx				
1600	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx					xxx		xxx	xxx	xxx
1300	xxx								xxx	xxx	xxx	xxx			xxx	xxx	xxx
900	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx					xxx	xxx	xxx	xxx	xxx

DQ alpha / Bgl II

kb	J	M	G	C	N	P	H	E	Q	K	S'L	B	D	A	Q	L	F
9500	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx									
5800														xxx			
4800	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx				
4500														xxx			
3700	xxx						xxx	xxx	xxx	xxx	xxx	xxx	xxx				
3500																	
2450																	
2250	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx					xxx		xxx	xxx	xxx
1600													xxx		xxx	xxx	xxx
1500	xxx								xxx	xxx	xxx	xxx	xxx				

C4 / Eco RI

kb	J	M	G	C	N	P	H	E	Q	K	S'L	B	D	A	Q	L	F
2350	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
1800	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx					xxx	xxx	xxx	xxx	xxx
1550	xxx						xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
1400	xxx								xxx	xxx	xxx	xxx					

E alpha (DR alpha / BAM HI

kb	J	M	G	C	N	P	H	E	Q	K	S'L	B	D	A	Q	L	F
2000	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx				
850	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx

DQ beta / BAM

kb	J	M	G	C	N	P	H	E	Q	K	S'L	B	D	A	Q	L	F
6400		xxx	xxx		xxx	xxx											
5500	xxx			xxx									xxx		xxx	xxx	xxx
4200							xxx	xxx						xxx			
3700													xxx				
2800				xxx					xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
2600	xxx	xxx	xxx		xxx	xxx	xxx	xxx					xxx	xxx	xxx	xxx	xxx
2100	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx									
0																	

| Pattern number | 6 | 5 | 5 | 5B | 2 | 2 | 1 | 1 | 4A | 4A | 4B | 4B | 8 | 7 | 3 | 3 | 3 |

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24

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RESEARCH INTERESTS AND PROPOSED PROJECTS

I am primarily interested in how small mammals, including *Peromyscus*, respond and adapt to stressful winter conditions, particularly cold temperature and food shortage. Currently, I am interested in following up on research I began as a grad student and post-doc. This research, none of which is currently supported by outside funding, can be categorized as follows:'

(1) Hormonal basis underlying food caching behavior. Abundant evidence suggests that food caching in *Peromyscus* is stimulated by short days, with cold temperature playing a smaller role. This response in turn suggests the involvement of the pineal gland and its hormone melatonin, which have been implicated in several other seasonal changes. I would like to determine whether the pineal is indeed involved in food caching, and, if so, whether melatonin acts directly or indirectly, perhaps through its inhibitory effect on the reproductive system (studies in gerbils and hamsters show that estrogen suppresses caching).

(2) Influence of ambient temperature on spontaneous daily torpor in *Peromyscus*. Several field studies from around North America provide robust evidence suggesting that more individuals become torpid mornings following colder nights. Using controlled lab conditions, I would like to systematically determine whether such a relationship exists. If so, follow-up studies will be designed to elucidate the underlying mechanism for this response.

(3) Effects of acute and chronic cold exposure on production of melatonin by the pineal. Contrary to our predictions, acute cold exposure appears to depress production of melatonin by both the rat and *Peromyscus* pineal. Future studies seek to assess the effect of different lengths of cold exposure, exposure at different times of day/night, and the effects of age on sensitivity of the pineal to temperature.

I am also open to working on other, related projects suggested by prospective graduate students with an interest in physiological ecology of *Peromyscus* or other small rodents.

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A project has been initiated to determine the role of *P. leucopus* and *P. maniculatus* in vectoring lyme disease in Kentucky; and to relate results, geographically, to the density of white-tailed deer. Collections of mice by various contributors are underway. Principal investigators are Dr. Pete Thompson (Wildlife/Mammalogy) and Dr. John Harley (Parasitology/Microbiology). Graduate student selection will be made in Fall 1988.
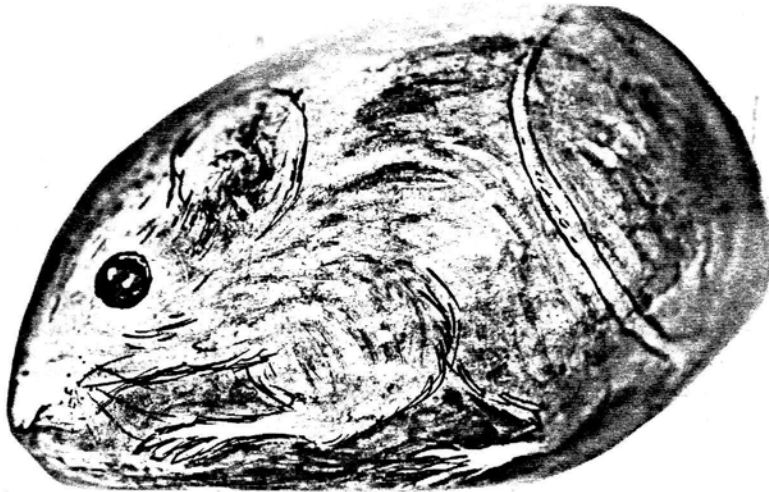
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