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RESEARCH

Patterns of abundance of three reptile species inside the metropolitan area of Rome (Italy)

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Abstract

Urbanization reshapes natural environments, impacting biodiversity and creating complex ecosystems where some species adapt while others decline. This study examines the abundance and distribution patterns of three reptile species — *Podarcis siculus*, *P. muralis*, and *Tarentola mauritanica* — within the metropolitan area of Rome, Italy. Data were collected from 36 plots representing different level of urbanization, categorized by green cover percentage. Results reveal *P. siculus* as the most widespread species, found across all vegetation cover categories, while *P. muralis* and *T. mauritanica* were more frequent in plots with over 50% of green cover. Vegetation type emerged as a primary factor influencing reptile abundance, with meadow and tree cover positively affecting *Podarcis* species, while bush cover promoted *T. mauritanica* abundance. Notably, *P. muralis* abundance increased with the number of urban features such as fountains and garbage bins, the latter suggesting potential exploitation of anthropogenic food resources. Possibly, species interactions also played a role, with *P. siculus* and *P. muralis* exhibiting a negative relationship in abundance, while *P. muralis* and *T. mauritanica* showed a positive association. The study highlights the importance of maintaining heterogeneous urban green spaces to support reptile biodiversity. These insights contribute to urban ecology and inform strategies to enhance biodiversity in metropolitan landscapes.

Keywords urban biodiversity · urban ecology · habitat use · *Podarcis siculus* · *Podarcis muralis* · *Tarentola mauritanica*

Introduction

Urbanization is a dynamic and ongoing process that reshapes natural habitats, leading to profound effects on biodiversity. This transformation involves habitat loss, fragmentation, and the introduction of exotic species, coupled with changes in resource availability (Garrard et al. 2018). Urban areas are among the fastest growing land-use types across the globe, driven by rapid population growth and economic development (McDonald 2008). Current projections suggest that by 2050, approximately 68% of the global population will reside in urban and peri-urban areas, intensifying the pressure on natural ecosystems (United Nations Department of Economic and Social Affairs 2018). This expansion converts natural landscapes into impervious surfaces, such as roads, buildings, and industrial zones, which not only fragment habitats but also isolate populations, disrupt ecological networks, and contribute to biodiversity loss (McKinney 2002; Grimm et al. 2008; Aronson et al. 2014). Moreover, the remnant vegetation, particularly the shrub layer essential for many species' cover and foraging, is drastically reduced and native flora and fauna are increasingly replaced by exotic, often opportunistic, species better suited to withstand urban stressors (McKinney 2002, 2006).

However, urban environments are not exclusively hostile to wildlife. In certain contexts, they provide novel ecological opportunities. Man-made structures, such as walls, abandoned buildings, and drainage systems, create refuges and microhabitats that some species exploit for shelter and thermoregulation. Additionally, urban areas can offer lower predation pressures, particularly where natural predators are scarce and non-native predators have limited impact, and

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may present abundant food resources, including anthropogenic waste (McKinney 2002; Francis and Chadwick 2013; Parris 2016). This duality — where cities act as both a threat and an opportunity — shapes urban biodiversity in complex ways.

Although studies on the impact of urbanization on reptiles are not lacking (e.g., Ackley et al. 2015; Hall and Warner 2017; Tiatragul et al. 2017; Putman et al. 2019; Gainsbury et al. 2022; Larson et al. 2024), they are fewer in number compared to those conducted on birds and mammals (Brum et al. 2023). In fact, this group of vertebrates remains scarcely studied when it comes to understanding how specific urban features influence their ability to tolerate city environments (French et al. 2018). While some species adapt and even thrive in urban fragmentation and development, many others are highly susceptible to habitat alterations and landscape modifications, as observed in squamates (Wolf et al. 2013; French et al. 2018). Reptiles, being ectothermic organisms, are particularly sensitive to environmental changes, with temperature playing a critical role in their behaviour, physiology, and overall survival (Kearney et al. 2009). Urban areas often create "urban heat islands", where temperatures are significantly higher than in surrounding rural areas due to heat-retaining materials and reduced vegetation cover (Ackley et al. 2015; Kolbe et al. 2016). This altered microclimate can influence reptile basking behaviours, abundance, growth rates, and reproductive success, while also increasing mortality risks due to higher predation rates by domestic animals and road traffic (Simbula et al. 2019; De Andrade 2020; Putman and Tippie2020). Previous studies have shown that the diversity and abundance of reptile species in urban environments are closely linked to the extent and configuration of green cover, with larger, irregularly shaped patches supporting greater biodiversity (Vignoli et al. 2009; Smolensky and Fitzgerald 2011; Ackley et al. 2015; Kolbe et al. 2016; Brum et al. 2023). Moreover, microhabitat preferences among species influence their spatial distribution within the cities, reflecting a combination of ecological requirements and interspecific interactions (Capula et al. 1993; Simbula et al. 2019).

