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Quantifying biodiversity using digital cameras and automated image analysis.

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Monitoring the effects on biodiversity of extensive grazing in complex semi-natural habitats is labour intensive. There are also concerns about the standardization of semi-quantitative data collection. We have chosen to focus initially on automating the most time consuming aspect – the image analysis. The advent of cheaper and more sophisticated digital camera technology has lead to a sudden increase in the number of habitat monitoring images and information that is being collected. We report on the use of automated trail cameras (designed for the game hunting market) to continuously capture images of grazer activity in a variety of habitats at Moor House National Nature Reserve, which is situated in the North of England at an average altitude of over 600m. Rainfall is high, and in most areas the soil consists of deep peat (1m to 3m), populated by a mix of heather, mosses and sedges. The cameras have been continuously in operation over a 6 month period, daylight images are in full colour and night images (IR flash) are black and white.
We have developed artificial intelligence based methods to assist in the analysis of the large number of images collected, generating alert states for new or unusual image conditions. This paper describes the data collection techniques, outlines the quantitative and qualitative data collected and proposes online and offline systems that can reduce the manpower overheads and increase focus on important subsets in the collected data. By converting digital image data into statistical composite data it can be handled in a similar way to other biodiversity statistics thus improving the scalability of monitoring experiments. Unsupervised feature detection methods and supervised neural methods were tested and offered solutions to simplifying the process. Accurate (85 to 95%) categorization of faunal content can be obtained, requiring human intervention for only those images containing rare animals or unusual (undecidable) conditions, and enabling automatic deletion of images generated by erroneous triggering (e.g. cloud movements). This is the first step to a hierarchical image processing framework, where situation subclasses such as birds or climatic conditions can be fed into more appropriate automated or semi-automated data mining software.