# Sex bias of small mammals captured in Sherman live traps

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**ABSTRACT** The sex ratios and the possibility of capture bias varies from species to species. By looking at results from other papers and comparing the juvenile sex ratio to the adult sex ratio you can determine if the bias towards one sex is a trapping bias or just the population's sex ratio. *Peromyscus leucopus*, *Sigmodon hispidis*, *Reithrodontomys montanus*, *Chaetodipus hispidus*, *Onychomys leucogaster*, *Neotoma micropus*, *Baiomys taylori*, *Reithrodontomys megalotis*, and *Peromyscus maniculatus* were the species used in this study. Other species were present in the data but the sample sizes were to small to use. Several species seemed to have trap biases while others seemed to only represent population sex ratios. *Peromyscus leucopus* was found to have a trapping bias towards male, though this could change over time. *Sigmodon hispidus* seemed to have a female biased population but did not seem to have a trapping bias. *Reithrodontomys montanus* seemed to have a male biased population and no trapping bias. *Chaetodipus hispidus* seemed to have a trapping bias towards females. *Onychomys leucogaster* seemed to only have a population sex bias and not a trapping bias. *Neotoma micropus* seemed to have a female biased population and no trapping bias. *Baiomys taylori* seemed to have an extremely female biased population but not a trapping bias. For *Reithrodontomys megalotis* it could not be determined if there was a trapping bias because of unavailability of data.

*Peromyscus maniculatus* did not seem to have a trapping bias, or it could not be determined because of the variability of deer mice population sex ratio. The variability of these results demonstrates how each species has its own set of factors affecting the sex ratio of the population and the probability of capture for each sex.

**KEY WORDS:** sex ratio, Sherman live traps, small mammals, Texas Panhandle

## INTRODUCTION

The amount of studies, past, present and future, that will and have been done on small mammals makes it necessary to understand if the trapping methods being used have a sex bias. This is necessary because in some cases a biased sex ratio because of the trap could make the results of some studies inaccurate. The number of years and amount of data collected for this study gives a unique opportunity to, with the help of information from previous studies, determine if a trap sex bias exists for Sherman live traps.

An example of a type of study that would be greatly affected by a biased sex ratio caused by a type or trap is the capture-recapture method that is commonly used to estimate population sex ratios (Domenech and Senar 1998). A main assumption this method makes is that each sex has the same probability of capture which would make the sample captured an unbiased sample of the chosen population (Domenech and Senar 1998). Therefore when a certain type of trap has a sex bias the results for these studies would be invalid.  Since sex ratio is part of the data that is of interest in population studies, the affect of the invalidity of data can be devastating (Domenech and Senar 1998).

**STUDY AREA**

This study was conducted on the Cross Bar Cooperative Management Area (CMA), which is located on the northern edge of the Llano Estacado.  The Llano Estacado is a portion of the southern Great Plains located to the south of the Canadian river, east of Pecos valley New Mexico, west of the Rolling plains of Texas, and it joins the Edwards Plateau on the south (Lotspeich and Coover  1962, Lotspeich and Everhart 1962). The Llano Estacado part of the CMA is relatively flat, while the rest of it ranges from rolling hills to somewhat rough terrain (Lotspeich and Coover 1962, Walker 2009) The Cross Bar CMA is about 16 km north of Amarillo, Texas, in Potter County (Walker 2009). Cross Bar CMA is 4,789 ha and is in a located in a transitional area so it contains wildlife and habitats from several eco-regions (Walker 2009).  The CMA contains portions of the High Plains and the Rolling Plains ecoregions (Fig. 2). Temperature on the Llano Estacado Ranges from highs of 38 degrees Celsius during the summer to lows of below freezing during winter (Lotspeich and Everhart 1962).  The wind in this area is almost constant and can be more then 97 kph and the mean annual rainfall is less then 51 cm (Lotspeich and Everhart 1962, Walker 2009).  The soil type for the Amarillo area of the Llano Estacado is silty clay loam soil (Lotspeich and Coover 1962, Lotspeich and Everhart 1962, Walker 2009).  The vegetation that can be found on the Crossbar CMA is honey mesquite, and cholla (*Cylindropuntia* spp.), catclaw mimosa (*Mimosa borealis*), purple dalea (*Dalea Formosa*), prickly pear (*Opuntia* spp.), blue gramma, side-oats gramma, junipers, big bluestem, Indian grass, sand dropseed, willows (*Salix* spp.), hackberry (*Celtis reticularia*), cottonwoods (*Populus deltoids*), salt cedar (*Tamarix* sp.), sedges (*Cyperaceae*), rushes (*Juncaceae*), cattails (*Typha* sp.), sage brush, and sand plum (*Prunus augustifolia*; Lotspeich and Everhart 1962, Walker 2009).

