

Population size of the Monk Parakeet *Myiopsitta monachus* in Catalonia

Jordi Domènech, José Carrillo & Juan Carlos Senar

The Monk Parakeet *Myiopsitta monachus* was first recorded in Barcelona city in 1974, and by 1994 its population had grown to 850 individuals. The aim of the work reported herein was to produce an updated estimate of its current population size both in Barcelona city and in Catalonia, as this information is essential for predicting the spread of this invasive species in the near future. Post-reproductive population size was estimated indirectly during September and October 2001, by counting the total number of nests and chambers present, and estimating the mean number of individuals roosting per chamber ($n = 129$ chambers). Given totals of 313 nests in Barcelona and 492 in Catalonia, and an occupancy rate of 1.52 (SD = 1.80) birds per chamber, we estimated the Monk Parakeet population in Barcelona city at $1,441 \pm 265$ individuals and that of Catalonia at $2,199 \pm 392$ individuals. In Barcelona the detected population growth fits an exponential model, with a current population-doubling time of approximately nine years. From a direct inspection of 146 chambers for breeding activity, we estimated the number of breeding pairs in Catalonia in 2001 at 610-650 pairs, of which 402 were in Barcelona. The Monk Parakeet population has shown a marked range expansion in Barcelona and substantial population growth in several areas around the city. The species has also expanded its range all around Catalonia, and has already colonized important crop-growing areas. This could point towards possible problems in the future, and the advisability of active management of the species before too long.

Key words: Monk Parakeet, *Myiopsitta monachus*, population estimate, exotic species, Catalonia.

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Exotic species have been recognized as one of the greatest threats to biodiversity (Diamond 1989, Temple 1992, Wilcove *et al.* 1998). Typically, exotic species persist in low numbers during the first stages of colonization, and then the population increases exponentially till the species may become a pest (Stockwell *et al.* 2003). Therefore, it is critical to detect the establishment of new exotic species at early stages and to monitor their population changes.

As a result of its popularity as a pet, the Monk Parakeet *Myiopsitta monachus* has recently established naturalized breeding populations in many parts of the world (Bull 1973, Shields 1974, Summerour 1990, Clavell

et al. 1991, Schwab & Gwynn III 1992, Caruso & Scelsi 1994, Hyman & Pruett-Jones 1995, Van Bael & Pruett-Jones 1996, Weiserbs & Jacob 2000). In Catalonia, NE Spain, the species was first detected in the city of Barcelona in 1975 (Batllori & Nos 1985). By 1994, the population was estimated to have risen to about 850 individuals (Sol & Santos 1995, Domènech 1997), and the species had also appeared at many other localities throughout Catalonia (Clavell *et al.* 1991). The aim of this paper is to update the estimate of the Monk Parakeet population in Catalonia, in order to permit predictions of population changes in the near future.

Material and methods

Nest survey

The Monk Parakeet population size was indirectly estimated from a survey of nests. Monk Parakeet nests can be isolated or in close proximity to others, and a nest can have one or more entrances. We use the term "nesting area" for a site where two or more nests were located in close proximity, so that birds nesting there would normally be in visual contact with each other (Hyman & Pruett-Jones 1995); we use "nest" to refer to a stick structure that contained one or more chambers ("nesting structure" in the terminology of Hyman & Pruett-Jones 1995); we use "chamber" to refer to a cavity in a nest, and "active chamber" when the chamber was visited or occupied by Monk Parakeets at any time during the census period (see Navarro et al. 1992).

In Catalonia, the Monk Parakeet mainly appears in association with urban habitats, the largest populations being located in and around the city of Barcelona (Clavell et al. 1991, Estrada 2001). This, and the fact that the rest of the territory seems to support only low numbers (Diaz et al. 1996, Román-Muñoz & Ferrer 1997), led us to divide the territory into three survey units, A, B and C (Figure 1 and Table 1).

