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ABSTRACT

During this scientific investigation, decomposition rates of mice in water and mice in a prairie setting were compared. Decomposition rates of specimens with larger body mass (rats) and specimens with smaller body mass (mice) in a prairie setting were also compared. It was hypothesized that mice in the prairie would decompose more quickly than mice in water, and that mice in the prairie would decompose faster than rats in the prairie due to lower body mass. This investigation took place at the College of DuPage. Set up for the investigation included weighing the individual mouse and rat specimens, building cages, placing 25 mice and 10 rats into the cages, placing 25 mice on screens (uncaged), then placing all 60 specimens into either a prairie, water, or brush setting. After the investigation, it was found that initial body mass did not play a significant role in decomposition, but that water submersion did prolong the effects of decomposition. Body mass most likely did not play a significant role in this investigation due to cold temperatures, possible desiccation of the carcasses, and lack of substantial body fat in the carcasses initially. Water submersion most likely had a significant effect on decomposition rates due to cold water temperatures which postponed insect colonization.

Keywords: decomposition, desiccation, body mass, water submersion, insect colonization.

INTRODUCTION

The goal of this scientific investigation was to address and answer essential questions about the effects of water submersion on decomposition in mice and the effects of initial body mass on decomposition in both mice and rats. In the majority of studies done on the effects of water on decomposition, most aquatic decomposition rate data is compared to surface decomposition rate data (Ayers 2000). For this reason, I have chosen to compare decomposition rates of our mouse specimens that were placed in the water to the decomposition rates of our mouse specimens that were placed in the prairie area. The most frequently stated generalization regarding aquatic decomposition is that a body decomposing one week on the surface of the ground is equivalent to a body decomposing for two weeks in the water (Ayers 2000). If a body is placed in water, it should decompose more slowly than a body placed on a hill. Therefore, the mice on the exposed area of the hill will exhibit more signs of decomposition at the end of the investigation than the mice placed in the water.

Initial body mass is another potential factor of decomposition. When carcasses of a variety of body masses were colonized by insects, small carcasses decomposed more quickly than large ones. This could be due to the greater body mass for insects to consume in larger carcasses (Simmons et al. 2010). In a study where the effect of body mass on pig carcass decomposition was tested, it was found that decomposition began at the same moment in pigs with both large body mass and small body mass. However, decomposition lasted much longer on larger carcasses, meaning that for smaller carcasses, decomposition occurred more rapidly (Matuszewski et al. 2013). The two body sizes being measured must be subjected to the same weather conditions, and must be in the same environment. In the study I have conducted, the mice and rats being compared were both placed on the hill in the prairie and were subjected to the same weather conditions. If an animal has a lower body mass before the process of decomposition begins, it will decompose more quickly. Therefore, the mice on the hill will decompose more quickly than the rats on the hill.

METHODS

This study took place at the Russell Kirt prairie on the College of DuPage campus in North Eastern Illinois. The prairie is approximately 7.3 hectares and consists of restored tall grass prairie and cottonwood swamp; the prairie was restored in 1995. The two species studied during this investigation, *Mus musculus* and *Rattus norvegicus*, obtained from American Rodent of Indianapolis, IN, were euthanized with carbon dioxide then promptly frozen until approximately 12 hours before the study began. The rodents were thawed in a refrigerator until placed in the field to delay decomposition.

We began the set up for the scientific investigation by placing 50 mice and 10 rats individually upon pieces of plastic screening then recording their individual weights. 25 of the mice and all ten of the rats, placed upon plastic screening, were placed into a 12.7 mm steel mesh hardware cloth 180x180x160mm cage that was completely enclosed to prevent animal scavengers. The cages were secured to the ground via a metal stake. A small wooden stick marked with a number was placed inside each cage in order to identify each individual. The 25 mice that were not placed in cages were placed upon a piece of screening and were staked to ground; one end of a thin wire was wrapped around the stake, the other end was wrapped around the mouse to keep it in place. The specimens were dispersed amongst three different environments, 8 mice were placed in the water, 21 mice in a lightly wooded area (brush), and 21 on top of a hill in the prairie. 5 rats were placed in the lightly wooded area (brush) and 5 on the hill. The construction of the cages and screens, the weighing of the individual mice and rats, and the placement of the specimens in their respective environments was done on March 30th 2016.

After 20 days, all of the remaining specimens were collected from the brush, pond, and prairie. The specimens were then placed into an environmental chamber until the next day, when they were reweighed individually. The proportional change in weight was calculated for each individual carcass. Means of these values were calculated for mice and rats that were placed on the hill in the prairie. A Student's t-test was used to compare the means between mice and rats in the prairie, and significance determined at $\alpha = 0.05$. The same was done to compare the mice that were placed in the water and the mice that were placed in the prairie.

