



Deciphering variation of moose (*Alces alces*) antlers



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Introduction

- An understanding of the variation in antler size and age structure of a population is vital for moose management [1].
- As moose age, they develop larger antlers, and antler size determines whether a moose can be legally shot [2]
- However, antler size can vary each year, due to environmental variation. Variation in moose age data (aging moose), introduced by human error, can also affect moose management.
- Our research addresses two questions central to these sources of variation.



Fun Fact: Antlers provide males a means of defense during mating competition.

Question 1: Do moose of different ages show similar inter-annual variation in antler size?

Methods:

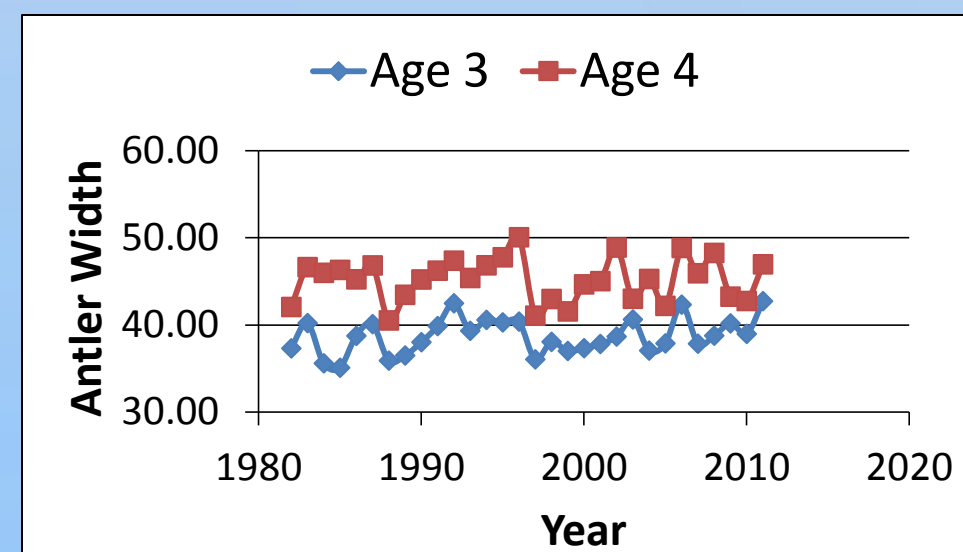


Figure 1. Moose antler width varies by season and age.

STEP 1 (Example for Age 3-4)

- We regressed 31 years of antler width data (1981-2011) for moose ages 2-9 to examine patterns of inter-annual variation.
- Data was collected from Galena, AK by the Alaska Department of Fish and Game

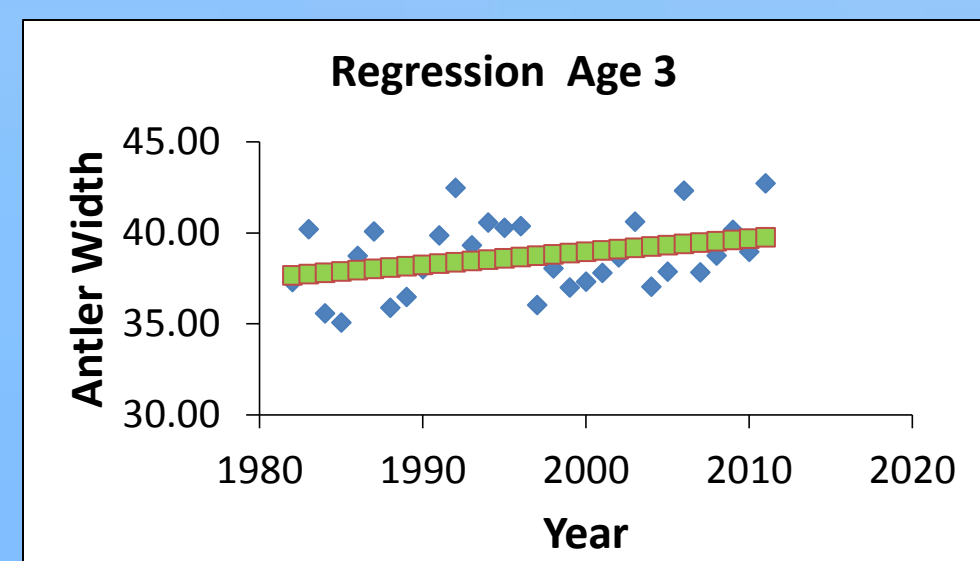


Figure 2. Regression of residuals for Age 4 v. Year

STEP 2

- We collected the residuals from a regression of antler vs. width for each year (i.e. Figure 2).
- The residuals for a given year indicates whether antlers grew more or less than average.

