

## Hairless Field Mice (*Apodemus sylvaticus*) caught in the wild

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### Abstract

Described two hairless field-mice (*Apodemus sylvaticus*) which were caught in the wild within a time-span of 11 months. The two phenotypes were slightly different from one another. The first specimen was hairless except for the thoracal region. The second specimen was completely hairless. During observation in the laboratory, it displayed periodical waves of hairgrowth and hairloss. The cause of the hairless condition is probably genetic and most likely arose because of prolonged inbreeding in the enclosed natural population. The survival of these hairless mice can be explained by the excess of food which was supplied during this period and which would alleviate their thermoregulatory problems.

### Introduction

Hairless mice have been reported in *Mus musculus* (e.g. BROOKE 1926; HOWARD 1940; GARBER 1952), *Peromyscus maniculatus* (SUMNER 1924; EGOSCUE 1962) and *Peromyscus californicus* (PACKCHANIAN and LOUIS 1984). With one exception (BROOKE 1926) all of these phenotypes appeared in laboratory populations. As far as we know, all of these phenotypes are inherited in a simple fashion.

Here we report two hairless specimens from *Apodemus sylvaticus* caught under natural conditions during an extensive capture-mark-recapture study of this species in the Antwerpse Noorderkempen (Turnhout, Belgium). The specimens are described and the conditions in which they could have originated are discussed.

### Material and methods

Two populations of field mice were followed for 9 years, one in an open grid (Grid B, 12 ha), the other in an enclosed grid (Grid A, 2.7 ha). At each grid point, two Sherman life traps were stationed. Two neighbouring trapping stations were 15 m apart. The populations were sampled on a regular basis and toe clipping pattern, weight, sex and sexual condition were registered for all captured animals. For details of the sample area, ecological methodology and results of the demographic study, we refer to VERHAGEN (1980). From October 1979 to January 1982 excess food was presented to the enclosed population.

The two hairless mice were both captured in Grid A. The first specimen was found dead in a trap on June 17, 1980. It was registered in our collection under serial number 7209 and frozen until further examination.

The second specimen was caught alive on March 7, 1981 approximately 60 m from the trapping position of the first specimen. It was placed immediately in a cage. Food and water were presented ad libitum. The photoperiod was fixed at 12 hours of light vs. 12 hours of darkness. The animal was left undisturbed for one week to habituate it to its new environment. The first photograph was taken on March 13, 1981 and subsequently, the animal was followed regularly. On March 24, 1981, a female was introduced in its cage for breeding purposes. On June 6, 1981 three more females were added. The cage was disturbed as little as possible.

Unfortunately, this second specimen died and could not be retrieved for further examination.

## Results

### Specimen 1

This specimen (collection number 7209, Fig. 1) was caught on June 17, 1980 between 2 a.m. and 4.30 a.m. on grid position W6. It is a sexually inactive male of 15.7 g. Age was estimated at 50 days.

External measurements are : total length : 139 mm, tail length : 65 mm, length of hindfoot : 20.1 mm, ear length : 13.4 mm.

The head and most of the body are naked. Breast and shoulders are furred, but the hairs are very short in relation to those of a normal mouse. The hair on the tail is normal except for the tail basis.

The vibrissae are normal in number but are extremely short. In a normal field mouse the longest vibrissae extend posteriorly behind the shoulder girdle while in the naked mouse they do not even reach the basis of the ear.

The toe nails are normal. The skin is pink and slightly wrinkled.

An internal examination of the dorsal side of the skin showed that the lumbal area is totally devoid of hair follicles while follicles are very scarce in the thoracal region.