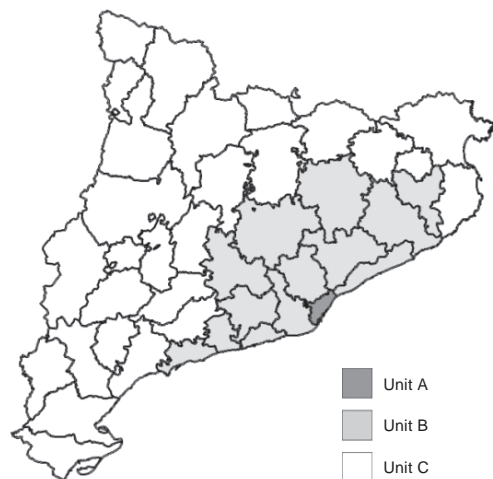


Figure 1. Map of Catalonian Counties showing the three Units considered in this study.
Mapa de les comarques de Catalunya on es diferencien les tres unitats de cens.

Unit A, including Barcelona and surrounding municipalities, was inspected systematically, with visits to all areas where Monk Parakeets might potentially build nests, including all parks, gardens and squares, as well as wide streets with trees. Unit B comprised other cities with detected presence of parakeets, and Unit C the remaining parts of Catalonia.

For Units B and C we obtained preliminary information about cities and towns with possible presence of Monk Parakeets (nests or individuals) from three different sources: 1) the Catalan Institute of Ornithology (ICO) allowed us access to the databases of both the Atlas of the Breeding Birds in Catalonia, with data until 2000, and Catalan Annual Bird Report, thus enabling us to obtain information on cities with the presence of nests of this species; 2) direct contact with bird ringers and ornithologists in both units; and 3) a questionnaire that we sent to all town councils with human populations of over 10,000 (n = 85), and to all regional headquarters of forest wardens (Agents Rurals comarcals) based in these units. On the basis of the data obtained, we visited 40 cities within Unit B, in order to check directly on the pres-

Table 1. Counties of Catalonia assigned to each study unit.
Comarques de Catalunya assignades a les diferents àrees d'estudi.

Unit	Counties / Comarques	
A	Barcelonès	
B	Alt Penedès	La Selva
	Anoia	Maresme
	Bages	Osona
	Baix Llobregat	Tarragonès
	Baix Penedès	Vallès Oriental
	Garraf	Vallès Occidental
	Gironès	
C	Alt Camp	Pallars Jussà
	Alt Empordà	Pallars Sobirà
	Alt Urgell	Pla de l'Estany
	Alta Ribagorça	Pla d'Urgell
	Baix Camp	Priorat
	Baix Ebre	Ribera d'Ebre
	Baix Empordà	Ripollès
	Berguedà	Segarra
	Cerdanya	Segrià
	Conca de Barberà	Solsonès
	Garrigues	Terra Alta
	Garrotxa	Urgell
	Montsià	Val d'Aran
Noguera		

ence of Monk Parakeets. Cities within Unit C were not visited; we relied on information provided by the aforementioned sources for our population estimates.

In addition, from April to June 2001 we mapped all nesting areas and nest sites located in Units A and B, counted the number of chambers, and identified the nest support substrate.

Data on the numbers of parakeets present during previous stages of colonization were obtained from: Batllori & Nos (1985) for the period 1981-1985; Santos & Sol (1995) for 1985-1994; Clavell *et al.* (1991) for 1990-1991; and the ICO Annual Bird Reports (Copete 1998, Larruy 2000, Estrada 2001) for 1996 to 1998.

Population estimation

Within Units A and B, we used the total number of chambers found to make an indirect estimate of population size (Santos & Sol 1995). Given that one chamber may be used for roosting by a variable number of individuals everyday, and that not all chambers are in use within a given breeding season (Navarro *et al.* 1992, Eberhard 1998), we previously estimated the mean number of individuals per chamber. In order to estimate this figure within the post-reproductive period, from 3rd September to 2nd October 2001 we recorded the number of individuals roosting in 129 chambers (9% of the total number of chambers in the two units, $n = 1,397$) of 47 nests (single and compound; 10% of the total number of nests in the two units, $n = 484$) from Barcelona and the Baix Llobregat (Table 2). These figures were obtained by monitoring arrivals and departures of individuals at each chamber from two hours before sunset (i.e. before the parakeets started returning to their nests) to the end of bird activity