Rome (Italy) is among the oldest continuously inhabited cities in the world, with the first urbanization processes dating back to at least the 9th and 5th century BC (Attema et al. 2014; Fulminante 2014). Rome's municipal territory spans 1285 km^2 and stands out as one of the greenest European urban areas, with more than 60% of its land covered by green spaces, including public gardens and woodlands — half of which are designated as protected areas (Blasi et al. 2001; Celesti Grapow et al. 2006). A significant portion of these green spaces comprises remnants of larger natural habitats that predate urban expansion or originated as estates belonging to the Roman nobility (Celesti Grapow 1995; Bologna et al. 2003; Vignoli et al. 2009). Moreover, Rome lies inside the Mediterranean basin, a well-known biodiversity hotspot with a unique and diverse herpetofauna (Myers et al. 2000). The present study aims to investigate the influence of environmental factors (natural and anthropogenic) on the abundance and distribution of two lizards and a gecko within Rome's urban landscape. Specifically, this study will test (1) how the presence of urban reptiles is influenced by the green cover inside the city, (2) how land cover and urban/landscape factors shape the relative abundance of the target species, and (3) how different reptile species influence the abundance of each other. We expect more generalist species to be less affected by urbanization and by the presence of other potentially competitor species. Moreover, different vegetation types are expected to influence reptile abundance differently, accordingly to each species ecology and needs. By examining these relationships, this research seeks to uncover how urban environments impact reptile communities. Additionally, assessing potential interspecific interactions would be helpful to understand how coexistence and competition might further modulate species distributions inside a city.

Materials and methods

The study focuses on three very common and easy to observe reptile species: the Italian wall lizard (*Podarcis siculus*), the common wall lizard (*P. muralis*), and the Moorish gecko (*Tarentola mauritanica*) (Fig. 1). Both *Podarcis* species are among the two most common reptiles in Italian cities (Corti et al. 2011) but, despite often occurring in sympatry, they show some significant ecological differences: *P. siculus* is usually more generalist and thermophilic, while *P. muralis* tends to occupy shadier and wetter environments but still thrives in urban areas, and it is often found living in wall cavities (Corti et al. 2011; Biaggini et al. 2011). For *T. mauritanica*, recent studies suggested the presence of two divergent diurnal and nocturnal lineages (Fulgione et al. 2019, 2025). In this study (and hereafter), we focused on individuals observed during daytime surveys, since the sampling activity took place during daylight and the two *Podarcis* species are exclusively diurnal.

The study area lies entirely inside the metropolitan area of Rome (Italy) and it consists of 36 square plots. We selected nine areas of 1 km^2 and, for each of them, four square plots of 100×100 m were chosen. The four square plots were selected based on their accessibility and the presence of green cover (see Table 1 for detailed definitions of variables), with aim to represent all the levels of variability found in the city of Rome (green cover ranging from 9 to

Fig. 1 The three reptile species included in this study: (**A**) *Podarcis siculus*, (**B**) *P. muralis*, (**C**) *Tarentola mauritanica*. Pictures by F. Gallozzi, all rights reserved

Table 1 List of the variables collected for each plot during this study

Variable	Description
Tree cover	Percentage of the plot area covered by trees.
Bush cover	Percentage of the plot area covered by shrubs (woody plants < 2 m, branched at the base).
Meadow cover	Percentage of the plot area covered by meadows, grass and other herbaceous plants.
Number of fountains	Number of water fountains present within the plot.
Impervious soil	Percentage of the plot area covered by impermeable surfaces (e.g., asphalt roads, infrastructure).
Bare soil	Percentage of the plot area covered by unvegetated permeable bare soil (e.g., dirt roads, unpaved parking lots).
Number of garbage cans	Number of medium and large garbage cans present within the plot.
Green cover	Percentage of the plot area covered by trees, shrubs, and grass.
Non-vegetated cover	Percentage of the plot area covered by bare soil and impermeable surfaces.
Distance from nearest body of water	Distance in meters from the center of the plot to the nearest body of water.

99%). The location of the 9 areas and the plots inside them is shown in Fig. 2.

