

REPRODUCTIVE MALFORMATIONS ON MULTIPLE RODENT SPECIES

Judy Hoy, 2858 Pheasant Lane, Stevensville, MT 59870
©2014 by Judy Hoy. All rights reserved.

A. PHOTOGRAPHIC EVIDENCE FOR A HIGH PREVALENCE OF DEVELOPMENTAL MALFORMATIONS OF THE MALE REPRODUCTIVE ORGANS ON RODENTS

Similar developmental malformations of the male reproductive organs as those that have been documented on multiple species of male ruminants and males of other mammal species have also been documented in multiple rodent species. Additionally birth defects of the reproductive organs not observed on ruminants have been observed on rodents and some rodent species appear to be declining. This is concerning because so many other species depend on rodents for food. The various birth defects of the external reproductive organs on the male rodents thus far observed are described and shown in the photos herein.

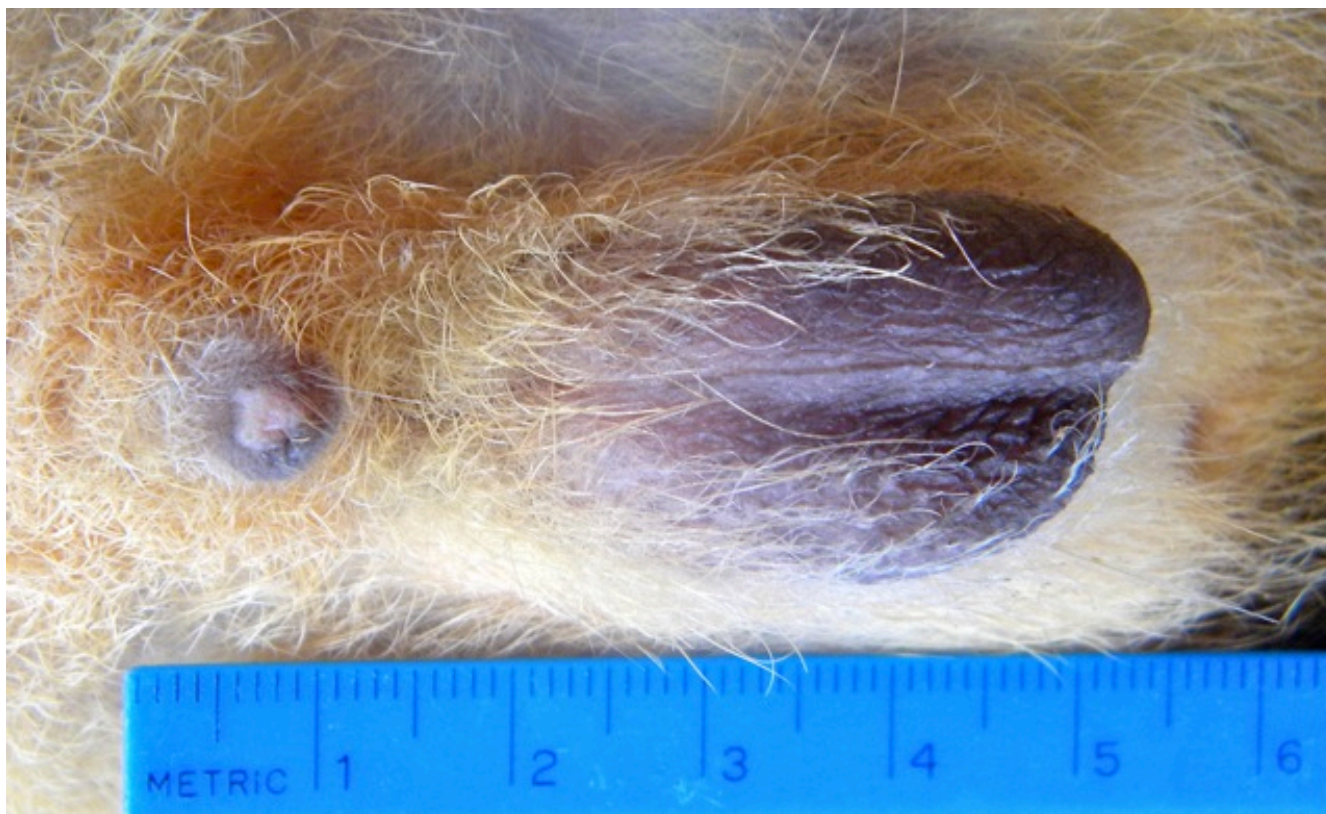
Reproductive birth defects on squirrel species and mice were documented on some individuals prior to 2012 and 2013. This document shows photos of abnormal genitalia on introduced eastern fox squirrel (*Sciurus niger*) and abnormal genitalia on several native rodent species. Between 2010 and 2013, 4 male red squirrels (*Tamiasciurus hudsonicus*), 1 male northern flying squirrel (*Glaucomys sabrinus*) and 4 male yellow pine chipmunks (*Eutamias amoenus*) were brought to me to raise and release. Additionally, a dog killed 1 young male yellow-bellied marmot (*Marmota flaviventris*) on our land. None of those male rodents from near several different areas in Ravalli County and towns in other areas of Montana had a scrotum formed on the external skin. Since most were alive, I was able to examine them, but not take photos. It is very difficult to photograph a small wiggly animal. The male northern flying squirrel, in addition to having no scrotum and ectopic testes, had nerve damage and remained dwarfish (about half the size of normal) even when fully grown and several months old. Having no scrotum and ectopic testes had nothing to do with my receiving the rodents for care or as carcasses.

