

Are you aware of what you are doing? Asking Italian hunters about an invasive alien species they are introducing



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ABSTRACT

The human-driven spread of Invasive Alien Species is a major concern for conservation biologists. Since hunters are spreading invasive Eastern cottontails (*Sylvilagus floridanus*) in Italy, we investigated their beliefs about the species through semi-qualitative questionnaires in Tuscany, an area where cottontails have been occurring since 2000. Most respondents regarded invasive cottontails as a subspecies of the native European wild rabbit. Native European hares were highly valued as a game and perceived as a declining species, whereas no clear reason explained the hunting of cottontails and their population trend. We found no relationship between perceiving hares as a declining game and supporting the introduction of cottontails, or hunting cottontails. Respondents supported or opposed the eradication of cottontails according to their beliefs about the negative impact of the species over native hares. Hunters seem to have unclear ideas about cottontails and their impact and hold stable and positive attitudes towards the conservation of native hares. Cottontails are unlikely to replace hares as a game in the short term but may become a substitute game in case of a severe reduction in the abundance of hares. Our results could enable wildlife managers to plan eradication schemes to counteract invasive cottontails without fearing any strong opposition by hunters, provided that effective conservation plans are available for native game species. Hunters could also be engaged in large-scale monitoring programs based on hunting bags, as an encouraging number of respondents record killed cottontails on their hunting card. Future studies should broaden the investigation of hunters' and angler's perception of invasive alien species, as these two leisure activities are responsible for their spread worldwide.

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1. Introduction

Invasive Alien Species (IAS) are a major issue for conservation biologists, being one of the main causes behind the biodiversity loss worldwide and because they are responsible for massive changes in ecosystems structure and functionality (Simberloff et al., 2013). The costs associated to IAS have been estimated as 120 billion \$ per year in the US (Pimentel, Zuniga, & Morrison, 2005) and about 12–20 billion € per year in the European Union (Kettunen et al., 2009).

Despite the majority of IAS being accidentally spread through global commerce or transport (Hulme, 2009), some taxa are deliberately introduced in the environment for recreational purposes. Some well-known cases include freshwater fish used in

sport angling (Cambray, 2003; Hargrove, Weyl, Allen, & Deacon, 2015), as well as game birds (Lockwood, 1999) and mammals (Dolman & Wäber, 2008) for hunting. Hunting and angling are two leisure activities with a strong cultural component and the role of hunters and anglers in contemporary society is quickly changing. Previous research has demonstrated that cultural factors affect several attributes of hunters, especially their recruitment (Hansen, Peterson, & Jensen, 2012). Furthermore, there is growing evidence that the gap between the value orientation of hunters and that of non-hunters is increasing, at least in Western Countries, where the majority of human population is shifting towards a non-consumptive perspective of wildlife (Manfredo, Teel, & Henry, 2009; Manfredo, 2008). Such a change is likely to result in deep transformations at the societal and the institutional level, including the management of native and invasive wildlife.

To address the issue of recreational-introduced IAS, wildlife managers have to access information about the stakeholders involved in spreading IAS. Otherwise, they may introduce inef-

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fective and socially unacceptable management actions (McNeely, 2001). A whole spectrum of approaches is available to surveyors to acquire such information. At one end of the spectrum, in-depth qualitative interviews or questionnaires are a valuable tool to define all the dimensions of a problem and, in general, to explore issues where no prior idea exists in the mind of the surveyors. At the opposite, once surveyors are certain about what has to be measured, structured quantitative questionnaires can be implemented, to measure specific constructs and to predict stakeholders' behaviour through quantitative analysis. Semi-qualitative questionnaires lie in the middle of the spectrum, enabling surveyors to collect structured information for quantitative analysis meanwhile acquiring additional details through open-ended questions (Vaske, 2008).

The Eastern cottontail (*Sylvilagus floridanus*) is a North-American lagomorph, which has been repeatedly introduced in Northern and Central Italy in the last decades. Its first introduction dates back to 1960 in Piedmont (Silvano, Acquarone, & Cucco, 2000), therefore the species has expanded its distribution in the neighbouring areas of the Po plain (Bertolino, Ingegno, & Girardello, 2011). Established populations are now widespread in Central Italy, notably in Northern Tuscany, Umbria and Latium (Capizzi, Mortelliti, Amori, Colangelo, & Rondinini, 2012). Even if previous works highlighted the lack of competition between cottontails and the native European hare (*Lepus europaeus*) (Bertolino, Di Montezemolo, & Perrone, 2013; Vidus-Rosin et al., 2011), other studies demonstrated the potential role of cottontails as a vector for several pathologies. Cottontails can carry zoonoses (Zanet, Palese, Triscioglio, Alonso, & Ferroglio, 2013), fungal infections (Gallo, Tizzani, Peano, Rambozzi, & Meneguz, 2005; Tizzani et al., 2007) and virus like the European Brown Hare Syndrome Virus (EBHSV) (Lavazza et al., 2015).

