**Introduction**

Ring-necked Parakeets are an invasive species that are widespread across Europe. The British population is one of the largest in Europe, in 2015 there was 8,600 breeding pairs and 31,000 individuals [Pârâu, 2016].

Parakeets are cavity nesters that rely on natural cavities or cavities dug out by woodpeckers. Parakeets can enlarge existing cavities [Newson, 2011], [Orchan, 2013]. Cavities are usually a limited resource [Orchan, 2013] and throughout western Europe natural cavities have been substantially reduced due to land management [Strubbe, 2007]. Parakeet numbers have been shown to be heavily correlated to cavity density which suggests that cavities may be a limiting factor to parakeet numbers [Strubbe, 2007].

Invasive species enter an existing community of native and other alien species [Orchan, 2013]. Cavity-nesting birds are a clearly defined community that potentially use and interact over the same resource – the nesting cavities [Orchan, 2013]. Parakeets are entering the community of cavity-nesting birds, the effects of this has been widely studied by inconclusive. Parakeets have been found to reduce nuthatch numbers in Belgium [Strubbe, 2007] but no correlation was found in a similar study in London [Newson, 2011]. Strong correlation has been found with reduced number of noctules but not with cavity-nesting birds in Tel-aviv [Hernández-Brito, 2018]. Parakeets have also been found to increase the amount of time tits spend being vigilant rather than feeding with potential impact on their fitness [Lord, 2014]. Some species may nest next to parakeets so as to benefit from parakeets’ aggression towards potential predators [Hernández-Brito, 2013].

Parks are important hot-spots for diversity and are also losing many native species due to increased exotic species [Nielsen, 2014]. The use of an urban green space has been shown to affect the local bird community [Tryjanowski, 2017].

This project will study the effect of parakeets on the cavity-nesting bird community within the parks and green spaces of Manchester.