**METHODS**

This research was conducted by setting several lines of Sherman live traps across different transects of Cross Bar CMA (Fig. 1). These areas were 3 treatment plots of 2, 4, and 10 year burns, which were replicated 3 times each with each plot randomly assigned a treatment, and a control was also used (Preismeyer 2010). Each plot was around 120 ha, with 2 small mammal transects in each (Preismeyer 2010). There were 15 stations each spaced 15 m apart and sampled with 2 Sherman live traps in each of the 9 different plots on Cross Bar CMA each trapping session (Preismeyer 2010). Total this is 540 Sherman live traps and 18 transects (Preismeyer 2010). These traps were set on Friday, and then checked on the mornings of Saturday, Sunday, and Monday. On each Monday the traps were taken down after they had been checked. The data was collected in 2 sessions, spring, from March to April and fall, from September to November, therefore there was a total of 1620 trap nights each session (Preismeyer 2010). The traps were baited with dry oats. Cotton was placed in the trap during cold weather so that the any animals captured did not freeze. When a capture was made the animal was weighed and measured, its gender, condition, age and species was ascertained, with all of the information recorded. The trap line, date, and station the animal was captured at were also recorded. The animal's hair was also clipped on the right rump so that we could record when or if we recaptured an animal and from October 2004 to March 2008 ear tags were used (Preismeyer 2010). The animals captured were released immediately after all the information needed had been gathered.

The data was then sorted by species and each of those groups was further separated into male and female. Finally these groups were divided into adults, sub-adults and juveniles and number of recaptures was ascertained. The data collected is from 2004 to 2010.

## RESULTS

The species captured from 2004 to 2010 included white-footed mice (*Peromyscus leucopus*), hispid cotton rats (*Sigmodon hispidus*), plains harvest mice (*Reithrodontomys montanus*), hispid pocket mice (*Chaetodipus hispidus*), northern grasshopper mice (*Onychomys leucogaster*), southern plains wood rats (*Neotoma micropus*), northern pygmy mice (*Baiomys taylori*), western harvest mice (*Rheithrodontomys megalotis*), deer mice (*Peromyscus maniculatus*), white-throated wood rats (*Neotoma albigula*), silky pocket mice (*Perognathus flavus*), Ord's kangaroo rats (*Dipodomys ordii*), spotted ground squirrels (*Spermophilus spilosoma*), and house mice (*Mus musculus*). Of those captured the spotted ground squirrels, white-throated wood rats, silky pocket mice, house mice, and kangaroo rats were excluded from the results because the sample size gathered was less than or equal to 20. Of the species used, not including recaptures, there were 198 white-footed mice captured (84 adult females, 94 adult males, 8 subadult females, 7 subadult males, 4 juvenile females, and 1 juvenile male), 153 hispid cotton rats (64 adult females, 53 adult males, 19 juvenile females, and 17 juvenile males), 146 plains harvest mice (59 adult females, 82 adult males, 2 subadult females, 1 subadult male, and 2 juvenile males), 101 hispid pocket mice (61 adult females, 35 adult males, 1 juvenile female, and 4 juvenile males), 86 northern grasshopper mice (35 adult females, 41 adult males, 1 subadult female, 2 subadult males, 4 juvenile females, 3 juvenile males), 71 southern plains wood rats (40 adult females, 28 adult males, 2 juvenile females and 1 juvenile male), 43 northern pygmy mice (32 adult females, 10 adult males, and 1 juvenile female), 35 western harvest mice (11 adult females, 24 adult males), and 23 deer mice (12 adult females, 7 adult males, 2 subadult females, and 2 subadult males; Fig. 3, Fig. 4, Fig. 5).

