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HEADCOUNT 2010: THE MULTIPLICATION OF THE GREY SQUIRREL INTRODUCED IN ITALY

ADRIANO MARTINOLI[1], SANDRO BERTOLINO.[2], DAMIANO G. PREATONI[1*], ANDREA BALDUZZI [3], ANDREA MARSAN[3], PIERO GENOVESI[4], GUIDO TOSI[1], LUCAS A. WAUTERS[1]

[1]Dipartimento Ambiente-Salute-Sicurezza, Università degli Studi dell'Insubria, Varese, Via J.H. Dunant 3, I-21100 Varese, Italy; * Corresponding author, E-mail: prea@uninsubria.it
[2]DIVAPRA Entomologia e Zoologia, Università degli Studi di Torino, Via L. da Vinci 44, I-10095
[3]Dipartimento per lo studio del Territorio e delle sue Risorse, Università degli Studi di Genova, corso Europa 26, I-16132 Genova, Italy
[4]Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA), Via Curtatone 3, I-00185 Roma, Italy

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ABSTRACT - The introduction of non-native animal species is an important cause of loss of biodiversity. Tree squirrels as a taxon and grey squirrels (*Sciurus carolinensis*) in particular are among the most successful invasive alien species. Here we present the current situation (October 2010) of the grey squirrel in Italy. The grey squirrel was first reported in Piedmont in 1948. Subsequent major introductions were reported in Genova-Nervi (1966) and the Ticino Valley Regional Park in Lombardy (1999). In 2010, there were 24 areas with a (meta) population or nucleus of grey squirrels: 23 of these were in the three regions most affected by the invasive species Piedmont, Lombardy and Liguria. The number of known areas with grey squirrel presence has strongly increased in the last years. With the exception of the Genova-Nervi population, there is a lack of detailed knowledge on grey squirrel distribution and population size in areas where animals are now known or believed to be present. We underline the need for the immediate ban of squirrel trade and control or eradication actions.

Key words: invasive species, biodiversity, *Sciurus carolinensis*, distribution range, introductions

RIASSUNTO - ***Headcount 2010: il proliferare delle popolazioni di scoiattolo grigio introdotte in Italia***. L'introduzione di fauna alloctona è una causa importante di perdita di biodiversità. Gli scoiattoli arboricoli, e in particolare lo scoiattolo grigio (*Sciurus carolinensis*), sono tra le specie invasive di maggior successo. Nel presente lavoro viene mostrata la situazione aggiornata (a ottobre 2010) relativa alla presenza delle popolazioni di scoiattolo grigio in Italia. La prima introduzione di scoiattolo grigio risale al 1948 in Piemonte. In seguito le principali introduzioni della specie sono avvenute nel parco di Genova Nervi (1966) e nel Parco Lombardo della Valle del Ticino (1999). Attualmente sono state individuate 24 aree con (meta) popolazioni o nuclei di scoiattolo grigio: 23 di queste sono nelle tre regioni principalmente interessate dalla specie invasiva, Piemonte, Lombardia e Liguria. Il numero di aree interessate dalla presenza dello scoiattolo grigio è

fortemente incrementato negli ultimi anni. A fronte di questa espansione della specie, esiste tuttora una mancanza di conoscenza di dettaglio della distribuzione e della dimensione delle popolazioni locali per tutte le aree di presenza. Si sottolinea la necessità di introdurre immediatamente il bando del commercio di tutte le specie invasive della famiglia degli Sciuridi e di partire immediatamente con interventi di controllo o eradicazione delle popolazioni.

Parole chiave: specie alloctone, biodiversità, *Sciurus carolinensis*, distribuzione, introduzioni

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INTRODUCTION

Recently, at its 455th plenary session, held on 15 and 16 July 2009, the European Economic and Social Committee adopted the following opinion: "*is very disappointed that the goal of halting the loss of biodiversity by 2010 will not be achieved. However, it is encouraging that the Habitats and Birds Directives have resulted in positive developments for some habitats and species. This shows that European legislation on nature conservation works if it is properly applied. All the same, it is unable to halt the continuing serious biodiversity loss outside protected areas resulting from economic practices which are completely legal. The EESC agrees with the Commission that the mainstreaming of biodiversity considerations has not yet gone nearly far enough*" (Ribbe, 2009).