The Italian legislation about hunting relies on a general framework set by the national law on wildlife (n.157/92), upon which local dispositions are nested. Currently, most of the provinces where cottontails occur have enforced numerical control schemes to contain the species, based on authorized shooting sessions during the year. Furthermore, some regions like Tuscany removed the upper limit to the daily hunting bag of cottontails and the obligation for hunters to record killed individuals. Such measures aimed to increase cottontail culling by reducing hunters' effort to record individuals.

Practical evidence, altogether with the highly fragmented distribution of cottontails in Italy and the low dispersal of the species, indicates a series of repeated introductions in the environment. Hunters regularly purchase cottontails at local game fairs and release them as a game (a picture showing this phenomenon is available in Supplementary material). Paradoxically, as professional hunting does not exist in Italy, hunters are also engaged in control programs for cottontails. Understanding their knowledge and beliefs about cottontails could guide wildlife managers in developing feasible management options for the species.

This work has multiple goals; firstly, it aims to provide qualitative insights about hunters' knowledge and beliefs about introduced cottontails and about their relationships with the native European hare. Secondly, it aims to investigate whether hunters have adopted cottontails as the main game prey. Finally, it aims to highlight feasible solutions for monitoring the spread of cottontails and for engaging hunters in cottontail management.

2. Materials and methods

From August 2014 to January 2015, we surveyed hunters at 17 municipal offices in Tuscany, Italy, (Fig. 1) during the withdrawal or the delivery of their hunting licence. Municipal employees asked

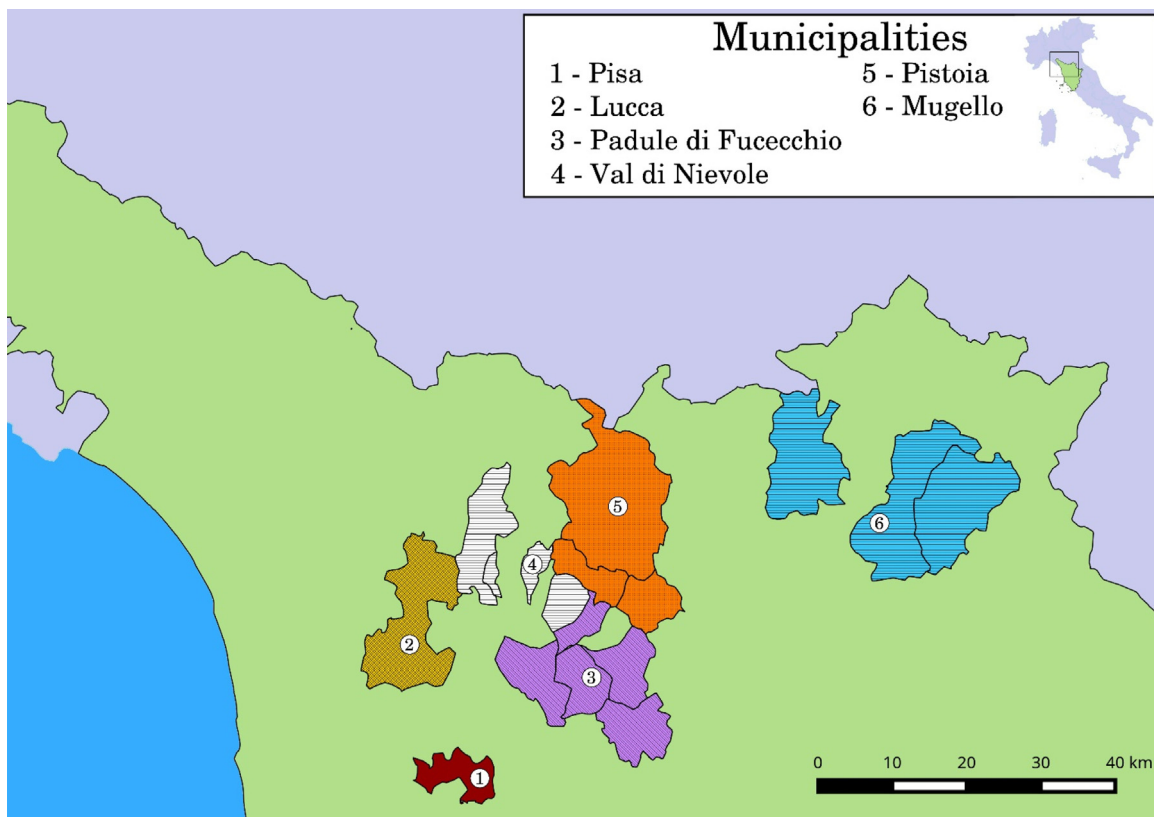


Fig. 1. Study area: the municipalities involved in the survey, divided in six geographical areas.

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