BREEDING STATUS AND NEST CHARACTERISTICS OF ROSE-RINGED (*PSITTACULA KRAMERI*) AND ALEXANDRINE PARAKEETS (*PSITTACULA EUPATRIA*) IN ISTANBUL'S CITY PARKS

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Abstract. Invasive non-native parakeet populations are increasing throughout Europe with proved negative impact on native fauna and Turkey is no exception. Rose-ringed and Alexandrine parakeets have established populations in Turkey's large cities but even basic distribution, abundance and breeding behaviour information is missing. This study aims at determining the breeding status and identifying the nest characteristics of Rose-ringed and Alexandrine parakeets in Istanbul's city parks. The study is carried out in 9 city parks during one breeding season. Data on the presence of breeding parakeet species, their nest characteristics and characteristic of suitable cavities on non-nesting trees were collected. Both species were recorded breeding sympatrically in 5 out of 9 city parks with probable breeding in one more park. When nesting, both species preferred high trees with high diameter but Rose-ringed parakeet nests were placed lower than those of Alexandrine parakeet's. Plane (*Platanus* sp.) species were the most used as a nesting tree for both species. This study reveals the first systematic observations on the breeding Rose-ringed and Alexandrine parakeet populations in Istanbul and serves as a basis for further detailed research on both species in Turkey.
Keywords: *invasive species, non-native fauna, nest selection, nest site competition, cavity nesters, environmental change*

Introduction

Invasive non-native species, a human-caused problem, are considered to be amongst the major problems for biodiversity in the Anthropocene (Pievani, 2014). Although there has been a debate on whether invasive species are themselves a cause for ecosystem change or they benefit from already disturbed ecosystems (Didham et al., 2005; Gurevitch and Padilla, 2004; Clavero and García-Berthou, 2005; Davis, 2003) studies show a correlation between invasive species presence and altered local biodiversity. Invasive non-native species can alter the local biodiversity by excluding native species through competition for resources (Mazzamuto et al., 2017), by predation (Wanless et al., 2007), by parasitism (Douda et al., 2017), by disease (Morand, 2017), by hybridization (Kovach et al. 2016) or by causing evolutionary changes (Mooney and Cleland, 2001). All these changes impact ecosystem functioning and therefore creates direct or indirect economic loss (Kaiser, 2006; Dehnen-Schmutz et al., 2004; Schwoerer et al., 2014).

Parakeets, especially the Rose-ringed parakeet (*Psittacula krameri*) are one of the widespread and common invasive bird species with well-established populations in Europe (Pârâu et al., 2016). Rose-ringed parakeets originate from Asia and Africa,

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mostly found around human settlements in Europe and is known to compete for nest-sites (Strubbe and Matthysen, 2009), or for food (Peck et al., 2014) with local species. Alexandrine parakeet (*Psittacula eupatria*), has its native distribution from Afghanistan to Vietnam and is not as widespread and as common as the Rose-ringed parakeet in Europe. Major Alexandrine parakeet populations were reported from Belgium, Germany and Netherlands, all with a couple of hundred individuals (Ancillotto et al., 2016) but Ancillotto et al., (2016) suggested that the number of Alexandrine parakeets is increasing and according to their model its establishment success might be benefiting from the past invasion of Rose-ringed parakeet in Europe.

Rose-ringed parakeet is smaller (40 cm) than Alexandrine parakeet (58 cm) (Juniper and Parr, 2010). In their native ranges both species occur in wide variety of habitats but mainly in woodlands; prefer tree cavities as nest; feed on wild and cultivated seeds, flowers and fruits and considered as serious crop pests (Parr and Juniper, 2010). In its native range, the clutch size of rose-ringed parakeet ranges from two to six (Lamba, 1966).

Two species of invasive non-native parakeets are common in Turkey, Rose-ringed and Alexandrine parakeet (*Psittacula eupatria*). The first observations on the established Rose-ringed parakeet populations in large cities (Istanbul, Ankara and Izmir) were recorded in the 1990s (Boyla et al., 1998). Alexandrine parakeet records, on the other hand, started to increase during the 2000s (eBird, 2012) and probably outnumbered Rose-ringed parakeets in some parts of Istanbul (Sahin, personal observation). Although both species were quickly increased in number in large cities, basic information on their distribution, abundance and breeding status are missing in Turkey.

It is for sure that in order to have a comprehensive understanding of the impact of invasive parakeet species on native biodiversity and to create an effective management plan we first need to understand their distribution, abundance and invasion ecology. Introduction of parakeet species is under strict control by legislation in European Union (European Commission, 2007), however, it is still uncontrolled in Turkey (Per, 2018). Turkey's rich bird diversity is already under various threats due to speed-up in development and urbanisation projects (Şekercioğlu et al., 2011) and the impact of invasive non-native species on native species such as Common starling (*Sturnus vulgaris*, Eurasian nuthatch (*Sitta europaea*), and Syrian woodpecker (*Dendrocopos syriacus*), is probably making it worse in urbanised areas. An immediate research on the topic is needed. This study attempts for the first time to use systematic observations to reveal information about breeding Rose-ringed and Alexandrine parakeets in one of the largest cities of Turkey. The aim of this study is to provide baseline information on the distribution, breeding status and nest preferences of two invasive parakeet species in Istanbul's city parks. Although this study was conducted in 2012, the results are still relevant as both species are present, breeding and moreover, likely to increasing in distribution and abundance in Istanbul according to the number of sightings in global bird-sightings database, e-bird (eBird, 2012). We expect that the baseline information revealed by this study will trigger further studies on the two invasive parakeet species in Turkey.

