The Monks go to the countryside: nest density and host tree characteristics of a new suburban colony of non-native Monk parakeet (*Myiopsitta monachus*)

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Abstract - Non-native Monk parakeets (*Myiopsitta monachus*) are invasive birds widely distributed in European urban parks and gardens. In recent years this species has also begun to expand into suburban areas, representing a threat due to the impact it can have on agro-ecosystems. Therefore, understanding the density and distribution of nesting sites, as well as the structural characteristics of both the nests and their host trees, is crucial. In this study, we surveyed all Monk parakeet's nests in a small town, in the suburban area of Rome (central Italy), where this species has colonized the site in the last 5-7 years. Our data supports previous findings on nest tree selection in Monk parakeets, while also providing new insights. We recorded 49 colonial nests on trees belonging to 2 ornamental species: *Cedrus libani* (n=36) and *Yucca* sp. (n=13; first record for Italy on this taxon as host tree), observing different patterns in nest location on these host trees, due to extremely different plant architecture. In both the tree species, the mean neighbouring distance among nests trees was significantly lower when compared to the distance among all the suitable trees suggesting a role of predators in explain this spatial pattern. Our findings, combined with citizen science data, could contribute to more effective management and control strategies in these sites of recent colonization.

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Riassunto - I monaci vanno in campagna: densità dei nidi e caratteristiche degli alberi ospiti di una nuova colonia suburbana di parrocchetti monaci alloctoni (*Myiopsitta monachus*).

Il parrocchetto monaco (*Myiopsitta monachus*) è specie alloctona, ampiamente distribuita nei parchi e nei giardini urbani europei. Negli ultimi anni, questa specie ha iniziato a espandersi anche nelle aree suburbane, rappresentando una minaccia per l'impatto che può avere sugli agroecosistemi. Pertanto, è fondamentale comprendere la densità e la distribuzione dei siti di nidificazione, nonché le caratteristiche strutturali sia dei nidi che degli alberi ospiti, in siti di recente colonizzazione. In questo studio, abbiamo esaminato tutti i nidi di questa specie in un piccolo centro suburbano collocato a 40 km da Roma (Italia centrale), colonizzato negli ultimi 5-7 anni. I nostri dati supportano precedenti risultati sulla selezione degli alberi che ospitano nidi dei parrocchetti monaci, fornendo al contempo nuove informazioni. Abbiamo registrato 49 nidi coloniali su alberi appartenenti a 2 specie ornamentali: *Cedrus libani* (n=36) e *Yucca* sp. (n=13; prima segnalazione in Italia per questo taxon come albero ospite), osservando diverse modalità di collocazione dei nidi sugli alberi ospiti, a causa della loro differente struttura e portamento. In entrambe le specie arboree, la distanza media tra gli alberi ospiti limitrofi è risultata significativamente inferiore rispetto alla distanza tra tutti gli alberi idonei (compresi i controlli), il che suggerisce un ruolo dei predatori nella spiegazione di questo schema spaziale. I nostri dati, uniti ad altri potenzialmente ottenibili con la partecipazione dei cittadini, potrebbero contribuire a definire strategie di controllo di questa specie in siti di recente colonizzazione.

Parole chiave: altezza dei nidi, *Cedrus libani*, densità dei nidi, dimensioni degli alberi, scienza dei cittadini, specie non autoctone, *Yucca* sp.

INTRODUCTION

The Monk parakeet (*Myiopsitta monachus*) is a parrot species in the family *Psittacidae*, native to South America where it inhabits riparian forests, ecotones, savannahs and synanthropic environments (Menchetti & Mori, 2014; Avery & Shiels, 2017). This bird is one of the most widely introduced parrot species in Europe and is listed among the world's most invasive bird species (Keller *et al*., 2011).

In non-native range it constructs large communal nests in mature (often ornamental) trees (Postigo *et al*., 2021), primarily *Cedrus libani*, *Eucalyptus* spp., and

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palms (*Washingtonia* spp., *Phoenix* spp.: Di Santo *et al*., 2017b; Battisti & Cerfolli, 2022; Battisti *et al*., 2026), consisting of multiple nest chambers, occupied by different pairs, also in non-breeding periods (Burger & Gochfeld, 2005; Romero *et al*., 2015; Battisti & Fanelli, 2021). The selection toward mature trees is known also for the native range (e.g., Romero *et al*., 2015). The Monk parakeet is, also, a generalist and an opportunistic feeder with high behavioural flexibility and herbivorous diet (Postigo *et al*., 2021; Battisti & Fanelli, 2022).