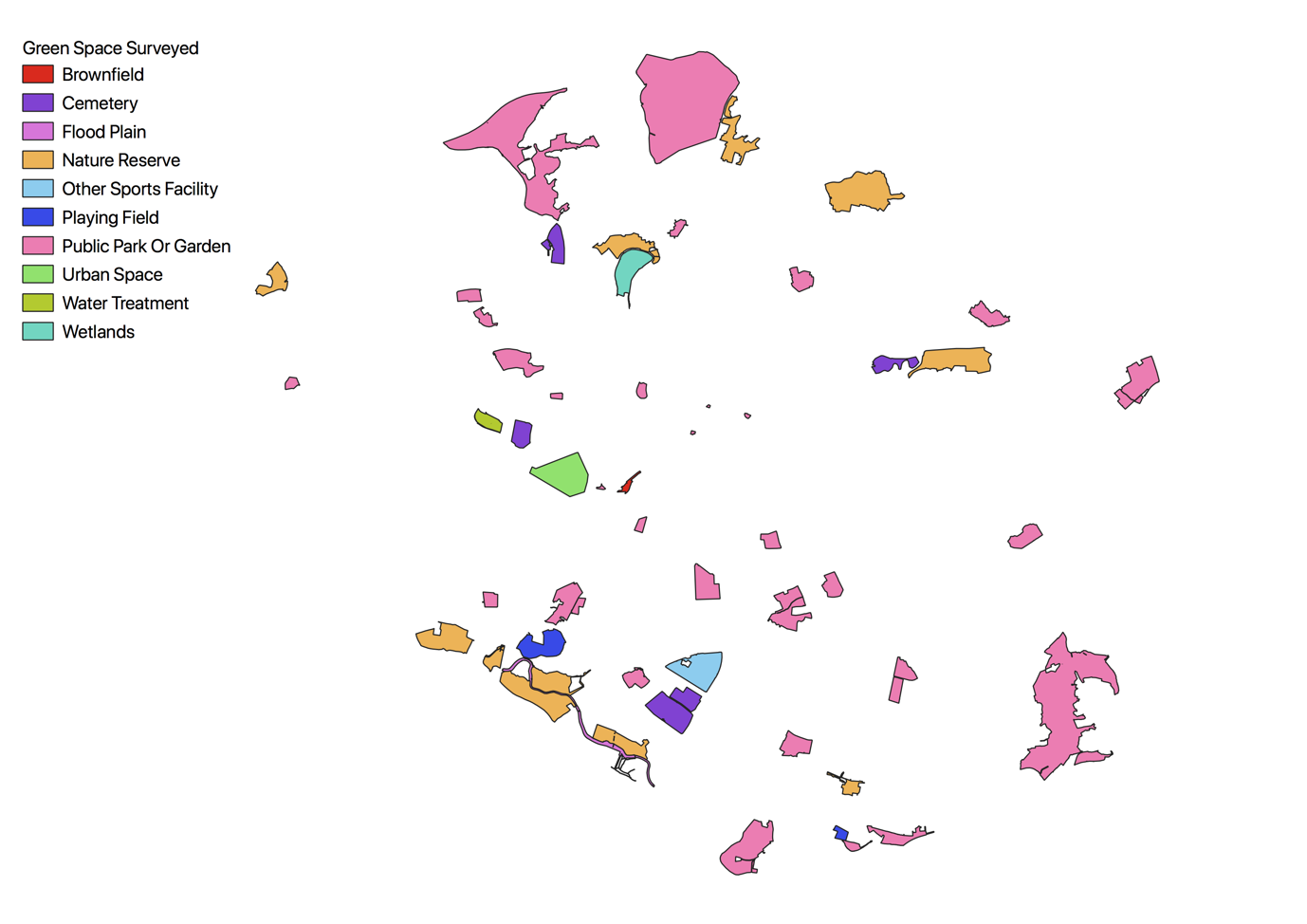
**Hypothesis**

1. There is a significant difference in the diversity of cavity-nesting birds between green space with parakeets and those without.
2. There is a significant correlation in the cavity-nesting species richness of a green space and the number of parakeets.
3. There is a significant difference in the cavity-nesting bird community composition between green spaces with parakeets and those without.

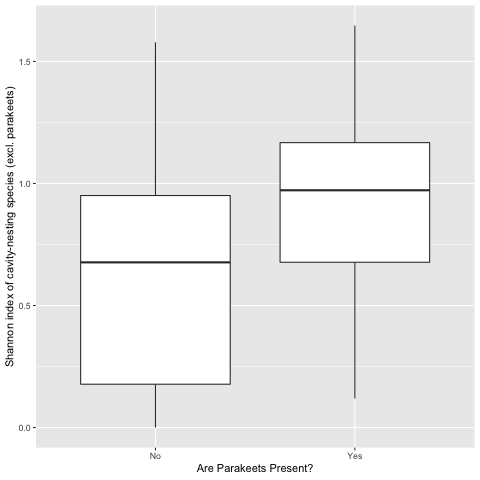
**Methods and Data**

56 green spaces in Manchester were visited and comprehensively surveyed. Each hectare of a green space was entered, and each site was searched for 5 minutes per hectare. Every sighting or call of a cavity-nesting bird was recorded.

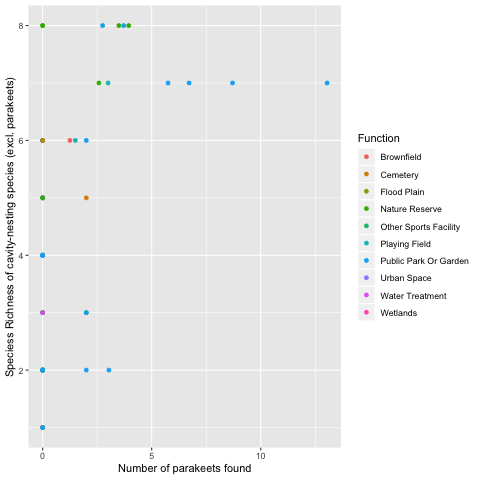
Parakeets were found on 18 of the sites and not found on 38 of the sites.

**Data Analysis**

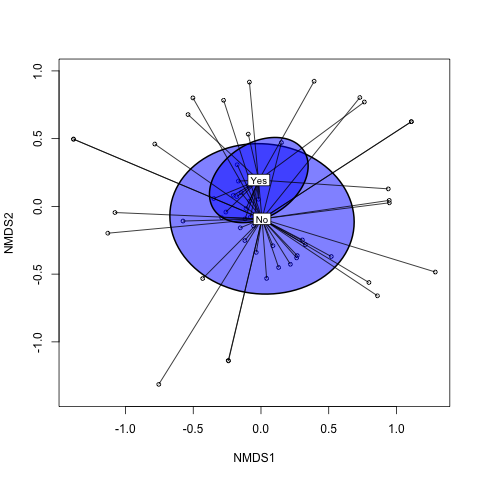
The Shannon index was calculated for each site for the cavity-nesting birds excluding parakeets. A Mann-Whitney U test was done to test parakeet presence against this Shannon index. The test showed there was a significant difference in the Shannon index of cavity-nesting birds between sites with parakeets (mean±sd; 0.99±0.40) and sites without parakeets (mean±sd; 0.64±0.47) (p = 0.013).



The species richness of each site was also calculated for cavity-nesting birds excluding parakeets. A Spearman’s test was done to test correlation between the number of parakeets and this species richness. The test showed there is a positive correlation between the number of parakeets and the species richness of a site (Spearman’s; n = 56, p < 0.01, rho = 0.53).

