

Effects of avalanches on rodent populations

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Abstract

Ecologists are interested in studying the factors that affect the abundance of a species. Disturbances, such as avalanches, could affect the populations of small mammals. Live trapping has been a traditional method to study abundances of small mammals; however, it has some downsides. A new, non-invasive method of measuring small mammal abundance was tested in a study last year (2018), and proved to be a good indicator of abundance, but not identification of specific species. This new method is using hair tube traps. This year (2019), these hair tube traps were used to measure the effect of avalanches on small mammal populations. The results showed that avalanches had an effect on abundance at three of the four sites, and that these sites showed a recovery at both the avalanche and non-avalanche sites over the summer.

Introduction

Ecologists are interested in studying the factors that influence species abundance. Small mammals make up an important part of the ecosystem and when their numbers change it can affect other species that they interact with in a system. Disturbances, whether human made or natural, can influence animal communities. They can cause the population sizes to go up or down. Previous studies of small mammal populations show that respond to disturbances such as fire, flooding, clear cutting and more (Zwolak 2009).

Avalanches can affect small mammal communities because they disturb trees and plants, which small mammals possibly use as food, and because they disturb the soil in which the small mammal live (Rideout 1993). It is possible that avalanches disturb the small mammal populations either by crushing them in their burrows, destroying the food they have stored under the snowpack or limiting their ability to emerge after hibernation. In the East River Valley, the 2018-2019 winter had an unusually high number of avalanches (Colorado Avalanche Information Center).

In the ecosystems surrounding RMBL there are various populations of small mammals including *Sorex sp.*, *Peromyscus maniculatus*, *Tamias minimus*, *Zapus princeps* and *Microtus montanus*. *Peromyscus* do not hibernate. They need the snowpack as an insulating cover. They mostly forage their food during the winter under the snowpack and do not rely very much on stored food. *Microtus* are active in the winter under the snowpack as well. They eat mostly grasses. *Zapus* are unlike most of the small mammals and do hibernate. They mate shortly after emerging from hibernation. They are active in the summer months. Their hibernation chamber is two feet underground. *Tamias* also hibernate and store food in their hibernation chambers

(Struebel 1989). All of these species have different behaviors, but they could possibly be affected by a disturbance such as an avalanche. For the winter active animals, an avalanche could possibly crush them, destroy their burrows or get rid of any food source near them. For the hibernating animals, it is likely that they can remain safe if their burrows are very deep underground. However, the surface would be disturbed, and it is possible that they would be unable to emerge when mating season comes around May. Thus, there is potential for avalanches to negatively affect small mammals.

In a study conducted last year (2018), I used hair tube traps and live traps to compare abundance of small mammal populations in various locations. Live traps have been a common way to sample the population of a species for a long time. Hair tube traps was a new method of measuring abundance of a small mammal population (Chiron 2018). Last summer I experimented with this new method by placing hair tube traps and Longworth traps in the same sites and comparing the results of abundance measured by each of the traps. Live traps are set up the night before and must be checked early in the morning for live animals, which are weighed, marked and then released. The point of hair tube traps was to create a trap that did not require the trapping and handling of the animal. Hair tube traps were made using a Pvc pipe that had been cut to create a notch where the tape would be placed, where the animal would leave their hair as they ran through it. I attempted to identify the hair by comparing the hair collected on the tape to slides created from reference slides from museum specimens. This, however, proved to be a very difficult method to identifying by species and did not show much results. But when it came to general abundance, the hair tube traps, and live traps did show similar results. This can be seen in a graph from this study from 2018 (**Figure 3**).

The purpose of this study was 1) to provide additional evidence for the efficiency of hair tubes versus live traps by comparing the two techniques on established grids. 2) To use the new method of measuring small mammal abundance, hair tube traps, to determine the impact of the 2019 avalanches on small mammals. This was done by pairing avalanche and non-avalanche sites and measuring small mammal abundance.