In Europe, the impact of the Monk parakeet remains relatively limited, because most individuals are, still, concentrated in urban areas, where they primarily forage in parks and gardens (Strubbe & Matthysen, 2009; Di Santo *et al*., 2013; Mori *et al*., 2013; Senar *et al*., 2016). However, in recent years, studies have shown that the species has begun to expand into suburban and extra-urban agricultural areas (MacGregor-Fors *et al.,* 2011; Castro *et al*., 2022; Hernández-Brito *et al*., 2020). This spread from urban parks into adjacent farmland raises economic concerns, as it may negatively affect croplands and orchards of commercial importance, potentially causing significant economic damage in non-native regions. In Italy, Monk parakeets have already been observed in farmland bordering several major cities (Biondi *et al*., 2005; Battisti, 2019; Battisti & Cerfolli, 2022; Lardelli *et al*., 2022).

In Rome (central Italy), the Monk parakeet is widely distributed across historical urban parks and their immediate surroundings (Taffon *et al*., 2008; Zocchi *et al*., 2008; Brunelli *et al*., 2011; Di Santo *et al*., 2013; 2017a; 2017b; Battisti *et al.,* 2026), but studies in neighbouring suburban areas are still scanty (e.g., Battisti, 2019; Battisti & Cerfolli, 2022). Although the species' impact in urban parks is generally limited to altering the structure of ornamental vegetation, primarily through the cutting of branches from various shrub species for nest construction (Battisti & Fanelli, 2021), the study of nesting ecology remains essential, as it often serves as a starting point to define control strategies (Postigo *et al*., 2017; Blanco-González *et al*., 2025). Indeed, effective implementation of such measures requires detailed knowledge of nest density, spatial distribution and structural characteristics of both nests and their host trees.

In this regard, although the nesting behaviour and ecology of this species have been widely analyzed (e.g., Pranty, 2009; Volpe & Aramburú, 2011; Avery *et al*., 2012; Burgio *et al*., 2014; Reed *et al*., 2014; Romero *et al*., 2015; Di Santo *et al*., 2017a; 2017b), studies on density and structural placement of nests and host trees, in recently colonized suburban areas, are limited. Therefore, the aims of the study are: (i) to identify the spatial distribution and density of Monk parakeet (*Myiopsitta monachus*) nests in a small suburban, recently colonized, town; (ii) to assess the structural characteristics and location of nesting trees used by the species, focusing on tree species preference and nest architecture. Our data could provide insight for future management strategies aimed at controlling the spread of Monk parakeet populations in non-native areas.

MATERIALS AND METHODS

Study area

The study area is located in Marina di Cerveteri (Lat. 4652099.932, Long. 752850.593), a small residential town situated 40 km from Rome (Fig. 1) where Monk parakeets were first observed in 2018-2020 (Ortica Web, 2020). All the study area is characterized by dense settlements (1-2 level homes) with surrounding isolated trees along roads and private gardens with spot occurrences of ornamental trees (mainly cedars, *Cedrus libani*; yuccas, *Yucca* sp., but also *Eucalyptus* sp.; holm oaks, *Quercus ilex*; pines, *Pinus pinea*, *P. pinaster*; poplars, *Populus* sp. and other species). The survey was conducted between June and July 2025. Transects were systematically established to comprehensively cover all the study area, enabling the identification and recording of Monk parakeet colonial nests and related hosting trees.

Data sampling

"Nests" were defined as complex structures, comprising multiple chambers hosting different nesting pairs, actively constructed by parakeets using mainly twigs and branches. Identification relied on visual observations and the detection of vocalizations emitted near nesting sites (Martella *&* Bucher, 1990). For detectability reasons, we were unable to count the number of hole's chambers (and breeding pairs) for each nest structure (however, always >2-4).

We walked the entire study area following all the roads and noting the presence of mature trees and, among these, host trees. Because we observed that only cedar and yucca trees hosted monk parakeet nests, we focused only on these species (for both host and control trees). Once a nest was located, its geographical coordinates were recorded using an E-Garmin GPS device, and the species of the supporting tree (hereafter referred to as the "host tree") was recorded.

