"Sometimes they come back": citizen science reveals the presence of the Italian red squirrel in Campania

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Abstract

Citizen science currently represents a cost-effective strategy to collect points of occurrency through the involvement of common people. The current presence of the Europaen red squirrel in Campania has been since now doubtful, so that the regional Red List classified this arboreal rodent as Data Deficient. This species is threatened primarily by fragmentation of forest habitats as well as by competition with alien squirrels throughout its Italian range. Recently, red squirrel underwent a range expansion in the range of southern Latium, particularly evident since 2005.
A citizen science project developed *ad hoc* for squirrels in Italy revealed three points of occurrence of red squirrel in northern Campania, on the border with Latium and Molise, where this arboreal rodent is well distributed. Morphological analysis ascribes these individuals to the Apennine endemic subspecies *Sciurus vulgaris italicus*. Further research will be needed to ascertain the presence of established reproductive nuclei in this region.

Key words: citizen science, red squirrel, Campania (Italy).

Introduction

Citizen science currently represents a cost-effective strategy to collect baseline scientific data by engaging common, non-professional people (*e.g.* Cohn, 2011; Dickinson *et al.*, 2012). A global growing public environmental awareness is inviting a large number of volunteers to collect huge quantities of data for broad-scale scientific projects (Silvertown *et al.*, 2011), in particular in the field of conservation biogeography (*e.g.* Devictor *et al.*, 2010; Mori *et al.*, 2013a). Validation of so-collected data is challenging (Dickinson *et al.*, 2010; Bonter & Cooper, 2012) although technology may provide a valuable help. New generation mobile phones, social networks, online platforms and digital cameras represent cheap and user-friendly tools to collect, transmit and spread verifiable information. This is particularly evident for large sized and/or easily recognizable species (*e.g.* Sullivan *et al.*, 2009; Mori *et al.*, 2013a). The European red squirrel *Sciurus vulgaris* is the only indigenous arboreal squirrel in Europe, and it is a species of conservation concern (*e.g.* Battisti *et al.*, 2013; Bertolino *et al.*, 2014). In Italy, three subspecies of *S. vulgaris* are recognized, two of which endemic, with *S. v. meridionalis*, distributed in Basilicata and Calabria, possibly representing a new species (Grill *et al.,* 2009).
The species clearly prefers woodlands, mainly middle-aged and old forests (Andrèn & Delin, 1994; Wauters *et al.,* 1994). Habitat loss, as well as the introduction of alien species which share similar ecological niches, constitute the main threats to this species in Italy (Amori *et al.,* 2008; Mortelliti *et al.,* 2011; Mori *et al.,* 2013b; Bertolino *et al.,* 2014). Thus, a detailed knowledge on the distribution of *Sciurus vulgaris* in Italy plays a key role for its conservation. As for Campania (Southern Italy) no adequate occurrency data are available for this arboreal rodent, which is classified as "Data Deficient" by the Regional Red List (Fraissinet & Russo, 2013). Historically, the European red squirrel was recored in the area of Somma - Vesuvio (Maio et al., 2000) as well as along the Partenio ridge (Caputo, 1989). Then, it went extinct, possibly because of habitat fragmentation (Fraissinet & Russo, 2013).
An individual from Irpinia (Province of Avellino), belonging to the subspecies *S. v. italicus*, endemic to the Apennine ridge, was collected on February 2003 and currently stored at the Museum of Natural History and Ecology, in Marano sul Panaro (Province of Modena: Fraissinet & Russo, 2013). While Spagnesi & De Marinis (2002) surely overestimated the distribution of red squirrels in Italy, the map provided by Amori *et al.* (2008) lacks some updated information, particularly concerning Southern Latium, where the species is undergoing a consistent range-expansion (Battisti *et al.,* 2013).
Eurasian red squirrels are diurnal, easily recognizable and detectable rodents. Furthermore, they are considered as a "flag species" as they have the ability to emotionally capture the attention of the general public, inducing people to support conservation actions. Thus, we aimed to collect occurrency points (documented by dates, geographical coordinates and photos) of European red squirrels all over the Italian peninsula, involving both experts and common people. In this work we present the first data and photos of individuals from Campania.

