Research Article

Received: 9 October 2018 Revised: 10 December 2018 Accepted article published: 9 January 2019 Published online in Wiley Online Library: 19 February 2019

(wileyonlinelibrary.com) DOI 10.1002/ps.5320

Mediterranean *versus* Atlantic monk parakeets *Myiopsitta monachus*: towards differentiated management at the European scale

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Abstract

BACKGROUND: The monk parakeet *Myiopsitta monachus* (Boddaert), native to South America, is an invasive species in several European countries, causing crop damage and potential negative impacts on wildlife. Only Spain and Great Britain have regulations to control monk parakeets, thus fast growth and spread of populations are likely to occur on a wide scale. The aims of this research are to update information on the distribution and population size of monk parakeets in Europe, assess whether differences in population growth or spread rate exist between populations, and provide recommendations to decision-makers.

RESULTS: Our study estimates that there are 23 758 monk parakeets in the wild, across 179 municipalities in eight European Union (EU) countries; 84% of these municipalities hold between 1 and 100 monk parakeets. All countries with a representative historical record are experiencing exponential growth of monk parakeets. Mediterranean countries are experiencing higher exponential growth, spread rate and faster colonization of new municipalities than Atlantic countries.

CONCLUSIONS: We recommend that EU Mediterranean countries consider declaration of the monk parakeet as invasive alien species of regional concern, and develop coordinated efforts to monitor and manage the species, taking advantage of the low population sizes in most municipalities.

Keywords: invasive species management; population growth; spread rate; stratified dispersal theory and management policies

1 INTRODUCTION

Alien species are species introduced outside their historical or current native range as a result of accidental or deliberate human action;[1] such introductions have increased dramatically in the past century.[2] Alien species may alter the structure and function of native ecosystems through competition and/or disease, among others causes.[3–5] Indeed, biological invasions represent a leading cause underlying the ongoing sixth global biodiversity crisis;[6] in Europe, over 12 200 alien species have been recorded (www.europe-aliens.org/aboutDAISIE.do). Although only a fraction of these species is currently invasive (i.e. spreading and causing damage),[7,8] invasive alien species (IAS) impose a yearly estimated cost of €12.5–20 billion, due to the damage they cause and the costs of managing them.[9] To manage the threats posed by IAS, the European Union (EU) adopted Regulation (EU) 1143/2014 on IAS in 2015, and in 2017, published the list of IAS of Union Concern (the 'Union List') through Regulation (EU) 2016/1141. Currently, this list includes 49 species for which a set of measures aimed at controlling or eradicating invasive populations are required across the EU (art. 7).[10,11] In addition to the 'Union List', Regulation (EU) 1143/2014 also allows Member States (MS) to create lists of IAS of Member State Concern (the 'Member List') and apply measures deemed necessary to control or eradicate IAS (art. 12). From these lists, MS may identify IAS of regional concern that

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require regional cooperation, especially between MS that share borders and/or biogeographical region, as described in the Habitats Directive (92/43/EEC); and for species with high potential to cause damage or spread only in some countries (art. 11). The declaration of IAS of regional concern is voluntary and actions rely on agreements among partners, rather than being dictated by art. 7.

Currently, no psittacids (Psittaciformes) are included on the 'Union List'. Spain is the only EU country to date that has banned the trade and possession of monk parakeets *Myiopsitta monachus* (Boddaert), as a response to both the real and potential threats posed by this species (Spanish Real Decreto 630/2013).[12] Across Europe, eradication campaigns for monk parakeets have been initiated, for example in the UK (The Great Britain Invasive Non-native Species Strategy 2015). At the EU level, the importation of wild-caught birds has been banned since 2005 (Commission Decision (EC) 2005/760/EC of 27 October 2005). Originally implemented to stop the spread of avian influenza, this has resulted in a sharp decline in the import of potentially invasive birds including monk parakeets.[13]

