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MANAGING URBAN FAUNA: ENGAGING CITIZENS AND MODIFYING HABITATS TO REDUCE RODENTICIDE USE, A FIRST REPORT ON *RATTUS NORVEGICUS* MANAGEMENT IN GENOA

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Abstract The city of Genoa combines a historic urban structure with the presence of a tourist and commercial port. These characteristics provide a suitable habitat for the proliferation of *Rattus norvegicus*. The presence is confirmed both in the Historic Center and in the peripheral areas, often due to numerous factors also linked to bad habits of the population and a non-integrated approach of the public administration. The local Animal Office, in synergy with "Il Rastrello" (Pest Control Company), has prepared a protocol that includes several targeted actions, which cannot be limited to the use of rodenticide baits but managing the habitat to reduce proliferation. 1st Action: mapping of the critical issues present in the identified areas, based on reports from citizens. 2nd Action: use of an emergency response team for rat-proofing actions. 3rd Action: rodenticide integration phase, through innovative mechanical and technological systems. 4th Action: replacement of rodenticide bait with virtual bait in the absence of consumption, change of dispenser model in the most critical points. 5th Action: coordination between offices for the continuation of synergistic actions, combined with communication to the population of the actions implemented and the results obtained. The application of this protocol has given excellent results, leading in some cases to the total eradication of the problem, as well as to a significant decrease in the use of poison and a more ethical approach. These actions can also be successfully applied to other cities, at least in the Mediterranean area.

Key words Rat-proofing, *Rattus norvegicus*, urban ecology, Integrated Pest Management

INTRODUCTION

The Historic Center of Genoa, one of the largest and most complex in Europe, represents an urban environment particularly conducive to the proliferation of rodents, especially *Rattus norvegicus*. Its intricate structure, characterized by narrow alleys, historical buildings, manholes, and underground canals, provides an ideal habitat for rodents. The presence of abandoned waste, lack of maintenance in some areas, and high population density further contribute to the spread of these synanthropic animals, which are closely associated with urban environments.

Rodent-related issues are not new in densely populated urban areas (Byers et al., 2019; Maas et al., 2020). In this sense, the city of Genoa is no exception. However, the emergence of new factors, such as changes in waste management practices and maintenance challenges, has led to the proliferation of numerous colonies that are difficult to contain using traditional methods (e.g., rodenticide application through "permanent baiting" technique). Moreover, Genoa is a

"composite" city (Lin et al., 2013), characterized by numerous historic urban cores corresponding to former municipalities that existed prior to their unification under Greater Genoa in 1926. These areas largely feature architectural characteristics dating back to the 19th century.
In recent years, the issue has become particularly evident in the Historic Center of the old city and in some historical peripheral areas, such as the districts of Sampierdarena and Sestri Ponente—areas with high population density and a structural vulnerability to this type of infestation. Rodent control has become a priority for the municipal administration, especially considering that 51% of reported sightings and/or carcasses originate from the Historic Center alone, reaching 67% when including other peripheral historic areas in the city.
Additionally, 78% of reported cases in the city (with a lower percentage in the Historic Center) occur in the immediate vicinity of solid urban waste collection points, which include non-differentiated and edible waste, commonly referred to as "Municipal Solid Waste (MSW) points."
The need for structural, organized, and continuous intervention has become crucial to preserving the health of the urban environment and improving the quality of life for citizens. This approach also aligns with goals to reduce pollutants dispersed in the environment and minimize the risk of secondary poisoning.

MATERIALS AND METHODS

Mapping Structural Vulnerabilities (The "SfRatto" Project) The first step in a territorial management project involves acquiring a thorough understanding of its specific features, particularly those eco-ethological characteristics that favor the presence of a synanthropic species like *Rattus norvegicus*. These factors primarily include food sources, shelters, water sources, and climatic stability. In a historic area like Genoa, these are respectively provided by abandoned waste and food, underground systems such as sewers, drainage systems and fountains, and the urban heat island effect.
Additional risk factors arise from unpredictable, localized vulnerabilities, often linked to improper behavior by the resident population (e.g., abandonment or improper disposal of edible materials) or structural deficiencies in buildings.
For this reason, the first fundamental step in the containment project for urban populations of *Rattus norvegicus* in Genoa, named the "SfRatto" project, was the precise mapping of potential infestation sources and structural vulnerabilities in the Historic Center and historical peripheral areas.
The name "SfRatto" is a play on words between the Italian terms "Ratto" (rat) and "Sfratto" (eviction) that can be translated in "DefenestRATion".
While the primary sources of infestation mentioned above are often easily identifiable and typically mapped structural vulnerabilities affecting urban fabric or residential buildings (often privately owned) are less evident. These issues include holes in walls, poorly maintained manholes, abandoned buildings, and inadequately monitored construction sites.