Nest density, in all the study area, was calculated by dividing the number of nests detected by the total area of the town, expressed as nests per hectare. More particularly, (i) the area of Marina di Cerveteri was calculated using the software QGIS version 3.34 (resolution of satellite image: lat.: 0.0000667 /pixel; 0.2sec/px; long.: 0.0000898 /pixel; 0.3sec/px); (ii) two different nest densities were calculated using the nest numbers/total area ratio and the nest number/vegetated area ratio. Nest density was calculated within the entire area (136.8 ha) and the vegetated subarea (27.8 ha). To calculate the size of vegetated subarea we used the NDVI (Normalized Difference Vegetation Index) approach, being the NDVI as an index linking vegetation to animal performance, derived from the red: near-infrared reflectance ratio (Pettorelli *et al*., 2005).

The surface covered by vegetation was calculated via NDVI, obtained using the following formula:

$$\frac{(NIR-RED)}{(NIR+RED)}$$

that considers the near-IR (NIR) and red (RED) reflectance (Pettorelli *et al*., 2005; Filgueiras *et al*., 2019).

Subsequently, the area covered by vegetation was found through QGIS (version 3.34), considering the NDVI values in the range 0.5-1. We calculated also the subarea of tree vegetated area using a threshold of NDVI value ≥ 0.66 (Yang *et al.*, 2019) obtaining a size area of 8.6 ha. Three different nest densities (in n. nests/ha) were calculated: nests/total area, nests/vegetated area, and nests/tree vegetated area.

For each nest, the following measurements and average values (and standard deviation, s.d.) were recorded: (i) tree diameter at breast height (DBH), measured at 1.40 m from the ground, in centimeters: if the host tree trunk splits into multiple stems at a height less than the breast height, as typical in some ornamental species (as, for example, *Yucca* sp.). We considered each stem as a 'host tree'. Since each sucker, at its apex, can constitute a potential and independent support for nesting, the observed nests were assigned to the corresponding suckers and not treated as multiple nests on a single plant. This approach prevents underestimation of the actual number of structures used by Monk parakeets for nesting and ensures greater consistency with the real distribution of nesting sites in the field; (ii) nest height (in meters); (iii) horizontal distance from the nest to the tree trunk (in meters); (iv) nest structural type, categorized into two predefined classes: OH (Open Hand): nests positioned on multiple third- and fourth-order branches with a predominantly horizontal orientation, and CR (Crown): nests located near the main trunk at the apex of the tree canopy (see structural categorization methods in Zocchi *et al*., 2004). Additionally, the number of nests per host tree and the nest height/tree height ratio were recorded (range: 0-1).

For the host trees, we measured DBH and total height and related averaged values and standard deviations (s.d.). In some cases, for both nest and host trees, it was not possible to have direct contact and the measurements were carried out remotely using a range finder.

Additionally, we recorded trees (of the same tree species used by parakeets for nesting) without nests, serving as 'control trees'. For these control trees, both diameter (in cm) and height (in m) were measured, and corresponding mean values with standard deviations were calculated. All the measurements were taken using a professional dendrometric caliper, a range finder and a clinometer, these last to calculate the tree heigth measuring distance and angles, then using trigonometry.

Separately for cedars and yuccas, we measured the distance of each nest tree from the neighbouring ones (including nest structures located on the same tree), calculating the mean neighbouring distance (and standard deviation) among all. We measured this distance also among all the suitable trees (both nest trees and control ones) using the QGIS software version 3.34. We compared the averaged values for both the three species. Finally, we paid attention to the presence of co-occurring species in the parakeet nests (e.g., sparrows).

Focusing on single tree species used for nesting – cedars (*Cedrus libani*) and yuccas (*Yucca* sp.; see Results section) – both univariate and bivariate statistical analyses were performed. In the univariate analysis, median values of tree diameter and height were compared between host trees and control trees using the Mann-Whitney U test. To assess the goodness of fit for diameter frequency distributions, a one-sample Kolmogorov-Smirnov test was applied. The null hypothesis assumed that the diameter distributions of both host trees and control trees followed a normal distribution.

An Ordinary Least Squares (OLS) regression analysis was carried out to examine the relations between tree height vs. nest height, and distance from the trunk vs. tree height. Bootstrapped 95% confidence intervals (N = 1999) were applied to increase robustness.