The monk parakeet is native to South America, ranging from southern Brazil to central Argentina. Monk parakeets are unique among parakeets in that they build their nests from twigs. These nests can consist of one or more chambers. Typically every chamber has only one entry and can be occupied by a variable number of parakeets, and the nests are commonly grouped in colonies.[14–16] Since 1981, when it was listed in CITES Appendix II, ∼259 000 wild-caught monk parakeets have been imported legally into the EU (CITES Trade Database; https://trade.cites.org/). Accidental escapes or local intentional releases have resulted in the establishment of alien populations in Europe, North America, Asia and Maghreb.[17–20] The current status of the monk parakeet in some Europeans countries is unclear, and the population size and/or spread patterns are unknown for most of the populations. In its alien range, most populations occur in urban areas,[21,22] although recent studies report a shift in the species' distribution towards the borders of cities, with occurrences close to agricultural areas.[23,24] Where invasive monk parakeet population growth has been studied, populations typically exhibit exponential growth rates.[24–27]

Within their native area, monk parakeets expand their range mainly through a process of 'neighbourhood diffusion', spreading from source populations to nearby favourable areas,[28] consistent with the estimates of low natal dispersal distances.[29] By contrast, in non-native areas, monk parakeet populations are typically scattered.[25,26,30] This has been proposed to be the result of short- and long-distance spread mechanisms acting simultaneously, as described by Hengeveld[31] in the 'stratified theory'. Local range expansion of populations is probably due to natal dispersal of juvenile birds, while the occurrence of novel populations may result from either novel introduction by humans or occasional long-distance dispersal (e.g. Gonçalves da Silva *et al.*[32] found genetic evidence of dispersal movements > 100 km in their invaded range in Florida).

The monk parakeet is reported to be a crop pest in some locations where it has been introduced, particularly where it is present at high density.[33,34] Crop losses of ≤ 36% by this parrot species in Europe have been recorded mostly for the outskirts of Barcelona (Spain), where one of the largest European populations occurs.[35,36] Preliminary data on impacts by monk parakeets are also available for crops in Italy with up to 25% loss of tomatoes in home gardens in Rome and up to 50% loss of cabbages in Apulia, southern Italy.[37] In north-eastern Italy, anecdotal evidence indicates damage to vineyards.[37] Potential competition mediated by parasites of introduced monk parakeets with native species sharing the same feeding and breeding sites (i.e. house sparrows *Passer domesticus* Linnaeus and rock pigeons *Columba livia* Gmelin) has been suggested for Italian populations (with monk parakeets infested by alien lice and mites, as well as by native European lice and flat-flies).[38,39] Monk parakeets may also act as a reservoir of the nodule-shaped bill lesion, which may affect native bird species and poultry.[40]

Given the widespread introduction of this parakeet into Europe and the fact that it causes damage to both native biodiversity and agriculture, a better understanding of its current pan-European distribution, as well as demographic and dispersal parameters is crucial to allow conservation managers to set up tailored plans aimed at reducing monk parakeet impacts. Therefore, the aims of this research were to: (i) update information about the current distribution and population size of monk parakeets across Europe; (ii) characterize the invasion capacity of the species; (iii) assess whether differences in population growth or spread rates exist between populations; and (iv) provide recommendations to decision-makers based on our results to help them make informed decisions about monk parakeet management plans.

2 MATERIALS AND METHODS

2.1 Study area and data collection

The study area included the 28 MS of the EU. Embedded within the ParrotNet network (https://www.kent.ac.uk/parrotnet), a team of national coordinators from countries possibly supporting introduced populations of monk parakeets was created. Coordinators were assigned to countries with recent records, countries with historical records and neighbouring countries. They conducted bibliographic searches of both academic and grey literature, including national reports, often only available in their native languages, to uncover the history of monk parakeet invasion in their countries, and to gather and summarize data on population growth trajectories (Kruopis I; http://piraeus-port.blogspot.gr/2009/09/blog-post.html).[40–56] Contemporary data on monk parakeet population sizes were obtained from surveys initiated through ParrotNet or from recent literature (2014–2017). Surveys of monk parakeet colonies were conducted through censuses between 2015 and 2017. When it was not possible to conduct surveys, publications and direct interviews with local experts were used to estimate population size. These censuses followed a standard methodology based on the number of chambers per nest and experimental estimation of the 'occupation index', as used by Domènech,[57] Molina,[26] and Weiserbs and Paquet.[27] When the occupancy index could not be estimated, we used the Spanish occupancy rates as a reference for Mediterranean populations (1.3 and 1.47 monk parakeets per chamber).[26] For colonies of < 100 individuals, population sizes were estimated by direct counts of birds flying into their nests to roost at dusk.[26,27] The Spanish and Belgian censuses were already published as technical reports in their native languages.[26,27]