(Santos & Sol 1995). The validity of repeating this estimation was measured by recording this figure in the same nest and chamber on two different days, for a sample of nests and chambers. Repeatability was computed from the mean squares of ANOVA of the two repeated measures per nest or per chamber (Lessells & Boag 1987, Harper 1994, Senar 1999). The estimation of the number of individuals within the study units A and B was obtained by multiplying the total number of chambers by the mean number of individuals roosting per chamber. The population size for Unit C was estimated on the basis of information provided by local councils and ornithologists regarding nests and individual numbers.

We recorded the individuals roosting in the autumn for three reasons: a) to allow comparison of our results with a previous census conducted in the city of Barcelona (Santos & Sol 1995); b) because an important proportion of juveniles (second-year birds) are non-reproductive individuals in their first spring after hatching (Martin & Bucher 1993), so just recording the number of breeding pairs would underestimate total population size; and c) estimations from the non-reproductive period avoid biases associated with potentially poor estimation of parameters such as reproductive timing, breeding success and the dispersal of young birds.

In order to estimate population size during the breeding period, we calculated the proportion of chambers with active reproduction by taking a sample of trees which we climbed and then directly inspected the chamber for breeding activity. In this way we checked 146 chambers out of a total of 58 nests, from April to June 2002, the breeding period for the species in our study area. In order to check whether the presence of Monk Parakeet activity around the chambers or observations of birds entering or leaving the chambers were good indications that the chamber could have breeding activity, we had previously categorized these chambers as presumably being either occupied (showing these signs) or unoccupied (no activity).

The rate of population growth was calculated using the standard equation of exponential growth: $N_1 = N_0 e^{rt}$, where N_1 and N_0 are the initial and the final population size, t is the time interval, and r is the rate of population growth.

Table 2. Location and number of Monk Parakeet nests and chambers selected to determine the mean number of individuals per chamber.

Nombre i localització dels nius (nests) i cambres (chambers) seleccionats per determinar la mitjana d'individus per cambra.

Unit	City or County	Number of nests	Number of chambers
A	Barcelona	42	100
B	Baix Llobregat	5	29

Results

Number of nests

We found nests in 14 out of the 41 counties of Catalonia. We found a total of 492 nests within the study area (Table 3): 339 in Unit A (313 of these within the city of Barcelona, Figure 2); 145 in Unit B; and 8 in Unit C. Most nests contained 1-2 chambers, with 5 nests showing 16 or more chambers, and 36 being the maximum number of chambers in a single nest.

Population size estimation

From the 129 monitored chambers we obtained an occupancy estimate of 1.52 birds per chamber (SD = 1.80, range: 0-8), with 49% of chambers empty. This allowed us to estimate the number of Monk Parakeets in Barcelona city at $1,441 \pm 265$ individuals. The number of birds in the whole of Unit A was $1,584 \pm 292$. By adding Unit B, the figure rose to $2,129 \pm 382$ individuals. The estimated population for Unit C was around 70 ± 10 individuals. Using these data, the estimated Monk Parakeet population for the whole of Catalonia was of $2,199 \pm 392$ individuals.

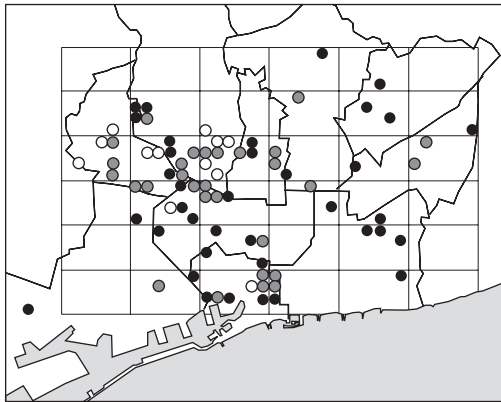


Figure 2. Nest sites in Barcelona city. Black dots – new sites located in 2001; grey dots – nest sites located in 2001 but described previously (Sol et al. 1995); and white dots – nests described previously, but not located in 2001 (Sol et al. 1995). *Localitzacions de nius a la ciutat de Barcelona. Cercles negres – noves zones de nidificació localitzades l'any 2001; cercles grisos – zones localitzades l'any 2001 però ja descrites abans (Sol et al. 1995); i cercles blancs – nius descrits en anys anteriors (Sol et al. 1995) i no localitzats durant el 2001.*

Table 3. Number of Monk Parakeet nests counted in each city or county within Units A and B, and estimated for Unit C.