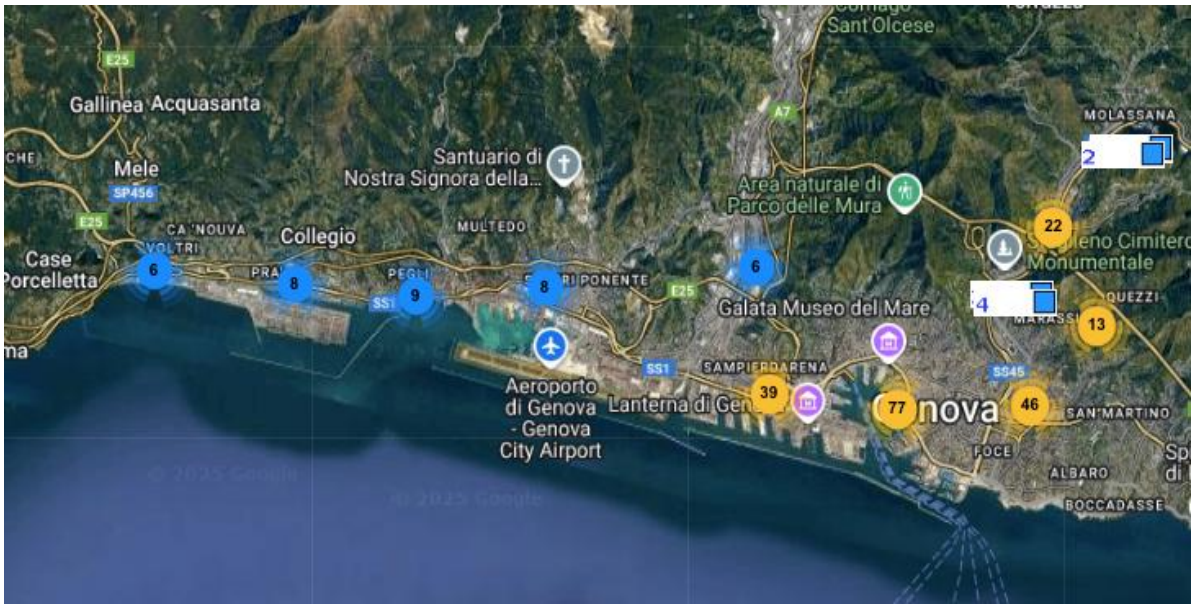

Figure 1 Number of Interventions carried out in each section of Genoa's municipality.

Figure 2 Mechanical barriers (in roadside drains) position in downtown.

To obtain a detailed map, data from Geoportal of the Genoa's Municipality were used. This database includes information such as the distribution of sewer networks, the passage of public lighting cables, buried streams, and other similar features. The information was verified and updated directly in the field by naturalists and specialized technicians, then georeferenced using QGIS software. Additional inputs include reports received by the offices of the Municipality of Genoa responsible for urban wildlife management, regardless of the communication method (email, phone, or the "SegnalaCi" portal). These reports are subject to careful on-site verification. The resulting product is a risk map indicating the presence of *Rattus norvegicus* in the historical center of Genoa.

Remediation of Critical Areas and Creation of an Inhospitable Habitat Once the issues are identified, the next step involves environmental remediation of the critical areas. The project, grounded in ecological and ethical principles such as minimizing the use of chemical substances and eliminating the trophic niche of *Rattus norvegicus*, focuses on the physical removal of all resources that support rat proliferation. This entails interventions in the urban habitat, including measures to eliminate shelters and the construction of burrows and riser holes by sealing them, as well as sealing any potential access points that could allow rodents to enter and exit underground areas (manholes, storm drains).

Additional measures also include improving waste management to prevent access to food sources and maintaining cleanliness in public and private areas. Attention is paid to infrastructure maintenance, such as repairing sewer systems and closing gaps in building foundations, which can serve as entry points or nesting sites for rodents. The goal is to create an environment that is structurally and ecologically unfavorable for the survival and reproduction of *Rattus norvegicus*. This approach not only mitigates the current infestation but also reduces the likelihood of reinfestation in the long term. The project aims to establish a model for urban wildlife management that is both effective and respectful of the surrounding ecosystem.

Innovative Technologies: Mechanical and Technological Systems The "SfRatto" project goes beyond structural interventions, incorporating innovative technological solutions to further reduce rodent presence. Among these, one of the most significant measures is the installation of tilting devices in manholes and storm drains. In the historical center, manholes and underground pipelines are commonly used by rodents as transit routes and shelters. The installation of the mechanical "Ecosystem®" system in manholes prevents rats from exiting while allowing rainwater to flow unimpeded. This tilting device functions as a rat barrier while maintaining the normal drainage of rainwater. The introduction of this system provides a dual benefit: it not only reduces rat proliferation but also helps prevent the spread of mosquitoes in manholes by blocking their access to stagnant water, which they use for egg-laying.