2.2 Habitat classification

Following EU Regulation 1143/2014 on IAS (art. 22), we classified monk parakeet populations according to the biogeographical regions in which they occur, as described in the Habitats Directive (92/43/EEC) version 2016 (European Environmental

Agency). We grouped monk parakeet population data by country because IAS policies are usually developed at the national scale. We classified countries by biogeographical regions. In the case of a country with monk parakeet populations in more than one biogeographical region, we considered each fraction of the population as independent, e.g. Italy (Mediterranean) and Italy (Continental).

2.3 Population growth rates

We defined a 'focus' as a group of monk parakeets inhabiting a municipality. We defined a 'municipality' as an area with political boundaries, smaller than the urban area in the metropolis and generally bigger than typical cities.[58] We verified whether local monk parakeet control programmes existed that may have affected population trends (e.g. through trapping of birds or egg control) and removed those foci from the analysis. This resulted in the removal of Deventer, The Netherlands,[53] Zaragoza and all foci at the Balearic Archipelago, Spain.[26] In the UK, a monk parakeet eradication programme began in 2008 but because it was focused on the only three foci in the country, and some historical records are available, we decided to exclude the monk parakeet counts after the start of the eradication campaign rather than removing these three foci completely from the analysis.[52]

We assessed the current status of monk parakeet populations for all 28 EU MS. We grouped the populations by country and biogeographical region following two criteria: (i) historical information is often available as nationwide estimations, rather than at the municipality level; (ii) in the survey, 11 populations from Italy and Greece were described for the first time at the municipality level (4–900 monk parakeets), hence no historical information was available, thus conducting the analysis at the municipality level would not consider all these parakeets, underestimating the population growth trend.

To group the populations by country, the first sighting in each country was used as the starting point, excluding historical first sightings of extirpated populations. When historical nationwide estimations were available, these were used to calculate population growth rates. When these data were not available, population growth rates were calculated based on foci, although we only summarized local information if all foci for a country had data available for at least one of two consecutive years. We tested two broad alternative models of population growth, namely a 'linear' and an 'exponential' growth model. We used the linear equation $Y_t = a + bt$, where t is the time interval, Y_t is the population size at time t, b is the population growth rate, and a is the initial population size at $t = 0$. We used the standard exponential equation $N_{t+1} = N_t\, e^{rt}$, where N_{t+1} is the population size at time $t + 1$, N_t is the population at time t, e is the natural logarithm base, r is the intrinsic rate of population growth and t is the time interval. We used then the Akaike information criterion (AIC) as an estimator of the relative quality of the statistical models, to determine which model best fits the population data. The smaller the AIC value, the higher the relative quality of the model. Finally, we examined whether population growth rates differed between monk parakeets introduced into Mediterranean and Atlantic biogeographical regions. We considered three data records to be the minimum acceptable to adjust population growth, thus when a population had only two data records available, it was not included in the analysis, although we display the results of testing both models in such populations for information.