In late summer of 2012, a man living on the edge of Florence, MT shot 12 fox squirrels, 8 males and 4 females. They were given to a friend, who gave them to me to feed to carnivorous birds of prey. The male fox squirrels were given a number followed by the year in front of the species name as in #1-12FoxSquirrelAM Florence, MT. The AM stands for adult male. No malformations were found on female squirrels. Any rodent born with an underbite, the most common birth defect on female ruminants, would likely die before reaching adulthood because it would be unable to eat.

Six of the 8 male squirrels, or 75% had a reproductive malformation. This is quite a high prevalence, and strongly suggests a serious problem, even with such a small sample. What is most concerning is the fox squirrels "collected" at Florence, MT grew up in a town near people and foraged for food on lawns where children play and pregnant women walk. Any endocrine disruptor that can do what was done to many of those Florence fox squirrels and to squirrels and other rodents from other areas of Western Montana during

fetal development is capable of causing similar affects on human male newborns. Humans are mammals and rodent species are the mammals most often used by researchers to test pesticides (umbrella term) and other chemicals for effects that cause hormone disruption and other health problems in humans.

MALE FOX SQUIRRELS - FLORENCE, MT - NORMAL AND ABNORMAL GENITALIA



#3-12FoxSquirrelAM Florence, MT. This male fox squirrel is shown first because it had a normal scrotum, for comparison with the other squirrels, which have birth defects. The hemiscrota (half a scrotum) on this squirrel are bilateral (side by side) and are large enough to contain the normal sized testes. The penis sheath on this squirrel was quite short for an adult male fox squirrel. Penis sheath length on examined males of the rodent species listed (**page1**) varied from normal length to no penis sheath formed. Comparison of this normal scrotum on a fox squirrel with the scrotums on the fox squirrels in subsequent photos of fox squirrel genitalia will help address how severe the reproductive malformations are on squirrels with birth defects.



This young male fox squirrel, which exhibited sudden neurological damage, was photographed in Lolo, MT. It was found as a baby and given to a squirrel rehabber to be raised and released. A couple of weeks after release, it suddenly began tipping over when it sat up to eat. This type of sudden neurological damage causing an animal to tip over when it tries to sit up, walk and especially run, has been observed on many individuals of rodent and other mammal and bird species. Rodents observed with this problem included deer mouse, house mouse, fox squirrel, red squirrel, Columbian ground squirrel, northern flying squirrel and porcupine. It was also observed on several mountain cottontail rabbits prior to having none living on our land.

This young male fox squirrel is shown here because it has a penis sheath that is quite long, much longer than any of the adult male squirrels shown in this document and more like what was normal on male fox squirrels prior to them having reproductive birth defects.



#5-12FoxSquirrelAM Florence, MT. This was the fifth male fox squirrel from Florence examined in 2012. It had a long narrow flap of dark skin, with the left hemiscrota (flap of skin) positioned directly forward of the right hemiscrota (flap of skin).



#5-12FoxSquirrelAM Florence, MT. This is a side view of the genitalia. The narrow hemiscrota was not visible from the side due to the short skin flaps not hanging down far enough to be visible past the hair. The penis sheath is short.



#5-12FoxSquirrelAM Florence, MT. This view shows the penis cut and pulled out of place to show both testes. Anterior of the squirrel is toward the left in the photo. The lower ends of the testes were in the long narrow scrotum, with the lower end of the left testis directly forward of the lower end of the right testis. The left is lowest testis in the photo, with the right testis above the left testis.