Field surveys took place between April and October 2023 with a break from the end of July to September due to the extreme heat resulting in reduced reptile activity. These periods correspond to the peak activity of reptiles, and under similar temperature conditions (approximately 25–30 °C). The months selected for the study were chosen because they generally present similar climatic and thermal conditions in the study area, minimizing potential seasonal bias. Sampling was performed using time-constrained visual encounter surveys (Heyer et al. 1994; Montgomery et al. 2021; Barkmann et al. 2023; Ávalos-Hernandez et al. 2024). For each plot, the number of adult individuals for each species was recorded by a single observer during a 30-minute observation. To avoid double counts, a one-way direction was followed along a path throughout the entire the plot. Surveys were conducted along haphazard sampling paths within each study area. The starting point was always selected along the perimeter of each plot, depending on accessibility features. From there, the sampling route was

Fig. 2 Location of the nine 1 km^2 areas (empty squares in red) inside Rome urban area and of the four plots inside each of them (small red squares). Green cover is highlighted in dark green

designed to minimize the likelihood of repeated sampling by first covering approximately half of the plot perimeter and then gradually moving toward the inner portion of the plot. The subsequent route followed accessible paths determined by the urban structure (e.g., streets and buildings). Each plot was visited four times on different days and times to ensure temporal replication. The observer followed the same survey path and walked in the same direction during each visit. We aimed to ensure two morning surveys (08h00-11h00) and two afternoon surveys (16h00-19h00) for each plot. Additionally, an effort was made to visit each plot twice during the April–June period and twice during the September–October period whenever possible (see Supplementary Materials for detailed sampling dates). Therefore, the combination of consistent daily timing and relatively homogeneous temperature across months ensured that the surveys were carried out under comparable environmental conditions.

The majority of the individuals observed were basking and therefore fully exposed. Consequently, the presence of urban obstacles (e.g., walls, buildings) was unlikely to strongly affect detectability of reptiles across the different plots, even though some obstacle-related variation among the plots remained possible. This allowed us to obtain four abundance values for each species in each plot. Urban factors like the number of fountains and garbage cans found in each plot was also recorded during field work, while landscape factors and land cover data were obtained through remote sensing in QGis using the HCMGIS plugin and validated during fieldwork. A detailed description of each variable is provided in Table 1.

The obtained dataset composed of species abundance and environmental variables was imported in R (R Core Team 2021), where all statistical analyses were performed. To test if the percentage of green cover had a statistically significant effect on the presence of the three reptile species, a Wilcoxon-Mann-Whitney test was run (function *wilcox.test*, package *stats*) for all species presence and cases of syntopy. Subsequently, a Pearson correlation matrix (function *corrplot*, package *corrplot*) was built among all the urban, landscape and land cover variables collected inside the 36 plots. When a pair of variables showed $r > 0.75$, one of them was removed and not included in the models. Then, all values, including relative abundance of all the three species, were log-transformed to standardize the dataset. After that, a linear mixed model (LMM) for each species was built (function *lmer*, package *lmerTest*) to understand the relationships between the relative abundances of the three studied species, land cover, urban and landscape factors and including the different plots and visiting dates as random factors. Specifically, for each species, the following formula was adopted: *Abundance species1 ~ Tree cover + Meadow cover + Bush cover + Bare soil + N garbage cans + N fountains + Distance from nearest body of water + Abundance species2 + Abundance species3 + (1 | plot ID) + (1 | date)*.

Model assumptions were assessed by inspecting simulated residuals using the DHARMa package. Additionally, we tested whether the observed relationships could arise by chance by comparing the fitted model with 1000 null models obtained by randomly permuting the abundance values among plots. Then, we compared the null models to the fitted models by using the Akaike Information Criterion (AIC). Significantly lower AIC values in the fitted models indicate that the detected relationships are unlikely to result from random patterns.

Results

Across the 36 plots selected within the municipality of Rome, we recorded a total of 1309 sightings of the three target species: 983 of *P. siculus*, 189 of *P. muralis*, 137 of *T. mauritanica*; *P. siculus* was by far the most common species and observed in 32 plots (88.9%), *T. mauritanica* was recorded in 25 plots (69.4%) and *P. muralis* was sighted in 20 plots (55.6%). Specifically, *P. siculus* was observed in a wide range of green cover percentage, meaning from the most urbanized plots to the more natural ones. On the other hand, *P. muralis* and *T. mauritanica* were more commonly found in plots with green cover greater than 50%.

It is also worth noting that in several cases, the presence of more than one species was recorded in the same plot. In 19 plots, *P. muralis* and *P. siculus* were found in syntopy, corresponding to 52.8% of the total; *P. siculus* and *T. mauritanica* in 24 plots (66.7%); *P. muralis* and *T. mauritanica* in 16 plots (44.4%); finally, all three species were observed in syntopy in 15 plots (41.67%).