2.4 Geographical spread rates

Detailed georeferenced data on monk parakeet occurrence over time were not available, thus we estimated all the spread parameters based on the results of this survey. To approximate spatial spread patterns, we defined a set of contiguous municipalities that were occupied by monk parakeets at a given period as a 'nucleus'. We used the average number of foci per nucleus as a proxy for the relative contribution of short-distance 'neighbourhood dispersal' to the total dispersion of the species. The average number of foci per nucleus can range from one (i.e. variable number of municipalities currently invaded by monk parakeets but isolated from each other) to the total number of municipalities for each country. The higher the average number of foci per nucleus, the greater the contribution of short-distance dispersal to the total dispersion of the species. To quantify the relative contribution of long-distance dispersal to the total dispersion of the species, we calculated the average number of new nuclei that appeared per year since the first sighting, defining the annual average number of new nuclei (*AANNu*) as: $AANNu_t = Nu_t/(t - t_0)$; where $AANNu_t$ is the number of nuclei at time 't' and t_0 is the time of the first detection of the species in the country, measured in years. The higher the *AANNu* value, the greater the long-distance dispersal component of the total dispersion of the species. To calculate the total surface area occupied by monk parakeets, we considered the total area of the municipality occupied by parakeets following Bucher and Aramburú.[28] We estimated the total area occupied by parakeets for every biogeographical region of every country by summarizing the total surface area of all nuclei. The area of municipalities was obtained from the Eurostat website (https://ec.\ignorespaceseuropa.eu/eurostat/web/gisco/geodata/reference-data/administrative-units-statistical-units) and calculated using QGIS 3.0.3 geographic information system software (QGIS Development Team, Boston, USA, 2018).[59]

2.5 Analysis

Mann–Whitney *U*-tests were used to compare: (i) population growth rates (i.e. the population doubling time); and (ii) velocity of the geographical spread (i.e. the number of nuclei per country, the average number of foci per nucleus and the *AANNu*) in Atlantic compared with Mediterranean populations. Only significant or marginally significant results are shown. Countries with biogeographical regions containing only either poorly sampled populations or scarce historical records (i.e. Mediterranean Portugal and France, Continental and Macaronesian Spanish regions) were excluded from the analysis. Analyses were conducted with R software (R Core Team, Vienna, Austria).[60]

3 RESULTS

Between 2015 and 2017, introduced monk parakeet populations were detected in eight of the 28 MS examined, and the pan-European monk parakeet population size was estimated at 23 758 (95% CI 20 631–26 749) individuals. The species was detected in 179 municipalities, and estimated to occupy 25 990 km^2 (Table 1). Four of nine biogeographical regions in the Habitats Directive were occupied by monk parakeets: Atlantic, Continental, Macaronesian and Mediterranean (Fig. 1).

3.1 Population growth model

For all country-level population growth rates in Europe with more than two historical records, an exponential growth model

Table 1. Demographic variables of the European monk parakeet populations, characteristics of the population growth models and dispersion analysis

				Population growth models						Dispersion analysis				
Country	Biogeographical regions	MP	Years	Model	N	IGR	Pop. doub. time (Y)	R^2	AIC	Foci	Nuclei	Foci/ Nucleus	AAN Nu_t	Surface (km^2)
United Kingdom	Atlantic	100	21	Exponential	6	0.17	4.073	0.964***	6.024	3	3	1	0.103	0.118
				Linear	6	4.112	NA	0.827**	54.631					
The Netherlands	Atlantic	52	25	Exponential	3	0.13	5.344	1***	−10.831	3	2	1.5	0.08	952.304
				Linear	3	1.796	NA	0.937	24.383					
Belgium	Atlantic	225	37	Exponential	10	0.115	6.033	0.728***	30.255	8	2	4	0.054	55.611
				Linear	10	7.481	NA	0.565*	121.023					
Portugal	Atlantic†	32	8	Exponential	2	0.123	5.654	1	NA	1	1	1	0.125	7.847
				Linear	2	2.5	NA	1	NA					
	Mediterranean†	7	17	Exponential	2	0.116	6.001	1	4.509	1	1	1	0.059	0.717
				Linear	2	0.5	NA	1	16.841					
France	Mediterranean†	41	33	Exponential	3	0.089	7.788	0.984*	3.333	2	2	1	0.061	34.055
				Linear	3	1.233	NA	0.967	21.368					
Greece	Mediterranean†	461	7	Exponential	3	0.421	1.647	0.994*	0.855	3	3	1	0.429	65.299
				Linear	3	65.14	NA	0.992*	31.915					
Italy	Mediterranean	2330	27	Exponential	3	0.198	3.506	0.997**	3.451	8	8	1	0.296	3071.549
				Linear	3	74.081	NA	0.988*	43.284					
	Continental†	244	31	Exponential	2	0.11	6.29	1	NA	8	8	1	0.258	580
				Linear	2	7.613	NA	1	NA					
Spain	Mediterranean	20 074	40	Exponential	4	0.234	2.957	0.983***	10.948	131	50	2.56	1.25	19 923.94
				Linear	4	433.1	NA	0.582	85.996					
	Atlantic†	101	25	Exponential	2	0.157	4.418	1	NA	4	3	1.33	0.12	198.058
				Linear	2	3.96	NA	1	NA					
	Macaronesia†	91	30	Exponential	3	0.157	4.423	0.703	18.132	7	7	1	0.233	1101.019
				Linear	3	3.974	NA	0.318*	50.495					

