Reconstructing the diet of elusive wood grouse (western capercaillies) using metagenomics

Environmental DNA provides a non-invasive and simple means of biomonitoring

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Environmental DNA provides a non-invasive and simple means of biomonitoring

Gone are the days when researchers needed to spend countless hours observing an animal in the wild to understand its behaviour and ecology. As we demonstrate with our study, valuable data can be gathered by simply examining faecal samples with powerful metagenomics approaches.

The need for data that effectively informs biological conservation is intensifying as the rate of biodiversity loss increases. Traditionally, scientists have endured long hours in the field, often hiding uncomfortably in bushes or traversing dangerous and hard-to-reach places, all for the purpose of observing elusive animals.

With the advent of next-generation sequencing (NGS) technologies – those that effectively provide large amounts of DNA sequence data – it is now possible to obtain a wealth of ecological information from just a single faecal sample. The ease of collecting such samples circumvents some of the challenges of studying animals otherwise hard to find.

One such NGS approach is metagenomics shotgun sequencing (MSS), which determines the nucleotide composition of large amounts of random DNA molecules recovered from complex samples of DNA from various sources. This method makes it possible to simultaneously retrieve information about the host’s diet, microbiome, gut parasites, as well as the population structure of the species. While it has vast potential for conservation biology, few studies have utilised MSS to reconstruct the diet of animals, and none have done so for herbivorous birds.

The western capercaillie (*Tetrao urogallus*), or wood grouse, is an emblematic species which can be found in the coniferous forest of Eurasia. Highly susceptible to the increased levels of habitat destruction and fragmentation, their declining population has...
placed them on the International Union for Conservation of Nature (IUCN) Red-list throughout most of western and central Europe. By studying the wood grouse’s diet, we could gain clues about the resources it requires and the other species it interacts with in its habitat, informing better conservation strategies. By observing the animal and morphologically identifying plant remains from their faecal samples, it was determined that the capercaillie’s diet consists of mostly pine needles in the winter, and *Vaccinium* species in the summer.

However, preliminary results from our study show promising signs that the capercaillie’s diet is more diverse than once thought. Other than plants, we have also discovered parasitoid wasps and several species of mites, which could have been accidental ingestion while feeding or preening. And with the use of metagenomics, there is also the possibility of obtaining more detailed quantitative information about its diet that can be used to inform habitat management choices. Their gut microbiome, intestinal parasites, and population genetics are also currently being analysed.

Unexpectedly, we were also able to detect the presence of plant-pathogenic fungus and nematodes from their faecal samples, providing some interesting ecological insights about the capercaillie’s habitat. Even though our research is still in its infancy, by using metagenomics shotgun sequencing on faecal samples, our initial study has already yielded a wealth of data. There is truly an untapped potential for its application in conservation biology and biomonitoring, which should be further explored.
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