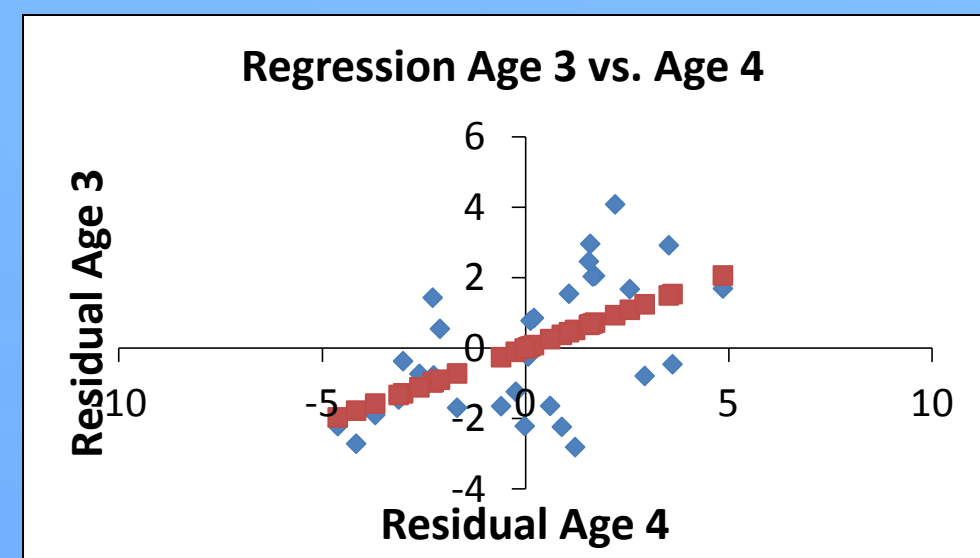


Figure 3. A positive relationship indicates that moose antlers vary predictably between age classes.

STEP 3

- We regressed residuals between different age classes (i.e. Figure 3).
- All possible pairs of age classes were regressed.

Results:

Age	2	3	4	5	6	7	8	9
2		Significant	Significant	Significant	Significant	Significant	Significant	Significant
3			Significant	Significant	Significant	Significant	Significant	Significant
4				Significant	Significant	Significant	Significant	Significant
5					Significant	Significant	Significant	Significant
6						Significant	Significant	Significant
7							Significant	Significant
8								Significant

Legend:
 Significant: 0.00023 < P < 0.04
 Non significant: 0.05 < P < 0.9

Table 1. Comparison of inter-annual variation in antler width between moose (*Alces alces*) age 2-9.



Moose antlers vary in size and shape as depicted here.

YES! Antler width of moose aged ~2-6yrs show similar patterns of inter-annual variation.

Conclusion:

- Similar patterns of inter-annual variation suggest that moose aged 2-6yrs may be responding to environmental pressures (e.g. food supply, competition) in a similar manner.
- Antler width continues to grow until moose reach 6-7 years. Younger ages may be more susceptible to environmental stressors, and hence "track" one another more closely than moose aged 7yrs or older.

References

- [1] Stegemann, E. (2006, February). The moose. *New York State Conservationist*, 1-2.
 [2] Rolandsen, C.M., Solberg, E.J., Heim, M., Holmstrom, F., Solem, M.I., and Saether, B. 2008. Accuracy and repeatability of moose (*Alces alces*) age as estimated from dental cement layers. *European Journal of Wildlife Research*, 54(1):6-14.

Question 2: Does a technician's experience level matter when aging moose teeth?

Methods:

- Step 1**
- It is possible to age a moose tooth, similar to counting tree rings (see picture below).
- Step 2**
- Inexperienced (undergraduate interns) were given 1 hour of instruction on how to age moose teeth.
 - The interns and an experienced technician conducted a double-blind test in which they each aged 28 teeth from known-aged animals.
- Step 3**
- Percent error was calculated for each group using this equation: $\text{Abs}(\text{actual age} - \text{observed age}) / \text{actual age} * 100$.
 - T-test of unequal variance determined statistical significance.