MP, number of monk parakeets; Years, number of years since the first sighting of the species until the last survey; Model, demographic model tested; N, number of historical records; IGR, intrinsic growth rate; R^2, coefficient of determination of regression; AIC, Akaike Information Criterion; Pop. doub. time, population doubling time for populations fitting the exponential growth model; Y, years; Foci, number of municipalities occupied by monk parakeets; Nuclei, group of neighbouring municipalities occupied by monk parakeets; Foci/Nucleus, number of foci per nucleus; $AANNu_t$, annual average number of new nuclei or number of nuclei divided by the number of years since the first sighting of monk parakeets; NA, not applicable.
Significance: ***$P < 0.01$, **$P < 0.05$, *$P < 0.1$.
†Excluded from the analysis to characterize biogeographical regions.

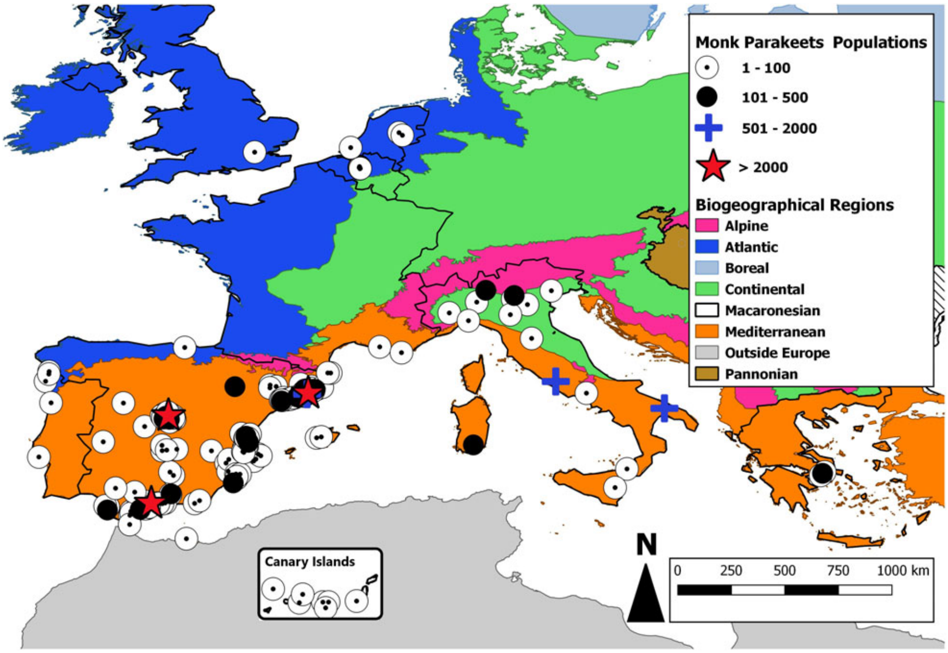

Figure 1. Monk parakeet populations by municipality in the European Union (including Spanish territories in North Africa and the Canary Islands) and biogeographical regions.

provided the best fit, that is, with smaller AIC values than the respective linear models (Table 1). The average population doubling time for Atlantic and Mediterranean countries' monk parakeet populations were 5.1 (SD = 1.0) and 2.7 (SD = 1.0) years respectively ($W = 9$, $P = 0.1$) (Fig. 2).