All statistical analyses were performed using PAST software (Hammer *et al*., 2001), with the significance level (α) set at 0.05.

RESULTS

We recorded 49 nests (as "complex structures hosting multiple pairs", see Methods) on 16 hosting trees belonging to two species: *Cedrus libani* (hereafter "cedar") and *Yucca* sp. (hereafter 'yucca'; Table 1; Fig. 1). Cedar was the most utilized tree species, hosting 36 nests on 9 trees (73.5% of total nests); yuccas hosted 13 nests on 7 trees (13 branches; 26.5% of total nests; Fig. 2). Considering the total number of nests (n=49), nest density value obtained for the entire area was 0.36 nests/ha, for the vegetated subarea was 1.76 nests/ha, and for tree vegetated area was 5.7 nests/ha. Since each nest hosted at least 2-4 holes (entrances to the chambers), we can roughly estimate at least 98-196 pairs in the study area.

The diameters of host trees were significantly larger than those of control trees in yuccas (host trees: 36.5±8.74 vs control trees: 26.82±20.51 cm; z=2.33; p=0.018) but not in cedars (host trees: 66.56 ±9.22 vs control trees: 60.28±14.37 cm; z=1.06; p=0.29; Mann-Whitney U test). The frequency distribution showed a significant skewness of host trees toward larger size classes in yuccas (D=0.65, p<0.01) while pattern in cedars, although skewed, was not significant (D=0.44, p=0.25; Kolmogorov-Smirnov test; Fig. 3).

Host tree species with highly different characteristics both in terms of height and structure. Therefore, in cedars, mean nest height (7.76 m±2.04), host tree height (11.72 m±1.82) and relative height (0.7±0.17) were significantly different when compared to yuccas (respectively, 5.69 m±1.33, 4.73 m±1.44, and 0.83±0.15; z=3.91, z=4.09, p<0.001, and p=0.026, z=2.23, Mann-Whitney U test). However, in both the species, the taller the host tree, the higher the nest is placed (cedars: r = 0.35, t = 2.204, p =0.034; yucca: r = 0.79, t = 4.31, p = 0.001; Ordinary Least Squares Regression).

Cedars host a significantly higher number of nests per tree (4.11 nests/tree ± 2.42; n = 9 host trees) compared to yuccas (n = 13; z=3.99, p <0.001; Mann-Whitney U test), these last hosting only one nest per branch. In cedars, nests are consistently located openly on 3rd or 4th order branches (OH structure), with a mean distance from the trunk of 4.13 m (±2.16; range: 0-8 m). Differently, in yuccas, nests are always placed near the top of the branch, inserted in the crown of the branches of the leaves (CR structure:

Table 1 - Characteristics of Monk parakeet (*Myiopsitta monachus*) nests and host trees in the study area. Top section: Nests: number of nests (and percentage, %, of the total) in the host trees, mean nest height (m ±s.d.), height range, and nest height/tree height ratio (ranging between 0 and 1, and ±s.d.). Bottom section: host trees (and percentage of the total host trees), mean tree height (m ± s.d.), mean trunk diameter (m ± s.d.), and mean number of nests per host tree (± s.d.). / Caratteristiche dei nidi e degli alberi ospiti del Parrocchetto monaco (*Myiopsitta monachus*) nell'area di studio. Sezione superiore: Nidi: numero di nidi (e percentuale, %, del totale) negli alberi ospiti, altezza media del nido (m ± d.s.), intervallo di altezza e rapporto altezza del nido/altezza dell'albero (range: 0-1, e ± d.s.). Sezione inferiore: alberi ospiti (e percentuale del totale degli alberi ospiti), altezza media dell'albero (m ± d.s.), diametro medio del tronco (m ± d.s.) e numero medio di nidi per albero ospite (± d.s.).

