Exploring Premature Detachment of Radio-Transmitters Used on Bats in Telemetry Surveys

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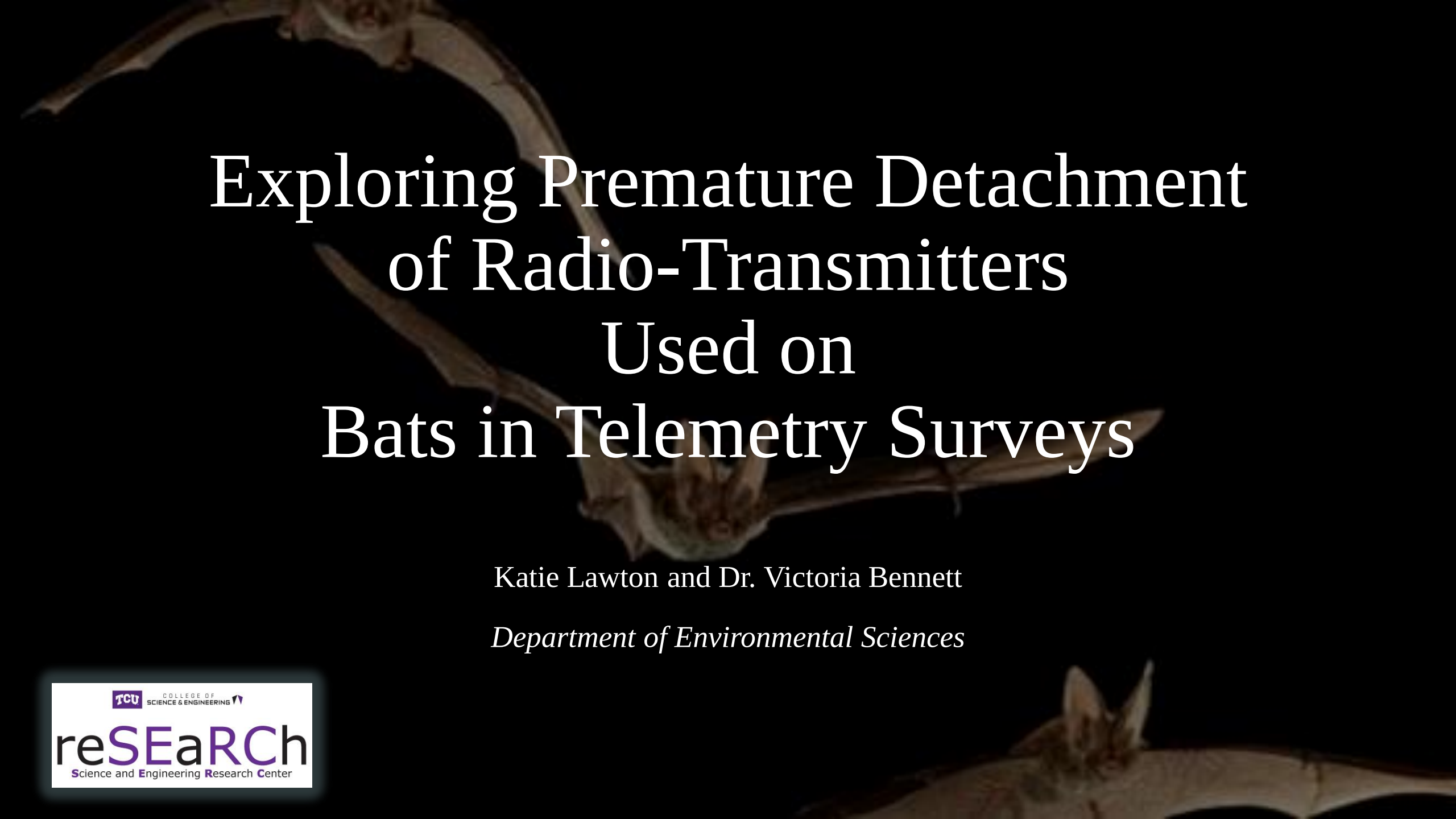


Introduction

- Telemetry survey techniques are important to wildlife studies because they can help determine habitat requirements, diet preferences, breeding habits, social dynamics, movement and activity patterns, and other resource use.
- The technique of telemetry involves attaching radio-transmitters to an animal (Figs. 1-2) and tracking their location through the transmitter's signal via an antenna and receiver (Fig. 3).