3.2 Spread rate

The average number of nuclei for Atlantic and Mediterranean countries was 2.3 (SD = 0.6) and 20.3 (SD = 25.8) respectively. The average number of foci per nucleus for Atlantic and Mediterranean countries was 2.167 (SD = 1.6) and 1.520 (SD = 0.9) respectively. The *AANNu* for Atlantic and Mediterranean countries was 0.092 (SD = 0.1) and 0.7 (SD = 0.5) respectively. The average area occupied by monk parakeets in Atlantic and Mediterranean countries was 336 km^2 (SD = 534.4) and 7686.9 km^2 (SD = 10 703.6) respectively ($W = 0$, $P = 0.1$).

4 DISCUSSION

Our work provides an estimate of the current distribution and population size of invasive alien monk parakeets present in the EU, and historical population growth trends. Our study reveals that all monk parakeet populations at the country level, with more than two historical records, are growing at an exponential rate (excluding managed populations). This is also true for populations introduced into Atlantic countries, although here populations tend to be smaller and growing at a slower pace compared with the Mediterranean. Interestingly, around the 50% of the EU monk parakeet population inhabits the municipalities of Madrid and Barcelona, with 6702 and 5000 monk parakeets respectively. In total, Spain alone hosts 84% of the EU monk parakeet population, and ~79% of the municipalities occupied by this species are in Spain. Monk parakeets have previously been reported in colder, northern European countries,[30,61–63] but these populations have likely gone extinct as we found no recent evidence of monk parakeet occurrences in Denmark, Germany, Austria and the Czech Republic. We also found some records of small monk parakeet populations that have gone extinct in UK, France and the Netherlands,[42,52,53] while the population in Belgium suffered two sharp declines following its establishment in Brussels in the late 1970s.[27]

Monk parakeet populations introduced into the Mediterranean tend to grow and expand at faster rates than populations in the Atlantic region. Our data also suggest a difference in the underlying mechanism of range expansion, as Atlantic populations spread mainly through neighbourhood diffusion (i.e. they typically have a higher average number of foci per nucleus than Mediterranean populations). The reason for lower long-distance dispersal in Atlantic compared with Mediterranean populations requires more research, but possible factors include differences in the popularity of monk parakeets as pets and climatic conditions. Greater popularity of monk parakeets as cage birds likely increases the probability of new escapes or releases. Spain and Italy not only have the two biggest monk parakeet populations in Europe, they also have 92% of the parakeets imported to the eight Europeans countries that currently sustain invasive monk parakeet populations (CITES Trade Database). Less suitable climatic conditions in the Atlantic region could drive long-distance dispersing birds, or newly released birds to be less successful in establishing new populations in colder parts of Europe.

Strubbe and Matthysen[20] reported that monk parakeet invasion success correlates with temperature and that populations are likely to collapse when the yearly number of frost days is > 50. Weathers and Caccamise[64] found that monk parakeets are relatively tolerant to low air temperature, but their metabolic rate rises sharply with decreasing temperature. Abundant food is necessary to maintain these higher metabolic rates and colder temperature also limit the amount of energy available for growth and reproduction.[65] We found marginally significant differences between Atlantic and Mediterranean populations in terms of population growth rates and spatial spread, despite the reduced set of data. This supports