Location	Date	Coordinates (degrees, WGS84)		Habitat type
Monte Massico	29th September 2012	41.162117N	13.933533E	Deciduous woodland
Sessa Aurunca	17th August 2013	41.247063N	13.938947E	Suburban park
Capriati a Volturno	19th October 2013	41.474392N	14.152591E	Deciduous woodland

Tab. 1. Coordinates of the sightings of *Sciurus vulgaris* in Campania, assessed through a citizen science project.

Materials and methods

An email address to collect all coordinates and photos of squirrels in Italy has been created at the beginning of 2012 (savered-squirrel@gmail.com). The project has been advertised through flyers in several university centers, natural history museums, scientific congresses, social networks, mailing lists, blogs of photographers and hikers, to give maximum publicity to the idea and gather as much data as possible. So, we developed a network of both professional and volunteer observers who collected chance data on a local scale throughout the Italian peninsula. Records were then validated through expert-based approaches (cf. Breitenmoser *et al.*, 2006; Molinari-Jobin *et al.*, 2011). Data without photo were included in the database only when provided by experts (cf. Mori *et al.*, 2013c). In most cases, photos were sent by "detective-citizens", and rapidly identified to the reference species, thus constituting undisputable records. A second category of data included tracks and low-quality photos, who were confirmed by experts on small mammals from areas surrounding the point of occurrency reported. Just few data remained as "unconfirmed" and thus not included within the database. Sighting data and email address of each "detector" were reported in a table created *ad hoc* to regularly inform member of the network about the use of their data and photos. Coordinates (unprojected latitude/longitude, datum WGS84, EPSG reference code 4326) were then plotted on a map, using ArcMap 10 (ESRI 2011, Redlands, CA: Environmental Systems Research Institute).

Results

Three points of occurrence were identified in northern Campania (Caserta Province), two of them in a deciduous wood-

