Harnessing Crowd Sourcing and Computer Vision for Video Analysis of Sharp-tailed Grouse Nesting Ecology and Nest Predators

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The goals of this collaborative proposal are to begin: *i*) gathering video to understand the sharp-tailed grouse nesting ecology, nest predators and the impact of western North Dakota's gas and oil development on this species, *ii*) developing a volunteer/crowd sourced computing project for the storage, management and analysis of this video, and *iii*) the implementation of algorithms to automate this video analysis, using input from students and volunteers for additional verification.

Scientific Merit: Camera technology has become a common tool in the field of wildlife biology. Both still images and video surveillance can allow researchers to monitor wildlife in remote locations and negate effects of human observers on animal behaviors. However, this technology results in large amounts of data in order to obtain samples sizes to make sound ecological inference. For example, gas and oil development in western North Dakota has potential to influence sharp-tailed grouse (*Tympanuchus phasianellus*) reproductive success, alter nesting behaviors, and change predator-prey interactions at the nest. In order to evaluate potential implications gas and oil development on grouse reproductive ecology, Dr. Ellis-Felege will monitor 60-65 grouse nests with ~30 miniature cameras. Given a nesting season of May to September, these cameras could potentially generate over 80,000 hours of video requiring observation. Examining this much video is extremely time consuming and tedious, which can lead to human errors. Dr. Desell will develop a computing system for video storage and analysis, and a web-based portal where students and the public will be able to stream the videos and report their observations. These human volunteers will provide additional guidance for the computer vision techniques used to analyze the video, which opens interesting questions in supervised machine learning, as this supervision can potentially be contradictory and will need to be validated to prevent malicious users from harming the system.

Broader Impact: Monitoring the sharp-tailed grouse provides a means to demonstrate the impact of landscape changes from gas and oil development on North Dakota's prairie species. This computing project will allow investigation into problems of storing, maintaining, and automating the analyses of large digital datasets to study wildlife ecology. Problems in computer vision, such as separating moving grass from wildlife, can be explored. This infrastructure for automated video analysis will not only be invaluable for Dr. Ellis-Felege's work, enabling her to analyze significantly more video, but also has applications in defense, aerospace and medical sciences where these techniques are frequently employed. Outreach to the public will also be a significant part of the work, by providing a web portal allowing not only UND students, but North Dakota residents and K-12 students to watch videos of local wildlife in action, while gaining a better understanding of biology and the environment.