TOPIC 7. MUSCULAR SYSTEM FUNCTIONS

Movements of vertebrate animals are made possible by the contraction of the muscles spanning skeletal articulations. Speedy locomotion is a very important attribute of wild ruminants as they often depend on short bursts of speed to escape danger.

Muscular contraction is an exothermic process, resulting in the release of heat energy. The heat energy must be dissipated or else the temperature of the body tissue will rise. Dissipation can become a problem on warm autumn days when the winter coat has grown enough to provide good insulation. Then, heat energy cannot escape efficiently, and warm autumn days can be thermally stressful for animals that must run as the emerging winter coat provides good insulation from heat loss. I have observed white-tailed deer with tongues out for cooling on several occasions under such conditions.

Muscles can also be a source of heat production without body movement; shivering is a form of thermogenesis that may be important for animals in extreme cold. Thus muscles function in more ways than for locomotion. Free-ranging animals, well adapted for their nautral environments, integrate all of their life functions into a way of being, a continuum in space and time, that is best understood by studying the animal as a whole in relation to the functions of its different parts or systems.

UNIT 7.1: LOCOMOTION

Locomotion occurs when muscles spanning skeletal articulations contract. The details of locomotion have been studied for several domestic and some wild species. The mechanics of locomotion by race horses, for example, is currently being studied in Sweden and at Cornell University, USA. Details of locomotion have not been critically evaluated for North American wild ruminants however.

One of the major characteristics of locomotion that has a distinct practical value is the mechanics of weight-loading when an animal is moving. Static weight loads, determined by relating body mass to hoof area, are of less value than dynamic weight loads when different species of animals are being compared, or different activities such as walking or running. More research in this rather specialized area of investigation would greatly increase our understanding of the effects of snow on animals in the northern regions.

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UNIT 7.2: THERMOGENESIS

Thermogenesis is another term for heat production. It is a term applied to increases in heat production as a response to cold, implying that thermogenesis is a specific response in addition to the heat production that is a continuous characteristic of life.

Voluntary activity is a thermogenic response, and may be employed by ruminants to "keep warm." Severinghaus and Cheatum (1956:146) describe cases where white-tailed deer in the Adirondacks were observed to be walking slowly along heavily-used trails at midnight when temperatures approached -35°C, presumably to keep warm by excercising. While heat production increases will result from increased movement, it is not a good long-term adaptation because of the energy costs incurred at a time when food resources are declining in quality and may not be readily accessible, while body reserves are decreasing.

Muscular thermogenesis may occur as a result of shivering, without an increase in activity. Shivering is an involuntary muscular response, which includes an initial increase in muscle tone followed by several muscular tremors per second. Andersson (1970:1125-6) states that shivering may increase oxygen consumption by 400 percent, and that it is more effective from a thermodynamic point of view than voluntary muscle contractions. Thus thermogenics may be an important part of an animals' response to cold, but a difficult one to interpret in the field.

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UNIT 7.3: INVOLUNTARY MUSCULAR CONTRACTIONS

Involuntary muscular contractions occur continuously as a part of the maintenance of life. The heart beats without voluntary control, the diaphragm contracts and external respiration occurs, the rumen and rest of the gastrointestinal tract experience involuntary contractions that keep food materials moving, and there are other involuntary contractions of muscles associated with different system functions. All of these muscular contractions cost the animal something, but the costs are a part of maintenance. There is essentially no literature on this subject for wild ruminants, except that in references describing the functions of various body systems.

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INVOLUNTARY MUSCULAR CONTRACTIONS

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