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Material and Methods

Study Area

This study is conducted in Istanbul, one of the largest cities in Turkey. Although two parakeet species can be seen in most parts of the city, especially in densely populated areas, the breeding occurs in parks where a high amount of old trees can be found together (Sahin, personal observation, see "Discussion"). Therefore this study was carried out in the historic parks of Istanbul that are managed by the Istanbul Metropolitan Municipality. Five of these parks (Beykoz (27.9 ha), Buyuk Camlica (12.9 ha), Kucuk Camlica (27.14 ha), Fethipasa (13.4 ha) and Cubuklu (16.3 ha)) are located in Asian and four of them (Emirgan (42.7 ha), Florya (67.5 ha), Gulhane (12.1 ha), Yildiz (39.2 ha)) are located in European side of Istanbul. The location and size of the parks are given in *Figure 1*.

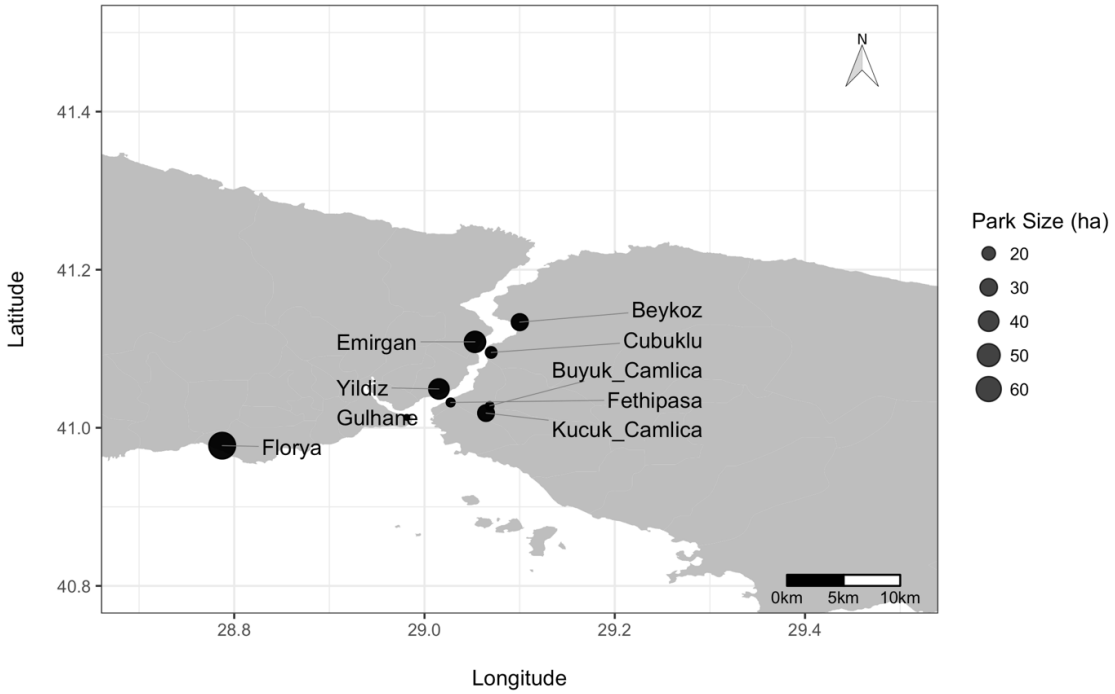

Figure 1. *Location and size of the studied parks in Istanbul. Size of the black circles represents the size of the parks in hectare*

The whole area is a transition zone between the dry Mediterranean and wet Black Sea climate. This impacts the climatic conditions between the northern and the southern part of the city; northern parts get more rain and are colder on average than southern parts.

As all the studied parks are managed, both native and non-native tree species with different ages can be found in these areas. The three most common Gymnosperm genera are *Pinus*, *Cedrus* and *Cupressus* whereas the three most common Angiosperm genera are *Quercus*, *Fraxinus* and *Platanus* for all parks. The total volume of trees belong to these two major classes are given in *Figure 2* and volumes of the most common Angiosperm genera were given in *Figure 3*.