For the white-footed mice recaptures there were 65 adult females, 56 adult males, 1 subadult female, and 1 subadult male (Fig. 6, Fig. 7). For the hispid cotton rat recaptures there were 30 adult females, 15 adult males, 1 juvenile female, and 1 juvenile male (Fig. 6, Fig. 8). For the plains harvest mouse recaptures there were 16 adult females, and 16 adult males (Fig. 6). For the hispid pocket mice recaptures there were 24 adult females, 18 adult males, and 1 juvenile male (Fig. 6, Fig. 8). For the Northern grasshopper mice recaptures there were 16 adult females, and 15 adult males (Fig.6). For the southern plains wood rat recaptures there were 32 adult females, and 10 adult males (Fig. 6). For the northern pygmy mice recaptures there were 2 adult females (Fig. 6). For the western harvest mice recaptures there were 6 adult females, and 6 adult males (Fig. 6). For the deer mice recaptures there were 4 adult females, 4 adult males, 1 juvenile female, and 1 juvenile male (Fig. 6, Fig. 8).

## DISCUSSION

The results for the white-footed mice show that more adult males were captured then adult females, however females were recaptured more than males. In the subadults and juveniles captured however, more females were captured then males. As the sex ratio in several studies and the North American Census of small mammals for white-footed mice state populations usually have a male to female sex ratio of 1:1. These results may indicate a sex bias for Sherman traps toward adult males and younger females (Kaufman and Kaufman 1982, Phelps and McBee 2010). Though in another study, white-footed mice were seen to have a bias sex ratio at birth toward males in the spring and females in the fall, so this could be a consequence of this pattern instead (Goundie and Vessey 1986). If we only compare the juvenile and adult capture ratios it would appear that there is an adult male sex bias for traps. This could also be a factor in the results as males tend to disperse about 75 m from their nest while females only disperse about 39 m (Goundie and Vessey 1986). So from this data it can be assumed that more adult males could be captured because they move farther afield. The trapping results probably are a combination of these factors so trap sex bias may actually change over time.

The number of adult and juvenile females captured was larger than the number of adult and juvenile males for hispid cotton rats. The recaptures also favored female adults and it was similar for both sexes in the juveniles. Another study had the same results as this study (Green and Rose 2009). The exception to these trends is one study conducted in Georgia and Virginia where male captures were more common then females (Bergstrom and Rose 2004). Despite the exception the trend seems to be a female biased population, rather than a trapping bias because of the matching data from other studies and from the juvenile data.

The plains harvest mouse adult and juveniles were male biased while subadults were female biased, and an equal number of both sexes were recaptured. Another study that used Sherman live traps got the same bias as this study (Clark et al. 2005). Therefore this information, along with the fact that the juveniles were biased the same way, may indicate that the population has a male biased sex ratio.

Of the hispid pocket mice captured more adult females were captured and were also recaptured more often. These results were reversed for juveniles with more males being captured then females. The fact that the juvenile sex ratio is different than the adult seems to indicate that there may be a trapping sex bias.

For the northern grasshopper mice, more adult females were captured then adult males and the same pattern was evident in the juveniles. The subadults however displayed a male bias in captures. These results are similar to those found in another study (Mann and Towe 2002). The similar results may indicate a trap sex bias, but the fact that the same bias was shown in the juveniles seems to indicate that it is the actual sex ratio.

More adult females and juvenile females were captured for the southern plains wood rat and recaptures captured more females as well. This same adult sex bias was recorded in several other studies (Conditt and Ribble 1997, Raymond et al. 2003). A female bias of the population may be more likely than a trapping bias in this case. The trapping results above and the similarities in the adult and juvenile captures would seem to indicate this.

The northern pygmy mice captured was strongly female biased in adults, juveniles, and recaptures.  If you then compare the adult and juvenile sex ratios it would seem that northern pygmy mice populations tend to be female biased in their sex ratio.

Western harvest mice seem to have a population sex ratio that is skewed toward males.  This seems to be the case in this study with more males being captured then females.  It is further supported by another study done which also captured more males then females (Johnson and Gaines 1988).  In another study the number of females captured was greater than the number of males (Skupski 1995). No juveniles were captured of this species in this study so results from those captures cannot be compared. The combination of conflicting data and unavailability of data makes it hard to determine whether this is a population sex ratio or a trap sex bias.