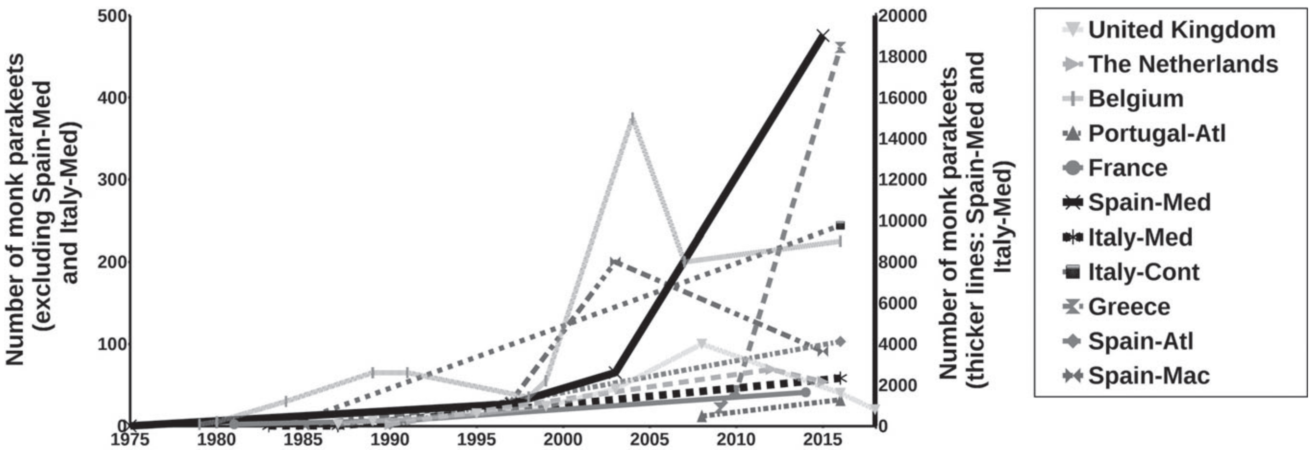

Figure 2. Evolution of European monk parakeet populations per country and biogeographical region. Countries with different biogeographical regions are noted as country-biogeographical region. Atl, Atlantic; Cont, Continental; Mac, Macaronesia; Med, Mediterranean. The left-hand *y*-axis indicates the number of monk parakeets for thinner lines. The right-hand *y*-axis indicates the number of monk parakeets for thicker lines (Spain-Med and Italy-Med).

the theory that energy demands imposed on parakeets by the governing climates across Europe allow us to discern two different 'invasion patterns' across Europe, namely: (i) fast growing and spreading Mediterranean monk parakeet populations, and (ii) slow growing and spreading Atlantic monk parakeet populations.

In the absence of management measures, the situation in Spain may offer a window into a possible future when monk parakeets become common and widespread, at least across parts of the Mediterranean. Growing urban parakeet populations may serve as a bridgehead for further invasion of adjacent croplands or birds from metropolitan regions may migrate to agricultural lands bordering the urban fringe for feeding. In the Barcelona area, foraging trips have been recorded to cover distances of up to 10 km from the city,[36] which is less than the maximum feeding distance of 15 km in the species' native range.[28] Damage to crops was reported from the outskirts of Barcelona in 2001, where a group of 120 monk parakeets frequented the area and caused damage ranging from mean values of 0.4% to 37% depending on the crop type. The damage to tomatoes was estimated at €8000 in the same year; today the population has tripled and thus the damage is expected to have grown accordingly.[36,66]

Based on our observations of population growth, range expansion and the available literature on monk parakeet crop damage in Europe, Mediterranean countries in particular, may have to consider formulating management strategies to avoid crop damage. Britain declared the monk parakeet a priority species for 'rapid reaction' in 2008. The programme entails the capture and relocation of adults and minimizing breeding success by removing eggs. The majority of breeding attempts have been disrupted since 2011 and the number of adults has been reduced from over 100 to ~ 40 in 2017 during the surveys (around 20 in 2018). This programme is ongoing and includes activities to reduce opposition to eradication by landowners.[67] In The Netherlands, between 2011 and 2013, the city of Deventer reduced the number of free-living monk parakeets from 35 to 2. This population came from an open aviary, which the birds still visited for feeding, thus recapture was technically very easy.[53] Although other populations in the country are growing, they might be dependent on nearby aviaries. The Spanish city of Zaragoza deployed a control plan based on removing eggs, trapping and shooting with air-rifles to remove adults. The egg removal phase failed to stop the population growth rate. The air-rifle shooting phase resulted in the removal of up to 800 individuals per year. Both methods combined reduced the population from 1400 individuals to 20 in 2 years.[68] Management in the Balearic Archipelago (Spain), by several methods including air-rifle shooting removed three foci and achieved almost full eradication of monk parakeets in the islands (Coloma V, personal communication). These experiences indicate that it is possible to remove invasive monk parakeets from the wild, considering different population sizes.