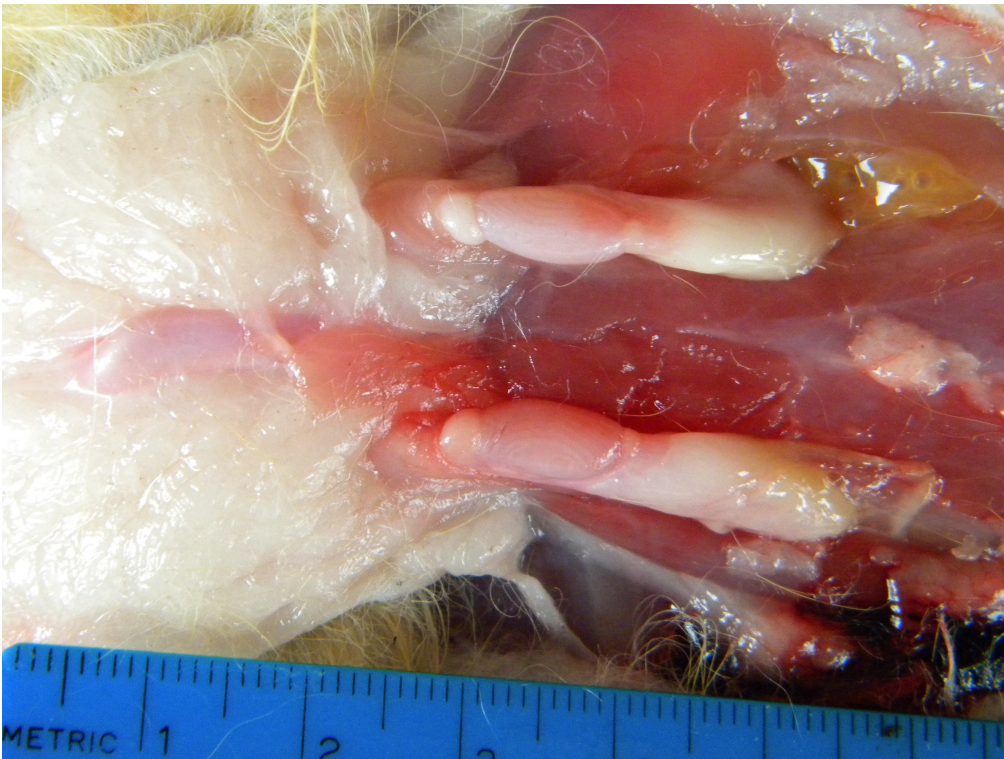


#5-12FoxSquirrelAM Florence, MT. These are the testes removed from the spermatic cord enough so the size and shape are more evident. Note these testes are quite a bit larger than the testes of the squirrel shown in the next series of photos. Both squirrels appeared to be adults. Also note that this squirrel does not have nearly as much fat surrounding the testes. This squirrel may have been able to produce viable sperm, even though the scrotum was malformed.

The squirrel in the next series did not likely produce adequate testosterone or viable sperm as the undersized testes were completely ectopic and against the warm body wall. It also came from Florence, MT, but was killed in 2010.



#1-10FoxSquirrelAM Florence, MT. This is the first photo in a series of three of this squirrel's genitalia. This fox squirrel had a small white spot rather than a scrotum.



#1-10FoxSquirrelAM Florence, MT. This photo shows the testes still in the spermatic cords, with the cords cut to expose the testes. The squirrel had a large amount of fat around the testes. The small testes were side-by-side (bilateral) and horizontal under the skin (ectopic) directly above the white spot on the skin and against the body wall, on each side of the penis.



#1-10FoxSquirrelAM Florence, MT. These are the same two testes completely removed from the spermatic cord. Even if this squirrel was a juvenile with incomplete development of the testes, the testes would remain ectopic and horizontal its entire life because there was no scrotal sac to contain the testes. Also after the testes descend into a horizontal, ectopic position just above the skin on a developing fetus, it is not physically possible for the testes to go into any other position. They can get larger with maturity, as shown in photos of other squirrels in this document with ectopic testes. This squirrel was full grown and appeared to be a mature adult. That it was not a juvenile was also indicated by how much fat it had built up in the abdominal and genital area.



#4-12Fox SquirrelAM Florence, MT. This fox squirrel had only one hemiscrota formed with the right testis contained in it. The left testis was ectopic, forward and to the side (above in photo) of the right testis as shown in the next photo.



#4-12FoxSquirrelAM Florence, MT This photo shows the left testis exposed.



#4-12Fox Squirrel Florence, MT showing both testes exposed. The right testis has been pulled out of the hemiscrota so both testes can be seen. On this squirrel, as on most deer, the ectopic left testis was forward of the right testis. However, the left hemiscrota was not formed during development in the womb. Having one hemiscrota not formed as on this squirrel or both hemiscrota not formed, as on #1-10FoxSquirrelAM above, is a serious birth defect/developmental malformation according to all veterinarians consulted.