In the results for deer mice more adult females were captured then adult males and an equal number of subadults of each sex were captured. Several studies all had different biases for deer mice, though one displayed equal numbers of each sex of the juveniles captured as was seen in our study (Laverty and Adler 2008, Lehmer et al. 2007, Schulte-Hostedde et al. 2001, Wasserman and Nash 1979, Zwolak and Foresman). Because of the variability of all of these results it is reasonable to think that there isn't a trapping sex bias for this species.  Or if there is a trapping bias it cannot be seen in this study because of the many variables that affect the sex ratio of deer mice, such as precipitation, the weight of the mother, and sex biased infanticide (Havelka and Miller 1997).

To further this information a study including several different trap types in the same area would be useful. This is necessary because different trap types may have a different trapping sex bias than others or some types of traps may not have a bias for some species at all. In tandem with this a laboratory study on the birth sex ratios of each species would also help with understanding if the results from the trapping are a bias from the trap or if the population is usually biased in that way. Another useful study would be of mortality rates of male and females of each species. This would show whether a difference in juvenile and adult captures is because of a higher mortality rate in one sex. It is necessary for this type of study to be done in other regions as well to observe whether location has an effect on trap bias or population bias.

## MANAGEMENT IMPLICATONS

With further study of trap sex bias, biologist will be able to know for sure if the populations they are looking at are actually biased one way or the other or if it is a trapping bias. With this information it is then easier to know what steps need to be taken to control or help populations. This information would also help researchers doing research in the future because they would know another advantage or disadvantage of using a certain trap type.

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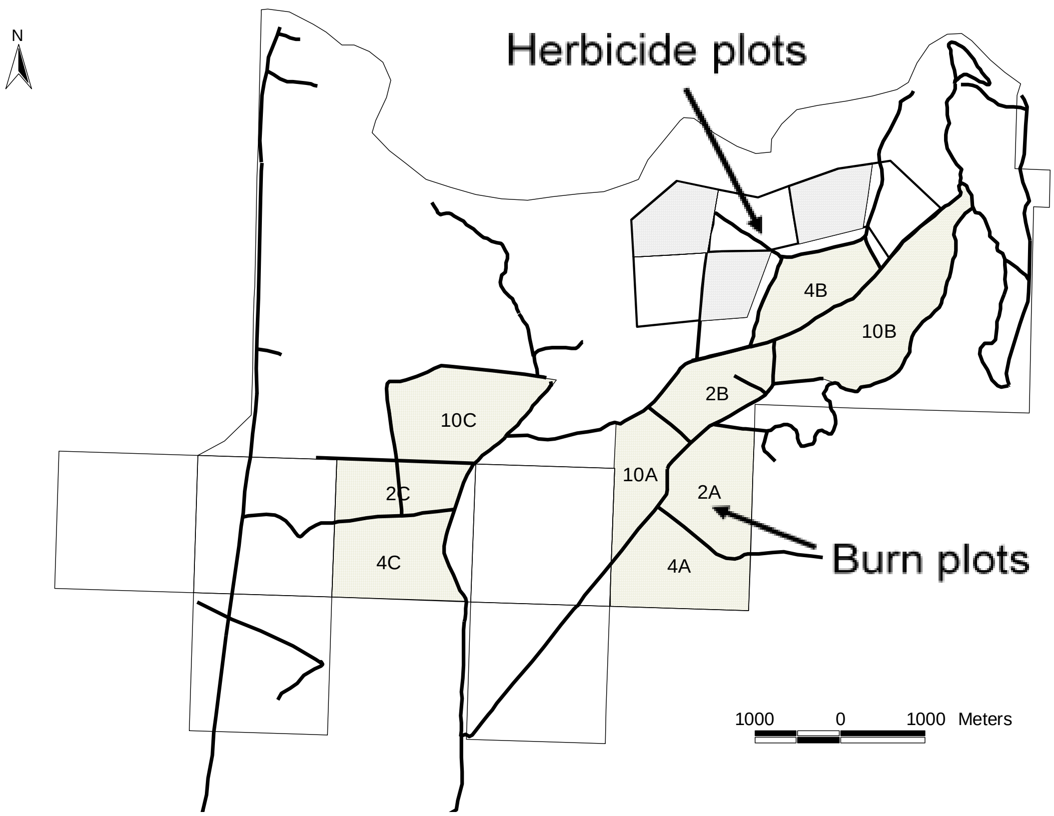
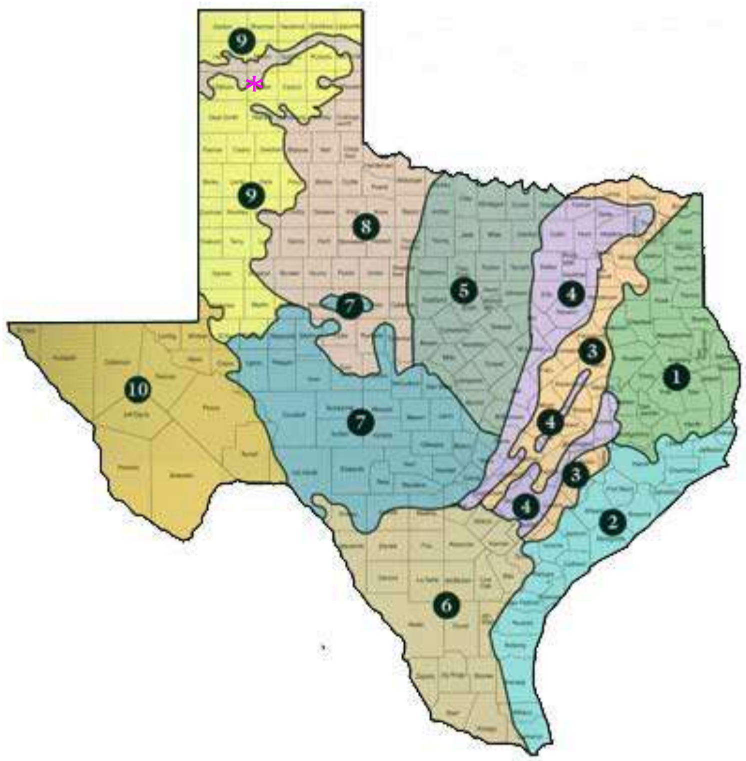