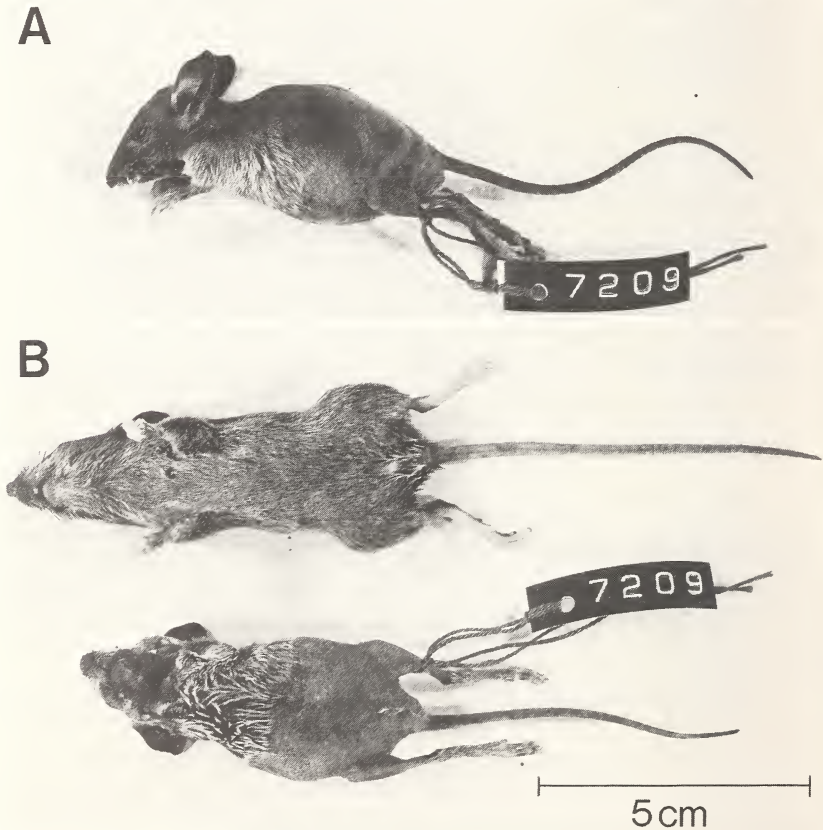


Fig. 1. The first hairless specimen of *Apodemus sylvaticus*. A: lateral view; B: ventral view compared with a normally furred field mouse. Note the short vibrissae and the abnormal fur in the thoracal region

Interscapular brown fat is well developed.

The visceral organs (stomach, intestines, spleen, kidney, adrenals) are completely normal with the exception that liver and spleen are exceptionally pale when contrasted with normal mice.

Reproductive organs are not developed but are not abnormal. Length of testis is 4.5 mm.

Lungs, heart and thymus are apparently normal.

Liver and intestines were removed for later parasitological examination. A piece of dorsal skin was removed for later histological examination.

### Specimen 2

The second specimen (no collection number, Fig. 2) was caught on March 7, 1981 around 1 a.m. on grid position V2. It was a sexually inactive male of 16.5 g and with normal body dimensions. Age was estimated at 47 days.

Its phenotype was roughly the same as that of specimen 1. It was more extreme in its hairlessness and had no breast hairs. To our surprise the mouse developed a coat of very short, fuzzy hairs of normal coloration within one week after capture. Only the head remained hairless (Fig. 2a). This coat was rapidly shed (after 7 days), giving the animal a very rugged outlook (Fig. 2b). This pattern of hair growth and hair loss could be observed periodically over the following two months.

Over the period the animal was kept captive it showed no appreciable gain in weight. This is very aberrant in captive field mice of that age which usually show an increase in weight of about 5 g over a similar time interval.

The animal was apparently accepted by the females which were introduced in its cage but it sired no young.

### Discussion

The two phenotypes presented show only superficial resemblance to the hairless conditions described in *Mus* and *Peromyscus* (GREEN 1966; SUMNER 1942; PACKCHANIAN and LOUIS 1984). However, in both these genera as well as in *Apodemus*, hairlessness was obviously related to moulting (GREEN 1966; MOUNT 1971; PACKCHANIAN and LOUIS 1984 and see phenotype of specimen 2).

Hairlessness in *Mus* and *Peromyscus* is apparently inherited in a simple manner (GREEN 1966; PACKCHANIAN and LOUIS 1984). The two consecutive appearances of hairless individuals of *Apodemus sylvaticus* in the same population and within a relatively short time interval can also best be explained as being the result of an autosomal recessive characteristic.

In this scenario, the mutant allele would first have appeared in heterozygous condition, most probably in a female. Severe inbreeding (either between parent and offspring or between sibs) would rapidly lead to the appearance of some homozygous, hairless mice. The possible phenotypic differences between the two specimens could be explained by postulating a slightly different genetic background. Recapture data of the population in grid A prove that at least three females could have mothered both specimens. These females survived the entire period and showed signs of obvious pregnancy at the appropriate times. Moreover, one of these females had an observed home range which included the two trapping positions of the two hairless specimens. However, no males were found which could possibly have sired both hairless mice. It must be pointed out that survival rates in grid A were very high in this period, apparently the result of the additional food supply (VERHAGEN 1984).