#1-12FoxSquirrelAM Florence, MT. This male fox squirrel had a very short wrinkled bump in the scrotal area and a fairly short penis sheath. The testes were horizontal and ectopic.



#2-12FoxSquirrelAM Florence, MT. These photos show the view from the right side (above) and the top view of the genitalia (below) of an adult male fox squirrel. The scrotum had the left hemiscrota directly forward of the right hemiscrota and the right hemiscrota was almost not formed at all (see the tiny skin flap immediately posterior to the larger skin flap). The testes were ectopic on each side of the skin flaps that made up this squirrel's scrotum. The penis sheath is extremely short.



#2-12FoxSquirrelAM Florence, MT.



#6-12 Fox Squirrel AM Florence, MT. This squirrel has one tiny flap of skin where the scrotum should be and both testes were ectopic and horizontal. This is the sixth examined male fox squirrel from Florence, MT, killed in fall of 2012.



#6-12 Fox Squirrel Florence, MT. The very short penis sheath is on the right. The tiny flap of dark skin on the left above the 3 on the ruler is what the squirrel was born with where its scrotum should have been.



#6-2012 Fox Squirrel Florence, MT. This photo shows the upper end of the undersized ectopic testes and the cut spermatic cords. The ectopic testes were bilateral on this squirrel and on several other squirrels with essentially no scrotum. Anterior is to the left.



#1-13FoxSquirrel Florence, MT. This adult male fox squirrel had a small area of dark skin where the scrotum should be and a very short penis sheath.



#1-13FoxSquirrel Florence, MT. This photo shows the measurement of the penis sheath length. A normal adult male fox squirrel's penis sheath is usually well over 1 cm in length.



#1-13FoxSquirrel Florence, MT. This photo shows the horizontal testes exposed. Except for being horizontal in placement, the testes appeared to be normal in size shape and color for a non-breeding adult male. The photo below shows a fox squirrel testis with a normal size, shape and color for a male in the breeding period for comparison.





#2-13FoxSquirrelAM Florence, MT. The scrotum was a fairly long thin empty flap of dark skin. The testes were located bilateral and ectopic on each side of the dark flap of skin. The penis sheath measured 1.5 cm in length. The flap of skin hung down 7 mm and was 2.1 cm long and 1 mm wide.



#2-13FoxSquirrelAM Florence, MT. This is a top view of the same squirrel's genitalia.



#2-13FoxSquirrelAM Florence, MT. This photo shows the normal sized testes exposed in a bilateral horizontal ectopic position.

MALE FOX SQUIRRELS WITH MALFORMED GENITALIA FROM STEVENSVILLE, MT



#1-10FoxSquirrelAM Stevensville, MT. This male fox squirrel was killed by a vehicle on Wildfowl Lane, 1 mile north of Stevensville, MT. It had the left hemiscrota formed directly forward of the right hemiscrota (one very short flap of dark skin directly forward of another short flap of dark skin) and ectopic testes similar to the photo on page 17. Because the penis sheath was damaged, no conclusion on penis sheath development could be made.



#2-10FoxSquirrelAM Stevensville, MT. This squirrel was found dead on the ESHYW in Stevensville. The scrotum consisted of two misaligned small empty flaps and the testes were ectopic, similar to #1-10FoxSquirrelAM Stevensville, MT, except the misaligned skin flaps were larger and more easily seen on this squirrel.

YELLOW BELLIED MARMOT WITH NO SCROTUM FORMED AND GENITAL CONFIGURATION OF A MARSUPIAL.

A very interesting rodent species male I had the opportunity to necropsy on May 30, 2013, was a young of the year yellow-bellied marmot. This marmot's reproductive malformations were unlike any I have previously observed on rodents, ungulates or other mammals. The penis sheath was normal in size, but it was directly anterior to the anus with no room for a scrotum and no scrotum was present. The penis sheath was approximately where the vagina would be on a female marmot in relation to the anus.



#1-13 Yellow-bellied Marmot YOY Stevensville, MT. This is the external genitalia of a young male yellow-bellied marmot, showing the penis sheath on the right above the 2 cm mark on the ruler and the anus on the left above the 0.5 mark on the ruler. Anterior is to the right.



#1-13 Yellow-bellied Marmot YOY Stevensville, MT. Anterior is at the bottom of the photo. I removed the genitalia skin and turned it over to determine the location of the testes. The testes were slightly more than a centimeter anterior of the penis sheath, ectopic between the skin and the body wall (immediately to the right of the ruler between the 2 centimeter and the three centimeter mark). I have seen some very strange looking genitalia on males of many species since 1995, but never have I seen the testes forward of the anterior of the penis sheath. If a human baby were born with this birth defect, the testes would be under the skin just posterior to the belly button.