Figure 3-4 Tilting device installation ***Ecopoints Control Using Seismic Waves and* Ultrasound** food sources.

The deterrents emit low-frequency vibrations and ultrasonic waves that are highly unpleasant for rats, effectively discouraging them from accessing these sites. This technology not only reduces rodent activity around waste but also creates an environment that is less conducive to their survival, making rodenticidal baits more appealing in comparison.
Furthermore, by limiting access to alternative food sources, competition for food among rodents is significantly reduced, thereby increasing the overall effectiveness of pest control measures. This integrated approach combines technological innovation with effective pest management strategies to ensure long-term results.

Replacement of Rodenticide Bait Dispensers The project includes a comprehensive initiative to replace rodenticide bait dispensers. In certain areas of the historical center, the use of box-style dispensers has been successfully tested, proving to be safer and more effective than traditional inverted "T" models. These new dispensers are temper-resistant, safer for non-target animals, and more attractive to rats.
The installation of these updated devices throughout the historical center will significantly reduce the number of rodent sightings and carcass reports. Moreover, the enhanced safety of the new design
minimizes the risk of exposure for non-target animals and reduces the environmental impact of rodenticides.
This shift to safer and more efficient baiting systems represents a crucial step in improving urban pest control while prioritizing ecological sustainability and public health.

Operational Program for Implementation To operate the “SfRatto” strategy, the plan includes the following key steps:

- Mapping Structural Issues: Utilizing Geoportal for continuous monitoring and identification of structural vulnerabilities.
- Maintenance Interventions: Conducted by the operational team to eliminate all sources of rat proliferation and seal critical areas.
- Installation of Technological Deterrents: Deploying devices at Ecopoints to limit rodent access to waste.
- Replacement of Rodenticide Bait Dispensers: Introducing safer and more effective models to improve baiting efficiency and reduce risks to non-target animals.
- Ongoing Monitoring: Tracking bait consumption and citizen reports to ensure a prompt and effective response to emerging issues across the territory.

This structured approach ensures that the strategy is both proactive and responsive, promoting long-term management of rodent populations while safeguarding urban environments.

RESULTS AND DISCUSSION

Medium- to Long-Term Expected Effects The expected outcomes of the “SfRatto” project is not limited to short-term impact but are designed to be evaluated over the medium to long term through territory monitoring and feedback from citizens. The project’s primary objectives aim to reduce the environmental impact of rodent control activities while improving urban hygiene and overall livability. Key goals:

- Reduction in Rodenticide Use: By implementing safer and more effective methods, the project seeks to minimize the use of rodenticides. This has a potentially significant secondary benefit for the water quality of Genoa’s Old Port, which receives runoff from

gutters and road surfaces. Reduced rodenticide use decreases the risk of synthetic substances entering the marine food chain, mitigating pollution and bioaccumulation.

- Improved Public Hygiene: Achieved by reducing signs of rodent presence (e.g., droppings) and decreasing the frequency of carcass sightings.

Evaluation of Effectiveness Evaluating the numerical consistency of a colony of rodents in a vast territory such as the one chosen for our project could be prohibitive in terms of economic and technical effort. For this reason we have chosen two indirect indicators, capable of providing a plausible picture of the effectiveness of the method we developed:
1- consumption of rodenticide baits monitoring rodenticide bait consumption over the medium term has enabled an initial assessment of the project's effectiveness. Although there is no direct correlation between bait consumption and the exact number of rodents in a colony, these two variables, under consistent environmental conditions, can be considered inversely proportional.
The following graph (Figure 5) illustrates a consistent decrease in bait consumption within the treated area, which initially displayed conditions identical to the control area. This decline, coupled with a significant reduction in reported rodent sightings, suggests a corresponding decrease in the rodent population. This trend is likely due to the elimination of a previously accommodating trophic niche, thereby disrupting the conditions necessary for colony support.