Fig. 1. Map of burn plots on Cross Bar CMA.



Ecoregion 1 – East Texas Pineywoods

Ecoregion 2 – Gulf Coast Prairies and Marshes

Ecoregion 3 – Post Oak Savannah

Ecoregion 4 – Blackland Prairies

Ecoregion 5 – Cross Timbers and Prairies

Ecoregion 6 – South Texas Plains

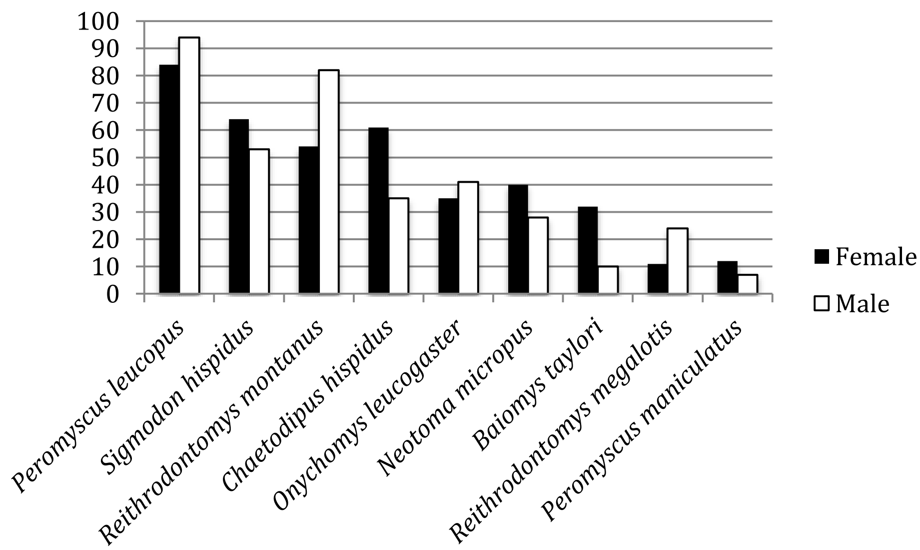
Ecoregion 7 – Edwards Plateau

Ecoregion 8 – Rolling Plains

Ecoregion 9 – High Plains

Ecoregion 10 – West of the Pecos ("Trans-pecos")

Fig. 2. Map of Ecoregions, star indicates approximate location of Cross Bar CMA




(TPWD 2008)