Two other factors probably also contributed significantly to the appearance of the

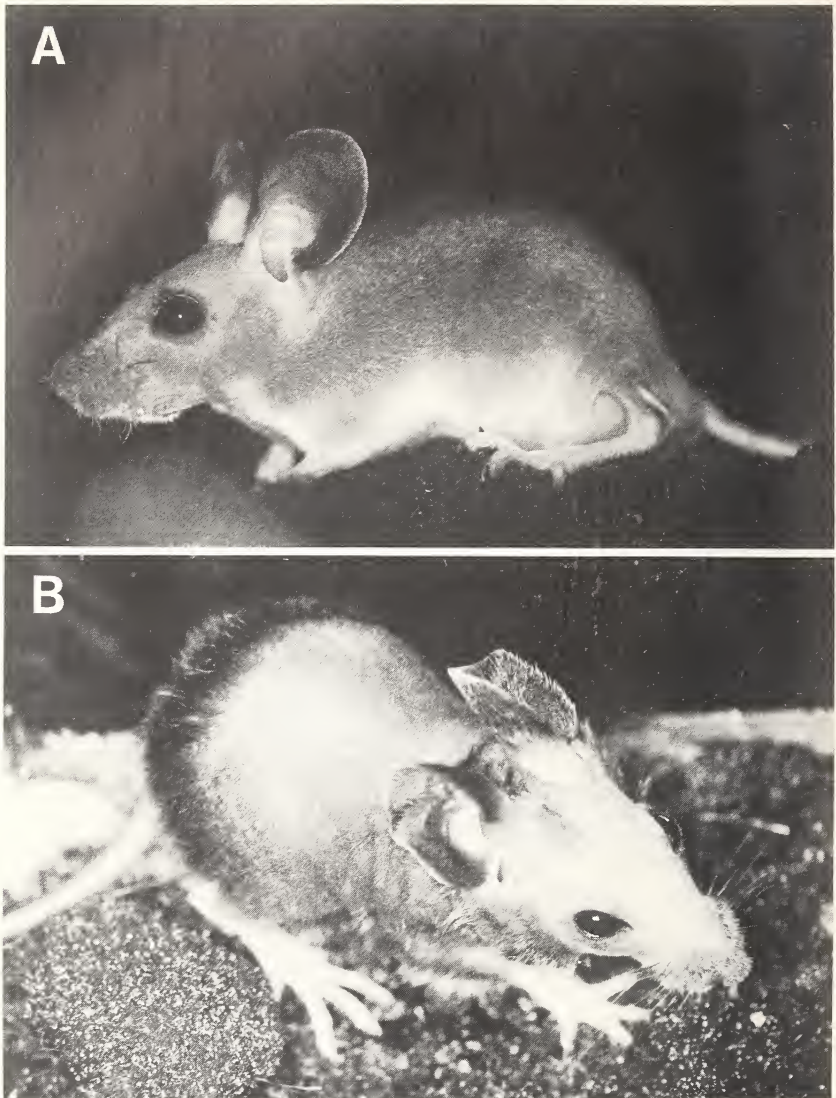


Fig. 2. The second hairless specimen of *Apodemus sylvaticus*. A: Photograph taken one week after capture. Note the naked head and the coat which consisted of very short, normally colored hairs; B: Photograph taken one week after photograph A. The animal had lost most of its hair

hairless mice. As already pointed out before, grid A is enclosed to prevent immi- and emigration. *Apodemus sylvaticus* has a yearly population cycle with maximal densities (20–30 animal/ha) in winter followed by a population decline in early spring to a minimal density of approximately 2–3 animals/ha (VERHAGEN 1980). At this time reproduction starts and the population slowly increases back to its maximal density. This typical cycle was observed several times since grid A was fenced off. This means that population numbers in grid A were reduced several times to a total of 6–10 animals. These bottlenecks would significantly reduce the genetic variation in this population through the effects of inbreeding and genetic drift (CROW and KIMURA 1970). The loss in variation could also

affect the genes responsible for fur growth and moulting. Possible interactions between these genes, which could mask the hairless gene would be reduced and the chance of penetration of the hairless gene in the phenotype would thereby increase. In this situation, even more complex patterns of inheritance, which can of course not be excluded, would essentially lead to the same result.