According to the Wilcox-Mann-Whitney test, *P. muralis* was the only species whose presence was significantly positively influenced by the green cover ($W = 81$, p-value $= 0.011$). Anyway, the same trend emerged for *P. siculus* ($W = 28$, p-value $= 0.073$) and *T. mauritanica* ($W = 87$, p-value $= 0.086$) as well (Fig. 3). Moreover, the green cover had a positive effect on all the types of syntopy, with statistically significant relationships (Fig. 3).

According to the Pearson correlation matrix, green cover, non-vegetated cover and impervious soil showed $r > 0.75$ with at least another variable in our dataset (see Supplementary Materials for details). Therefore, they were excluded from the LMMs.

All fitted models showed substantially lower AIC values than the corresponding null models, with ΔAIC values of 83.95 for *P. muralis*, 103.77 for *P. siculus*, and 29.12 for *T. mauritanica*. Simulated residual diagnostics did not indicate significant deviations from model assumptions. All the outputs of the models are reported in Table 2.

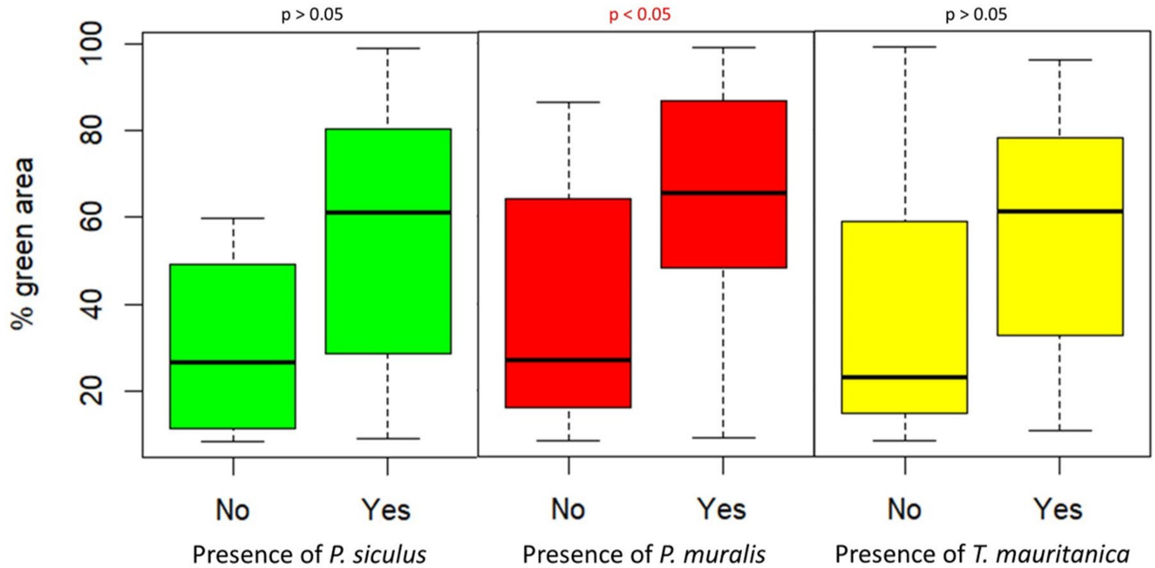
For *P. siculus*, abundance was positively associated with tree cover and meadow cover, both of which showed significant positive effects. None of the other land cover variables were significant predictors. In contrast, the abundance of *P. muralis* was significantly influenced by several land cover and urban factors. Tree cover, meadow cover, the number of garbage cans, the number of fountains were all positively associated with its abundance, while bush cover and bare soil showed significant negative effects. Finally, the abundance of *T. mauritanica* was significantly and positively related to bush cover while no significant relationships were detected with the remaining land cover and urban variables.