Nombre de nius detectats a les diferents ciutats o comarques dins de les àrees A i B, i nombre estimat a l'àrea C.

Unit A (cities)	Number of nests
Barcelona	313
L'Hospitalet de Llobregat	16
Badalona	8
St. Adrià del Besòs	0
Sta. Coloma de Gramenet	2
Unit B (counties)	
Maresme	12
Vallès Oriental	2
Vallès Occidental	20
Baix Llobregat	74
Garraf	28
Gironès	0
La Selva	0
Osona	1
Bages	1
Anoia	2
Alt Penedès	3
Baix Penedès	0
Tarragonès	2
Unit C (counties)	
Segrià	5
Alt Empordà	2
Baix Empordà	1

The rate of population growth between 1994 (Santos & Sol 1995) and 2001 was 0.08, showing a population-doubling time of approximately nine years. The rate of population increase since 1975 fits an exponential model of population growth (regression between log of population size and year: $R^2 = 0.98$, $F_{(1,9)} = 85.87$, $P < 0.001$) (Figure 3).

Our direct examination of chambers by climbing nest trees allowed us to estimate that only 42% of chambers contained birds engaged in breeding activity (62 active chambers from 146 monitored). From this figure, and assuming one pair for every active chamber, we obtain an estimate, based on 2001 chamber numbers, of 592 pairs in Units A and B, of which 402 were in Barcelona. For Catalonia as a whole, the number of breeding pairs in 2001 was estimated at 610-650 pairs. If we had estimated breeding activity merely relying on the visual monitoring of Monk Parakeet activity around the chamber, or on observations of birds enter-

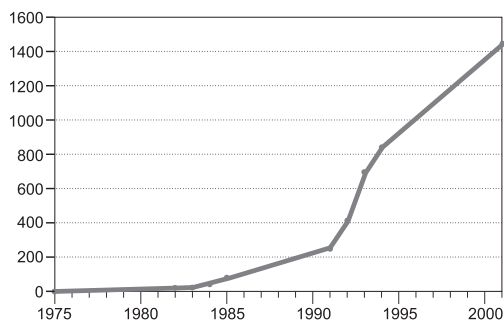


Figure 3. Rate of population growth in the Monk Parakeet during the period 1975-2001 in Barcelona city. It can be seen to fit an exponential model of population growth (regression between log of population size and year: $R^2=0.98$, $F_{(1,9)} = 185.87$, $P<0.001$).

Taxa de creixement de la població de la Cotorra de pit gris entre 1975-2001 a la ciutat de Barcelona on es mostra que segueix un model exponencial de creixement (regressió entre log de la mida de població i any: $R^2=0.98$, $F_{(1,9)} = 185.87$, $P<0.001$).

ing or leaving the chambers during the day, we would have obtained biased results: only 32 (46%) of 70 presumably occupied chambers were found upon inspection to contain breeding pairs, whereas 5 (36%) of 14 chambers presumed to be unoccupied were found in fact to be reproductively active.

Unfortunately, we did not monitor roosting individuals during the breeding period, so we do not know whether this method could be better for estimating breeding activity than monitoring daytime activity around the chambers. Nonetheless, the fact that an important proportion of juveniles do not breed during their first spring after hatching (Martin & Bucher 1993) suggests that the monitoring of roosting birds could cause an overestimate of the number of breeding pairs. For this reason, we suggest that chamber inspection may be a better estimation method in this case. On the other hand, monitoring roosting individuals can still be a useful method for estimating overall population size because in this case it is not necessary to distinguish between breeders and non-breeders.

