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ASSESSMENTS OF VELVET ANTLER GROWTH RATES USING DIGITAL INFRARED THERMOGRAPHY IN RED DEER STAGS

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Background. The harvesting of velvet antler from farmed red deer stags is a renewable resource of economic significance to the deer farming industry. The marketable aspects of growing velvet antler are found in its use as a medicinal agent in traditional Eastern cultures. While holistic medicine is often viewed with skepticism by Western societies, evidence exists which supports the use of velvet antler extracts for the natural performance enhancement of athletes, anti-ulcer treatments and the healing of epidermal wounds. Velvet antler is usually harvested based on morphology, conformation and size of the antler and not necessarily on peak growth. Digital infrared thermal imaging is a non-invasive technique that is able to detect infrared emissions from the antler and create thermal images displaying temperature distributions. These thermal gradients of the antler may permit the harvesting of velvet antler at its peak in the growth phase. Therefore, the objective of this study was to evaluate whether velvet antler temperature gradients as measured by digital infrared thermography would pattern velvet antler growth.

Research Findings. Velvet antler length increased ($P<0.05$) from 5.9 ± 0.9 cm on day 0 to 63.3 ± 2.7 cm on day 112. The greatest increase ($P<0.01$) in velvet antler growth rates occurred between days 14 and 28 (0.189 ± 0.1 cm/d) with peak growth occurring at day 70 (1.37 ± 0.1 cm/d). After day 70, velvet antler growth rates began to decline. For digital infrared thermography analysis, antler growth patterns were split into three time periods: early (d 0-28), mid (d 28-70) and late (d 70-112). During the early growth period velvet antler temperatures increased ($P<0.01$) from the base (38.9 ± 0.2°C) to the tip (39.3 ± 0.2°C) of the antler. This continued into the mid growth period with the tip (38.4 ± 0.2°C) having a tendency ($P<0.10$) to have a higher temperature than the base (37.9 ± 0.2°C). In contrast, during the late growth period temperatures were higher ($P<0.01$) at the base (36.8 ± 0.3°C) than at the tip (35.7 ± 0.3°C) of the antler (Figure 1). Velvet antler base, midpoint and tip thermal temperatures were positively correlated ($P<0.05$; 0.52, 0.54, 0.68, respectively) with velvet antler growth. However, the midpoint and tip temperatures of the velvet antler main beam were negatively correlated ($P<0.01$; R=-0.26, -0.32, respectively) with ambient temperatures (Table 1). As the tines began to develop the temperature of the tip of the main beam decreased. However, once the tine's growth declined

the temperature of the tip increased. In addition, tine temperatures were higher ($P<0.01$) during the early growth period (38.5 ± 0.4°C) than the late growth period (34.5 ± 0.5°C).

During the time of velvet antler growth, scrotal circumference was positively correlated ($P<0.01$) with body weight ($R=0.70$). Scrotal circumference increased ($P<0.01$) from 15.9 ± 0.5 cm on day 0 to 20.5 ± 0.7 cm on day 112. Body weight also increased ($P<0.01$) from 113.0 ± 5.4 kg on day 0 to 137.2 ± 6.9 kg on day 112. Serum concentrations of testosterone increased ($P<0.01$) from 0.09 ± 0.02 ng/ml during the early growth period to 1.2 ± 0.12 ng/ml during the late growth period (time of hardening).

Figure 1. Main beam antler growth and temperature during the early, mid and late growth periods.

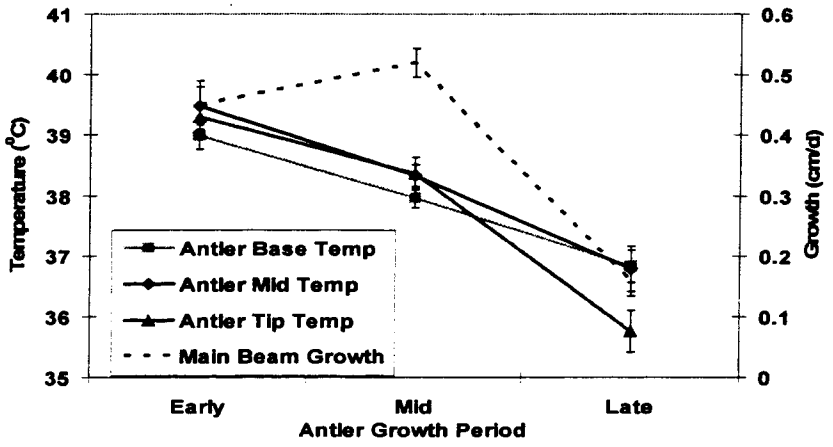

Table 1. Main beam antler and background temperatures

	Surface Temp	Eye Temp	Ambient Temp	Rectal Temp
Base Temp	**0.435***	**0.491***	**-0.081**	**0.191**
Mid Temp	**0.183**	**0.524***	**-0.258***	**0.220**
Tip Temp	**0.112**	**0.562***	**-0.315***	**0.284**
Rectal Temp	**-0.039**	**0.263***	**-0.248**	
Ambient Temp	**0.419***	**-0.567***		* $P<0.05$
Eye Temp	**-0.059**			

Application. Velvet antler thermogenesis patterned velvet antler growth with higher velvet antler temperatures occurring during the early and mid growth periods and lower temperatures occurring during the late growth period as antler hardening approached. This suggests that digital infrared thermal image measurements may have value in determining the peak of velvet antler growth as a tool to optimize harvesting to meet specific velvet antler markets.