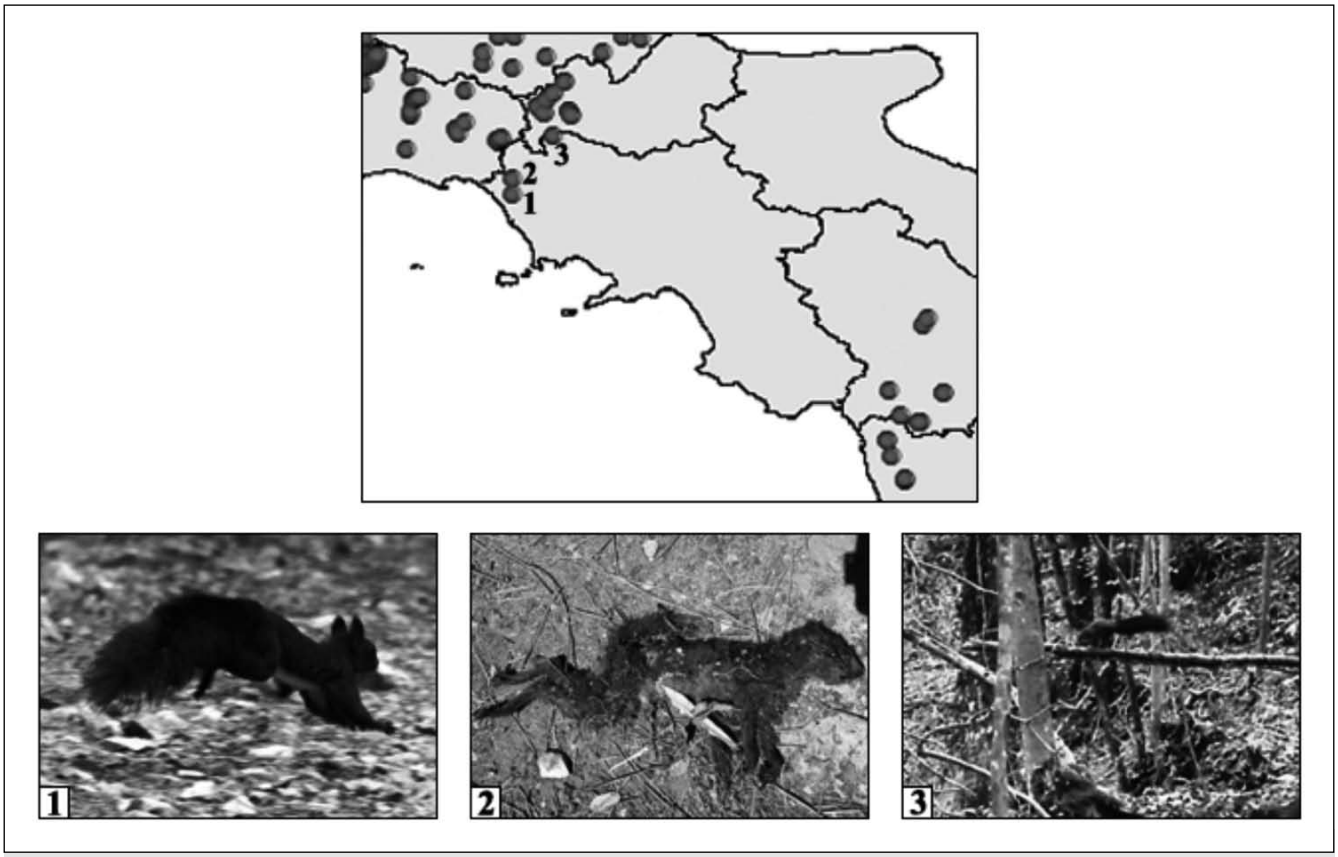

Fig. 1. Location of the three observations of *S. vulgaris italicus* in Campania. Distribution in the neighboring regions is also represented. 1, Monte Massico (Photo M. Foresta); 2, Sessa Aurunca (Photo A. Brandani), and 3, Capriati a Volturno (Photo A. Brandani). Points of occurrency of neighboring regions were taken by Menchetti & Mori, 2013.

land and one in a suburban park (Tab. 1).
Coat colour of the three individuals suggests that they belong to the Apennine subspecies *Sciurus vulgaris italicus* (cf. Amori *et al.,* 2008).
Fig. 1 summarizes the distribution of *Sciurus vulgaris* in Campania and reported the photos of the three observed individuals. Observations of red squirrels in neighboring regions are also reported (cf. Menchetti & Mori, 2013).

Discussion

The data reported in this study represent the first documentation of the occurrence of the red squirrel in northern Campania in recent times, although the presence of this species was expected, due to the fact that it is recorded both in Matese Massif of Molise and in Southern Latium (Menchetti & Mori, 2013).
The abandonment of traditionally settled mountainous and hilly areas (*e.g.* cultivations, sheep/cattle rearing) promoted a forest re-expansion in many regions, which allowed some species to re-colonize areas of historically presence (*e.g.* Russo, 2007; Moreira & Russo, 2007; Mori *et al*., 2013a). This is especially true for *Sciurus vulgaris*, as this species is particularly sensitive to habitat loss and fragmentation (Andrèn & Delin, 1994; Mortelliti *et al*., 2011). Range expansion of this arboreal native rodent has been observed both in the Po plain (*e.g.* Bon *et al*., 2008; Battiston & Amerini, 2013; Menchetti & Mori, 2013), and, mainly since 2005 (Battisti *et al*., 2013), along the Tyrrhenian coast (Province of Grosseto: Sforzi & Ragni, 1997; Northern and Southern Latium: Battisti *et al*., 2013). The presence of an expanding nucleus of the alien Finlayson's squirrel *Callosciurus finlaysonii*, distributed from Maratea plain to Sapri outskirts (Aloise & Bertolino, 2005), represents the only alien squirrel population in the latter area, who may hinder a possible expansion of the native species towards Campania from Basilicata. Spatio-temporal modifications in the management of coppices surely helped the range expansion of *Sciurus vulgaris* in the Province of Frosinone and Latina (Battisti *et al*., 2013), as well as an increase of synanthropy recorded for this species, which brought it to live also in in urban parks, or in the immediate surroundings of human settlements (Amori *et al*., 2008; Battisti *et al*., 2013; Battiston & Amerini, 2013). We suggest that the observations reported for the province of Caserta represent the southern expansion front of Latium (and/or of Molise). Although three records do not mean that a reproductive population is currently present in Campania, political boundaries among regions do not limit species range expansions, and a reconquest of the forested areas of the province of Caserta may occur. Handling was possible only for one squirrel, the road-killed one (cf. Fig. 1.2), Nevertheless, the carcass was degraded to such an extent that it was not possible to certify the sex, nor the reproductive status of the individual.
Further researches are needed in the framework of an adaptive management program, to clarify the current distribution range and status of the Italian red squirrel in Campania, as well as to develop properly addressed conservation programs.

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