Repeatability of number of birds per chamber

From the total number of 47 nests and 129 chambers used for obtaining the estimated number of birds per chamber, we repeated the

census on 8 nests with 22 chambers (17% of nests and chambers censused) in the area around the Ciutadella city park, in Barcelona.

Repeatability in the number of birds per nest was $r_1 = 0.99$ ($p<0.001$), and in the number of birds per chamber $r_1 = 0.76$ ($p<0.001$). Although repeatability for nests was apparently higher than for chambers, it must be pointed out that in 20 (91%) of the 22 chambers studied, the same results were obtained on both days.

Nesting substrate

The most commonly-used nesting substrates were palm trees *Phoenix* sp. (78%) and pines *Pinus* sp. Another common support tree was eucalyptus *Eucalyptus* sp., although this was only observed in two towns: Cubelles, with 14 nests in a single street; and El Prat del Llobregat, with 12 nests at La Ricarda, a private estate. Other widespread native trees such as oaks *Quercus* sp. and several kinds of human constructions were used as a supports (Table 4).

Discussion

The first Catalanian free-ranging Monk Parakeets were detected in Barcelona city in 1975

Table 4. Types of nest substrate used by the Monk Parakeet in Catalonia. We were unable to obtain information about the substrate for 47 nest sites. *Suports dels nius (en 47 casos no s'ha obtingut informació sobre el suport).*

Substrate	Number	%
Trees Arbres		
<i>Phoenix dactylifera</i> and <i>Phoenix canariensis</i>	349	78.3
<i>Pinus pinea</i> and <i>Pinus halepensis</i>	51	11.5
<i>Eucalyptus globulus</i> and <i>Eucalyptus camaldulensis</i>	26	5.8
<i>Platanus hispanica</i>	6	1.3
<i>Populus nigra</i>	3	0.7
<i>Cupressus sempervirens</i>	2	0.5
<i>Cedrus libani</i>	1	0.2
<i>Quercus ilex</i>	1	0.2
Others Altres		
Buildings <i>Edificis</i>	2	0.5
Pylons <i>Torres elèctriques</i>	2	0.5
Raised lighting (streetlight, stadium floodlight) <i>Torres d'il·luminació</i>	2	0.5

(Batllori & Nos 1985). Since then, the population has been growing continuously, at a rate that fits an exponential model. This agrees with the general population trends of the species reported from different parts of its introduced range (Hyman & Pruett-Jones 1995, Van Bael & Pruett-Jones 1996, Román-Muñoz 2003). Comparison of the census carried out during autumn 2001 in Barcelona (1,441 individuals, 313 nests) with the previous census performed in 1994 (850 individuals, 155 nests; Santos & Sol 1995), both following the same methodology, indicates a current population-doubling time of approximately nine years. Potential growth might, in fact, be greater than this, because the annual palm-tree pruning that the city council undertakes destroys a large number of eggs and chicks (Senar & Domènech 2001a), possibly slowing up the parakeet population growth in Barcelona. We document 37 new nesting areas within the city, as compared with data from previous censuses (Clavell *et al.* 1991, Santos & Sol 1995) (Figure 2), showing a substantial range expansion in Barcelona, especially in the north of the city, with an increase from 4 to 17 nesting areas between 1995 and 2001 (Santos & Sol 1995). Our 2001 estimate of population numbers in Barcelona city (1,441 individuals) was slightly greater than the numbers (800-1000) tentatively suggested by Clavell (2002, 2003).