Results:

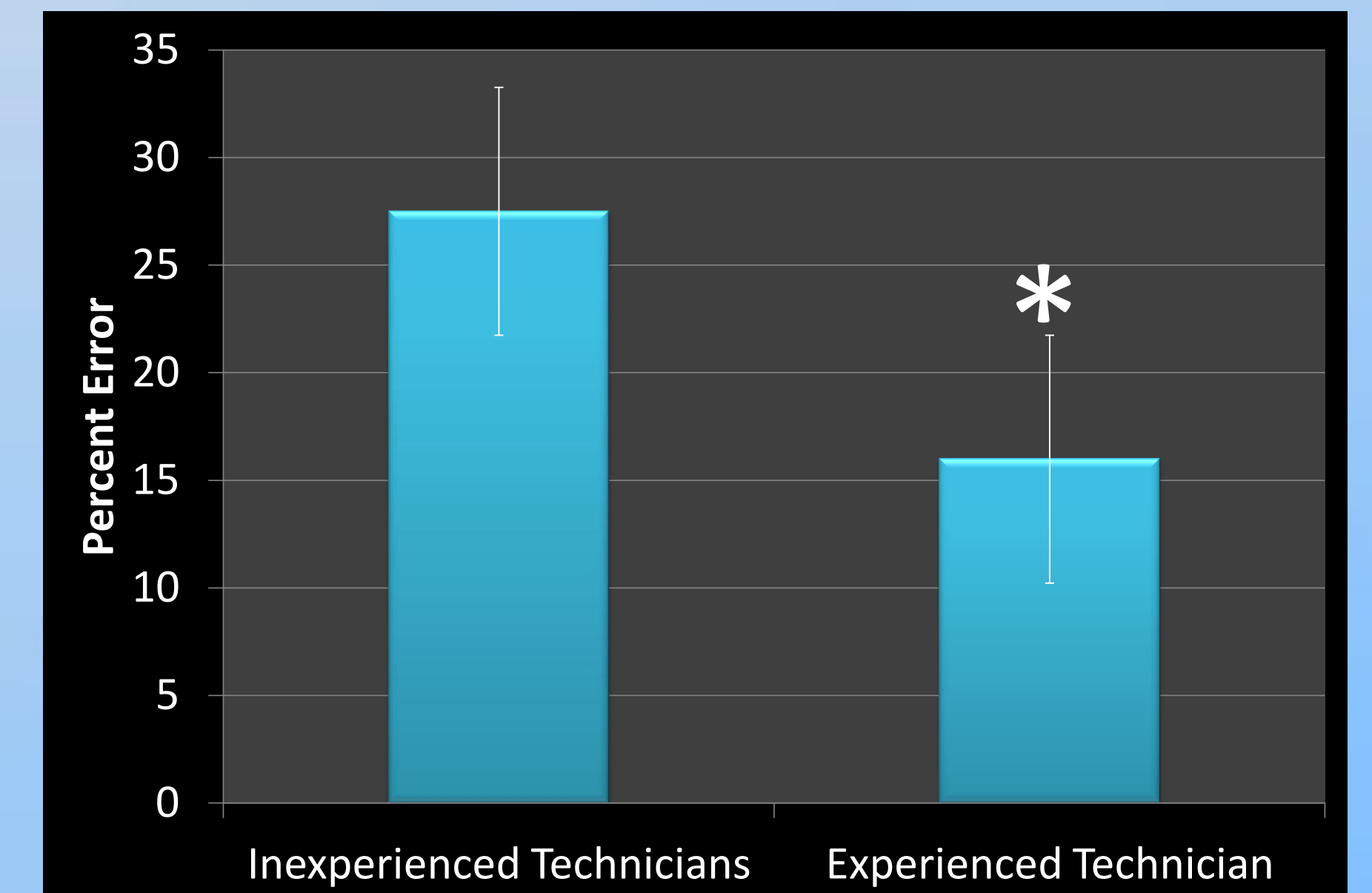


Figure 4. Percent error (+/- S.E.) of moose teeth (n=28) aged by two inexperienced (undergraduate) technicians and an experienced technician. *P= 0.047

YES! Experienced technicians can age moose teeth with approximately double the accuracy.

Picture showing the age rings in a stained moose tooth. Photo courtesy of Rolandsen, et al. 2008.



Conclusions:

- Accurately aging moose requires more practice than college interns typically receive (~1 hr).
- Differences in experience can introduce significant amounts of human-caused variation into moose age data.

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