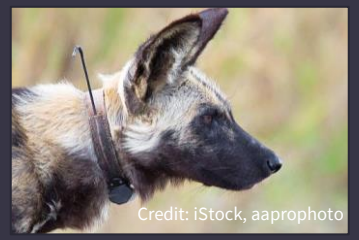


Figure 1: Transmitter and antenna on collar of African wild dog.

Figure 2: Radio-transmitter on ankle collar of white rhinoceros.

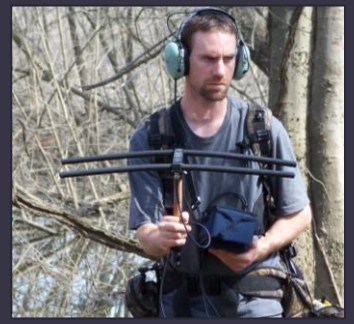


Figure 3: Antenna and receiver box used to track radio-transmitters attached to animals.

Figure 4: Radio-transmitter attached to liwi bird on back between wings.

- When attaching a radio-transmitter, there are two main factors that determine the attachment method: 1) size of the animal, and 2) whether the animal is aquatic, terrestrial, or volant.
- There are added challenges for volant species, as anything attached to them can interrupt their flight. For example, any additional weight reduces lift and increases drag.
- On small birds and bats, there is also limited placement for the transmitter, as it cannot throw off their balance or hinder their wing movement.
- Consequently, transmitters are glued on to the back of bats and small birds between the shoulder blades (Fig. 4).
- The problem with this attachment method is that the transmitters only stay on bats 9 days on average, which is <50% of the potential battery life of the transmitter (O'Mara et al. 2014).
- Our study aimed to prevent this premature detachment. For this, we conducted a two-part study to 1) determine how transmitters are being removed by bats (Fig. 5) and 2) explore a method to prevent their premature detachment.

Figure 5: Radio-transmitter attached to back of flying Eastern Red bat

Methods

- Evening bats (*Nycticeius humeralis*) were captured in local Fort Worth parks via mist netting surveys (Fig. 6).

Figure 6: Triple high mist nets used to catch bats in Fort Worth parks.

- During the study, bats were housed in the TCU flight facility, a 17 m x 10 m meshed room in an open-air facility with no artificial light to maintain their natural schedules.
- Bats were provided with water sources, roosting opportunities, and flying prey to simulate natural behavior.

Part 1: Transmitter Trials

- Our first trials tested whether transmitter brand made a difference to attachment time. We compared two brands, Pacific Northwest National Laboratory (PNNL; Fig. 7) and Wildlife Materials (WM; Fig. 8).
- The PNNL transmitters were tubular with slightly lighter antenna, while the WM transmitters were square with slightly heavier gage antenna.
- To attach transmitters, we trimmed the hair between the shoulder blades and applied the transmitter to the bat with an adhesive.

Figure 7: PNNL transmitter attached to back of Evening bat using a perma-type cement adhesive.

Part 2: Antenna Taste Trials

- Our second set of trials aimed to test the effectiveness of antenna coatings at preventing bats from damaging antennas.
- The antennas of the attached transmitters were coated in either cayenne pepper, nail biting deterrent, or Tabasco sauce, as well as some with no coating (i.e., the control).

Variables recorded and tested:

- Number of days transmitters remained attached
- Percentage of transmitters with damage
- Amount of damage (number of bends on antenna; Fig. 8)
- Number of days attached versus amount of damage