The only mammals that normally have the testes located significantly forward of the penis/penis sheath like this male yellow-bellied marmot are marsupials. The predecessors of placental mammals split off from the predecessors of marsupial mammals about 165 million years ago in the Jurassic Period. Because marsupials are the oldest type of mammal, placental mammals still have the same genetic material that marsupials have, but the genes that make a mammal develop into a marsupial are repressed in mammals. Or at least they are supposed to be. For a placental mammal to have the genital configuration of a marsupial is extremely unusual.

I also observed two live marmot young in our marmot colony in spring 2013 that

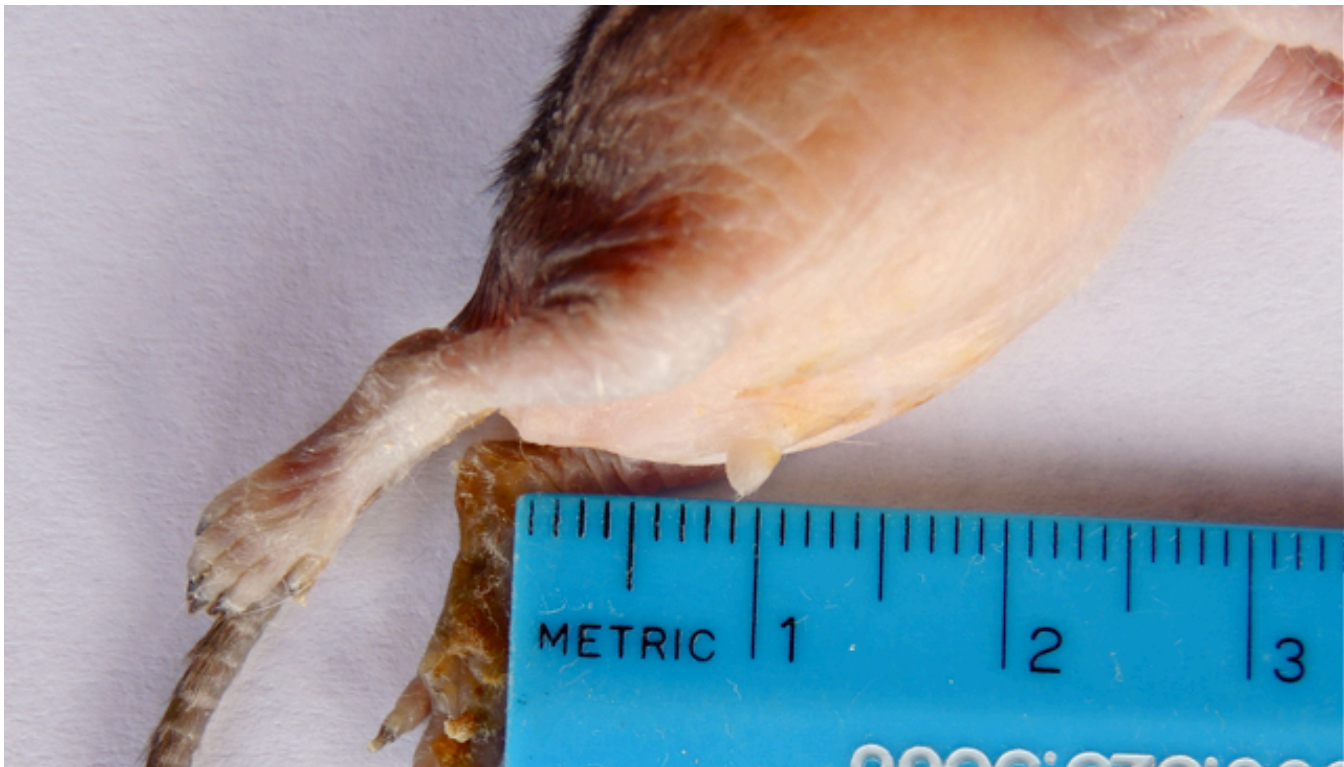
were born with almost no tail. Between June 5 and June 11, most of the yellow-bellied marmot young born in 2013 mysteriously disappeared. We assumed they died in their burrows, including both of the young with underdeveloped tails.

NATIVE SQUIRRELS WITH REPRODUCTIVE MALFORMATIONS

In spring of 2012, I raised and released 4 male red squirrels from three different areas of Ravalli County, none of which had a scrotum. I also received a young male northern flying squirrel from Frenchtown, MT, west of Missoula, that had nerve damage, remained dwarfish even when fully grown, and had no scrotum with testes ectopic. Thus, all but two squirrels of three species I examined in 2013 had no scrotum and ectopic testes. The birth defects had nothing to do with my receiving them for care or as carcasses.