Methods:

Choosing avalanche sites

Four different sites (**Figure 2**) where avalanches occurred were chosen for the on/off avalanche small mammal abundance comparison. Fifteen points were selected at each site for on avalanche and fifteen points were chosen for off avalanche, each 20 meters apart from each other. These two different plots at each site were paired so that the habitat type and vegetation were visibly similar. To describe what was an avalanche area, the amount of debris on two 100 meter transects were measured at each of the plots. The percent of debris was calculated for each transect. This was done for the Judd Falls parking lot, Marmot Meadow, and Maxfield Meadow avalanche site. The debris transect line method was not used for the Avalanche Cabin site, as there was not any debris on the avalanche side. However, it was

determined to be an avalanche site due to it still being covered in snow late into the summer and the late blooming of flowers. An indicator that an avalanche has occurred when there is not much ground covered in debris is snow that lasts long into the summer at a lower elevation. The snow that lands at the base of a mountain due to an avalanche is deposited as more packed and denser snow. As the surrounding softer snow melts throughout the summer season, this denser snow remains longer into the summer (Colorado Geological Survey). This was also the case with the Bellview Grid.

Avalanche vs. Non-avalanche

Hair tube traps were placed at the paired avalanche/non-avalanche sites at Maxfield Meadow, Judd Falls parking lot, Marmot Meadow, and Avalanche cabin (**Figure 2**). For the on/off avalanche sites, 10 large traps and 5 small traps were used each time. Hair tube sets were left out for about four nights at a time at each site. In order to detect recovery of population increases over the summer season, this was done three times for each of the sites.

Live trapping vs. Hair Tubes

For the live trap grids, 14 large and 10 small hair tube traps were used each time, placed between every other live trap location. Live trapping was done at Bellview Bench, Kettle Ponds, and Maxfield Meadow (**Figure 1**). For live trapping, Longworth live traps were used. These traps have two compartments, and the mammal has bait and bedding to keep it warm overnight until they are checked. At each of the three sites, there is a 7 x 7 grid of traps each 10 meters apart from each other. A total of 5 nights at Bellview, 6 nights at Maxfield and 9 nights at Kettle Ponds were conducted summer 2019. The species that were captured in the live traps were *Peromyscus maniculatus*, *Zapus princeps*, and *Microtus montanus*. The average percent of animals caught in Longworth traps was calculated across the days that correspond most closely with the days the tubes were deployed.

Results

Hair Tubes vs. Longworth Live Traps

The results showed that hair tubes are a good indicator of abundance. As in 2018, there was a significant positive correlation when comparing the percentage of tubes that captured hairs versus the percentage of traps that captured mammals in them across Bellview Bench, Kettle Ponds, and Maxfield Meadow (**Figure 4**).

Avalanche Debris at Sites

The sites visually determined to be avalanche sites were confirmed and further described by the three transect lines. The following table gives the percentage of debris for each the non-avalanche transects and avalanche transects for the three sites that this method was used for. The avalanche cabin site was visually determined by amount of late snow and

plant flowering. The range of debris for non-avalanche sites was 0%-2.6%, and for avalanche sites was 9.3%-61%.

Site	Non-avalanche	Avalanche
Maxfield Meadow	2.60%	11.17%
	0.67%	9.26%
Marmot Meadow	0.30%	32.35%
	1.00%	60.81%
Judd Falls	0.00%	42.70%
	0.00%	12.15%
	0.00%	22.30%
Avalanche Cabin	No debris	No debris

Avalanche vs. Non-avalanche Abundance

Avalanches had a negative effect on small mammal abundance at three of the four sites. For the three sites, there was also an observed pattern of higher abundance of the avalanche than non-avalanche recovery throughout the summer in both types of plots. These sites were Judd, Maxfield and Avalanche cabin. For Marmot Meadow there seemed to be no pattern of recovery as well as no difference between the avalanche and non-avalanche sites (**Figures 5 & 6**).