The second factor which would be advantageous is the additional food supply in grid A during this period. Hairless mice have obvious thermoregulatory problems. Fur contributes 30 to 40 % of total insulation in *Mus musculus* (MOUNT 1971). The absence of fur increases the lower critical temperature (i.e. the external temperature at which mammals respond to cold by increased heat production) by an average of 2 °C. In cold stress situations hairless house mice have increased metabolic rate and brown fat hypertrophy (HELDMAIER 1974, 1975). In our case, food abundance would meet the increased energy requirements of the hairless field mice and consequently increase survival rates under natural conditions.

Climatological conditions are probably also related to the energy balance of mice. Conditions in the months previous to the capture of both hairless specimens were relatively mild but not abnormally so. In May 1980 temperatures were normal (average minimum temperature 6.0 °C vs. 7.5 °C normal) but precipitation was only half the normal value (37.5 mm vs. 61.0 mm normal). In March 1981 both temperatures (average minimum temperature 4.8 °C vs. 1.3 °C normal) and precipitation (99.2 mm vs. 50.0 mm normal) were exceptionally high for the time of the year. Of course these data are probably not directly relevant because the actual microclimatological conditions in the sample area could differ significantly.

As specimen 2 was accepted by normal females in the cage, we presume that hairless field mice do not have problems with regard to their social behaviour. This would mean that they could further influence their energy budget favorably through huddling and/or nest utilization (GEBZYNSKI and GEBZYNSKI 1971; TERTIL 1972; HELDMAIER 1975).

Reproductive characteristics of hairless field mice are unfortunately unknown but in *Mus* and *Peromyscus*, hairless specimens are fertile and can produce viable offspring (EGOSCUE 1962; MOUNT 1971; HELDMAIER 1974). In *Peromyscus californicus* males were fertile but the females failed to raise offspring (PACKCHANIAN and LOUIS 1984).

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#### Zusammenfassung

##### *Haarlose Waldmäuse (Apodemus sylvaticus) aus freier Wildbahn*

Innerhalb von 11 Monaten wurden zwei haarlose Waldmäuse (*Apodemus sylvaticus*) in freier Wildbahn gefangen. Äußerlich sind beide Tiere voneinander leicht verschieden. Das eine war fast über den gesamten Körper unbehaart, nur die Brustseite zeigte eine Behaarung. Das zweite war vollständig haarlos, zeigte aber während einer Beobachtungsperiode im Labor aufeinanderfolgende Perioden von Haarwuchs und Haarausfall. Die Vibrissen beider Tiere waren sehr kurz.

Dieser haarlose Phänotyp ist wahrscheinlich genetisch bestimmt. Die Mutation ist möglicherweise die Folge starker Inzucht in der künstlich isolierten Population, der beide Tiere entstammen. Ökologische Angaben lassen uns vermuten, daß beide Tiere von einem Muttertier abstammen.

Das Überleben beider unbehaarten Waldmäuse wird am besten erklärt durch das übermäßige Futterangebot, daß während dieses Zeitraumes der Population zur Verfügung gestellt wurde. Dadurch konnten möglicherweise thermoregulatorische Probleme gelöst werden.

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## Genetic variation in the South American burrowing rodents of the genus *Ctenomys* (Rodentia: Ctenomyidae)

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### Abstract

An electrophomorphomic survey of protein variation was done on eleven populations of *Ctenomys* from Argentina. Thirty-four enzyme and protein loci were studied. Estimates of average heterozygosity ( $H$ ) per population ranged from 0 to 13 percent. Genetic relatedness (Nei's  $D$ ) is close between most populations ( $D = .03$  to  $.08$ ) collected from localities as far apart as 1800 kilometers and separated in elevation by as much as 3000 meters. However, two forms (*C. argentinus* and an undescribed species) are more distantly related to one another ( $D = .35$ ) and to other populations belonging to the *mendocinus* species group. These results are discussed with respect to the evolutionary relationships in this genus and to the hypothesis of reduced molecular variability in fossorial rodents, and they are compared to the well-studied fossorial pocket gophers (genus *Thomomys*) of North America.

### Introduction

Except in Australia burrowing rodents occur on all continents where they have independently derived from syntopic, above-ground relatives. Thus, the large number of shared specialized adaptations enabling subterranean existence must result from convergent

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