One of the risk factors causing loss of biodiversity that has received a lot of attention in the scientific literature but few practical actions is the introduction and/or control of non-native animal species (e.g. for Italy: Andreotti *et al*., 2001; for Europe: Genovesi, 2005; 2007; DAISIE, 2009). While the number of introduced species of many taxa is constantly growing (DAISIE, 2009), the eradication of new populations ("a posteriori" action) and the regulation in the trading of live animals and plants ("a priori" strategy) is going on slowly (Genovesi, 2005, 2007; Westphal *et al.*, 2008).

Tree squirrels as a taxon and grey squirrels (*Sciurus carolinensis*) in particular are among the most successful invasive alien species (Long, 2003; Bertolino, 2009, Nentwig *et al.*, 2009). In most cases introduction of alien tree squirrels are deliberate and there is a high probability that self-sustaining populations develop from only few released individuals (Currado *et al*.,1997; Wauters *et al.,* 2005; Wood *et al.*, 2007; Dijkstra and Dekker, 2008; Bertolino, 2009). The impact of introduced tree squirrels on wildlife and human activities can be devastating. In Great Britain grey squirrels are replacing the native congener, the Eurasian red squirrel (*Sciurus vulgaris*) in most of its range (Wauters *et al.*, 2000, Gurnell *et al.*, 2004, 2008a, b; Bertolino, 2008). Also, damage to forestry in the British isles is huge, with an estimated reduction of the value of tree crops by about 25% or 10 million pounds. Moreover, the costs of continuous control, by trapping,

drey-poking and shooting, and poisoning with warfarin in specially designed feeding-hoppers are estimated at 3 million pounds annually (Anonymous, 2003).

In Italy, the grey squirrel was first reported in Piedmont in an area around the Stupinigi forests (original release site) in 1948. Following the expansion of this population, red squirrels have gone extinct in most of the Piedmont range actually occupied by the alien species (Wauters *et al*., 1997a, 2005; Gurnell *et al*., 2004). Subsequent major introductions were reported in Genova-Nervi (1966) and the Ticino Valley Regional Park in Lombardy (1999) (reviewed by Bertolino *et al.*, 2000). The known or estimated distribution and population size of these populations have been used to forecast the future spread of the invasive species in North Italy and neighbouring countries by Spatially Explicit Population Dynamics Models (SEPM) (Lurz *et al.*, 2001; Tattoni *et al.*, 2005a, 2005b, 2006; Bertolino *et al.*, 2008). All predictive models agree that, if no control or eradication actions are undertaken, grey squirrels will invade France and Switzerland within the next 15-70 years and colonisation of the rest of Europe is only a matter of time. According to simulations, the eradication of the two populations of Genova and the River Ticino, would greatly postpone the invasion of Switzerland and Central Italy (Bertolino *et al.*, 2008).

It must be underlined that to manage highly invasive species efficiently, a co-ordinated European approach is mandatory (Bertolino and Genovesi, 2005; Bertolino *et al.*, 2008). Currently, the European Union still lacks a formal policy on biological invasions, although it has formally committed to develop an European policy on this issue, based on the strategy on alien species established by the Bern Convention in 2003 (Genovesi and Shine, 2004), by 2010 (see EC Communication "Towards an EU Strategy on Invasive Species" COM 2008; Conclusions of Council of European Ministers, Luxembourg, 25 June 2009). Meanwhile, single countries are preparing to introduce a trade ban for different squirrel species (e.g. The Netherlands, J.W. Lammers, pers. comm.).

A major problem for any Italian control/eradication program to be successful is that grey squirrels can still be traded and bought as pets. In fact, although problems caused by grey squirrels are now recognised by national and local politicians, a complete ban on grey squirrel trade is still lacking. Unfortunately, there is no central (inter)national database on animal trade for species that are not listed under the CITES convention: consequently it is nearly impossible to obtain reliable information on the extend of importation and trade of species such as the grey squirrel. A second problem is that, due to continuing trade, several new cases of grey squirrel occurrence in parks and woods have been reported over the past decade. Obviously, if in (some of) these cases, self-sustaining populations are going to establish, the modelled future scenario of spread of the grey squirrel will change for the worse. Unfortunately, no official document on the reliability and/or status of these

recent reports of grey squirrel presence is available.
The aim of this paper is to document and verify all currently (October 2010) known reports of grey squirrel presence in Italy, outlining, whenever possible, the distribution and status of each nucleus or population.