Effect test:		
	F=	P=
Trt. (Avalanche/Non-Avalanche)	7.3245	0.0180
Site	6.1211	0.0134
Set (1,2,3)	21.4218	0.0005

Discussion

The use of hair tubes this year (2019) supported the evidence found last year (2018) that they are an effective way to measure small mammal abundance. However, a method needs to be discovered to identify the hair for them to be a good measure for specific species. The advantage of hair tubes over live trapping is that there is no need for the animals to be handled, which reduces the chances of an animal death or people being bitten. Additionally, hair tubes do not have the time constraints that come with live trapping. Hair tubes can be set at whatever time of the day and left out for several days and in any weather.

The disturbance by avalanches in 2019 caused a decrease in abundance of small mammals at three of the four sites. The abundance increased over the summer, but the avalanche sites did not have as many small mammals as the non-disturbed sites, even at the end of the season. It is possible that *Microtus* and *Peromyscus* were disturbed while remaining active under the snowpack during the winter or that their food sources were destroyed.

There could be several reasons there was no differences in Marmot Meadow, possibly because of the high amount of *Tamias* activity. Being the larger of the four species, it is possible that they spread out faster in the spring or survived underground and recolonized the debris area quickly. Because *Tamias* hairs are the most distinctive, further study of the hair samples on the tape might be able to tell us more about this.

The different sized tubes were used in the study to allow for different sizes of mammals to go through them. While *Zapus*, *Microtus* and *Peromyscus* are roughly about the same size, *Tamias* are slightly larger and could probably only go through the bigger tubes. Again, separating the hairs by tube size might help understand which species are at each site.

A future study that could benefit from the use of hair tube traps is answering how avalanche disturbance compares with other type of disturbance? Another interesting question is to compare mammals that are active during the winter, such as *Peromyscus* and *Microtus*, to hibernating mammals like *Zapus* and *Tamias*, and seeing if they are affected differently by avalanches. Also, because two of the live-trapping grids were also disturbed by avalanches in 2019, historical live-trapping data, as well as current could help understand which species declined and how each species recovers or re-colonizes avalanche-disturbed sites.