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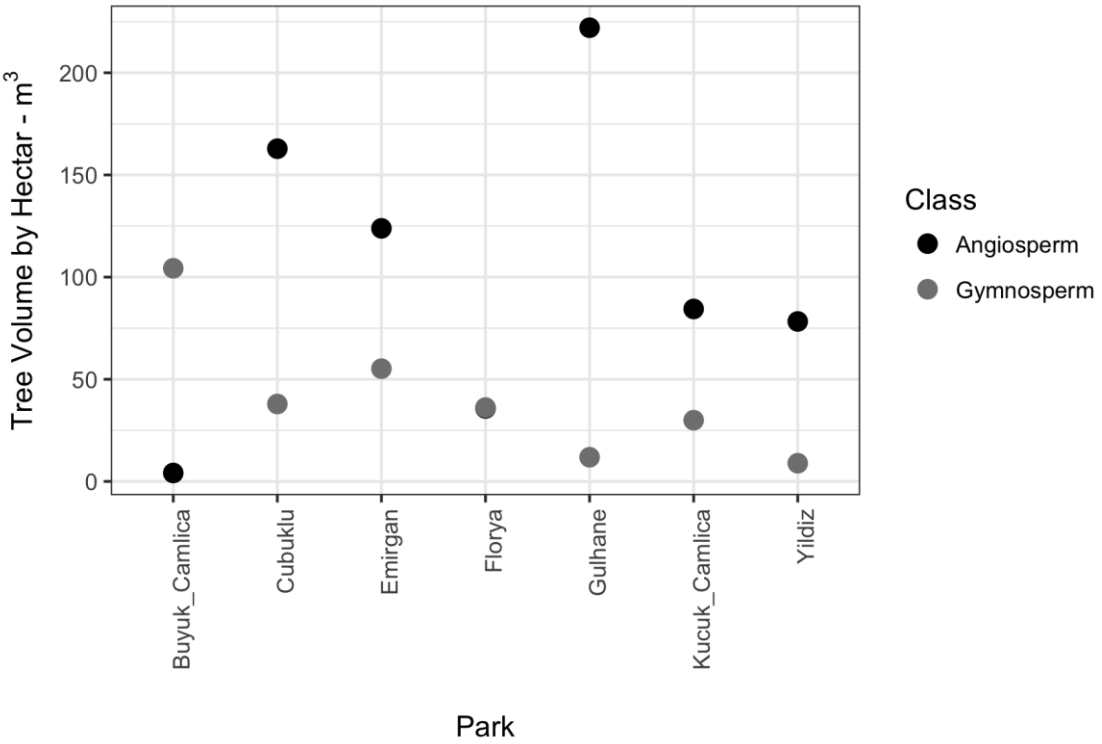

Figure 2. *Volume of Gymnosperm and Angiosperm trees in studied parks. Tree volumes are normalised by hectare for each park*

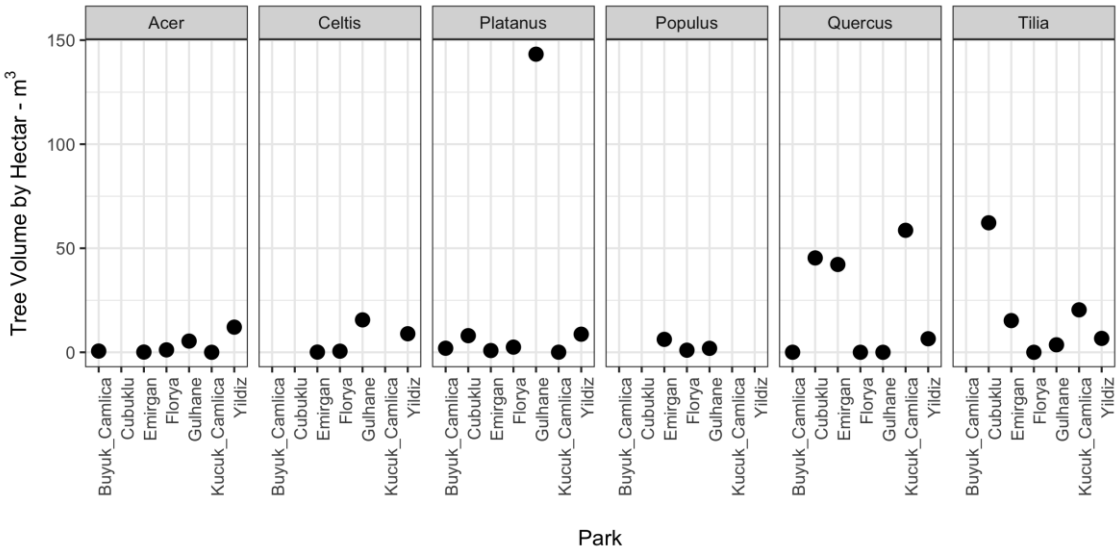

Figure 3. *Volume of the most common Angiosperm trees in studied parks. Tree volumes are normalised by hectare for each park*

The most common passerine species found in almost all parks includes Robin (*Erithacus rubecula*), Blackbird (*Turdus merula*), Great tit (*Parus major*), Blue tit (*Cyanistes caeruleus*), House sparrow (*Passer domesticus*), Chaffinch (*Fringilla coelebs*) among others.