SUDY AREA AND METHODS

The occurrence of the grey squirrel in the surroundings of Turin and Genova is well documented. The distribution area has been determined based on visual surveys and sightings by local residents in Liguria (Spanò *et al.*, 1999; Venturini *et al.*, 2005) and by hair-tube surveys, sightings and questionnaires to local residents in Piedmont (Wauters *et al.*, 1997a, b; Genovesi and Bertolino, 2001; Bertolino and Genovesi, 2003; Cordero di Montezemolo and Bertolino, 2007). In Lombardy, the situation is different. One area, the Ticino Valley Regional Park, has been partly surveyed using hair tubes in 2000-2001 (Fornasari *et al.*, 2002; Tattoni *et al.,* 2005, 2006) and 2009-2010 (Bonazzi *et al.*, 2010). Reports for the rest of Lombardy and other Italian regions come from various sources with different levels of reliability. We considered reliable records (Tab. 1) those verified by one of the authors or by other experts of mammals, directly contacted by one of us, or published in technical reports or in the literature.
During the last ten years, the authors of this paper have established themselves as a reference for the reporting of introduced squirrels in Italy. For this reason, we received sighting records, photos of live and dead animals and reports from people working in the field (e.g. foresters, park wardens). We checked directly most of the reported areas of introduction to collect further information, in particular for those situations for which specimens or photos were not available.
We defined as "nucleus" the presence of most probably a small number of individuals over a short period of time, without the certainty that reproduction already occurred. The term "population" indicates the presence of a number of individuals (> 10) sufficient to form a self-sustaining population by local reproduction and/or subsequent colonisation of areas surrounding the (assumed/known) release site.

RESULTS AND DISCUSSION

All records of grey squirrels in Italy are summarised in Table 1. Estimates of population size are only available for the population in the Genova-Nervi parks (115-286 animals in 2002, based on visual counts and distance sampling; Venturini *et al.*, 2005), while for most cases even the exact distribution area is still unknown. Moreover, where estimates of the distribution area have been made, they often refer to the situation of 10 years ago (e.g. Turin-Cuneo area 2000). This lack of knowledge is mainly due to a generalised lack of interest or awareness about the problems arising from invasive grey squirrels and, consequently, the lack of any support to carry out detailed monitoring.
In Piedmont there is one large meta population which, in 2000, had colonised an area of about 900 km^2 (Turin-Cuneo area, Tab. 1). Recently, grey squirrels have been reported in two other sites in Piedmont: both are probably small nuclei not yet expanding.
Grey squirrels in the Genova-Nervi park reach high densities (8 - 12

Table 1 - Current available records of the grey squirrel in Italy. *Ticino Park (meta) population. +first introductions. The codes in parentheses indicate the province (NUTS3) where each site is located (see also Fig. 1); [(1)]sighting on 13 May 2008, during an inspection issued by Bern Convention Standing Committee.