Fig. 3. Graph of adult captures

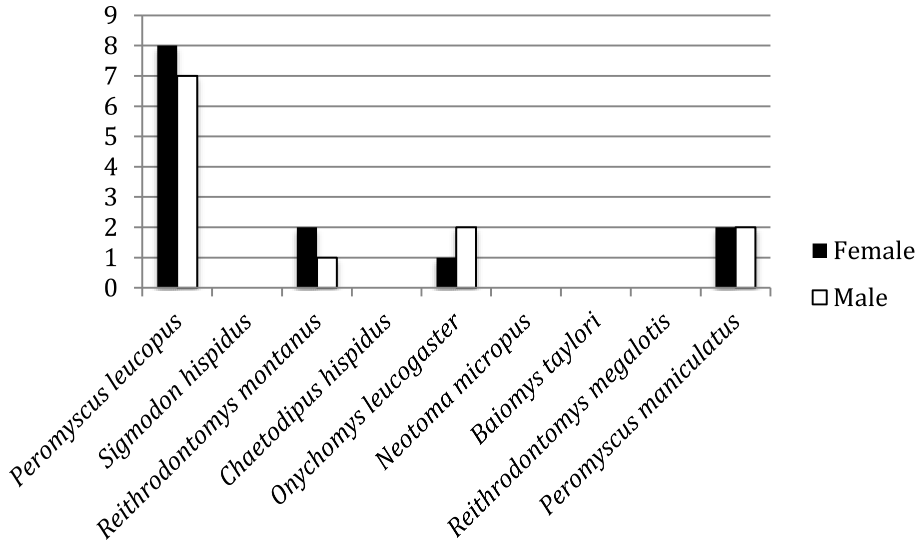



Fig. 4. Graph of subadult captures

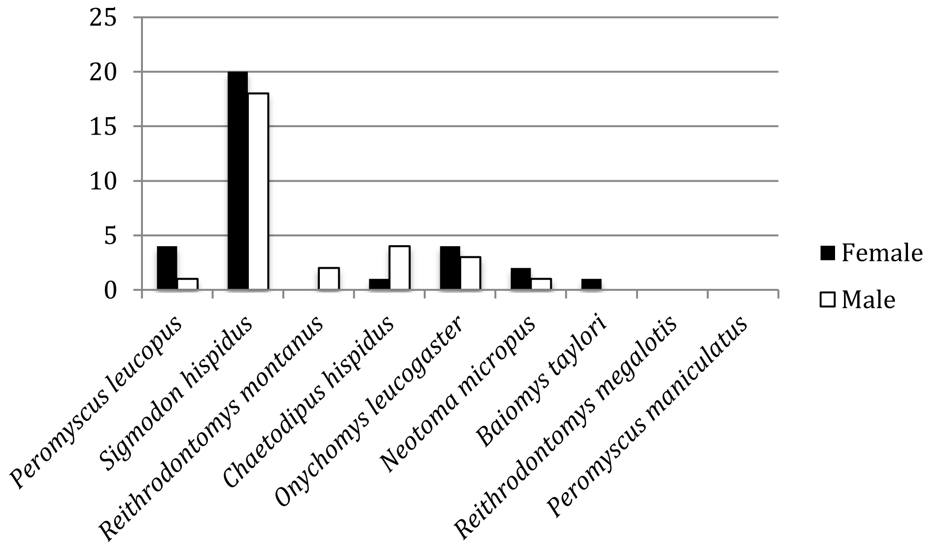



Fig. 5. Graph of juvenile captures

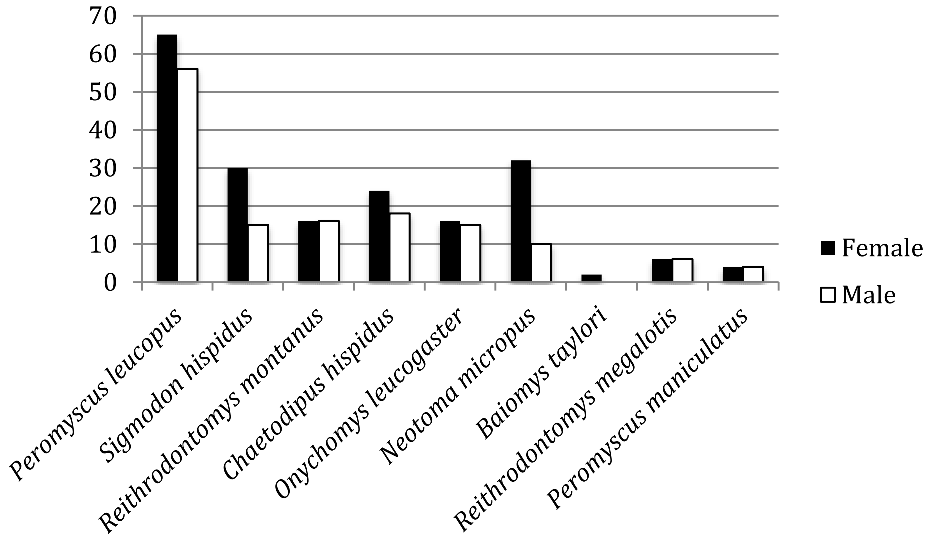