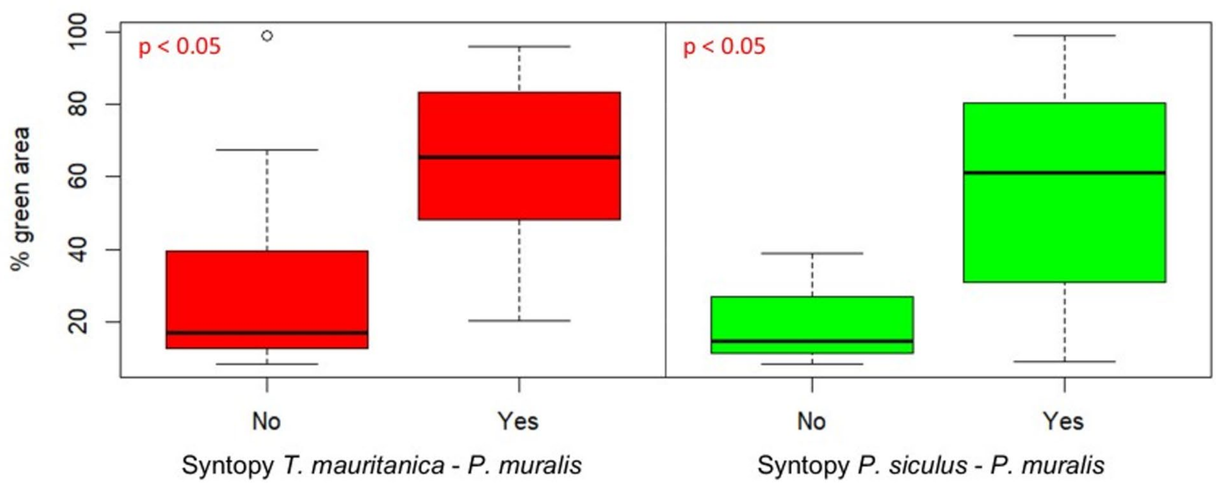
Regarding species interactions, a weak (p-value < 0.1) negative relationship was observed between the abundances of *P. muralis* and *P. siculus* respectively, while *T. mauritanica* showed a non-significant but positive relationship with both *P. siculus* and a significant positive relationship with *P. muralis*. Graphs showing the regressions fitted by the LMMs are shown in Fig. 4.

Discussion

Reptile communities in the city of Rome have already been investigated in several studies (Capula et al. 1993; Vignoli et al. 2009; Simbula et al. 2019), some of which also considered the three species examined here. However, these previous studies are mainly centred on size and shape of green areas (Vignoli et al. 2009) or are based on a restricted geographical scale (i.e., a single locality Capula et al. 1993; Simbula et al. 2019). Therefore, this research presents a complementary approach to previous works, focusing on a large area of the Rome metropolitan area that also includes highly urbanized spots. It also incorporates variables not considered in earlier works, such as anthropogenic factors and vegetation types.

The Italian wall lizard *P. siculus* was the most common reptile species in the metropolitan area of Rome. This


p > 0.05
p < 0.05
p > 0.05
% green area
100
80
60
40
20
No
Yes
No
Yes
No
Yes
Presence of P. siculus
Presence of P. muralis
Presence of T. mauritanica


p < 0.05
p < 0.05
% green area
100
80
60
40
20
No
Yes
No
Yes
Syntopy T. mauritanica - P. muralis
Syntopy P. siculus - P. muralis

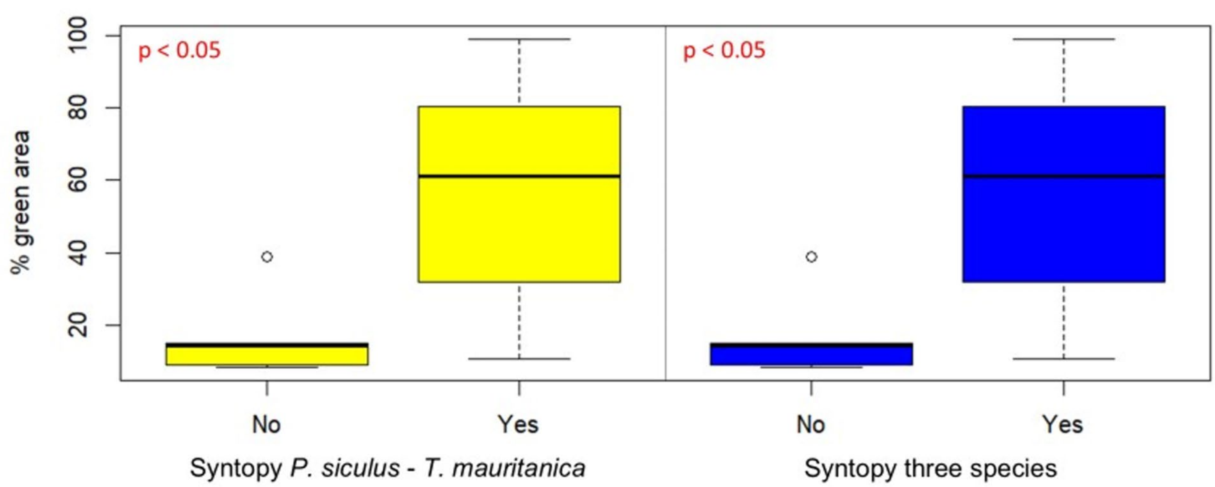

p < 0.05
p < 0.05
% green area
100
80
60
40
20
No
Yes
No
Yes
Syntopy P. siculus - T. mauritanica
Syntopy three species