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Data Collection

Two visits were made in breeding season between March-May in 2012. In the first (early) visit breeding status and the distribution of two parakeet species were recorded together with the number of adult individuals (recorded as the adult male and adult female / young male) in each park. In this first visit behaviour that indicates breeding (e.g. courtship, nest building etc.) and the location of detected nests were also recorded. In all parks, birds were counted by walking pedestrian paths.

In the second visit, data on nest characteristics were collected for all the nests determined in the first visit. Data on tree species, tree height and diameter, nest height, nest type (natural cavity, old nest for other species or nest box) and the nest orientation were collected. Tree height was measured with the clinometer, the orientation of nests was measured with a compass and the tree circumference was measured with a tape measure from 1.30 m height. Diameter at breast height (dbh) was calculated by dividing tree circumference with Pi number. To identify important factors shaping the nest selection data were collected on trees that have suitable cavities but no parakeet nests. These trees were randomly selected from maps created for forest management plans (Asan et al., 2002).

Statistical Analyses

To determine the factors that have an impact on nest selection, we compared data from nests and non-nest trees. To test within and between species differences among nest height, tree height, nest orientation and tree diameter we used one-way ANOVA tests on SPSS Version 21.0 (IBM Corporations Released 2012).

Results

Breeding Distribution and Abundance

Two species were found sympatrically breeding in 5 out of 9 city parks (*Table 1*). In Beykoz Park, birds were observed in suitable habitat during the breeding season, however, no breeding behaviour or nest were recorded, this area is marked as potential breeding area.

Table 1. *Breeding status of Rose-ringed parakeet (Psittacula krameri) and Alexandrine parakeet (Psittacula eupatria) in studied parks. Possible: species were seen during the breeding season, but no proof for breeding, Certain: active nest(s) were found in the park, No: no proof for breeding or no suitable habitat*

Park	**Breeding Status**	
	P. eupatria	P. krameri
Beykoz Park	Possible	Possible
Büyük Çamlıca Park	No	No
Emirgan Park	Certain	Certain
Fethipaşa Park	No	No
Florya Park	Certain	Certain
Gülhane Park	Certain	Certain
Çubuklu Park	No	No
Küçük Çamlıca Park	Certain	Certain
Yıldız Park	Certain	Certain

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In all parks visited and in all visits, Alexandrine parakeet was present during the breeding season where Rose-ringed parakeet was absent in two parks; Büyük Çamlıca and Çubuklu Parks. During the breeding season, the maximum number of individuals recorded for each species are 57 for Alexandrine parakeet in Gülhane Park and 37 for Rose-ringed parakeet in Küçük Çamlıca Park.

A total of 38 nests were found in studied parks during one breeding season, of which 15 belong to Rose-ringed parakeet and 23 belong to Alexandrine parakeet. In parks where both species breed sympatrically, nests of two species found congregated in specific parts of the park rather than scattered away from each other species' nesting area.

Nest Characteristics

The majority of Alexandrine parakeet nests were found on *Platanus* spp trees (especially *Platanus acerifolia* Wild.) followed by *Pinus pinea* and *Celtis australis*. All nests found to belong to Alexandrine parakeet were natural cavities. Similarly, the majority of Rose-ringed parakeet nests were found on *Platanus* spp trees (especially *Platanus acerifolia* Wild.) followed by *Pinus pinea*, *Tilia argantea*, *Populus tremula*, and *Sophora japonica*. Rose-ringed parakeets were observed using cavities that are used by *Dendrocopus* or *Sitta* species in some areas. These cavities were found on *Quercus robur* trees. The relative numbers of nesting trees for both species were given in *Figure 4*.