Fig. 6. Graph of recaptured adults

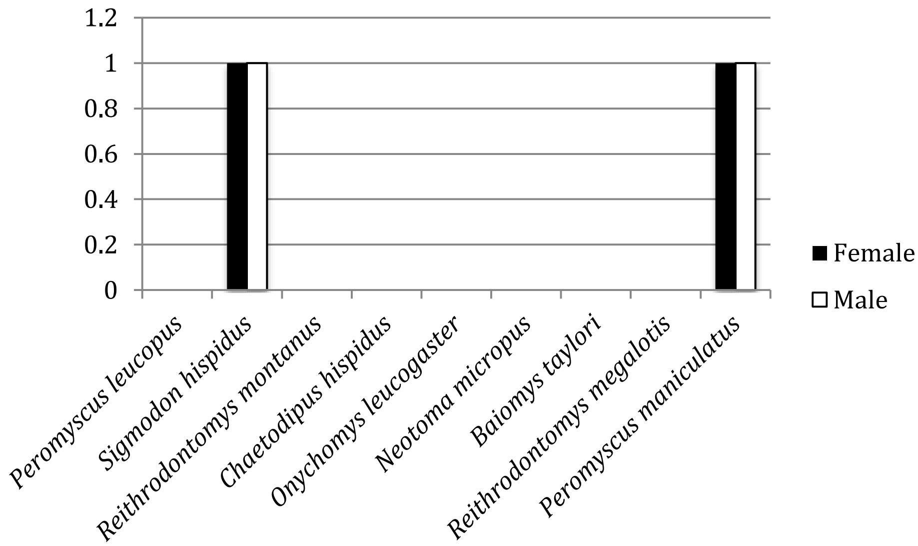



Fig. 7 Graph of recaptured subadults

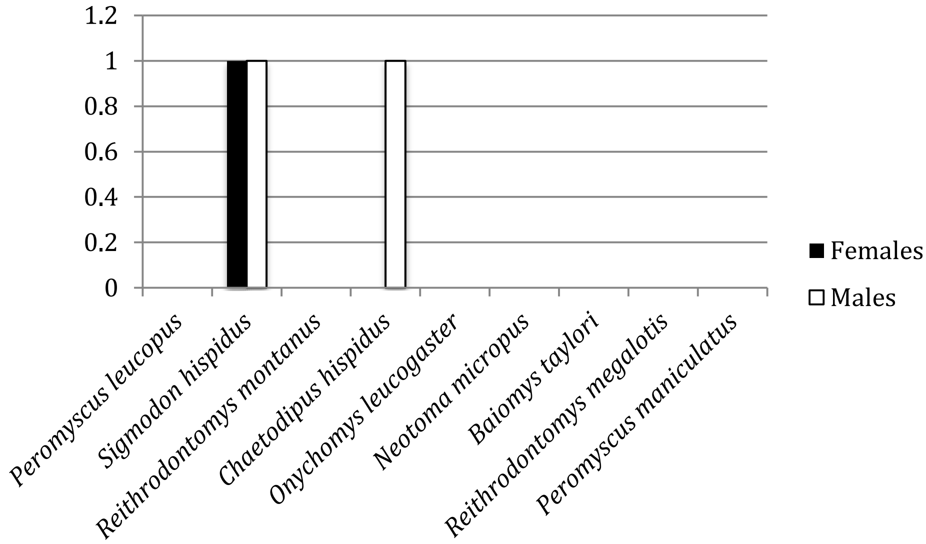



Fig. 8 Graph of recaptured juveniles