CHIPMUNKS WITH REPRODUCTIVE MALFORMATIONS

I received four very young male chipmunks for care in early spring of 2013. None of the chipmunks had scrotums, but the penis sheath on all was far enough forward of the anus that there was room for a scrotum. The scrotum was not formed during development. One of the male chipmunks had hypospadias and died because urine was not able to readily go through the small hole in a slight bump on the abdominal skin where the penis sheath should have been. That male had no scrotum or penis sheath, two serious birth defects. Even though it ate fairly well, it hardly grew at all in the four days I cared for it and it died. Two of the male chipmunks were from Missoula County and two were from Deer Lodge County. They were not from Ravalli County. I keep repeating that Ravalli County is where I have examined the most animals, but is not necessarily where the animals have the most malformations.



This photo is of one of the chipmunks, which had a penis sheath, but no scrotum formed.

DEER MICE WITH REPRODUCTIVE MALFORMATIONS

Since 2007, a significant number of male deer mouse (*Peromyscus maniculatus*) in Ravalli County, Montana have been observed with birth defects of the male reproductive organs on the external skin. The birth defects include no scrotum formed, scrotum surrounding the anus like a donut with the anus as the hole, and a short penis sheath. While having the testes on each side of the anus does not likely affect the viability of the sperm and the ability of the mouse to successfully reproduce, it is rather disturbing, because it is not a normal scrotal configuration and appears to be caused by a shortened distance between the anus and the penis sheath. Also, being an epigenetic change, this scrotal configuration is likely passed on to the next generation. Approximately half of the individual deer mouse males I found dead in 2012 and 2013 had a reproductive birth defect, many with no scrotum.



#1-12DeerMouseAM. This mature male mouse had a normal length penis sheath but there was no scrotum formed. It drowned in a water dish in March 2012 at the Hoy residence.



#1-12DeerMouseAM. This is a close-up of the genitalia, showing the area where the scrotum should have been has no scrotum formed.



This Deer Mouse had a normal scrotum with two hemiscrota, positioned between the penis sheath, barely visible anterior to the scrotum, and the anus, which is nearly hidden by the posterior tip of the scrotum.



#2-13DMAM. This male mouse had a normal length penis sheath, but because the area between the penis sheath and the anus appears to be too short, the left and right hemiscrota were formed on each side of the anus rather than forward of the anus. This is a very strange scrotal configuration I have observed on several domestic mice and several deer mice, but not on other rodent species.



#2-12DMAM. Similar to the mouse in the previous photo, the area between the penis sheath and the anus is short, causing the left and right hemiscrota to be formed on each side of the anus rather than forward of the anus, as is normal. On this mouse the distance between the penis sheath and the anus is not as short as on the mouse on **page 25**. This deer mouse had a short penis sheath.



#1-10DMAM. This photo shows the body of a dead male deer mouse.



#1-10DMAM. This close-up of the genitalia shows the somewhat short penis sheath and the area between the penis sheath and the anus is very short consequently the scrotum was not formed. The testes were in a horizontal position under the skin on each side of the penis.



#1-11DMAM. This deer mouse had a normal length penis sheath, but no scrotum. As on other deer mice with no scrotum, the penis sheath and anus were fairly close together.