Nests				
Trees	N nests (% on total)	Mean nest height (±s.d.)	Nest height range	Ratio nest/tree height (±s.d.)
Cedrus libani	36 (73.46%)	7.8 (±2)	5-12 m	0.70 (±0.17)
Yucca sp.	13 (26.53%)	4.7 (±1.4)	3-7 m	0.83 (±0.15)
Tot	49			
Host trees				
Trees	N trees (% on total)	Mean tree height (±s.d.)	Mean diameter (±s.d.)	Mean N nests/trees (±s.d.)
Cedrus libani	9 (56.25)	11.7 (±1.8)	66.56 (±9.22)	0.41 (±0.24)
Yucca sp.	7 (43.75; 13 branches)	5.7 (±1.3)	36.5 (±8.39)	1 (±0)
Tot	16			



Fig. 1 - Map of the study area with location of host (red points) and control (green points) trees. / Mappa dell'area di studio con la localizzazione degli alberi ospite (con nidi; punti rossi) e degli alberi controllo (punti verdi). (Source / Fonte: base map: Ortophoto from Geoportale AGEA (https://geoportale.agea.gov.it/), 2023, license CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/)).



Fig. 2 - A nest of Monk parakeet (*Myiopsitta monachus*) built on *Yucca* sp., representing the first record of this nesting behavior in Italy. / Un nido di parrocchetto monaco (*Myiopsitta monachus*) costruito su *Yucca* sp., che rappresenta la prima segnalazione di questo comportamento di nidificazione in Italia (Photo / Foto: M. Poletti).

distance from the trunk: 0.92 m±0.90; range: 0-2.5). More particularly, in cedars, the distance of the nest from the trunk is inversely related to nest height (reflecting the tree's tapering towards the top; $r = –0.67$, $t = –5.28$, $p < 0.001$; Ordinary Least Squares Regression) and the number of nests per tree does not correlate with tree size, considering both trunk diameter ($r = –0.46$, $t = –1.37$, $p = 0.21$) and tree height ($r = –0.57$, $t = –1.85$, $p = 0.11$).

In both the tree species, the mean neighbouring distance among nests trees was significantly lower when compared to the distance among all the trees (cedars: 166.55m ±89 vs. 474.45 m±403.74; U=1113.5; yuccas: 191.83m ±186.52 vs. 684.05 m±535.66; U=379,5; $p<0.01$; Mann-Whitney U test).

No other syntopic breeding species were found to be present in any nest.

DISCUSSION AND CONCLUSIONS

In this study, we present the first data on nest structure and host tree characteristics of Monk parakeets in a, recently colonized, site located in the suburban area North-West of Rome. Our findings support previous evidence on nest tree use and selection, both in the species' native range and in recently introduced areas (Pranty, 2009; Volpe & Aramburú, 2011; Avery *et al*., 2012; Burgio *et al*., 2014; Reed *et al*., 2014; Romero *et al*., 2015; Di Santo *et al*., 2017a; 2017b; Battisti *et al.,* 2026).

We recorded approximately 0.4 nests/ha considering all the urbanized areas and 1.8 nests/ha considering only the green areas, estimating a breeding population of the order of at least 100 pairs. These densities are comparable to other sites, both in urban (Barcelona: Rodrìguez-Pastor *et al*., 2012) and suburban contexts (Rome-Ostia: Battisti & Cerfolli, 2022), while they were significantly lower than those found in urban parks rich in ornamental tree species, colonized decades ago, where very high densities have been found (e.g., Rome: >13.5 nests/ha; Di Santo *et al*., 2017b). Therefore, the availability of suitable ornamental species and the time since colonization, most likely, explain the normalized number (i.e. density) of nests.

Our study confirms the use of ornamental trees for nesting (Di Santo *et al*., 2017b; Briceño *et al*., 2022), with cedars the most used species: *Cedrus libani* is a conifer introduced into cultivation in parks and gardens during colonial times (Pijut, 2000) and occurring in our study site. We also observed an use of ornamental yuccas