Fig. 3 Boxplots representing the variation of green cover among the plots in relation to the presence/absence of the three studied species and the syntopy of two or more species in the same plot. Significant p-values are in red

species was not found in four plots only, with very diverse values of green cover (8.42%, 14.55%, 39.12%, 59.78%). The absence of *P. siculus* in the two plots with low green cover (8.42%, 14.55%) can be explained by scarcity of suitable habitat, further confirmed by the statistically significant correlation with tree and meadow cover. As reported in Capula et al. (1993) and Piccoli et al. (2019), a higher number of individuals of this species are usually observed in grassland areas and open fields. This species' preference for open grassy areas is likely due to its physiological need to maintain a higher body temperature compared to other lacertid species like *P. muralis* (Avery 1978). On the other hand, for the two plots showing higher green cover (39.12%, 59.78%), the observed high abundance of *P. muralis* in the same area represents a more likely explanation, since the abundances of these two species showed a negative relationship with each other, even though not statistically significant (p-value <0.1).

The common wall lizard *P. muralis* is well known for preferring highly vegetated areas with abundant trees (Biaggini et al. 2011). Correspondingly, significant correlation was found between tree cover and this species abundance, in accordance with what has been reported in other studies conducted in non-urban contexts (Romano et al.2022). This species was also the only one whose abundance was affected by water availability, in relation to the number of fountains. This is likely related to the urban context, where impermeable surfaces limit water infiltration while promoting the formation of small water pools that may sustain lizard populations despite the absence of permanent water bodies. However, since a positive trend was observed exclusively for a single species, this seems to be a species-specific factor in reptiles, unlike what has been observed in some groups of urban mammals in which this effect appears to be more general (e.g., bats; Ancillotto et al. 2025). The negative relationship between the abundance of *P. muralis* and that of *P. siculus*, an urban-adapted and more generalist species, is probably explained by the fact that this lizard may be able to competitively exclude *P. muralis* in anthropic disturbed areas, even with high tree covers. This hypothesis

Table 2 Mixed model results for *P. muralis* (**A**), *P. siculus* (**B**) and *T. mauritanica* (**C**). Significant relationships are marked by asterisks

A)*Podarcis siculus*	Estimate	Std. Error	df	t value	p-value
Tree cover	0.33241	0.11322	133.05060	2.936	0.00392 *
Meadow cover	0.32537	0.09785	129.89806	3.325	0.00115 *
Bush cover	-0.08206	0.17399	131.93313	-0.472	0.63795
Bare soil	-0.07386	0.09482	133.62538	-0.779	0.43739
N garbage cans	0.13844	0.09833	130.27729	1.408	0.16156
Podarcis muralis	-0.18682	0.11236	131.26120	-1.663	0.09874
Tarentola mauritanica	0.18520	0.11030	129.30315	1.679	0.09555
N fountains	0.27462	0.19491	133.99520	1.409	0.16117
Distance from nearest body of water	0.03443	0.09735	119.98387	0.354	0.72423
B)*Podarcis muralis*	Estimate	Std. Error	df	t value	p-value
Tree cover	0.19233	0.08567	120.60090	2.245	0.026590 *
Meadow cover	0.46424	0.06542	119.96071	7.096	9.72e-11 *
Bush cover	-0.38355	0.12563	119.28728	-3.053	0.002794 *
Bare soil	-0.22394	0.06837	119.67382	-3.275	0.001381 *
N garbage cans	0.25327	0.07137	120.91668	3.549	0.000552 *
Podarcis siculus	-0.11203	0.06452	131.11461	-1.736	0.084848
Tarentola mauritanica	0.22912	0.08133	126.67821	2.817	0.005623 *
N fountains	0.53495	0.13924	113.59392	3.842	0.000202 *
Distance from nearest body of water	0.10737	0.07384	130.67319	1.454	0.148283
C)*Tarentola mauritanica*	Estimate	Std. Error	df	t value	p-value
Tree cover	0.05716	0.08618	103.84380	0.663	0.50860
Meadow cover	-0.04230	0.07244	90.59165	-0.584	0.56074
Bush cover	0.41214	0.12716	114.81110	3.241	0.00156 *
Bare soil	0.06942	0.06957	105.17749	0.998	0.32064
N garbage cans	-0.10635	0.06831	73.56222	-1.557	0.12382
Podarcis siculus	0.10080	0.06144	85.03945	1.641	0.10459
Podarcis muralis	0.16836	0.07721	67.13258	2.181	0.03272 *
N fountains	-0.05346	0.14010	75.17678	-0.382	0.70386
Distance from nearest body of water	-0.04296	0.06127	26.92468	-0.701	0.48930