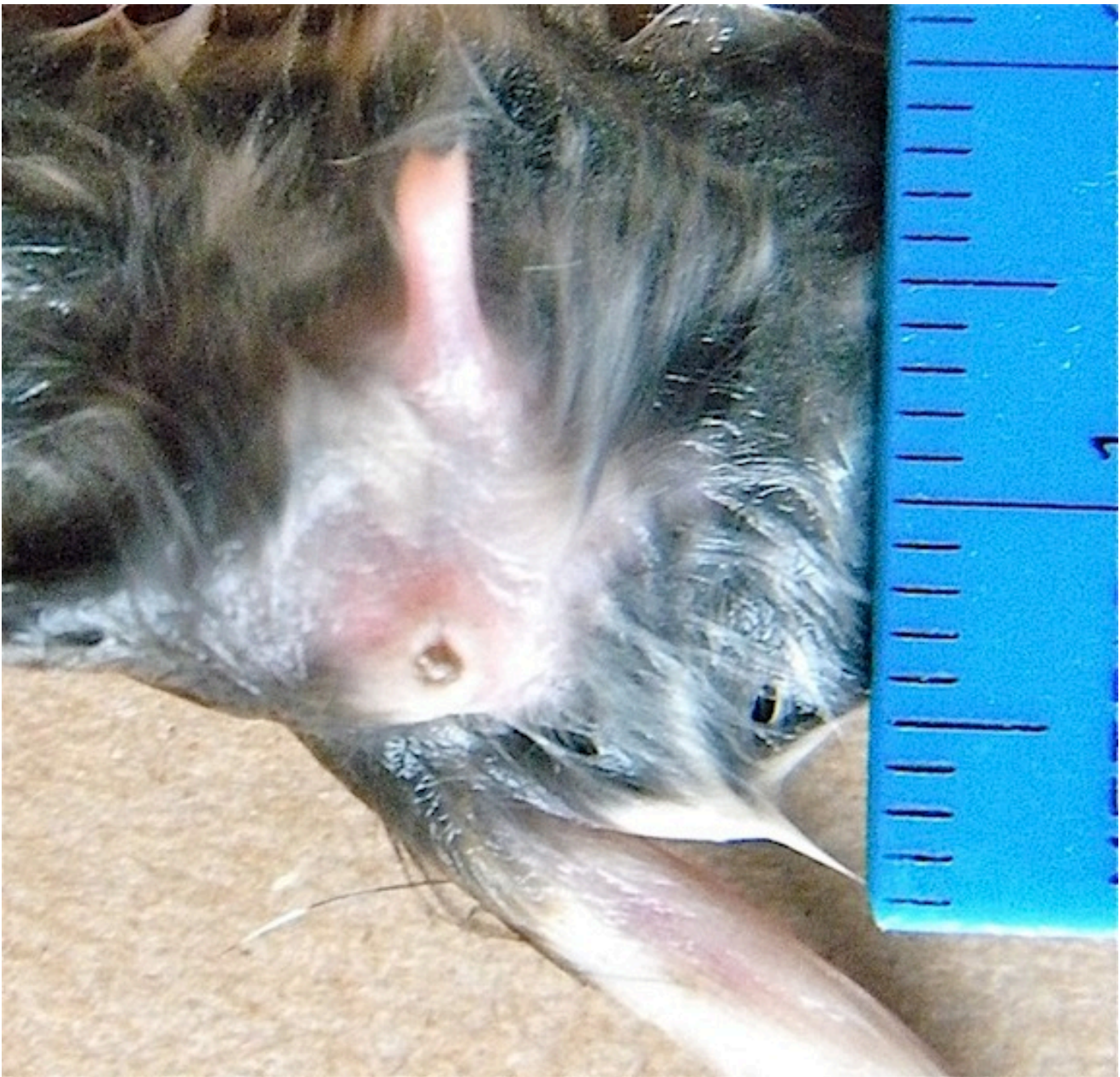
#1-11DMAM. Here the skin is peeled back to show the normal sized testes in a horizontal position between the body wall and the skin.



#1-13DMAM. This deer mouse was found dead on May 10, 2013.



#1-13DMAM. This is a close-up of the genitalia. There was no scrotum formed and the testes were horizontal between the body wall and the skin, similar to #1-11DMAM on page 28.



#3-12DMAM. This is a close up of the genitalia of a deer mouse with a normal length penis sheath and no scrotum formed. Like previously shown mice the distance between the posterior of the penis sheath and the anus appears short. The testes were horizontal between the skin and the body wall.

I could not determine prevalence of reproductive malformations on deer mice because I don't see enough male mice each year to provide an adequate sample. However, at least half or more of the few I examined between 2010 and 2014 had birth defects of the reproductive organs.

Many of the birth defects of the genitalia on rodents appear to be the result of a decreasing distance between the posterior of the penis sheath and the anus. This birth defect was reported by Dr. Shanna Swan on human babies in her study of reproductive malformations on human male newborns. (2006 Feb Swan SH. "[Prenatal phthalate exposure and anogenital distance in male infants.](#)" Environmental health perspectives. 2006 Feb 0; 114(2):A88-9.). If phthalates were responsible for such birth defects in rodents and ungulates in Montana, the phthalates would have to be mainly from septic tanks depositing the chemical into the water running into rivers and streams. The reproductive birth defects on rodents (and on ungulates) are more likely caused by endocrine disrupting toxins falling in rain and snow onto the foliage the animals eat.

The increasing reproductive birth defects on rodent species is concerning, because without rodents, a large number of birds and mammals that depend on rodents for food will have little to eat. Also, if the number of males with ectopic testes keeps increasing in the various species, without any viable males born, the affected species may eventually go extinct. The porcupine population has declined precipitously in Western United States. Porcupines are rodents, thus inability of some males to produce viable young may be partially involved in their population decline. Most importantly, wild rodents are wildlife and deserve protection like other wildlife.