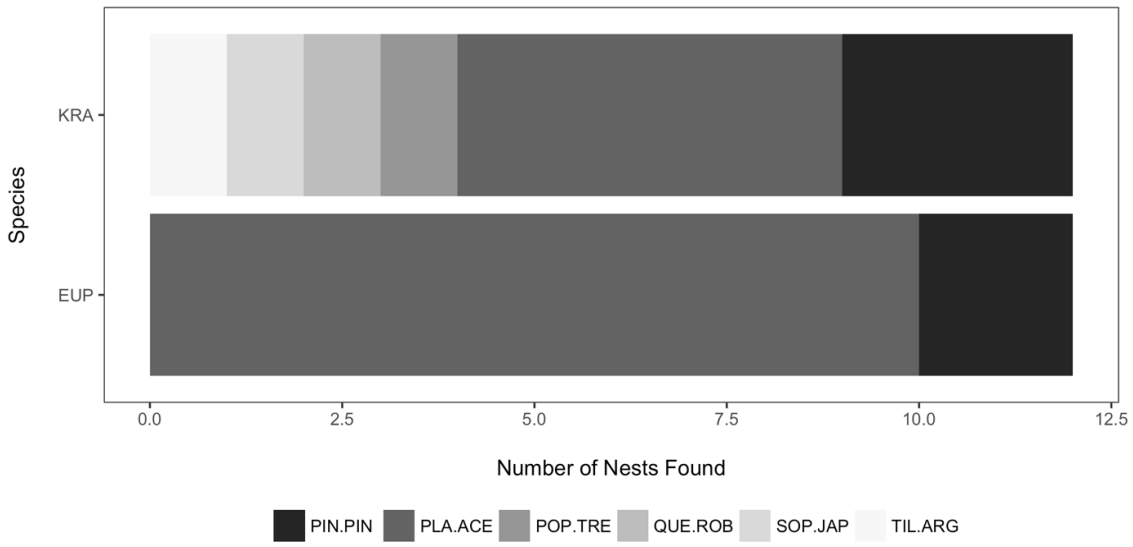

Figure 4. *Number and species of nesting trees for both parakeet species. KRA: Rose-ringed parakeet, EUP= Alexandrine parakeet, PIN.PIN: Pinus pinea, PLA.ACE: Platanus acerifolia, POP.TRE: Populus tremula, QUE.ROB: Quercus robur, SOP.JAP: Sophora japonica, TIL.ARG: Tilia argantea*

12 nests from each species were used in the analysis of comparing nest vs non-nest trees. Data from 24 non-nesting trees were used. For the 12 nests on which measurements were made, Alexandrine parakeet selected cavities placed higher on trees and trees with a wider diameter than Rose-ringed parakeet. The average height of Alexandrine parakeet nests was 8,6±3,6 m and the average tree diameter was 98,8 cm.

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These values were 6,8±1,6 m and 64,58 cm respectively for Rose-ringed parakeet. According to test results, nests were higher and nesting trees had wider diameter than randomly selected non-nesting trees. These measurements were 4,5±2,1 m and 57,92 cm in non-nesting trees.

Comparing nest and non-nest tree characteristics for each species individually revealed that nest orientation (p=0,000; F= 59,668, df= 34) and breast height diameter (p= 0,001; F= 14,693; df= 34) is the important factors in selection of nests for Alexandrine parakeet whereas it is tree height (p= 0,000; F= 20,120; df= 34) and breast height diameter (p= 0,000; F= 99,965; df= 34) for Rose-ringed parakeet.

When both species' nest characteristics evaluated together against non-nesting trees, tree height is not a significant factor (*Figure 5A*) but nest heights were found significantly higher than cavities measured on non-nesting trees (p= 0,000; F= 24,528; df=47, *Figure 5B*). Nesting trees were significantly wider in breast height diameter than non-nesting trees (p= 0,000; F= 15,006; df=47, *Figure 5D*).