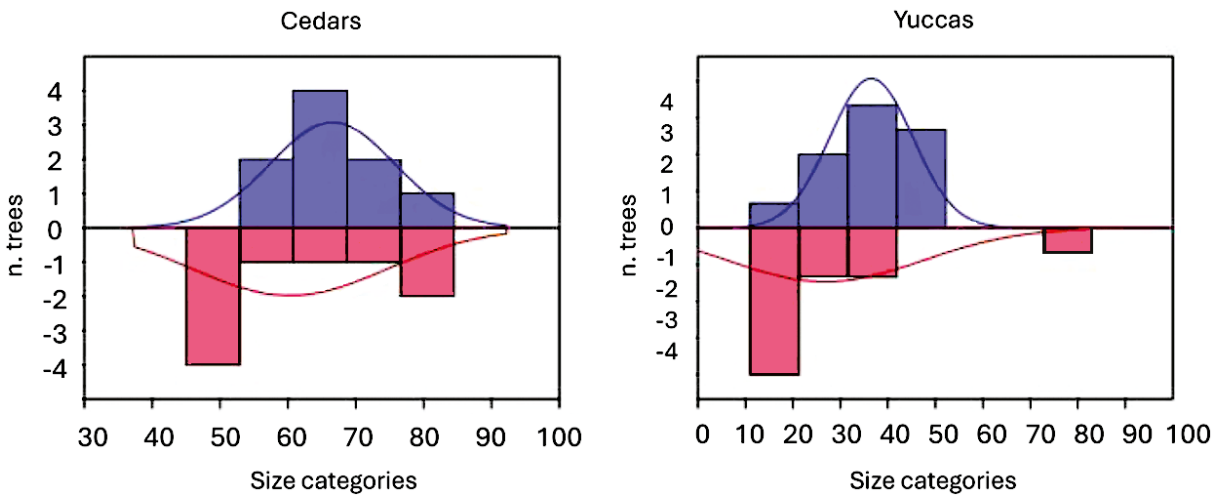

Fig. 3 - Frequency distribution of size categories (diameter at breast height, DBH, in cm; x-axis) of Monk parakeet's nests. Left: cedars: red: tree without nests (control trees); blue: with nests (host trees). Right: yuccas: red: without nests (control trees); blue: with nests (host trees). / Distribuzione di frequenza delle categorie di dimensione (diametro a petto d'uomo; DBH, in cm; asse x) dei nidi del parrocchetto monaco. Sinistra: cedri; destra: yucca (rosso: alberi controllo, senza nidi; blu: alberi ospite, con nidi).

as trees supporting nests. Monk parakeets are known to nest on this ornamental tree in non-native range of North America (Mexico: *Yucca elata*: Romero-Figueroa *et al*., 2017; *Y. filifera*: Zuria *et al*., 2017; *Yucca* sp.: Salgado-Miranda *et al*., 2016). However, to our knowledge, this is the third observation for Europe of Monk parakeets nesting on yuccas (see Sánchez & Gómez, 2013; Manzano, 2018) and the first for Italy. This plant is common in Mediterranean parks and widely used as ornamental and naturalized species in Italy (Lucchese, 2017; Caneva *et al*., 2020). However, although for naturalized Italian populations different congeneric species have been reported (*Yucca aloifolia* L., *Y. filamentosa* L., *Y. gigantea* Lem., *Y. gloriosa* L., *Y. recurvifolia* Salisb.; Portale della Flora d'Italia/Portal to the Flora of Italy, 2024+), we were unable to trace the diagnosis of the ornamental taxon used in our case study.

In yuccas, parakeets tend to select trees with larger trunk diameters. This preference results in a skewed diameter distribution, with host trees clustered in larger size classes. Larger trees offer greater stability – especially during adverse weather – and allow nests to be placed higher in the canopy, which benefits this highly gregarious species and enhances protection from predators (Senar *et al*., 2019). We did not observe a similar pattern in cedars, despite previous studies showing a preference for taller trees in colonial nesting (Calzada Preston *et al*., 2021; Battisti & Cerfolli, 2022). We believe this absence of pattern is due to the small sample (limited availability of cedars showing an uniformity in their size class distribution).

Marked differences in nest placement between the two host species reflect their contrasting structures. Cedars are tall (20-40 m), with massive trunks and wide-spreading branches (Chaney, 1993; Dirr *et al*., 1993). Their branches extend horizontally up to the 4th and 5th order, offering broad, stable surfaces where nests are typically placed in an 'open hand' position, mainly on 3rd and 4th order branches (Briceño *et al*., 2022).

This structural difference affects nest density: cedars host an average of four nests per tree, while yuccas rarely host more than one (but in this species, trees with nests were often adjacent, forming ornamental patches). Therefore, regarding the type of nest aggregation, our parakeet population could fall into the 'loose group' category: however, it will be necessary to verify in the coming years whether it can be structured as a 'dense colony' (see Senar *et al.,* 2019).