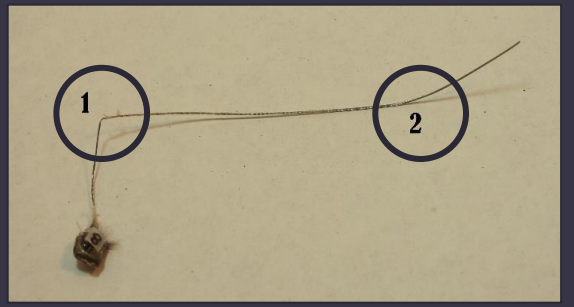


Figure 8: WM transmitter with antenna damage

Part 1: Results

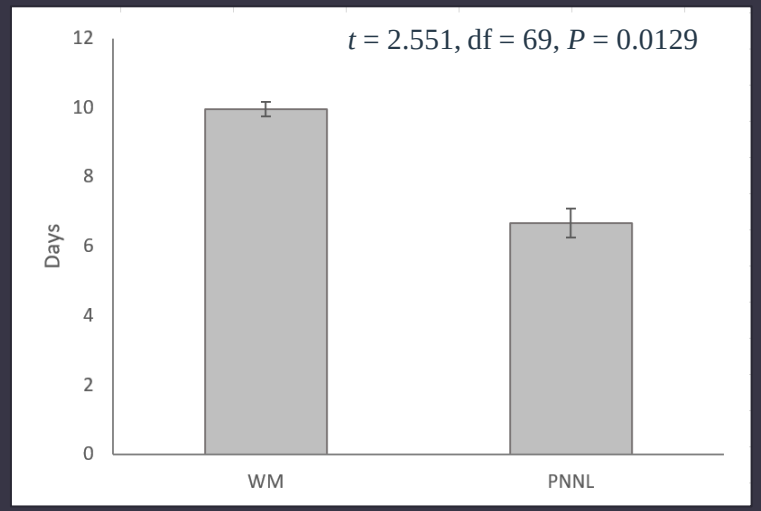


Figure 9: Mean ± SE number of days transmitters remained attached for the two transmitter brands used

WM transmitters stayed attached significantly longer than PNNL transmitters.

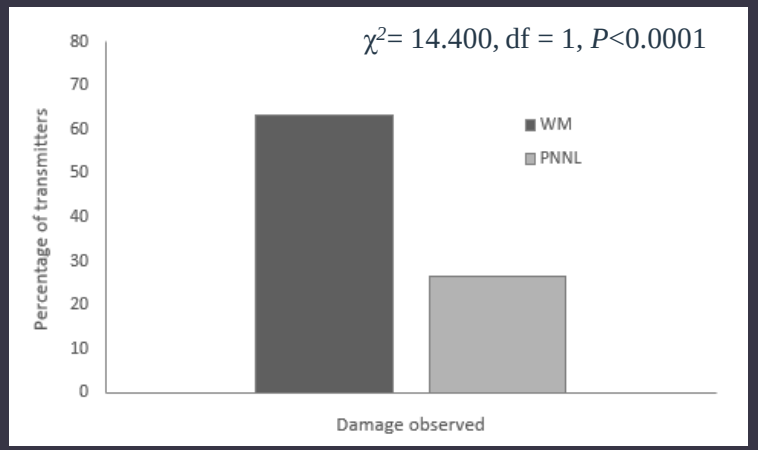


Figure 10: Percentage of transmitters with observed antenna damage for the two transmitter brands used

There were a higher percentage of WM transmitters damaged than there were PNNL.

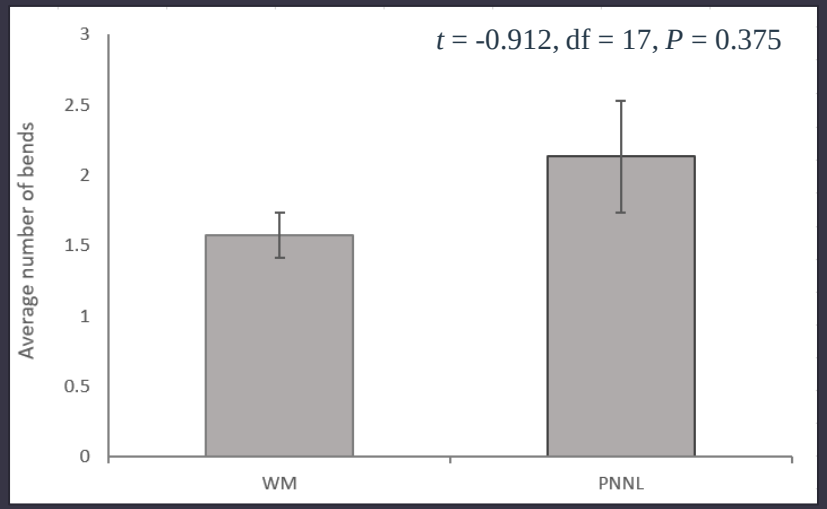


Figure 11: Mean ± SE number of bends observed among the two transmitter brands used

PNNL transmitters showed more damage than WM, but this difference was not significant.