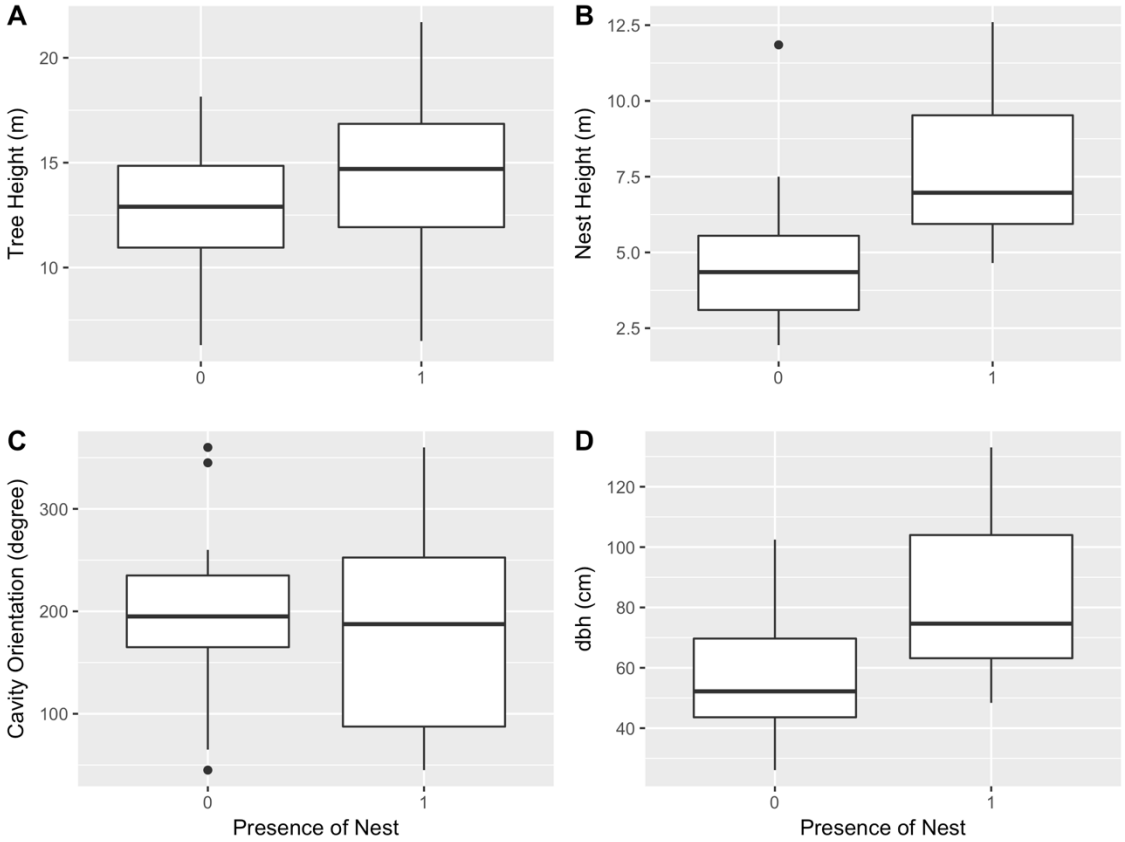

Figure 5. *Comparison of nesting (Presence of Nest =1, n=24) and non-nesting (Presence of Nest= 0, n=24) trees (95% CI). A: height of the tree, B: height of the cavity, C: orientation of the cavity, and D: diameter of the tree at breast height. Both species are evaluated together*

Discussion

This is the first systematic study on the two breeding parakeet species in Istanbul's city parks. The study covered large city parks. A preliminary work has been carried out to check the prevalence of the parakeet breeding sites in İstanbul. Accordingly, sighting data from an online database, e-bird (eBird, 2012), are mapped for both species and

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stratified random selection was applied to the areas outside of large city parks. 6 randomly selected 2 x 2 km squares with different habitats were visited to record the breeding. Although parakeets were observed on old trees in alleys and in open areas no breeding has recorded in these squares. As Pithon (1998); Butler (2003); Strubbe and Matthysen (2011) and Czajka et al. (2011) suggests, European breeding populations of parakeets are concentrated in city parks where there is a high concentration of trees and at the same time anthropogenic activities. According to our preliminary study, breeding parakeets seem to show a similar selection for breeding habitat in Istanbul: both species were recorded breeding in 5 out of 9 city parks investigated in this study. The reason that parakeets are choosing city parks for breeding is probably related with the wide variety of tree species, including exotic ones, which serves as a rich source of food but also a safe breeding habitat relatively isolated from constant human disturbance. In a study carried out in a botanical garden, Claes and Matthysen (2005) found that exotic plant species constitute 36% of the diet of Rose-ringed parakeets. Strubbe and Matthysen (2011) found that male Rose-ringed parakeets, which are responsible for feeding breeding females have a foraging distance a few hundred meters away from the nests. City parks probably provide plenty of suitable nests and food source to both parakeet species during the breeding season.

Strubbe and Matthysen (2007) also found a positive correlation between breeding Rose-ringed parakeet numbers and cavity availability in its breeding areas. In Büyük Çamlıca Park where both species were absent, the majority of the area is covered with pine plantations and therefore does not provide a suitable habitat with many cavities and a wide variety of food resources. In Fethipaşa and Çubuklu Parks, there are less available cavities in comparison to other parks, which might be a reason for the absence of breeding.

In parks where breeding occurred *Platanus acerifolia* were the most preferred nesting tree by both species. Studies on Rose-ringed parakeets found that they most preferred *Platanus* spp. trees in the UK (Pithon, 1998) and Germany (Czajka et al., 2011). In Germany, Czajka et al., (2011) reported that for the Rose-ringed parakeet *Acer* and *Fraxinus* spp. are the most preferred nesting trees, following *Platanus* spp. Strubbe and Matthysen (2007) found that Rose-ringed parakeets prefer habitats that are dominated by *Fraxinus* spp. and that include *Populus* and *Ulmus* spp. in Belgium. In this study, no Rose-ringed parakeet nests were found on *Fraxinus* or *Acer* trees.

To the best of our knowledge, there is no study reporting nest characteristics of Alexandrine parakeet in its non-native range. In this study, we found that the average height of the studied Alexandrine parakeet nests was 8.6 m and average dbh was 98.8 cm. For Rose-ringed parakeet these values were 6.8 m and 64.6 cm respectively. According to Pithon (1998) the average height for Rose-ringed parakeet nests in the UK was 11.1 m and according to Butler (2003), it was 8.1 m. Choosing higher nests probably provides protection from potential predators by making it more difficult to access. In our study, we found that both species prefer higher cavities compared to suitable cavities on non-nesting trees. However, an explanation for the lower average height for Rose-ringed parakeet nests might be the competition between two species for nest cavities. As Alexandrine parakeet is larger than the Rose-ringed parakeet it might be possible that it is taking better cavities and pushing Rose-ringed parakeet to cavities with poorer conditions. This might also have revealed by the nest orientation data we collected. In our study, Alexandrine parakeet nest were mostly south oriented. Given the fact that prevailing winds in Istanbul are northerly, it is possible that Alexandrine

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parakeets are choosing nests with the south orientation to have a protection from the impact of northerly winds. This competition hypothesis requires a more detailed study.