Population growth has been even greater in areas around the city (Unit B and other municipalities within Unit A), where the number of nests has increased from 23 in 1991 (Clavell *et al.* 1991) to 171 in 2001, 644% increase, compared to the growth rate within Barcelona, from 155 to 313 nests, 102% increase. The species has also expanded its range, having been recorded at 12 cities in 7 counties in 1991 (Clavell *et al.* 1991), compared with the 44 cities in 14 counties where the species has now been found. Some of these populations appear to be strongly established (e.g. Barcelonès, Baix Llobregat and Segrià, and probably Vallès Occidental and Garraf), as shown by the population size of the species in these counties and the fact that some of them have been occupied for quite some time (e.g. Segrià; Clavell *et al.* 1991). The breeding population in the Segrià is probably independent from the main core located in Barcelona, because the species is completely absent from a

very wide area between these two centres. Similarly, the multinuclear distribution of the species, with large distances between cities holding Monk Parakeets, in spite of the presence of apparently suitable habitat in the gap, suggests that individuals escaped or released from captivity may be responsible for the first colonization stages in most of the cities. Future DNA studies could confirm this hypothesis.

The fact that the five counties with the highest number of Monk Parakeet nests are also the five with the highest human population density (Barcelonès - 339 nests *vs* 14,712 inhabitants/km²; Baix Llobregat - 74 *vs* 1,423; Garraf - 28 *vs* 582; Vallès Occidental - 20 *vs* 1,260; Maresme - 12 *vs* 896) is probably not accidental. Colonization events may be more likely to occur in highly populated areas because they have a more active pet-bird trade (Mungui 2001). Moreover, the 14 counties (out of 41) in which the species was found are among the 17 most densely populated ones. The only three highly populated counties where the species was not found during this study were: La Selva, Baix Camp and Gironès, although in Baix Camp and Gironès some individuals were recorded in 2000 (Baix Camp and Gironès - Clavell 2003; Gironès - Regional Headquarters of Forest Wardens, *in litt.*, and in Gironès a nest of the Monk Parakeet was recorded in 1997 (Larruy 2000).

Population growth around the city of Barcelona has been asymmetrical, with more parakeets inhabiting the area to the south of the city than to the north (south, Baix Llobregat 74 nests *vs* north, Maresme 12 nests; Table 3). Interestingly, Barcelona city itself shows a more abundant and older parakeet presence in the south half (left side of Figure 2) of the city than in the north half (right side of Figure 2), which suggest that some birds may disperse from the city to colonize southern rural areas, as predicted by Sol *et al.* (1997), but this needs to be confirmed with the recapture of marked birds.

Our results also show that any estimate of breeding pairs that relies only on the visual monitoring of Monk Parakeet activity around the nest (birds entering or leaving the chamber) can produce biased results. Climbing the trees and checking the chambers to obtain a correction factor of breeding activity seems at present to be the only way to obtain reliable results.

The presence of Monk Parakeets in important agricultural areas (e.g. Baix Llobregat and Segrià) has the potential to lead to problems in the future, as indeed seems already to be the case in the Baix Llobregat, where damage has been reported, in some cases extensive (Senar & Domènech 2001b). This is especially true, given the species' known potential to become a pest locally within its native range (Bucher & Bedano 1976, Bucher 1984, Bucher 1992), and also given the wide spectrum of crops that it may attack (Senar & Domènech 2001b). In view of these considerations, it is important that steps be taken to keep the species under control in the near future, rather than waiting for large populations to become established in such areas, thereby rendering them much more difficult to manage (Stockwell *et al.* 2003).

The variation in types of nest substrate in Catalonia, from nearly exclusive use of palm trees at the first stages of colonization (Sol *et al.* 1997) to a great variety of trees, including widespread native ones such as oaks or pines and human constructions (see also Copete 1998, Larruy 2000, Estrada 2001), suggests that the availability of suitable nest substrate is not a limiting factor for the species in Catalonia. Nevertheless, it is interesting that at certain localities (e.g. eucalyptus in Cubelles) it does seem to show preference for certain types of substrate, as reported by Román-Muñoz (2003) with eucalyptus in Malaga (S of Spain) and cypress *Cupressus sempervirens* on the island of Mallorca. It appears that in the first stages of colonization the parakeet may be highly selective in its nest sites (Sol *et al.* 1997), but that this may change when the preferred substrate becomes less available, as a result of parakeet population increase, or when birds disperse to adjacent areas with different substrate availability. This could be an important factor in any attempts at population control based on the elimination of favoured nest substrates, because it might well simply lead to a change in nest substrate preference. In fact, this control method has been of very limited use in the USA (Neidermeyer & Hikey 1977, van Bael & Pruett-Jones 1996). Anyway the destruction of parakeet nests during the breeding period of the species might reduce the rate of population growth because a large number of eggs and chicks were destroyed (Senar & Domènech 2001a). Other important measures that could

