

RESPONSE

Feline leukemia virus and the Iberian lynx

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Small population size, low genetic diversity and the presence of reservoirs have been identified as major risk factors for disease-induced extinction (Castro & Bolker, 2005), and, unfortunately, the Iberian lynx currently suffers from all three factors. With only *c.* 200 Iberian lynxes remaining in the wild in two secluded high-density nuclei, the risk of devastating stochastic events, such as disease outbreaks, is high. In addition, genetic diversity in the Iberian lynx has been shown to be low, especially within the Doñana population (Johnson *et al.*, 2004). This low genetic diversity has been linked to the loss of immune capacity. Moreover, part of the distribution area of the Iberian lynx is composed of periurban lands where the occurrence of domestic carnivores, which can act as reservoirs of disease, is not uncommon. These factors combined were thought to be crucial to the outbreak of feline leukemia virus (FeLV) in the species in 2007.

All commentators agree that disease is a major concern in the conservation of endangered species. Human activity often underlies the emergence of wildlife diseases, and thus intervention decisions are usually difficult to make. When FeLV was first identified in two dead Iberian lynxes in early 2007, a major crisis was unleashed. Conservation institutions presented different views, however, as highlighted by Alexander (2009), one of the strengths of the FeLV control program for the Iberian lynx was a partnership approach. All opinions and suggestions were discussed and considered by the expert commission, and the final conclusions derived from agreements reached by the commission. Cleaveland (2009) mentions that 'wildlife managers must be prepared for the appearance of new diseases' and Acevedo-Whitehouse and Alexander stress the unpredictability of disease occurrence. Because quick decision making is crucial to successful management of disease outbreak, conservation authorities must be ready to initiate dialogue with all relevant institutions to promptly establish guidelines and define the necessary actions to be taken.

Alexander emphasizes the importance of long-term monitoring to detect disease outbreaks as soon as they occur.

The monitoring program for the Iberian lynx population is essential for the development of conservation measures; the species has been monitored for more than 20 years inside Doñana National Park, and the whole population has been under an intense monitoring program since 2002. Undoubtedly, the FeLV outbreak suffered by the Iberian lynx in 2007 would not have been detected without the monitoring program in place. Some individuals were radio-tagged as part of a research study in the National Park carried out by the Doñana Biological Station, and others were radio-tagged as part of a routine monitoring program. Without radio-collars it would not have been possible to locate dead animals and it is likely that some unmarked animals that disappeared in the same period died from FeLV. Acevedo-Whitehouse (2009) highlights the importance of conducting disease risk assessments to determine the potential risk that pathogens represent in a given population of an endangered species. A sanitary monitoring program has been carried out on the Iberian lynx population since 2004, which facilitated the prompt detection of FeLV-positive individuals (Meli *et al.*, 2009). Given this scenario, and taking into account the unpredictability of the occurrence of disease, long-term monitoring, including sanitary monitoring, seems to be essential for the management of many endangered species.

Evaluation of the success of each branch of the FeLV control program is required. As mentioned by Acevedo-Whitehouse and Cleaveland, the disease could have been self-limiting and such a dynamic could have helped the program to contain the outbreak. Thus, mathematical models seem to be the only tool to evaluate the program and make conclusions for the future. The comparison of morbidity and mortality of vaccinated and non-vaccinated individuals suggested by Cleaveland is planned, although it is not clear that the population size and the monitoring intensity allow such an approach.

It is now 2 years since the FeLV outbreak took place in Doñana, and no further positive cases have been found in the Iberian lynx population. Both active and passive surveillance are being carried out. Acevedo-Whitehouse stresses

the potential for the program to control feral cat populations to decrease disease risk for the lynx population. The sanitary surveillance program is being performed on a range of pathogens (see Meli *et al.*, 2009) because other pathogens present as much risk for the Iberian lynx as FeLV itself. As commented before, the pathogenicity of a disease agent can depend on many factors, and the risk for a population cannot be predicted in a general way. Monitoring in the Iberian lynx population has been intensified since the outbreak in 2007. As Alexander writes in her commentary, 'this species may lose the survival battle without intense and continued conservation intervention.'

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