Recent studies show that increasing parakeet populations are negatively impacting local species (Strubbe and Matthysen, 2009; Mori et al., 2017; Menchetti and Mori, 2014; Yosef et al., 2016). In our study, we observed that the Rose-ringed parakeets were interacting with Eurasian nuthatches *Sitta europaea*, Common starlings *Sturnus vulgaris*, Syrian woodpeckers *Dendrocopos syriacus*; and Alexandrine parakeets were interacting with Western jackdaws *Coloeus monedula*. Although these were only superficial observations, they still have a value in suggesting that competition for resources is probably occurring among invasive non-native parakeets and native species in Istanbul's large city parks. Furthermore, a third invasive bird species, Common myna *Acridotheres tristis* has established breeding grounds in a few of the parks investigated in this study (eBird, 2012). The presence of three invasive species might create complex interactions among invasive and native species (Orchan et al., 2013). This subject definitely requires further investigation. Furthermore, competition between two parakeet species might be affecting these interactions and creates a complex interaction among non-native and native species. These areas require detailed studies.

Conclusion

This is the first study that reports breeding status and nest-characteristics of Rose-ringed and Alexandrine parakeets, two invasive species in Istanbul's city parks and we found that both species breed sympatrically in all parks investigated. Our analyses demonstrated that both species prefer cavities placed higher and on wider trees in comparison to available but not occupied cavities. We could not detect a statistically significant difference between the nest characteristics of two species (not reported here), probably because of small sample size. Although this study was conducted in 2012, the presence and breeding status of both species has not changed in studied parks and moreover two species are seemingly increasing in abundance (eBird, 2012) with a third invasive bird species, Common myna, added to some of the parks. More detailed studies are required on the nest and habitat preferences with higher sample size, potential competition between two parakeet species and their impact on native bird fauna to better inform wildlife managers and protect urban native bird fauna.

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REFERENCES

[1] Ancillotto, L., Strubbe, D., Menchetti, M., Mori, E. (2016): An overlooked invader? Ecological niche, invasion success and range dynamics of the Alexandrine parakeet in the invaded range. – Biological Invasions 18 (2): 583-595.

[2] Asan, U., Yesil, A., Uzun, A., Caliskan, A., Destan, S., Ozdemir, I., Ozkan, U. Y. (2002): Management and silviculture plans of Istanbul City Groves – Istanbul (in Turkish).

[3] Boyla, K., Aydemir, G.O., Eken, G. (1998): The status and distribution of in Turkey krameri Ring-Necked Parakeet *Psittacula*. – Turna, The Bulletin of the Ornithological Council of Turkey 1 (1): 24-27.

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/1702_24612471

[4] Butler, C.J. (2003): Population biology of the introduced Rose-ringed parakeet *Psittacula krameri* in the UK. – PhD Thesis, University of Oxford.
[5] Claes, D., Matthysen, E. (2005): Inleidende studie naar de voedselecologie en de mogelijke schadeproblematiek van de Halsbandparkiet Psittacula krameri in België. – Natuur.oriolus / Natuurpunt 70: 145-151.
[6] Clavero, M., García-Berthou, E. (2005): Invasive species are a leading cause of animal extinctions. – Trends in Ecology and Evolution 20 (3): 1-110.
[7] Czajka, C., Braun, M.P., Wink, M. (2011): Resource Use by Non-Native Ring-Necked Parakeets (*Psittacula krameri*) and Native Starlings (*Sturnus vulgaris*) in Central Europe. – The Open Ornithology Journal 4(1): 17-22.
[8] Davis, M.A. (2003): Biotic Globalization: Does Competition from Introduced Species Threaten Biodiversity? – BioScience 53 (5): 481-489.
[9] Dehnen-Schmutz, K., Perrings, C., Williamson, M. (2004): Controlling Rhododendron ponticum in the British Isles: an economic analysis. – Journal of Environmental Management 70 (4): 323-332.
[10] Didham, R.K., Tylianakis, J.M., Hutchison, M.A., Ewers, R.M., Gemmell, N.J. (2005): Are invasive species the drivers of ecological change? – Trends in Ecology and Evolution 20 (9): 470-474.
[11] Douda, K. Velíšek, J., Kolářová, J., Rylková, K. Slavík, O., Horký, P., Langrová, I. (2017): Direct impact of invasive bivalve (*Sinanodonta woodiana*) parasitism on freshwater fish physiology: evidence and implications. – Biological Invasions 19 (3): 989-999.
[12] eBird (2012): An online database of bird distribution and abundance. – Available at: http://www.ebird.org [Accessed September 10, 2016].
[13] European Commission (2007): New rules for captive bird imports to protect animal health in the EU and improve the welfare of imported birds. – Available at: http://europa.eu/rapid/press-release_IP-07-40_en.htm.
[14] Gurevitch, J., Padilla, D.K. (2004): Are invasive species a major cause of extinctions? – Trends in Ecology and Evolution 19 (9): 470-474.
[15] IBM Corporations Released (2012). IBM SPSS Statistics for Windows.
[16] Kaiser, B.A. (2006): Economic impacts of non-indigenous species: Miconia and the Hawaiian economy. – Euphytica 148 (1–2): 135-150.
[17] Kovach, R.P., Hand, B.K., Hohenlohe, P.A., Cosart, T.F., Boyer, M.C., Neville, H.H., Muhlfeld, C.C., Amish, S.J., Carim, K., Narum, S.R., Lowe, W.H., Allendorf, F.W., Luikart, G. (2016): Vive la resistance: genome-wide selection against introduced alleles in invasive hybrid zones. – Proceedings of the Royal Society B: Biological Sciences 283: 1-9.
[18] Lamba, B.S. (1966): Nidification of some common Indian birds: 10. The rose-ringed parakeet, *Psittacula krameri* Scopoli. – Proceedings of the Zoological Society, Calcutta 19: 77-85.
[19] Mazzamuto, M.V., Morandini, M., Panzeri, M., Wauters, L.A., Preatoni, D.G. Martinoli, A. (2017): Space invaders: effects of invasive alien Pallas's squirrel on home range and body mass of native red squirrel. – Biological Invasions 19 (6): 1863-1877.
[20] Menchetti, M., Mori, E. (2014): Worldwide impact of alien parrots (Aves Psittaciformes) on native biodiversity and environment: a review. – Ethology Ecology and Evolution 26 (2–3): 172-194.
[21] Mooney, H.A., Cleland, E.E. (2001): The evolutionary impact of invasive species. – Proceedings of the National Academy of Sciences of the United States of America 98 (10): 5446-5451.
[22] Morand, S. (2017): Infections and Diseases in Wildlife by Non-native Organisms. – In Vila, M., Hulme, P.E. (eds) Impact of Biological Invasions on Ecosystem Services. Springer International Publishing AG, Switzerland, pp. 177-190.