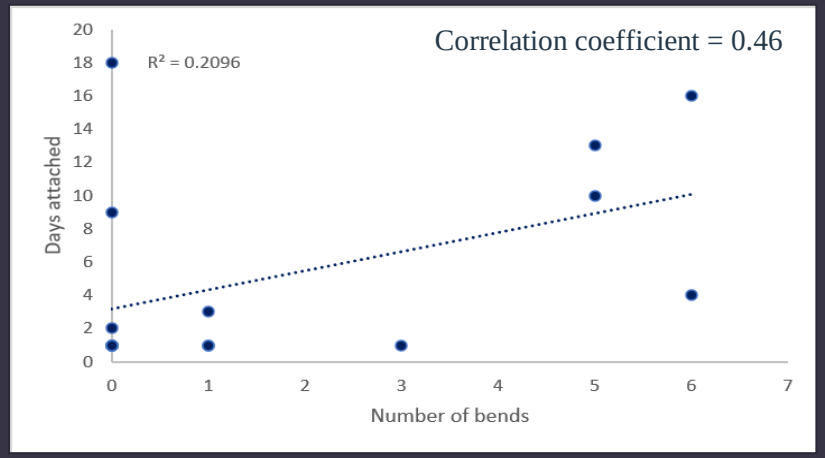


Figure 12: Correlation between amount of damage observed and length of time PNNL transmitters remained on bats

The longer the transmitters remained attached, the more bends the PNNL transmitters tended to have.

Part 2: Results

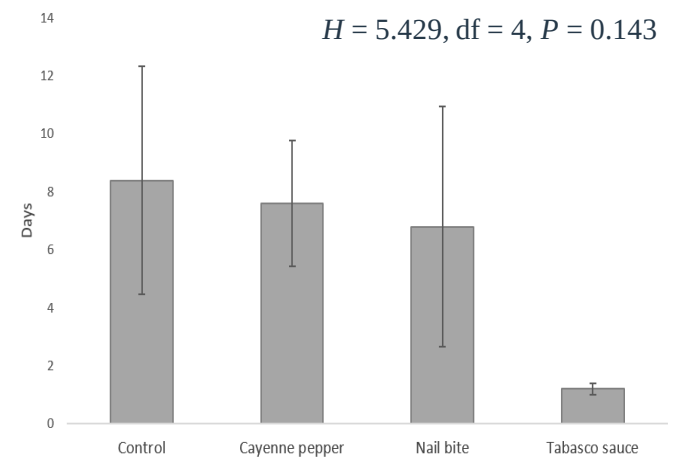


Figure 13: Mean ± SE number of days transmitters remained attached for the four antenna coatings used.

There was no significant difference between the length of attachment time with antenna coatings. When we tested the Tabasco sauce, it was particularly humid, which may have caused faster removal. This variable was removed from statistical analyses.

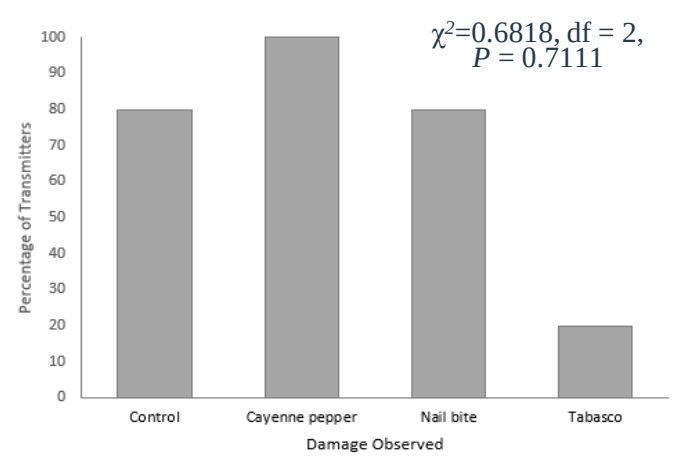


Figure 14: Percentage of transmitters with observed damage for the four antenna coatings used.

There was no significant difference between the percentage of transmitters with observed damage, excluding Tabasco sauce.

There was no significant difference in amount of damage between coatings, excluding Tabasco sauce.