RESULTS

Of the 50 mice placed outside, 25 that were not caged were scavenged by predators. The results of the investigation will not include data on these 25 missing specimens. The weather during the investigation varied significantly. The average high temperature in March was 47˚ F. The average high temperature for April was 59˚ F. Mice and rats that were placed on the hill in the prairie showed slight signs of decomposition after five days on the hill in the prairie. On April 4th, I observed minor bloating of the carcass with minor yellowing of the fur “(fig 1.)”. On April 13th, the last day of specimen exposure, I observed more significant yellowing of the fur, fur disintegration, significant bloating, and maggot infestation in the body cavities “(fig 2.)”.

Fig 1.

Fig 2.

At the end of the investigation, there were 8 mice remaining in the prairie, and 4 rats. The changes in body mass in mice and rat specimens were calculated independently. The average weight of the 8 mice in the prairie was 0.5729. The average weight of the 4 rat specimens in the prairie was

0.544011115. The difference in loss of body mass is not statistically significant (Table 1). Therefore, I cannot conclude that the specimens with larger body mass decomposed at a faster rate than the specimens with smaller body mass (t=0.3775 df=10 p=0.7137).

Table 1. Differences of mice and rats in tall grass prairie after three weeks

	Species	habitat	avg wt. change	s.e	range
1.	*Mus musculus*	prairie	0.5729	.6399	.48623
2.	*Rattus norvegicus*	prairie	0.5440	.0420	.19520

Mice were placed both on the exposed hill of the prairie, and in the water in the cottonwood swamp area. 8 mice were placed in the water, and 21 were placed on the hill. However, one of the mice placed in the water was not fully submerged for the duration of the investigation; therefore will not be included in the results. At the end of the investigation, the mice placed in the water showed significant algae growth. They also did not exhibit any visible infestation by maggots or other insects that may have aided in decomposition. The mice on the hill showed signs of fly activity/maggot infestation. This most likely aided in the more rapid rate of decomposition of the mice on the hill and the slower decomposition rates of the mice in the water. The average weight of mice in the prairie was more than two times greater than the mice submerged in the pond (Table 2). This difference was statistically significant (t=4.1551 df=13 p=0.0011).

Table 2. Differences between mice in water and mice in tall grass prairie after three weeks

	Species	habitat	avg wt. change	s.e	range
1.	Mus musculus	prairie	0.5787	.02599	.48623
2.	Rattus norvegicus	prairie	0.2687	.0277	.21923

DISCUSSION

My hypothesis stating that specimens with a higher body mass will decompose more slowly than those with a lower body mass was not supported by the results of this investigation. It was hypothesized that due to a higher surface area and higher fat content, rat carcasses would decompose at a significantly slower rate than the smaller mouse carcasses. It had been stated in several sources that body mass does play a critical role in decomposition rate in pigs. I assumed that due to the higher rate of decomposition in pigs with larger body mass, the same would be true about rats. However, the study about pig decomposition that I used to support my hypothesis were done in the summertime in San Marcos, Texas (Ayers 2000). The difference in spring climate in Texas and the spring climate in Illinois should have been taken into consideration. Due to the cold weather during the first part of the investigation, the carcasses may have experienced some desiccation, this may have interfered with the decompsotion process. The results may have been inconclusive due to initial lack of substantial body fat in the carcasses as well. A more precise investigation may have been to compare the body mass losses amongst members of the same species with differing body masses (eg. rats of a high weight range compared to rats of low weight range), instead of comparing body mass loss amongst members of two different species.

The evidence from this scientific investigation does support my hypothesis that mice placed in water will decompose more slowly than mice placed in the prairie. This was most likely due to higher activity of decomposers such as maggots that were seen in the specimens in the prairie. Not only do maggots ingest the flesh of the decomposing animals, but they also produce heat while doing so which aids in the decomposition process (Heaton et al. 2014). Cold water temperatures may have also played a role in the delayed decomposition of specimens submerged in water. In colder water, there is less of a chance for maggot infestation. Carcasses placed in water during the winter in Clemson, South Carolina showed significantly slower decomposition and less insect colonization. Winter temperatures in this area of South Carolina range from 40.8-51 degrees F. These temperatures are similar to the temperatures observed during our investigation (Tomberlin and Adler 1998).

The findings of this and similar investigations are crucial to the field of ecology. Through the study of decomposition of mammals, ecologists can further understand the contrbution of decomposing matter to soil nutrients, nutrient recycling, and nutrient uptake by plants. They can also gain a better understanding of what environmental factors (temperature, sun exposure, water submersion etc) impact decomposition rates more than others.

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