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/1702_24612471

[23] Mori, E., Ancilotto, L., Menchetti, M., Strubbe, D. (2017): The early bird catches the nest': possible competition between scops owls and ring-necked parakeets. – Animal Conservation 20 (5): 463-470.
[24] Orchan, Y., Chiron, F., Shwartz, A., Kark, S. (2013): The complex interaction network among multiple invasive bird species in a cavity-nesting community. – Biological Invasions 15(2): 429–445.
[25] Juniper, T., Parr, M. (2010): Parrots: A Guide to Parrots of the World. – Christopher Helm Publishers, London.
[26] Pârâu, L.G., Strubbe, D., Mori, E., Menchetti, M., Ancillotto, L., van Kleunen, A., White, R.L., Luna, Á., Hernández-Brito, D., Louarn, M.L., Clergeau, P., Albayrak, T., Franz, D., Braun, M.P., Schroeder, J., Wink, M. (2016): Rose-ringed Parakeet Populations and Numbers in Europe: A Complete Overview. – The Open Ornithology Journal 9 (1): 1-13.
[27] Peck, H.L., Pringle, H.E., Marshall, H.H., Owens, I.P.F., Lord, A.M. (2014): Experimental evidence of impacts of an invasive parakeet on foraging behavior of native birds. – Behavioral Ecology 25 (3): 582-590.
[28] Per, E., 2018. The status of the parrot trade from tropical forests to Turkey. – Turkish Journal of Forestry 19 (3): 275-283 (in Turkish).
[29] Pievani, T. (2014): The sixth mass extinction: Anthropocene and the human impact on biodiversity. – Rendiconti Lincei-Scienze Fisiche e Naturali 25 (1): 85-93.
[30] Pithon, J.A. (1998): The status and ecology of the ring-necked parakeet *Psittacula krameri* in Great Britain. – PhD Thesis, University of York.
[31] Schwörer, T., Federer, R.N., Ferren II, H.J. (2014): Invasive Species Management Programs in Alaska: A Survey of Statewide Expenditures, 2007-11. – Arctic 67 (1): 20-27.
[32] Şekercioğlu, Ç.H., Anderson, S., Akçay, E., Bilgin, R., Can, Ö.E., Semiz, G., Tavşanoğlu, Ç. Yokeş, M.B., Soyumert, A., İpekdal, K., Sağlam, İ.K., Yücel, M., Dalfes, N. (2011) Turkey's globally important biodiversity in crisis. – Biological Conservation, 144 (12): 2752-2769.
[33] Strubbe, D., Matthysen, E. (2011): A radiotelemetry study of habitat use by the exotic Ring-necked Parakeet *Psittacula krameri* in Belgium. – Ibis 153 (1): 180-184.
[34] Strubbe, D., Matthysen, E. (2009): Experimental evidence for nest-site competition between invasive ring-necked parakeets (*Psittacula krameri*) and native nuthatches (*Sitta europaea*). – Biological Conservation 142 (8): 1588-1594.
[35] Strubbe, D., Matthysen, E. (2007): Invasive ring-necked parakeets *Psittacula krameri* in Belgium: Habitat selection and impact on native birds. – Ecography 30 (4): 578–588.
[36] Wanless, R.M., Angel, A., Cuthbert, R.J., Hilton, G.M., Ryan, P.G. (2007): Can predation by invasive mice drive seabird extinctions? – Biology Letters 3 (3): 241-244.
[37] Yosef, R., Zduniak, P., Zmihorski, M. (2016): Invasive ring-necked parakeet negatively affects indigenous Eurasian hoopoe. – Annales Zoologici Fennici 53 (5–6): 281-287.

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