Site	First report	Distribution area (km^2)	Source
Piedmont			
Turin – Cuneo [PIE001]	1948[+]	900 km^2 (2000)	Genovesi & Bertolino, 2001; Bertolino & Genovesi, 2003
San Nazzaro Sesia (NO) [PIE002]	2009	Localised	
Bellinzago Novarese (NO) [PIE003]	2010	Localised	
Liguria			
Genova-Nervi (GE) [LIG001]	1966[+]	100 ha	Venturini *et al.,* 2005
Lombardy			
Trezzo sull'Adda [LOM001]	2008	unknown	
Legnano (MI) [LOM003]	2007	unknown	
Corbetta (MI) [LOM004]	2007	unknown	
"Montevecchia e Valle del Curone" Regional Park (CO) [LOM005]	2003	ca. 1000 ha	Calvi, 2008
Pusiano lake [LOM006]	2001	1 dead animal	
"Colli di Bergamo" Regional Park [LOM007]	2006	unknown	
Monza, River Lambro Regional Park (MB) [LOM008]	2006	unknown	
River Ticino Valley (MI) [LOM009]*	1999	ca. 1000 ha	Tattoni *et al.*, 2006; [(1)]
Sesto Calende (VA) [LOM019]*	2010	unknown	Bonazzi *et al.*, 2010
Arsago Seprio (VA) [LOM020]*	2010	unknown	Bonazzi *et al.*, 2010
Lonate Pozzolo (VA) [LOM021]*	2010	unknown	Bonazzi *et al.*, 2010
Cassolnovo (PV) [LOM022]*	2010	unknown	Bonazzi *et al.*, 2010
Robecco sul Naviglio (MI) [LOM027]*	2010	unknown	Bonazzi *et al.*, 2010
Abbiategrasso (MI) [LOM028]*	2010	unknown	Bonazzi *et al.*, 2010
Coarezza, Somma Lombardo (VA) [LOM010]*	1999	1 dead animal	
Canzo (CO) [LOM011]	2008	1 sighting	
Bareggio [LOM012]	2006	several photos	
Bellagio (CO) [LOM013]	2008	unknown	video on YouTube
Pertus Pass, Valley Imagna (BG) [LOM014]	2007	1 sighting	photo on internet
Cernusco sul Naviglio (MI) [LOM015]	2010	1 sighting	
Cassina de'Pecchi (MI) [LOM016, LOM017]	2010	Sightings	photographed
Settimo Milanese (MI) [LOM018]	2010	unknown	photographed
Cisliano (MI) [LOM023]	2010	unknown	
Sedriano (MI) [LOM024]	2010	unknown	Bonazzi *et al.*, 2010
Vittuone (MI) [LOM025]	2010	unknown	Bonazzi *et al.*, 2010
Magenta (MI) [LOM026]	2010	unknown	Bonazzi *et al.*, 2010
Umbria			
Perugia [UMB001]	2003	Localised, expanding	Paoloni *et al.,* 2010
Veneto			
Abano Terme (PN) [VEN001]	2009	Single site	Removed

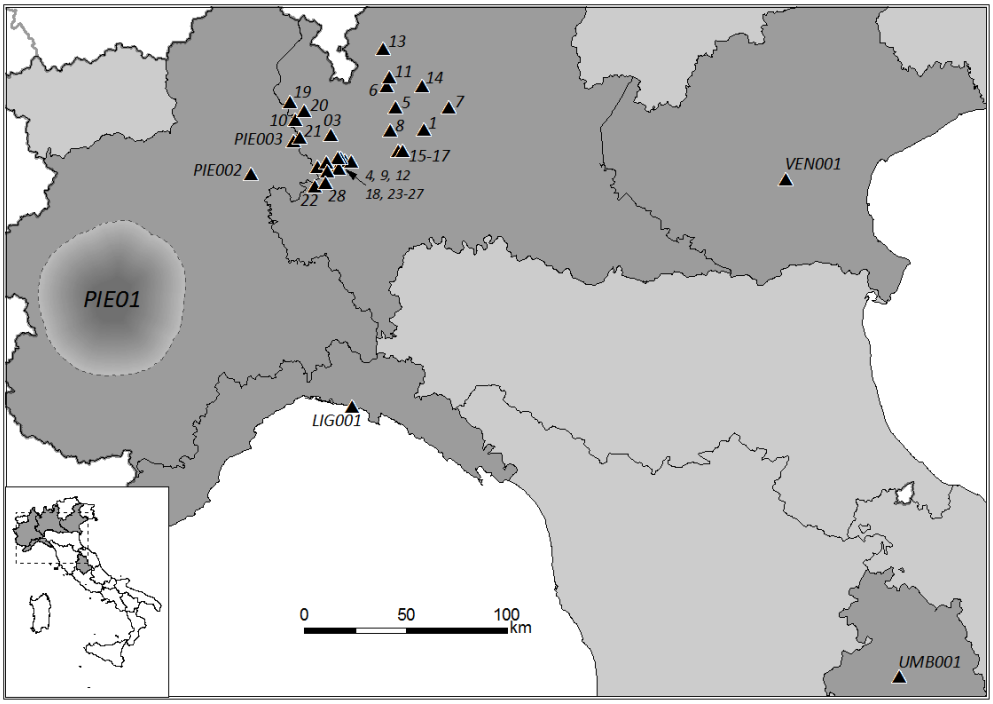

Figure 1 - Current distribution of the grey squirrel in Italy . Site codes refer to Table 1. Eight sites are within the Ticino Park (Lombardy) boundaries.

animals/ha, Venturini *et al.,* 2005) and recent observations outside the park indicate that at least some animals are dispersing from the introduction site to surrounding gardens and woodland (Balduzzi and Marsan, pers. comm.).

