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FACTORS AFFECTING VARIATION ON PRONGHORN HORN GROWTH

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Abstract: Annual variations in male pronghorn horn size appear to be related to the age of the animal, the severity of winter during the growing period of the horn sheath, forage conditions prior to horn sheath growth, and the genetic makeup of particular populations. Knowing these factors might enable wildlife managers in favorable areas to increase the number of "trophy bucks" present.

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INTRODUCTION

Arizona has long been famous for trophy-sized pronghorn (Allen 1877, Einarsen 1948, Seton 1953, Hoffmeister 1984). Seven of the top 10 pronghorn currently entered as trophies in the record book of the Boone and Crockett Club (BC) are from Arizona, and this state consistently produces more trophy animals than states having larger pronghorn populations (O'Gara and Morrison 2004). The conventional explanation for this phenomenon was that pronghorn live longer in Arizona due to the state's mild winters, and that the larger males are older aged animals (O'Connor 1961). Recent studies, however, have shown that the largest horns and greatest BC scores are

from 2 to 6-year old animals (Mitchell and Maher 2001, Brown et al. 2002, Mitchell and Maher 2004).

A study in southern New Mexico (Brown et al. 2002) showed that horns of bucks >7 years were significantly smaller than those of younger animals (P <0.03). Considering the effects of pronghorn age alone, the horn sheaths of hunted animals on this ranch decreased by an average of 0.28 cm (0.11 in) of length and 0.53 BC points for every year of age. Winter precipitation (October through March) the year prior to the hunt exerted a significant negative effect on BC scores but not on horn sheath length.

Picard et al. (1994) suggested an explanation for this phenomenon when they concluded that horns were a major source of heat loss when growing. Because pronghorn are unique in having horn sheaths that grow mostly during the winter months (O'Gara 2004), and because southern states appeared to produce a disproportionate number of trophy animals compared to more northern states and provinces, we reasoned that winter temperatures might have something to do with horn size (Table 1). Indeed, a comparison of mean January temperatures close to each state and province's pronghorn population center showed a significant negative relationship with the number of pronghorn trophies per 1000 bucks harvested according to BC and Safari Club International record books (r^2 = 0.35; P<0.01; Table 1 and figure 1).

To further test the assumption that pronghorn horn growth is negatively influenced by low winter temperatures, we compared winter temperature data with BC scores of pronghorn harvested on the Armendariz Ranch in southern New Mexico where "green" BC score have been collected since 1994. Although the annual variation in horn size on the Armendariz Ranch was not very large during this period, mean "green" BC

scores for all pronghorn age classes negatively correlated with the numbers of days having temperatures $\leq 0^{o}$ C during the previous winter ($r^2 = 0.33$; $P < 0.06$; Table 2).

Other environmental factors also appeared to be involved. Although winter precipitation amounts had no significantly positive effect on horn growth, adding April through August rainfall amounts received prior to or after the winter horn sheath growing season improved the correlation's probability value in a multiple regression equation ($r^2 = 0.64$; $P<0.02$; Table 2).

Later studies showed significant relationships between pronghorn population dynamics and the regional Palmer Drought Severity Index (PDSI), a monthly water balance index standardized to local climates, which considers both precipitation and temperature data to determine relative dryness and thus plant growth and foraging conditions (Palmer 1965). An index value of 0 is considered normal, a -2 is a moderate drought, -3 a severe drought, and -4 an extreme drought. When we compared the July PDSI for southwestern New Mexico preceding the onset of new horn sheath growth with the mean BC score recorded on the Armendariz Ranch the following year, the correlation coefficient had a value of $r^2 = 0.63$ and a probability value of $P < 0.002$. Figure 2). We therefore hypothesized that pronghorn horn growth not only varied with location but by year, and that the amount of this variation was determined in part, by environmental factors, *i.e.,* winter temperatures and moisture conditions.

To test this hypothesis in Arizona, we created a pronghorn trophy index by dividing that state's annual pronghorn harvest (Arizona Game and Fish Department 2006) into the number of pronghorn trophies recorded during the past 20 years in the Arizona Wildlife Federation's Wildlife Trophy book (Conrad 2005). We then compared

regional climate data with the resulting number of "Trophies per 1000 Pronghorn Harvested.". For winter temperature data, we used mean monthly minimum temperatures $\leq$ 32º F ($\leq$ 0 º C) and $\leq$ 0º F ($\leq$ -17.8 ºC) for the October through March period recorded at Flagstaff (Western Regional Climate Data Center 2005). We used the Flagstaff station as being the most representative of the game management units producing most of the trophy bucks in Arizona (Conrad 2005). We also used the monthly PDSI index for north-central Arizona encompassing Flagstaff provided by National Weather Service web site.