Literature cited

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Figures

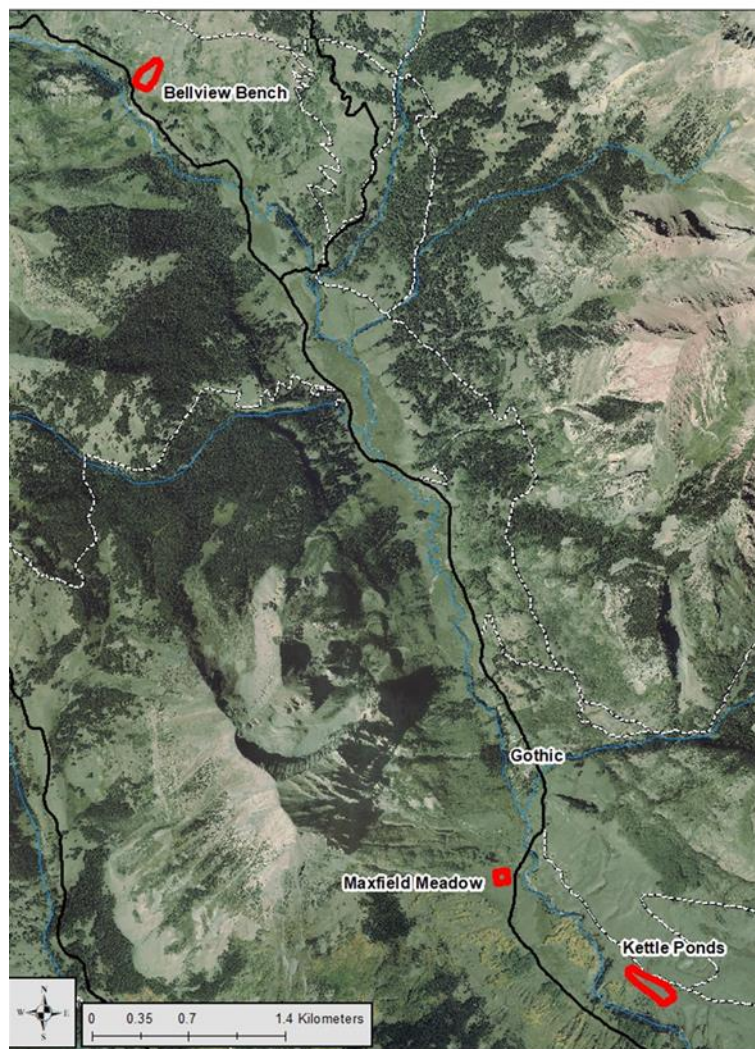


Figure 1 – Established long-term small mammal live- trapping grids

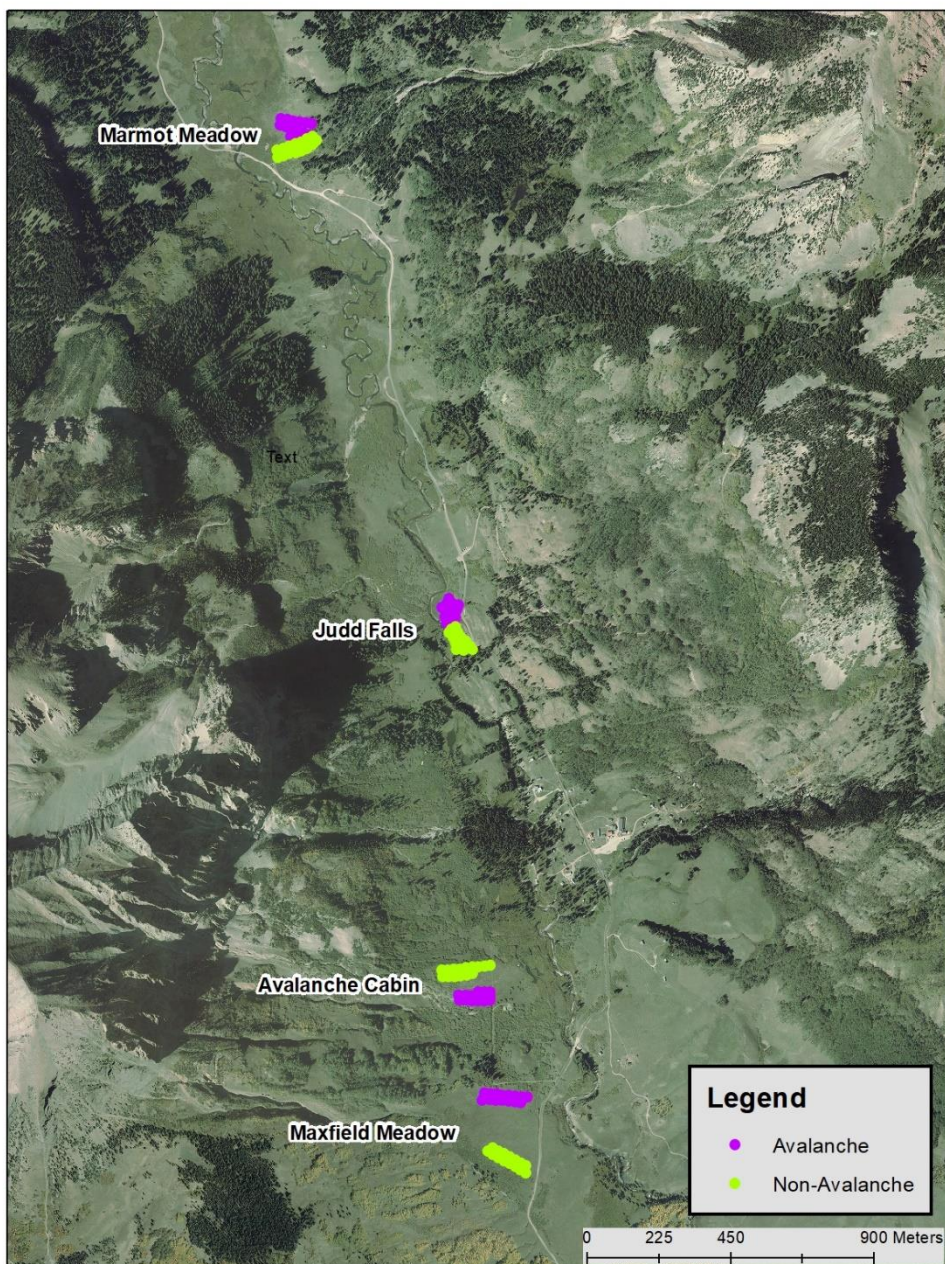