The worst situation is that in Lombardy, with many nuclei and populations of unknown size and distribution area, reported in 19 different areas (Tab. 1 and Fig. 1). In at least five areas there are populations with a high risk of further expansion: Legnano (urban park and surroundings), Montevecchia (natural woods), Monza and River Lambro (urban park and riparian woods), River Ticino valley (natural woods), and Bareggio (suburban park). Eight reports are from sites distributed throughout the Ticino Park, Lombardy (Tab. 1) and in May 2008, during a technical visit issued by the Standing Committee of the Bern Convention, a grey squirrel was seen in "La Fagiana" reserve, inside the Ticino Park (Tab. 1). Nevertheless, a recent hair-tube survey (Bonazzi *et al.*, 2010), failed to obtain reliable data on grey squirrel distribution and population size and on possible changes in the population's status with respect to an earlier survey carried out in 2000-2001(Fornasari *et al*., 2002). However, it must be stressed that the methodological approach applied by Bonazzi *et al*. (2010) was insufficient to reveal animals occurring at low densities, as admitted by the authors themselves. There is strong suspicion that some of the recent nuclei in

Lombardy (10 new reports in last 3 years, Tab. 1), often found in parks, are the result of voluntary introductions to get rid of individuals of grey squirrel detained in captivity as pets. In fact, grey squirrels, and tree squirrels in general, can originate new populations from the release of few animals. The oldest grey squirrel populations established in Italy originated from the release of only 4-6 animals (Bertolino and Genovesi, 2005), while worldwide the likelihood to successfully establish a viable population was 57% for a couple of animals belonging to a *Sciurus* species and 73% for a couple of *Callosciurus* (Bertolino, 2009).

Two reports come from outside the 'traditional' range in Northern Italy: the population at Perugia, first reported in 2003, is probably expanding. Fortunately, that area is now being monitored using hair-tube surveys (Paoloni *et al.*, 2010) and there are ongoing contacts with local authorities to start removing the animals. At Abano Terme (province of Padua, Veneto Region) a lactating female and her dependent young were found in 2009, but after the removal of this family group, no other observation has been reported (Giorgio Tocchetto, pers. comm.). Therefore, we did not count this sighting to obtain the number of areas with grey squirrel presence in October 2010.

So far the main problem caused by grey squirrel in Italy is the local extinction of red squirrel populations. As far as economic damage is concerned, several landowners complain about relevant damage to poplar plantations (Currado, 1993; Gautier, pers. comm.), but at present damage has been documented mainly on maize (Signorile and Avans, 2007).

The marked increase of grey squirrel sightings in new areas highlights the need for the immediate ban of the trade of grey squirrels and, preferably, all invasive tree squirrel species (genera *Sciurus, Callosciurus* and *Sciurotamias*, DAISIE, 2008). The latter to avoid problems as those that occurred with the ban of a single subspecies of genus *Trachemys*. In this case, the import of *T. scripta elegans,* suspended within the EU through the Wildlife Trade regulations since 1997, has been replaced by the trade of other, related taxa (e.g. *T. scripta scripta*, DAISIE, 2009).

In Europe, the trade of live specimens of four invasive animal species (*Trachemys scripta elegans*, *Rana catesbeiana*, *Chrysemys picta*, *Oxyura jamaicensis*), for which "it has been established that their introduction into the natural environment of the Community presents an ecological threat to wild species of fauna and flora indigenous to the Community", is currently restricted (Shine, 2006). It is surprising that *Sciurus carolinensis* has still not been included in this list, knowing the invasive character of tree squirrels and the extinction of the native red squirrel already caused by this species throughout most of the British Isles (Gurnell et al., 2008a, b; Bertolino, 2009).

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