After examining the fox squirrels from Florence, it occurred to me human fetuses and children would likely be susceptible to whatever was causing so many male squirrels to be born with birth defects of the reproductive organs. I left a message on the answering machine of Carol Ballew, PhD., Senior Public Health Epidemiologist at the Office of Epidemiology and Scientific Support in Helena, MT, voicing my concern for human health. I expressed specific concern for developing human male fetuses exposed to whatever caused the birth defects on the squirrels, which came from towns, especially Florence, MT. I suggested that whatever is causing the high prevalence in the rodent populations; especially fox squirrels living in towns might be a threat to human male fetuses.

For fox squirrels from Florence, MT, the prevalence was 6 of 8 male squirrels in 2012 with no or half a scrotum. I clearly stated I was telling her about the high prevalence of reproductive malformations in the squirrels because of concern for children and unborn fetuses in Florence and other Ravalli County towns. I did not state that children in Ravalli County had an elevated prevalence of reproductive birth defects. There is no way to determine the prevalence for children, as reproductive birth defects in human newborns are not tracked by the Montana State Health Department.

The following email was her reply. She equated my report by phone to the peer reviewed study on several hundred deer genitalia that my colleagues and I had published in 2002. It should be obvious to a person with a PhD. that a report by phone is nothing like a study. Also, when I was tracking human birth defects between 1996 and 1999, hypospadias were not at all rare. There were 4 babies born with hypospadias in one day in March of 1998 in the hospital in Hamilton, Montana and several single male babies born with that birth defect on other dates. Also, parents, grandparents and others in Ravalli County reported incidences to me of newborns with very short penises.

From: "Ballew, Carol" <CBallew@mt.gov>
Date: December 11, 2012 1:11:20 PM MST
To: "'bjhoy@localnet.com'" <bjhoy@localnet.com>
Cc: "Helgerson, Steven" <SHelgerson@mt.gov>
Subject: **your recent phone message re atypical squirrels**

Dear Ms. Hoy:

Thank you for your call. The state DPHHS has no systematic registry or other means of ascertainment for hypospadias, cryptorchidism, or other genital anomalies that would allow us to respond to your concerns about elevated prevalence in humans. These are rare but serious conditions in human infants, and they are referred to specialist services. If specialists were seeing an increase in cases, I am confident they would be in touch with us.

Without systematic sampling, it is not clear that the population prevalence of these and similar conditions in squirrels in the Bitterroot is actually elevated. Similar caveats apply to prevalence in deer, which you have brought to our attention previously.

Your voice mail message suggested that you were attributing these conditions to congenital hypothyroidism, but that usually manifests itself as neurologic and cognitive effects in human infants. Congenital hypothyroidism is most often due to low iodine intake or interference with iodine uptake and utilization. There have been a few large studies (with good statistical power) looking for potential effects of environmental contaminants at low to moderate levels of exposure on congenital hypothyroidism, and these have been negative.

Cordially,

Carol Ballew, PhD
Senior Public Health Epidemiologist
Office of Epidemiology and Scientific Support
A113 Cogswell, 1400 Broadway, Helena, MT 59620
406-444-6988 cballew@mt.gov
From: bjhoy@localnet.com [mailto:bjhoy@localnet.com]

B. CHEMICAL BLISTERS AND NERVE DAMAGE

In both 2012 and 2013 smoke came from wildfires in Idaho, straight west of the Bitterroot Valley. In 2012, the smoke from Idaho mixed with smoke from a big fire in the Bitterroot Valley. In 2013, the smoke from Idaho mixed with smoke coming from a very large fire near Yosemite National Park in California. In summer of 2012, I saw three children with chemical blisters on their hands. Both my female Corgi and I got very severe chemical blisters all over our bodies in summer of 2012, as did other animals. In

summer of 2013, my Corgi and I again had chemical blisters during the smoky period, but not as severe as in 2012.

Prior to 2012, I had seen other animals and people with chemical blisters. In February of 2003, a lady who lived north of us near Florence, MT got chemical blisters when she went out in the falling snow. Within hours, a red blistery rash appeared everywhere the snow contacted her hands and wrists.

In 1999, I received a fox squirrel for rehab that had quite severe chemical blisters on its left ear, but not on the right ear. The right front foot had unformed toes and the squirrel had neurological damage causing it to continuously circle to the left.



This photo shows a close-up of chemical blistering on the ear of a live fox squirrel.



This is the same squirrel showing the unformed toes on the right foot. When it stood on its own, it held its head down. Whenever the squirrel moved it went towards the left in continuous circles.



On the squirrel in the photo above, the right front foot had unformed digits.



A female red squirrel eating a seed while lying on its side after picking up the seed and falling over.



A female house mouse rolling around, trying to right itself after falling over when it attempted to run away from me. This behavior is not conducive to longevity.