Figure 2 – Paired avalanche/non-avalanche sites selected 2019 based on debris and snow cover.

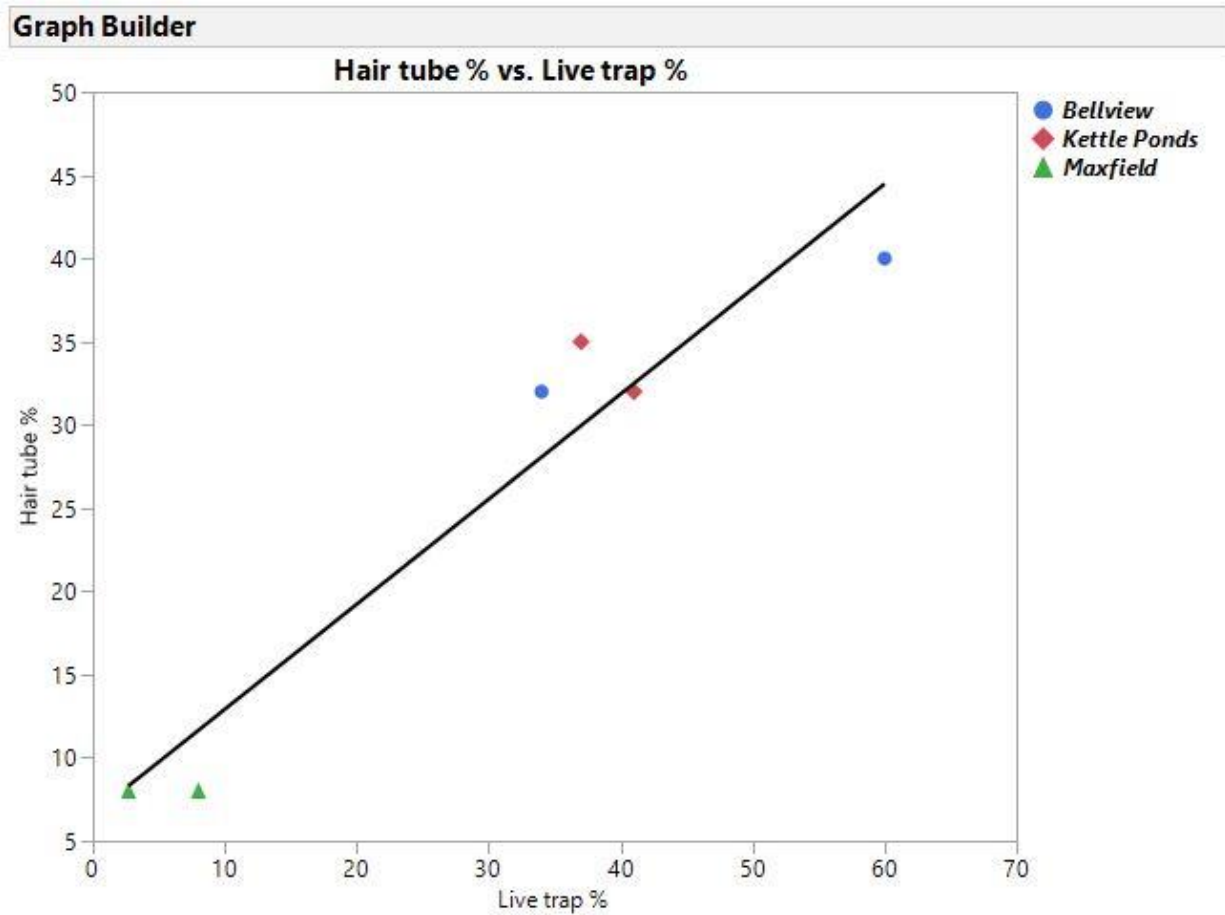


Figure 3

Hair tube % vs. Live trap % 2018

Regression analysis:

