
(Invasive) alien vertebrates

Balancing control methods for invasive tree squirrels with lethal and non-lethal approaches

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Invasive alien squirrels, particularly the Eastern grey squirrel (*Sciurus carolinensis*) and Pallas's squirrel (*Callosciurus erythraeus*), are significantly impacting Italy's ecosystems, threatening native species such as the Eurasian red squirrel (*Sciurus vulgaris*) through competition for trophic resources and habitat. In southern Italy, the variable squirrel (*C. finlaysonii*) is also spreading and likely beginning to overlap with the endemic *S. meridionalis*. In response, Italy has implemented diverse control strategies across different regions aligned with EU Regulation 1143/2014 to curb the spread of these invasive species. In urban parks, small populations have been managed successfully through capture, sterilization, and release (Liguria, western Italy), while urban to rural populations have been controlled using trapping and removal methods (Umbria, central Italy). Early intervention in these regions has led to effective eradication. In areas with larger, more established populations, such as in Piedmont and parts of Lombardy, north-west Italy, lethal removal methods involving capture and euthanasia with CO₂ have been employed. A control plan based on the same methods is currently underway to manage the variable squirrel in parts of its range in Basilicata (southern Italy). Additionally, at the Italian-Swiss border, the population of Pallas's squirrel is being managed using a combination of trapping and culling as part of an integrated strategy. Integrated strategies combining varying degrees of three main removal methods—capture followed by euthanasia, capture followed by surgical sterilization, and culling—are also being adopted to manage and potentially eradicate new grey squirrel outbreaks following early warning reports scattered throughout Italy.

These efforts demonstrate that early and continuous intervention is key to successful eradication, while delayed or sporadic actions are bound to fail, having escalating costs and impact on both biodiversity and financial resources. The Italian case highlights the necessity of a multifaceted approach to invasive squirrel management to safeguard native biodiversity and protect vulnerable native populations.