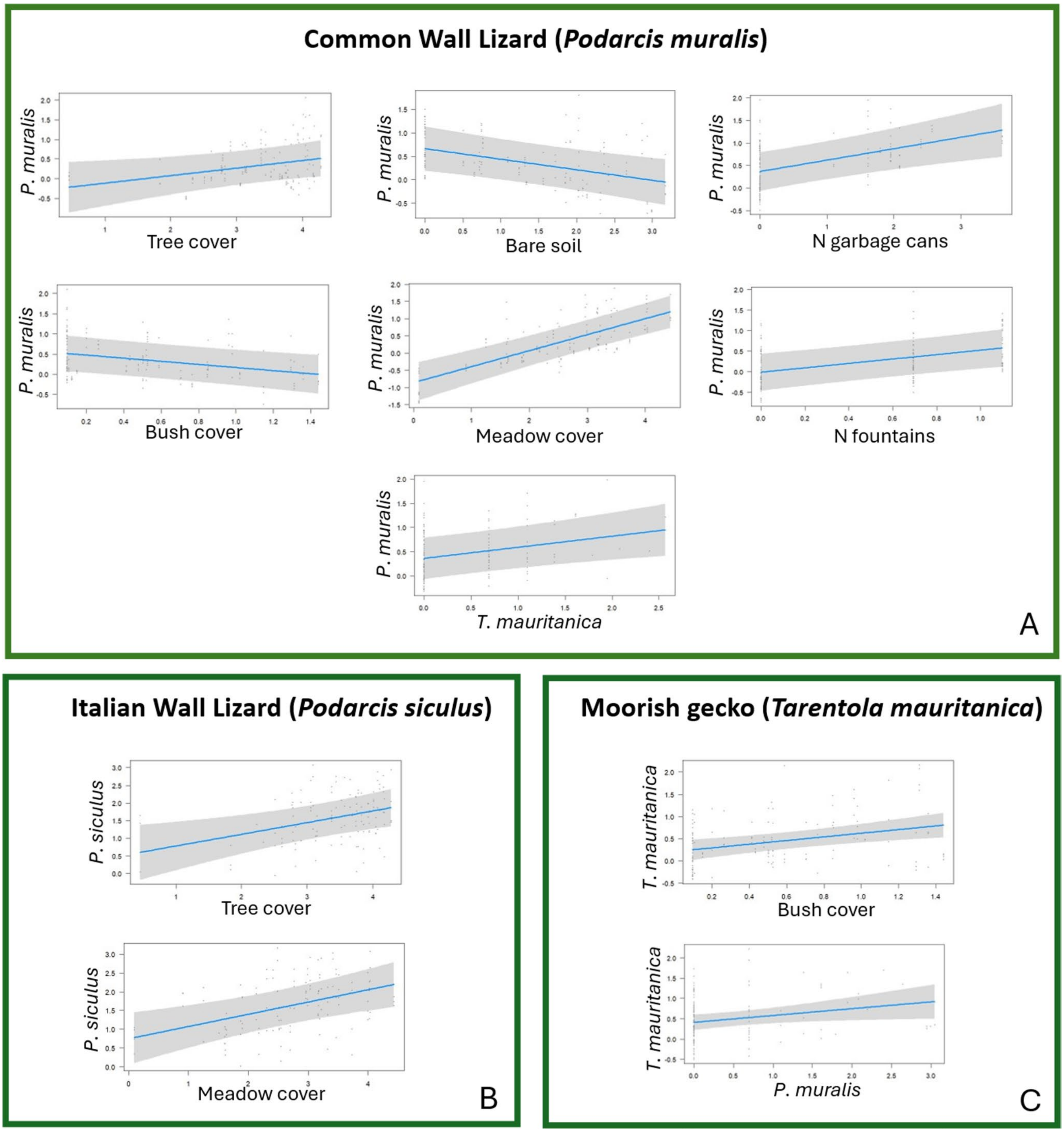


Fig. 4 Linear regressions from the LMMs. Each corresponds to a different species (**A**): *P. muralis*; (**B**): *P. siculus*, (**C**): *T. mauritanica*). Only statistically significant relationships are shown