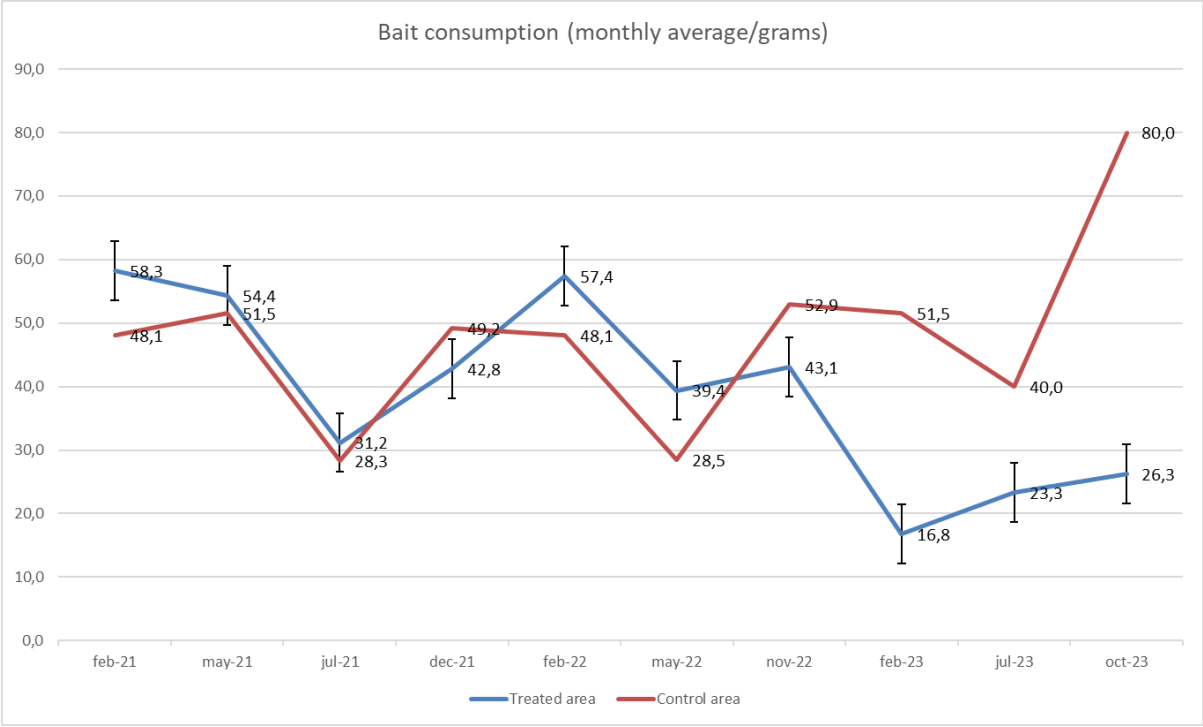

Figure 5 Bait consumption (monthly average/grams) in the Old Town of Genoa. Treated area (blue), control area (red).

This evidence underscores the project's capacity to deliver sustainable outcomes through targeted interventions and long-term monitoring. This statement will require validation through the analysis of data for the year 2024, which is not yet available for analysis.

2- feedback from citizens assuming that in situations of overpopulation of rodent colonies, the trophic activity is reflected in the visibility of the inhabitants of the old city. To have a further, indirect, picture of the effectiveness of the method, we analyzed the trend of the feedback received from citizens starting from 2021, for which the data referring to 2024 is already available. The following graphs show how, starting from a comparable situation (year 2022), there is a progressive decrease in the number of negative feedback (e.g. rodent sightings) in the area subjected to treatment, while the control area continue to show the same trend.

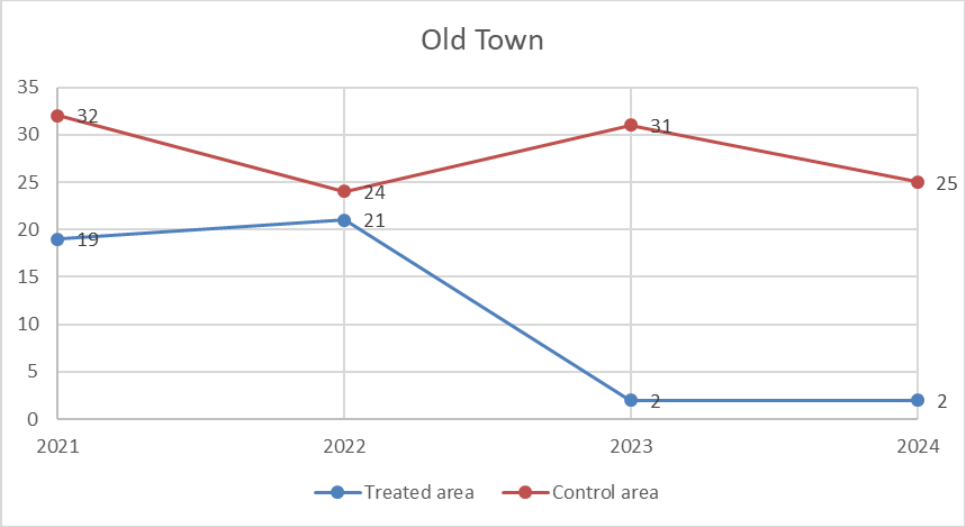

Figure 6 Number of reports from citizens in the two sites: blue (treated area) red (control area).

This evidence allows us to draw the first conclusions on the actual effectiveness of the containment method. If the positive trends are confirmed during 2024 (for rodenticide baits) and 2025 (for both indicators, rodenticide baits and citizen feedback), it will be possible to apply the method to increasingly larger parts of the city of Genoa.

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