$R^2 = 0.925$

$F(1,5) = 49.4$

$P = 0.0022$

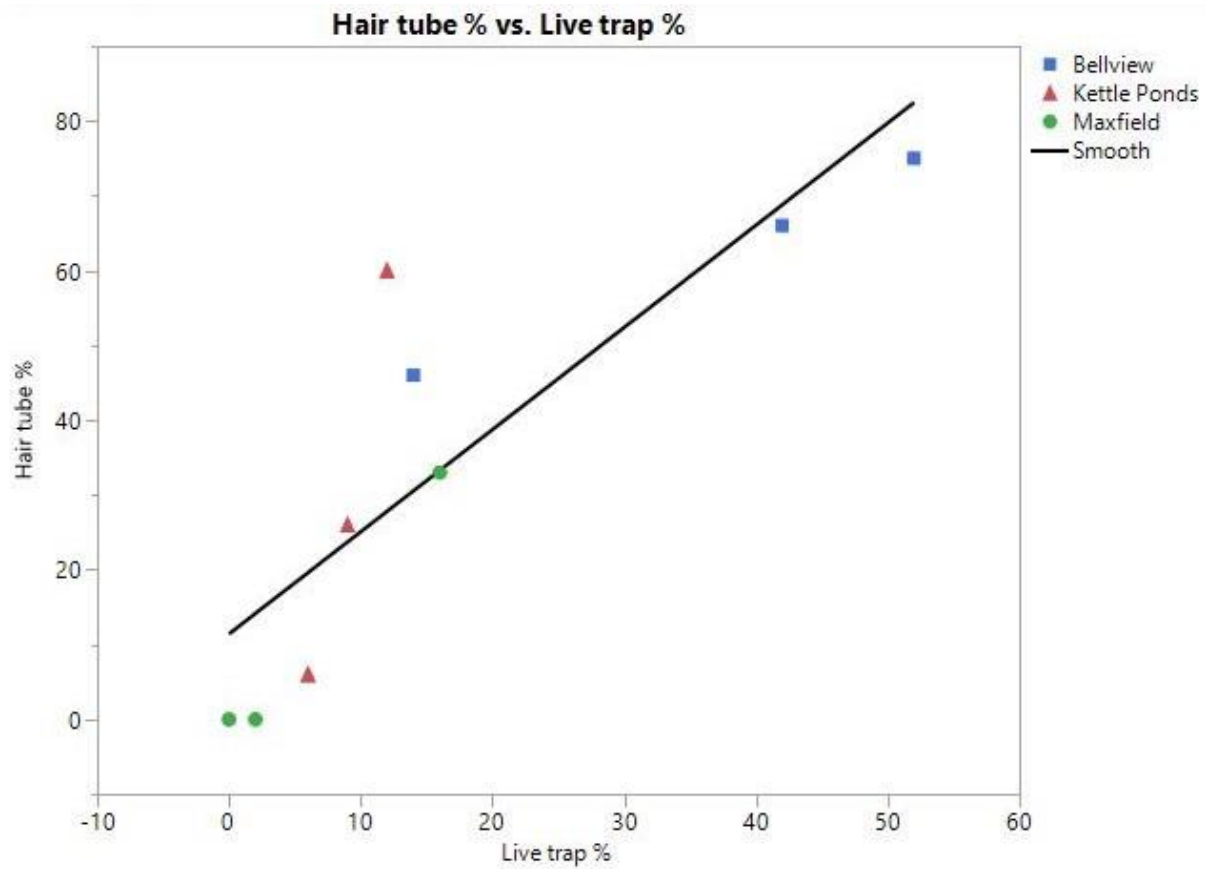


Figure 4