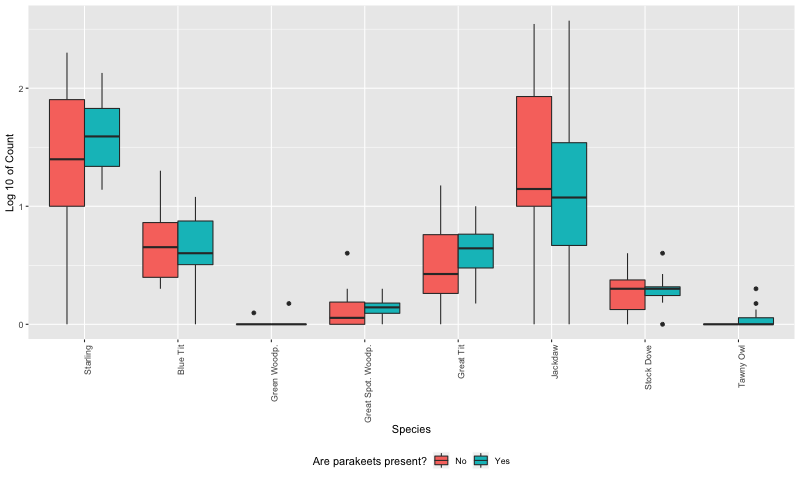


An NMDS was created using the cavity-nesting birds abundance excluding parakeets. This showed that the cavity-nesting birds’ community with parakeets was a subset of the communities without parakeets. An Analysis of Similarity was performed on the same data and this found that the composition difference was not significant (ANOSIM statistic R = 0.09076, p = 0.976).



**Future Work**

It has been shown that the composition of the cavity-nesting bird community is correlated to the presence and number of parakeets. Investigations of the individual species has shown that parakeet abundance is positively correlated with great spotted woodpecker abundance (Spearman’s; n = 56, p < 0.01, rho = 0.42, power = 0.90) and tawny owl abundance (Spearman’s; n = 56, p < 0.01, rho = 0.58, power = 0.99) but negatively correlated with jackdaw abundance (Spearman’s; n = 56, p < 0.01, rho = 0.38, power = 0.84).



Further research should look at that correlation with environmental factors and greenspace usage that correlate to the species richness and individual species abundance.

*Spearman’s correlation against parakeet numbers:*

|  |  |  |  |
| --- | --- | --- | --- |
| **Species** | **p-value** | **rho** | **Power (n = 56)** |
| Starling | 0.15 | 0.19 | 0.30 |
| Blue Tit | 0.09 | 0.23 | 0.40 |
| Green Woodpecker | 0.02 | 0.30 | 0.62 |
| Great Spotted Woodpecker \*\*\* | < 0.01 | 0.42 | 0.90 |
| Great Tit | 0.08 | 0.24 | 0.42 |
| Jackdaw \*\*\* | < 0.01 | 0.38 | 0.84 |
| Stock Dove | < 0.01 | 0.36 | 0.79 |
| Tawny Owl \*\*\* | < 0.01 | 0.58 | 0.997 |

**Effect Size**

[Hernández-Brito, 2018] surveyed a single park from 1992 to 2017 to record the impact of parakeets on noctules, this created 25 years of data.

[Strubbe, 2007] surveyed 44 different sites across the Brussels region when a negative correlation was found between nuthatch and parakeet numbers.

[Newson, 2011] surveyed 180 sites across London when no negative correlation was found between parakeet numbers and other cavity-nesting species.

The 56 sites in Manchester are not as numerous as the number of sites from the London survey, however, they are in line with the two other surveys.

A power analysis was done for the correlation test for parakeet numbers against species richness which showed a power of 99% for the 56 sites with a significance level of 0.05 and the calculated rho of 0.53.

**Bibliography**

Hernández-Brito, D. (2014) 'Crowding in the City: Losing and Winning Competitors of an Invasive Bird.', PLOS ONE, vol. 9(6), pp. e100593. Hernández-Brito, D. (2018) 'Nest-site competition and killing by invasive parakeets cause the decline of a threatened bat population.', Royal Society Open Science, vol. 5(5), p. 172477. Newson, S. E. (2011) 'Evaluating the population-level impact of an invasive species, Ring-necked Parakeet *Psittacula krameri*, on native avifauna.', Ibis, vol. 153(3), pp. 509-516. Nielsen, A. B. (2014) 'Species richness in urban parks and its drivers: A review of empirical evidence.', Urban Ecosystems, vol. 17(1), pp.305-327.

Orchan, Y. (2013) 'The complex interaction network among multiple invasive bird species in a cavity-nesting community.', Biological Invasions, vol. 15(2), pp. 429-445.

Lord, A. M. (2014) ‘Experimental evidence of impacts of an invasive parakeet on foraging behavior of native birds’, Behavioral Ecology, vol. 25 (3), vol. 1, pp. 582–590.

Pârâu, L. G. (2016) ‘Rose-ringed Parakeet *Psittacula krameri* Populations and Numbers in Europe: A Complete Overview’, The Open Ornithology Journal, vol. 9, pp. 1 – 13.

Strubbe, D. (2007) 'Invasive ring-necked parakeets *Psittacula krameri* in Belgium: habitat selection and impact on native birds.', Ecography, vol. 30(4), pp. 578-588. Tryjanowski, P. (2017) 'Bird diversity in urban green space: A large-scale analysis of differences between parks and cemeteries in Central Europe.', Urban Forestry & Urban Greening, vol. 27, pp. 264-271.

**Images**

[JayDalal5](https://commons.wikimedia.org/w/index.php?title=User:JayDalal5&action=edit&redlink=1) (parakeet) – wiki media