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Research Article

Wolf population monitoring and livestock depredation preventive measures in Europe

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Abstract

Reliable estimates of population parameters and their trends are necessary for effective management and conservation actions, especially for endangered species such as wolves in most European countries. Under the Habitat Directive 92/43/CEE, all countries are required to monitor the status of their endangered populations. The ultimate goal of population monitoring is to detect a change in both magnitude and direction for one of the population parameters. We discuss the importance of wolf populations monitoring in Europe, giving examples from the contributions of this theme issue, and we highlight the technical challenges of transboundary monitoring and of preventive measures implementation.

Reliable estimates of population parameters and assessment of their temporal trends are often necessary for effective management and conservation actions; however, such parameters are often very hard to obtain, especially for elusive and wide-ranging species, such as wolves. In Europe, population size and trend are primary factors that determine whether species are listed as endangered or threatened under the Habitat Directive 92/43/CEE, as well as under the Bern Convention (1979), the two major pan-European legislative frameworks for species conservation. Under these frameworks, all countries are required to secure that endangered populations are subject to a robust monitoring program with the goal of showing if the population of interest has a stable or increasing trend. Population monitoring has been defined in several different ways (cfr. Elzinga et al. 2001; McComb et al. 2010) depending on the objectives of the monitoring; the most general definition being an assessment of spatial distribution, abundance, density, or other population parameters for a species within a defined area over more than one time unit. The broad goal of population monitoring is to detect a change in both magnitude and direction for one of the population parameters over a defined time period (i.e. a trend) (Thompson et al., 1998).

Even though most of the monitoring programs in Europe are not linked to predetermined management objective, their "surveillance" approach is of utmost importance for driving conservation policies, especially for endangered species such as wolves for most European countries. Changes in distribution and abundance in local and national wolf populations are the typical focus, although changes in vital rates or other population parameters, are also monitored to determ-

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ine the wolf conservation status over the years. Consequently, many wolf researchers and managers devote considerable effort and resources to population monitoring. In doing so, they often assume that systematic surveys in different years will detect the same proportion of a population in every year and changes in the survey numbers will reflect changes in population size. Unfortunately, these and many other basic assumptions of a monitoring scheme are often overlooked (Boitani et al., 2012; Gese et al., 2012; McComb et al., 2010). Several key questions should be regularly addressed when a monitoring program is designed, such as: does the design allow to conclude that variation in counts reflect true changes in local population of wolves? What is the minimum change the program is designed to detect and is this change useful for management of the population? Is the monitoring program technically and economically feasible and sustainable in time? Failure to address these and other fundamental questions often results in costly monitoring programs that lack sufficient power to detect population trends (Boitani et al., 2012; Gibbs et al., 1998).

In this special theme issue, several wolf monitoring programs developed in different European countries are described and the difficulties and pitfalls encountered in running such programs are discussed. For instance, in Sweden (Liberg et al., 2012), France (Duchamp et al., 2012), and the Italian Alps (Marucco et al., 2012), where small recolonizing wolf population have been efficiently monitored from the very beginning of the recolonization process, the monitoring programs are based on the combination of snow-tracking and faecal genotyping within a framework of a highly integrated sampling design. However, these high quality monitoring programs require high levels of effort, are very resource-demanding, and applicable only to small populations. These authors all suggest that a combination of several methods is fundamental to document population trends, and the presence of snow is required, as well as the high-tech DNA information, which improves the results of the wolf monitoring system un-proportionally. However, pitfalls should be considered in designing field sampling and lab protocols to minimize genotyping errors which can overestimate wolf population size, and snow-tracking information is fundamental to properly interpret the genetic data. In the southern parts of the European wolf range, snow is often absent or unpredictable during winter, thus making the wolf population estimates more difficult to obtain. For instance, in Spain, number of wolf packs are estimated in summer by means of locating the litters of pups when they are at rendezvous sites (Blanco and Cortés, 2012). Blanco and Cortés (2012) presents a critical description of the methods used to survey wolves in Spain, where snow is absent in winter in most of the regions and the wolf population is distributed over a large range. The authors emphasize the high level of uncertainty of the population estimates, expected in high density wolf areas without snow, and encourage a more prudent approach to wolf management in such cases.