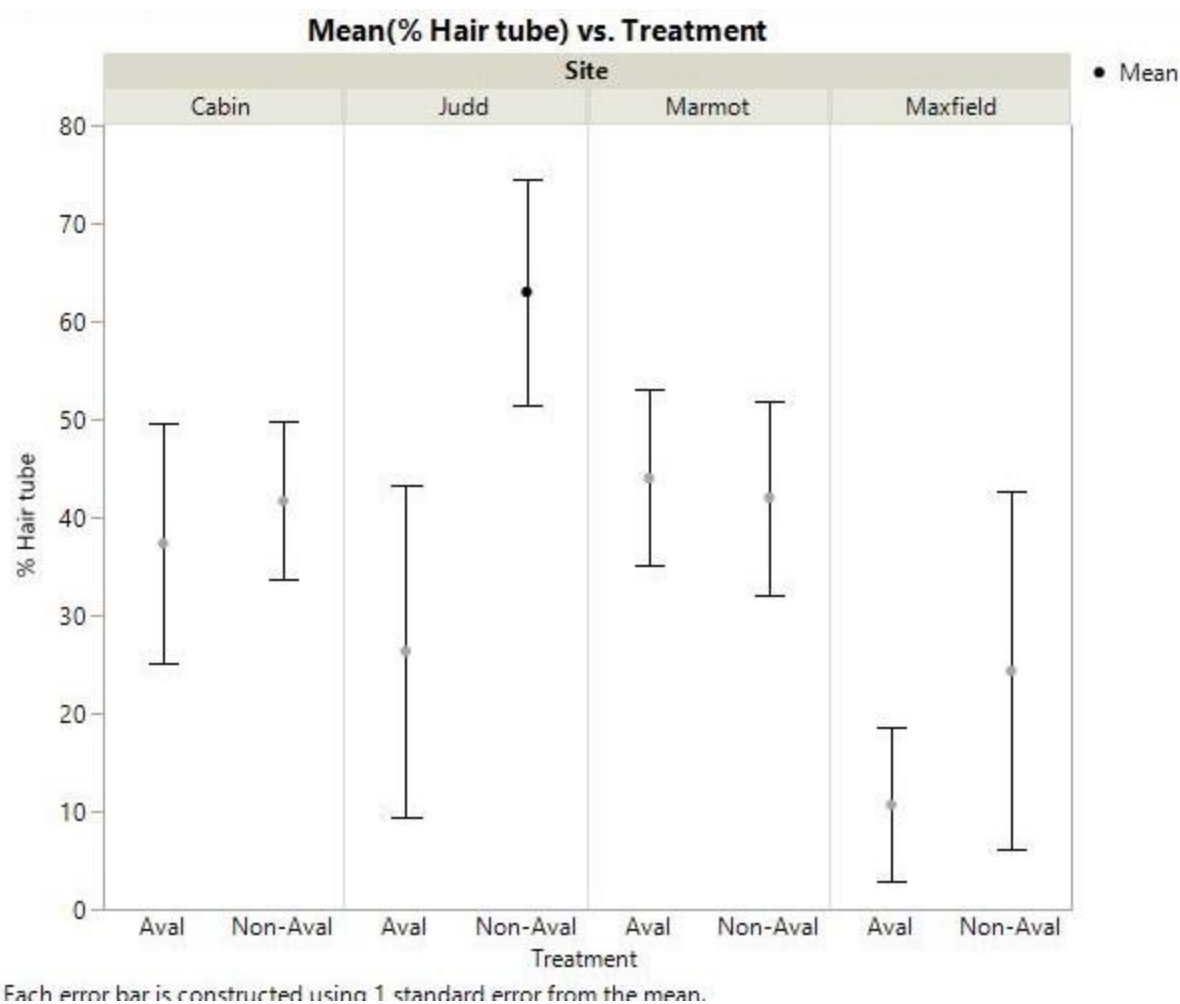
Hair tube % vs. Live trap % 2019

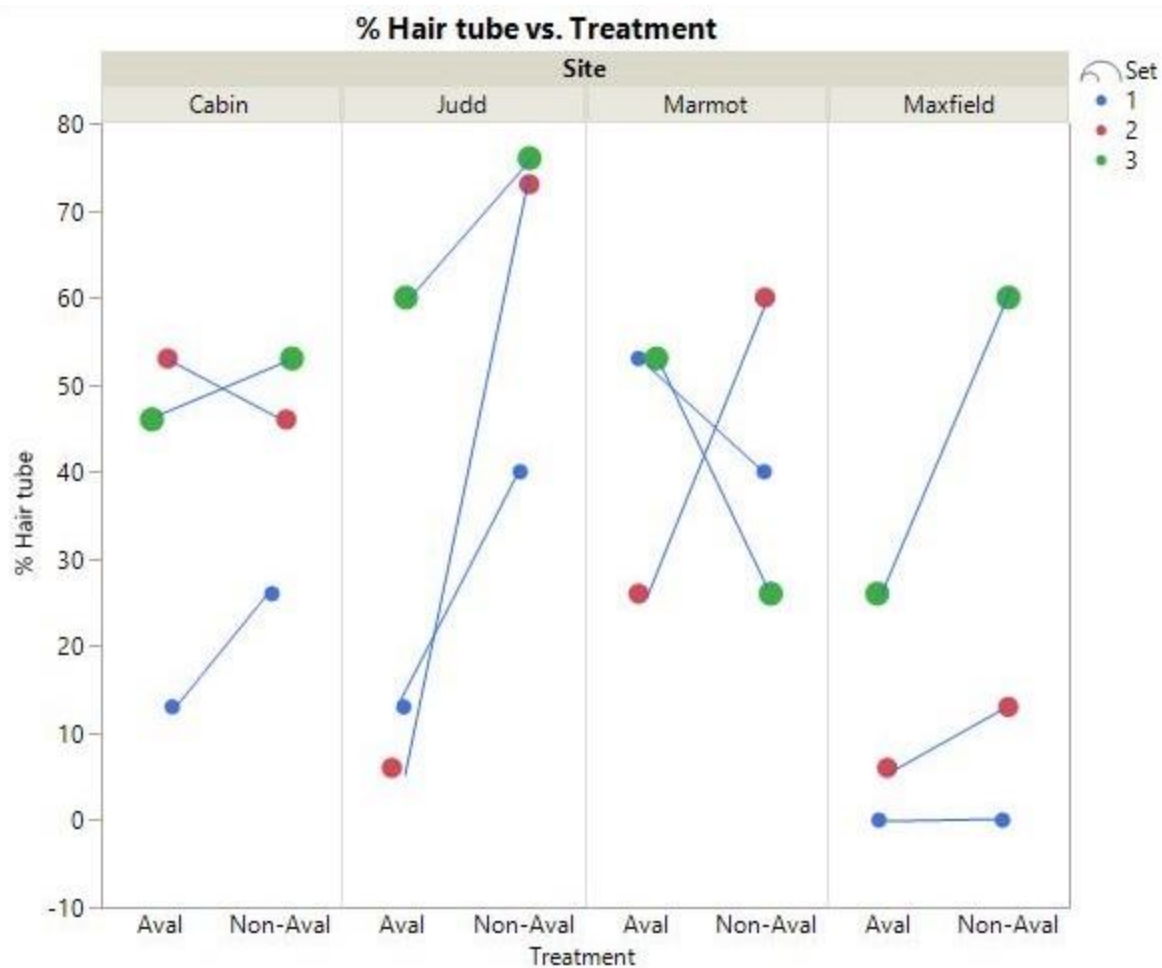
Regression analysis:

$R^2 = .722$

$F(1,8) = 18.1518$

$P = 0.0037$

**Figure 5**

**Figure 6**