Although there was no significant relationship between the number of "Trophies per 1000 Pronghorn Harvested" and the mean number of days having temperatures $\leq$ 0º C ($P < 0.10$), we did find a weak relationship between the number of "Trophies per 1000 Pronghorn Harvested" and the mean number of days $\leq$ -17.8º C ($r^2 = 0.17$; $P < 0.06$). As in New Mexico, this relationship was strengthened when the July PDSI prior to the horn sheath growing season was added to a multilinear regression equation ($r^2 = 0.38$; $P < 0.04$; Table 3 and figure 3). We thus conclude that at least some of the variation in annual growth in male pronghorn is explained by environmental conditions such as winter temperatures and the availability of nutritious forage (Yoakum 2004). Although the most important factor affecting pronghorn horn size in the Southwest is probably body condition as measured by the PDSI prior to horn sheath growth, we found the severity of the winter during horn sheath growth also affects horn size.

The implication of this study to pronghorn management in the Southwest is that it may be possible to increase horn size in trophy males. Ranch managers of pronghorn habitats in moderate environments may, at least in theory, be able to increase the size of pronghorn horns by providing nutritious forage prior to and during the horn sheath

growing season. Nonetheless, such efforts, will probably not suffice to overcome natural weather phenomena as cold winters and severe drought.

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Figure 1. Correlation between mean January temperature and number of trophies per 1000 bucks harvested for 18 localities.

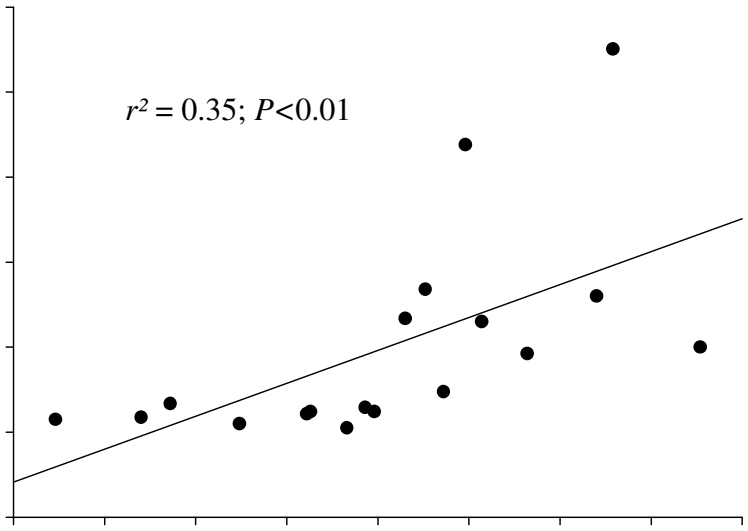

Figure 2. Correlation between Palmer Drought Severity Index (PDSI) and Boone and Crockett Club (BC) scores in Armendariz ranch in New Mexico.

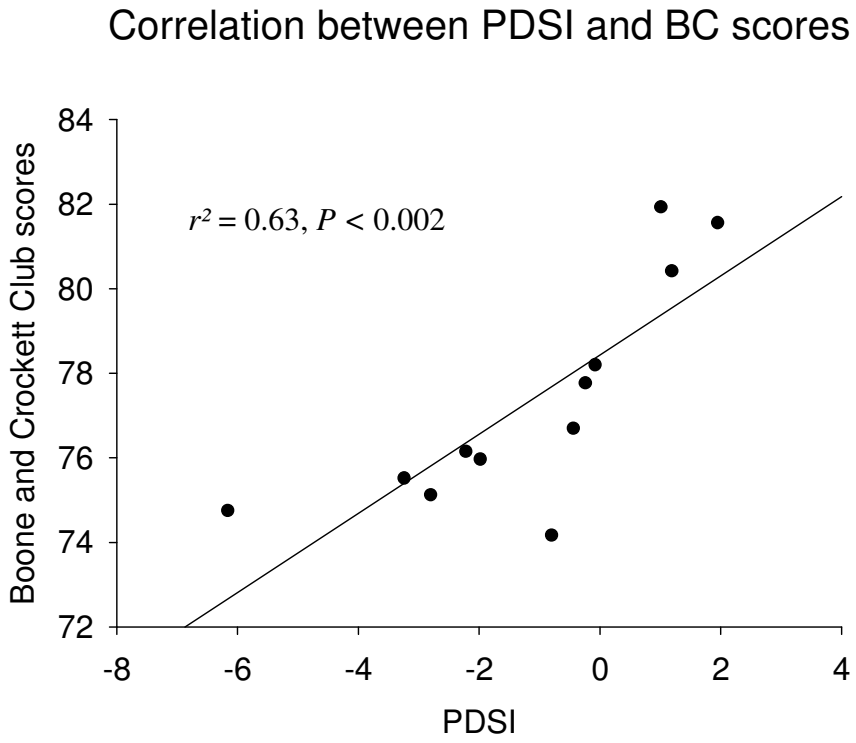

Figure 3. Correlation between number of trophies per 1000 bucks harvested in Arizona and the minimum October to March temperature and Palmer Drought Severity Index (PDSI) values.