However, the higher nest number in cedars has been reported in earlier studies (e.g., Romero *et al*., 2015; Briceño *et al*., 2022) and is likely linked to their complex branching (Chaney, 1993). Yuccas, in contrast, have multiple columnar trunks of relatively uniform diameter with an apical tuft of leaves emerging from the top (Gilman, 1999). This simplicity confines nest placement to the distal part of the trunk – under the leaf crown – where nesting space is limited to the area just below the leaf attachments. This resembles nests built on palms (Burger & Gochfeld, 2005; Romero *et al*., 2015) and on poles, a phenomenon mostly documented outside Europe (Burger & Gochfeld, 2009; Burgio *et al*., 2014; Reed *et al*., 2014), where nests are also placed near the top of artificial structures.

In both tree species, nests are placed at heights around 5 (yuccas) and 8 meters (cedars) in average, and nest height positively correlates with tree height, consistent with other studies (Di Santo *et al*., 2017b; Briceño *et al*., 2022), reflecting the structural differences between these trees (Sanchez & Gomez, 2013).

Nest site selection appears to reflect a trade-off between structural features, weather exposure and predation risk. In this regard, tree architecture also explains differences in relative nest height (e.g., nest height/tree height, in %). In yuccas, nests are located near the top, just below leaf branch attachments: the camouflage it provides the stiff leaves of yuccas facing the ground can offset the effect of height. Differently, in cedars, nests are placed in the inner sectors: in this tree, relative nest height likely balances the need to distance nests from ground predators (e.g., *Rattus rattus*: Senar *et al*., 2019; *Corvus cornix*: Di Santo *et al*., 2017a) with the advantage of placing them in more sheltered inner canopy areas, which offer protection from harsh weather (e.g., heavy rain, strong winds) that can lead to nest collapse (Burger & Gochfeld, 2005). Moreover, we should take into account the weight of the nests (until to 200 kg; Caccamise, 1980): building the nest close to the trunk can guarantee greater resistance. However, in cedars, nest placement shifts closer to the trunk as tree height increases, due to their pyramidal shape, which restricts options for exposed positions higher up. Conversely, lower in the canopy, nests are often placed farther from the trunk on outer branches, possibly reflecting parakeets' preference for perching on small terminal branches (Granatosky *et al*., 2022).

We observed a mean neighbouring distance significantly higher in nest trees when compared to all the available trees, both in cedars and yuccas. This result is likely due to the need to build aggregate nests to defend the colony from potential predators (Di Santo *et al.*, 2017b).

Finally, we did not find any other nesting species in the nests, unlike what has been reported in other works (e.g., sparrows: Di Santo *et al*., 2017a): since this was a recent colonization, a behavioral adaptation process in this sense may not have started yet.

Our study focused on a suburban town recently colonized by this invasive species, which has spread from Rome over the past 10-15 years, where it is now well established (Di Santo *et al*., 2013; Battisti, 2019; Battisti *et al.,* 2026), and to a few surrounding suburban areas (Brunelli *et al*., 2011; Battisti & Cerfolli, 2022). These towns typically feature numerous urban parks, private gardens, tree-lined avenues, and scattered mature trees – including cedars, yuccas, and other suitable nesting species such as palms and eucalyptus – within a densely built environment. This fine-grained network of potential nesting sites suggests the likelihood of a growing number of active Monk parakeet nests in the near future.

Our data, combined with citizen-based surveys and GIS analyses (see Hernández-Brito *et al*., 2022) focusing on the presence of ornamental trees in urban parks and private gardens (see Isaac *et al*., 2008 for analogous

habitat suitability surveys on other bird species), could help design more effective management and control strategies, as indicated by the laws and regulations for the EU (Regulation n°1143/2014) and for Italy (Legislative decree n.230/2017), using project-based tools (Battisti, 2018; Senar *et al*., 2021). In this regard, these preliminary data already suggest the tree sectors most used by monk parakeets to build their nests in these two ornamental taxa, with indications of the average absolute and relative heights and distances from the trunk: all useful initial indications for any tree pruning or directly carried out on the nests, when necessary. Further studies should focus (i) on the breeding bird census, obtaining more precise estimates of the number of pairs, (ii) on the role of predators as predictor of the observed spatial pattern. Finally, we would like to evidence as these data (mainly nest density and spatial location) could be compared with future monitoring to analyze the pattern of expansion of this species in suburban contexts.

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