Difficulties in providing estimates of population size increase when data from different countries need to be pulled together to provide population level assessment. Linnell and Boitani (2012) explain the need to move away from viewing wolf distribution within the arbitrary lines on maps that national or provincial borders represent and to look at the actual distributions of populations as true management units. It is crucial that these populations are monitored and managed as biological units settled over different countries. This innovative approach was described by Linnell et al. (2008) in the "Guidelines for Population Level Management Plans for Large Carnivores", later endorsed by both the European Commission's DG Environment and the Bern Convention, but it is not easy to implement in politically fragmented Europe. Linnell and Boitani (2012) discuss the difficulties in the implementation of such guidelines in Europe and suggest the necessary policy steps to advance their use across the continent. In this framework, countries need to ensure the compatibility of different monitoring programs (design and methods), as most European wolf populations are transboundary. However, at the moment, common and coordinated data collection and monitoring schemes are practically impossible in Europe, because each European country developed its own monitoring program, build on particular levels of economic and personnel ef-

fort, and sampling schemes differ to fulfill each country's specific goals. Wolf researchers asked to provide population level estimates and trends are facing the impossible task of merging data collected for different purposes and under different objectives, designs and techniques. However, various expert groups in Europe, like the SCALP group working on the European lynx in the Alps (Molinari-Jobin et al., 2012) or the Wolf Alpine Group (Wolf Alpine Group, 2011), defined a minimum set of common tasks and methods in order to produce baseline carnivore population level estimates. Many difficult technical problems have to be resolved in order to produce reliable population level estimates: in this context an important agreement between wolf researchers and managers has been that the more robust and biological meaningful unit to count and monitor is the wolf pack (Blanco and Cortés, 2012; Duchamp et al., 2012; Liberg et al., 2012; Marucco et al., 2012). Wolf packs are the reproductive units in a wolf population, are directly linked to the demography of the population, and are easier to estimate in a transboundary context, allowing to minimize errors in overestimation of the population. Wolf pack surveys are probably far more accurate in areas with expanding (low density) wolf populations, or at the edge of a wolf range, where packs are apparently well separated, than in saturated areas of high wolf density, where radio tracking studies have shown a large overlap among pack home ranges (Blanco and Cortés, 2012), and the presence of floaters and pairs settled in the interstices of packs' territories can obscure the pack delimitation. Hence, uncertainty need to be fully addressed and presented to managers, together with any population status assessment.

In many countries in Europe, wolf populations are now increasing in numbers and distribution ranges (Blanco and Cortés, 2012; Duchamp et al., 2012; Liberg et al., 2012; Marucco et al., 2012), and human conflicts and livestock depredations are increasing as well (Dalmasso et al., 2012; Reinhardt et al., 2012; Salvatori and Mertens, 2012). Preventive methods (especially electric fences and livestock guarding dogs) are the most effective management tool used to mitigate and manage wolf-livestock conflicts across Europe (Dalmasso et al., 2012; Reinhardt et al., 2012; Salvatori and Mertens, 2012). In general, it has been recognized by the different authors in different countries, that prevention of damage has higher probability to be a long-term solution of conflicts between wolf and livestock than just compensation of damages; and that compensation payment should be interlinked with damage prevention, to be efficiently promoted among herders (Dalmasso et al., 2012; Reinhardt et al., 2012; Salvatori and Mertens, 2012). They all suggest that responsible authorities should carry the burden of assisting livestock owners in testing and adopting new measures for damage prevention, prioritising such approach to the one of compensating for occurred damage. However, there appears to be a need to further increase the level of technical ability in using these methods and expand the economic support to farmers to acquire the necessary skills and equipment. In order to assist the member States in the implementation of the Habitats Directive, the European Commission has developed the LIFE programme (L'Instrument Financier pour l'Environment; http://ec.europa.eu/environment/life/). Its main aim is to provide funds for the implementation of management measures coherent with the Habitats Directive, and it has been generously used for the conservation of wolf, as discussed by Salvatori and Mertens (2012).

Monitoring wolf populations is a technical challenge anywhere, but it is more so in Europe where wolf populations spread across boundaries and are managed by a variety of administrations with huge differences in economic, technical and political capabilities. Moreover, the ecological and social contexts are extremely varied and impose an equally impressive variety of field techniques to detect wolves and their variations in time and space. The contributions of this special theme issue reflect these difficulties and suggest the need for an increased effort toward a more efficient coordination across the European countries. This theme issue results from contributions given at an international workshop held in Turin (Italy) on May 2010 and organized by the Regione Piemonte, which has been running since 1999 a wolf project aimed at monitoring the wolf population, preventing and managing conflicts between wolves and livestock industries and establishing coordination with au-

thorities in France over wolf management.

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