The control group had a strong correlation between the attachment time and amount of damage. However, the cayenne pepper showed a weak positive and nail bite showed a moderate positive correlation.

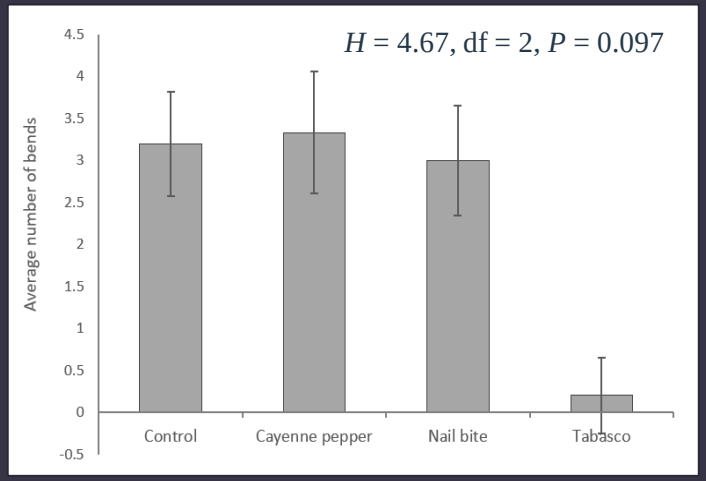
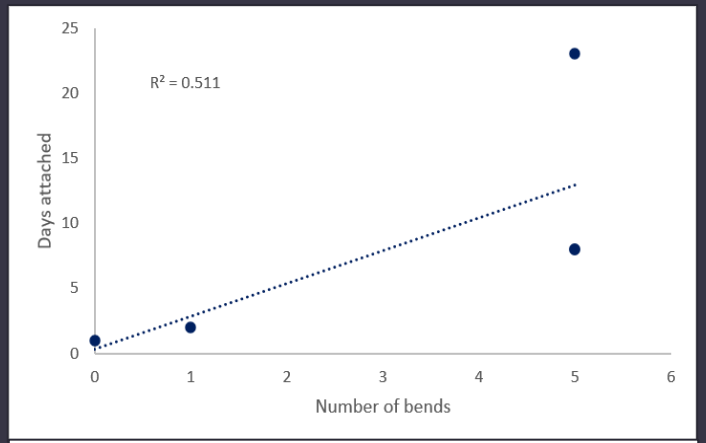


Figure 15: Mean ± SE number of bends observed among the four antenna coatings used.



Antenna coating	Correlation coefficient	Relationship
Control	0.71	Strong positive
Cayenne pepper	0.28	Weak positive
Nail bite	0.42	Moderate positive
Tabasco	-0.25	Weak negative

Figure 16: Pearson's Rank Correlation test comparing the # days control transmitters remained attached with the amount of damage to the antenna.

Discussion

- While WM transmitters stayed attached significantly longer than the PNNL transmitters, the WM transmitters remained attached for 10 days on average, which was consistent with the average 9-day attachment observed by O'Mara et al. (2014).
- Overall, brand did not improve attachment as transmitters were detached before 50% of the battery life potential was reached.
- For damage observed between brands, we found that damage occurred to the antenna regardless of transmitter type (Fig. 17).
- The coatings we used did not improve attachment times. In other words, the coatings did not deter bats from removing them.
- Furthermore, antennas did not show less damage with coatings.

Figure 17: Transmitters with observable antenna damage.

- As antennas with coatings had less damage over time compared to the controlled transmitters, this suggests that the distasteful coatings may be discouraging the bats from chewing on the antennas to remove them.
- However, the transmitters were removed in the same amount of time as those without coatings, this indicates that they were able to remove the transmitters in other ways.

Conclusions

- Bats remove transmitters regardless of brand, design, or antenna coating (Fig. 18).
- In addition, bats may not only be putting antennas in their mouths to remove them.
- We recommend modifying the antenna, or integrating it into the body of the transmitter, which may become an option as technology advances.
- Future research might include:
  - Testing the effectiveness of different adhesives in attaching transmitters
  - Testing the effectiveness of other distasteful antenna coatings
  - Examining the physiology of bat taste

Figure 18: Evening bat (*Nycticeius humeralis*) as used in surveys

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