assist in attempts to control the species include banning the importation of Monk Parakeets as pets, and the physical elimination of individuals (Shelgren *et al.* 1975, Temple 1992, Campbell 2000), although the suitability of the possible different control methods in different parts of its Catalonian range should be tested in advance. We would also suggest that any control efforts be preceded by a campaign to raise public awareness of the potential problems of the Monk Parakeet within Catalonia.

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Resum

Estimació de la població de la Cotorra de pit gris *Myiopsitta monachus* a Catalunya

La Cotorreta de pit gris *Myiopsitta monachus* va ser detectada per primera vegada a la ciutat de Barcelona el 1975 i l'any 1994 la població ja havia arribat als 850 individus. L'objectiu d'aquest estudi és actualitzar l'estima de la població de l'espècie a Barcelona i a Catalunya, una informació que és bàsica per preveure l'expansió d'aquesta espècie invasora en el futur. La població postreproductora va ser indirectament estimada durant els mesos de setembre i octubre de 2001 mitjançant el nombre de nius i cambres detectats a tot el territori, i es va estimar la mitjana d'individus que dormien per cambra ($n = 129$ cambres). El resultat de 492 nius (313 a Barcelona) i l'ocupació de 1,52 ($SD = 1,80$) individus per cambra va permetre estimar el nombre de cotorres a Barcelona en 1.441 ± 265 individus i per a tot Catalunya en 2.199 ± 392 . A Barcelona el creixement de la població segueix un model exponencial, amb un temps aproximat de nou anys per doblar la població. La inspecció directa de 146 cambres per detectar activitat reproductora va permetre estimar el nombre de parelles en 610-650 a Catalunya (402 a Barcelona) l'any 2001. La població de l'espècie ha mostrat una important expansió territorial a Barcelona i un important creixement poblacional a les zones del voltant de la ciutat. A Catalunya també s'ha produït una important expansió de l'espècie, que ha colonitzat ja algunes zones d'importància agrícola, la qual cosa pot ser un primer pas per a futurs problemes i aconsella estudiar la possibilitat de controlar la proliferació de l'espècie.

Resumen

Estima de la población de la Cotorra Argentina *Myiopsitta monachus* en Cataluña

La Cotorra Argentina *Myiopsitta monachus* fue detectada por primera vez en la ciudad de Barcelona el 1975, y en el año 1994 la población ya había alcanzado los 850 individuos. El objetivo de este estudio es actualizar la estima de la población de la especie en Barcelona y Cataluña, una información que es básica para prever la expansión de esta especie invasora en el futuro. La población post-reproductora fue indirectamente estimada durante los meses de septiembre y octubre de 2001, a partir del número de nidos y cámaras detectados en todo el territorio, y se estimó la mediana de individuos que dormían por cámara ($n = 129$ cámaras). El resultado de 492 nidos (313 en Barcelona) y la ocupación de 1,52 ($SD = 1,80$) individuos por cámara permitió estimar el número de cotorras en Barcelona en 1.441 ± 265 individuos, y para toda Cataluña en 2.199 ± 392 . En Barcelona el crecimiento de la población sigue un modelo exponencial, con un tiempo aproximado de nueve años para doblar la población. La inspección directa de 146 cámaras para detectar actividad reproductora permitió estimar el número de parejas en 610-650 en Cataluña (402 en Barcelona) el año 2001. La población de esta especie ha mostrado una importante expansión territorial en Barcelona y un importante crecimiento poblacional en las zonas de los alrededores de la ciudad. En Cataluña también se ha producido una importante expansión de la especie que ya ha colonizado algunas zonas de importancia agrícola, cosa que puede comportar un primer paso para futuros problemas y aconseja estudiar la posibilidad de controlar la proliferación de la especie.

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