is further confirmed by the fact that *P. muralis* abundance had statistically supported relationships with most of the variables included in our study, while *P. siculus* seemed to be more generalist and only partially influenced by them. However, given the limited geographical scale of our study if compared to the wide extent of sympatry of these two species in Italy, further investigation is probably needed to be conclusive on this point. Interestingly, *P. muralis* also showed a surprising positive relationship with garbage cans. To date, no studies have directly correlated the abundance of lacertid species with the number of garbage bins, but a similar increase in certain reptile taxa has been observed in relation to the presence of landfills (Plaza and Lambertucci 2017). In the context of the city of Rome, garbage bins often fail to keep their contents sealed inside (authors' personal observation). Various factors — such as poor maintenance, insufficient capacity, etc. — lead to waste spilling out and accumulating outside. It is therefore plausible that garbage bins may act as small-scale landfills, having a positive effect on the abundance of this lizard due to the presence of organic material that can either be directly consumed or attract small invertebrates, which can be preyed upon by the species. As a matter of fact, the ability to adapt to a high variety of food and even to exploit anthropogenic resources is a well-documented phenomenon in other *Podarcis* species, like *P. siculus* (Mačát et al. 2015; Mo and Mo 2021; Valerioti and Sperone 2024). Surprisingly, in our case, the relationship between *P. siculus* abundance and the number of garbage cans was not significant (p-value > 0.1) but still positive. Therefore, the abundance and distribution of *Podarcis* lizards inside cities can be the result of a combination of interspecific interactions, urban and vegetation factors.

The abundance of *T. mauritanica* had a positive statistically significant relationship with bush cover. The result would seem to contrast with the literature, as *T. mauritanica* is considered a highly abundant species near predominantly anthropic structures such as buildings, house walls, or near archaeological sites (Luiselli and Capizzi 1999; Piccoli et al. 2019; Simbula et al. 2019). This may indicate that the species could perform as well exploiting anthropic structures as exploiting bush cover. However, further investigation may reveal possible differences in habitat choice between the diurnal subpopulation studied here and the nocturnal one, thus explaining this discrepancy. Another significant positive relationship emerged with the abundance of *P. muralis*, which probably reflects some similarities in habitat choice between the two species with very limited or no competition. Accordingly, as already observed in an archaeological park in Rome, lizards and geckos can be abundant also when they live in syntopy, thanks to spatial and temporal partitioning of the available resources (Simbula et al. 2019).

Overall, our results suggest that the relative abundance of reptiles inside the city of Rome is influenced by specific vegetation types and species interaction. Otherwise, landscape and other urban factors influence minimally species abundances, since they were statistically significant in only one case (i.e., *P. muralis*). As a matter of fact, *P. siculus* and *T. mauritanica*, exhibit a generalist ecological strategy, with their abundance being influenced by relatively few environmental variables. In contrast, *P. muralis* was associated with a wider range of predictors and was the only species whose abundance was related to water availability. This pattern may reflect more specific ecological requirements or a greater sensitivity to local habitat conditions compared with the other two species. However, from a more general point of view, the percentage of green cover seemed to be the main determinant for the presence of all the three reptile species in the plots. Similarly, syntopy of species was more frequent in plots with higher green cover, particularly in those where green cover exceeded 50%, where two or three of the studied species were commonly recorded. This is likely because the high vegetation cover within the sampled areas allows for the presence of more ecological niches that can be occupied by more taxa, thanks to high environmental heterogeneity (Vignoli et al. 2009; Piccoli et al. 2019; Simbula et al. 2019). This result is coherent with previous studies, that highlighted how vegetation cover and natural patches size are the main drivers in determining the status of reptile communities in urbanized areas (Vignoli et al. 2009; Mulhall et al. 2022). However, further research is probably needed to evaluate more detailed aspects of reptiles living in syntopy in urban landscapes (e.g., interaction between species, spatial partitioning, etc.).

This work extends the spatial scale of investigation to the entire metropolitan area of Rome, and provides insights into how the studied species adapt to increasingly urbanized habitats. Our findings confirm the central role of different vegetation types in sustaining reptile communities, while also highlighting the importance of species interactions in shaping abundance patterns. Specifically, considering the overall situation, it appears evident that the extent of green cover favors the occurrence of the studied species. However, when looking at their abundances, tree cover and meadow cover significantly influenced the two *Podarcis* species while shrubs cover played a species-specific role for *T. mauritanica*. All this knowledge will inform conservation strategies aimed at enhancing urban biodiversity and ensuring the persistence of reptile populations within metropolitan landscapes.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11252-026-02079-0.

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Data availability No datasets were generated or analysed during the current study.

Declarations

Competing interests The authors declare no competing interests.

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