It should be noted that monk parakeet control measures may be opposed by members of the general public; in some cases, leading to reduced efficacy or even termination of the management programme.[67,69] Therefore, the development and implementation of a communication strategy is essential to: (i) measure the social perception of this alien species; (ii) help people understand the need to control free-living monk parakeets to prevent considerable damage in the future; and (iii) let the most sensitive groups in society participate, at some level, in the management decision process.[67] The more aggressive the management method, the more opposition can be expected. When dealing with small populations of monk parakeets (≤ 100), a variety of methods can be used to capture or relocate the whole population, which may be more readily accepted by the public. However, when managing large populations, more aggressive theniques are required to effectively reduce the population size and prevent further spread. In any case, the earlier a monk parakeet control programme starts, the higher the probability of success.[66] Eighty-four per cent (151) of municipalities in Europe hold between 1 and 100 monk parakeets; 12% (22) of municialities hold between 101 and 500 monk parakeets, and only the 2% (three) of municipalities hold populations between 501 and 2000 and > 2000 monk parakeets. This represents a window of opportunity to capture most populations, with little to no opposition from the public. Given that most of the foci are in the Meditrranean biogeographical region (81%), we strongly recommend that countries already showing established populations of feral monk parakeets, i.e. Portugal, Spain, France, Italy and Greece, take action to closely monitor the species and consider the possibility of declaring the monk parakeet an IAS of regional concern (in line with EU Regulation 143/2014). Because this declaration is voluntary and relies on measures agreed by the involved MS, it allows for the design of flexible tailored plans depending on the monk parakeet population size, level of spread and public perception of the problem; in contrast to severe and inflexible measures imposed by art. 7 on the species included in the Union list. This would allow affected countries to prevent new monk parakeet invasions, restrict their invasive range to areas currently occupied, and even considering removing the species to limit the potential for damage to agriculture and biodiversity.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the support provided by COST Action ES1304 for the realization of this manuscript. The contents of this manuscript are the authors' responsibility and neither COST nor any person acting on its behalf is responsible for use which might be made of the information contained herein. Also, we would like to acknowledge the feedback from three anonymous referees that provoked a significant improvement of the manuscript. D.S. was funded by H2020-MSCA-IF-2015 (grant number 706318) and acknowledges the Danish National Research Foundation for support to the Center for Macroecology, Evolution and Climate (grant number DNRF96), J.C.S. was funded by CGL-2016-79568-C3-3-P research project from the Spanish Research Council (Ministry of Economics and Competitiveness). L.R. was funded by FCT through grant SFRH/BPD/93079/2013 and by FEDER Funds through the Operational Competitiveness Factors Program 'COMPETE', and by National Funds through the Foundation for Science and Technology (FCT) within the framework of the project 'PTDC/AAG-GLO/0463/2014-POCI-01-0145-FEDER-016583.' The authors are indebted to all colleagues and bird experts who offered information on the status of monk parakeets in specific countries, as follows: Norbert Teufelbauer and Richard Zink (Austria), Viktar Fenchuk (Belarus), Nermina Sarajlic (Bosnia-Herzegovina), Boris Nikolov (Bulgaria), Ivan Budinski (Croatia), Martin Hellicar (Cyprus), Jana Skorpilova (Czech Republic), Henning Heldbjerg (Denmark), Riho Marja (Estonia, Latvia, Lithuania), Aleksi Lehikoinen (Finland), Frank Dhermain (France), Karoly Nagy (Hungary), Patric Lorgé (Luxembourg), Danka Uzunova (Macedonia), Denis Cachia (Malta), Vitalie Ajder (Moldova), Andrej Vizi (Montenegro), André van Kleunen (The Netherlands), Magne Husby (Norway), Mihail Huťuleac and Alex Rădac (Romania), Marko Sciban and Dragan Simić (Serbia), Tomáš Najer (Slovakia), Klemen Koselj (Slovenia), Gustav Eriksson (Sweden) and Emin Yoğurtcuoğlu and Esra Per (Turkey).

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