Public Abstract
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Ruminant livestock (cattle, sheep, goats) produce nearly 30 and 100% of our meat and milk, respectively. It is crucial to our food supply to continue improving techniques for managing these animals. This thesis aims to improve ruminant livestock management through several studies examining ruminant digestion, ecology, and evolution. In one study, we measured the rate and extent of food (hay) digestion in the reticulorumen, the ruminants' first stomach compartment and where most digestion occurs. We used these digestion data along with statistical approaches to criticize systems that livestock producers use to predict the quality of livestock feed. We developed a computer simulation of the ruminant digestive system to serve as a new system for predicting feed quality and utilization, particularly feed intake. Tests of this simulation suggest that it predicts feed intake more precisely than prior systems.

We also used labeled hay to trace the flow of feed through the reticulorumen. By giving a better picture of how this flow occurs, this study could be informative in the design of feed products.

Our next studies focused on wild ruminants (e.g., antelope, giraffe, deer). Wild ruminants are about 500-times larger than mammals in general. Using the computer simulation we developed, along with physiological and fossil evidence, we found that ruminants evolved to this large size to cope with limited nutritional resources. In our final study, we review ruminant ecology and evolution, then discuss how they and other points presented in the thesis challenge common practices used in managing ruminant livestock.