
Population monitoring and management

Optimizing wildlife monitoring through cost-effective distribution of observatories

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Effective wildlife management and conservation require reliable information on species distribution and abundance. Here, we present a scalable and transferable methodology designed to capture the ecological and management heterogeneity of any study area, thereby optimizing wildlife monitoring programs. By delineating homogeneous sampling units based on key environmental and management factors, this approach enables focused monitoring in a strategically selected subset of areas ("observatories"), ensuring robust data collection while optimizing resource use. Our procedure consists of three stages. First, we apply multivariate techniques to assess the main environmental, management, or biodiversity patterns across the study area. Second, clustering methods are used to identify homogeneous regions or management units. Finally, optimization algorithms establish a network of well-distributed monitoring points to ensure a cost-effective solution. This structured, adaptable framework is highly applicable across regions and scales.

We tested this methodology in two real-world case studies: (i) a management network for game ungulates in Castilla-La Mancha, central Spain, and (ii) a national-scale monitoring program for wild mammals across Spain. In both cases, we first identified and categorized homogeneous ecological regions using climate and vegetation data. We then incorporated management characteristics within each region or biodiversity indices, such as species richness and rarity, to form a network of representative observatories. This approach enables targeted data collection from a limited number of strategically distributed sites, capturing population trends and biodiversity metrics across broader areas. Our stratified, observatory-based framework provides a flexible and cost-effective solution adaptable to multiple species and regions globally. This protocol is well-suited to guiding wildlife management decisions at local, regional, and national levels, maximizing efficiency and representativity across diverse ecological contexts.