An evaluation of monk parakeet damage to crops in the metropolitan area of Barcelona

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Abstract

An evaluation of monk parakeet damage to crops in the metropolitan area of Barcelona.— We evaluated damage to commercial crops caused by the monk parakeet, *Myiopsitta monachus,* in the Baix Llobregat agricultural area (1,024 ha) bordering the city of Barcelona, Spain. Average crop loss was 0.4% for tomatoes, 28% for corn, 9% for red plums, 36% for round plums, 37% for pears, 17% for persimmons, and 7% for quinces. Our data show that the potential damage to crops by monk parakeets in this invaded area is now a reality. As a wait–and–see approach is likely to be a more costly strategy in the long–term, policy makers should assess issues such as the extent of damage, feasibility/cost benefit analysis, and public opinion so as to avoid greater damage and loss in the future.

Key words: Monk parakeet, *Myiopsitta monachus*, Damage to crops, Invasive species

Resumen

Evaluación de los daños producidos por la cotorra de pecho gris en los cultivos del área metropolitana de Barcelona.— En este trabajo evaluamos los daños producidos por la cotorra de pecho gris, *Myiopsitta monachus*, en los cultivos comerciales del área agrícola del Baix Llobregat (1.024 ha), adyacente a la ciudad de Barcelona (España). En promedio, las cotorras causaron pérdidas en los cultivos del orden del 0,4% en el tomate, el 28% en el maíz, el 9% en la ciruela claudia ovalada, el 36% en la ciruela claudia redonda, el 37% en la pera, el 17% en el caqui y el 7% en el membrillo. Nuestro trabajo confirma de forma objetiva que los daños potenciales producidos por la cotorra de pecho gris en esta zona invadida son ya una realidad. La pasividad en la gestión ante las especies invasoras a la larga siempre acarrea graves consecuencias. Por lo tanto, los sistemas de detección de daños y la rápida intervención en este tipo de conflictos son herramientas básicas en la gestión para evitar problemas a medio largo plazo.

Palabras clave: Cotorra de pecho gris, *Myiopsitta monachus*, Daños en cultivos, Especies invasoras

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Introduction

The monk parakeet, *Myiopsitta monachus*, native to South America, has invaded several areas in North America and Western Europe in recent decades (Strubbe & Matthysen, 2009). Although the species has long been considered a potential threat to agriculture (Davis, 1974; Bruggers et al., 1998), damage to crops by this species has only been evaluated in countries where the species is native (Mott, 1973; Canavelli et al., 2012, 2014) and in the United States (Tillman et al., 2000). No data are available for Europe (Menchetti & Mori, 2014).

Accurately assessing crop loss by birds is key to developing methods to reduce such damage and to delineate management policies (Bruggers et al., 1998; Strubbe et al., 2011). The metropolitan area of Barcelona holds one of the largest densities of monk parakeets in Europe, with the species invading agricultural areas close to the inner city (Domènech et al., 2003). Our aim was to evaluate crop damage by monk parakeets in the agricultural park of Baix Llobregat.

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Material and methods

We evaluated damage in the Baix Llobregat region, an agricultural area bordering Barcelona city (fig. 1). We focused on the municipalities of El Prat de Llobregat, Viladecans, Gavà and Sant Boi de Llobregat, where vegetable gardens and orchards occupy 10% (1,024 ha) of the area (fig. 1) and where preliminary observations identified monk parakeet activity and crop damage (Domènech et al., 2003). Surveys were carried out in 2001, from June to September when many of the main crops ripen. Furthermore, it is the end of the breeding period and juveniles are also foraging around (Carrillo–Ortiz, 2009), so potential damage can increase. We focused on the most common crops in the area, namely tomatoes and corn, and orchards.

The study area included 146 tomato fields, with an estimated total of 458,751 plants (table 1). Since plants in the fields were perfectly aligned, we estimated the number of plants by counting the number of plants along the perimeter and extrapolating this to the total area. We randomly sampled 26 fields (18% of total fields) for damage. We used a cluster sample approach, dividing the whole study area into various equally sized areas and obtaining a simple random sample from all the clusters. This ensured that the whole area was sampled. Fields were visited when tomatoes were, in general, of good size (> 5 cm) and sufficiently ripe to be palatable. We sampled 15% of the total plants within each of the 26 fields, randomly sampling lines of five plants and surveying all the tomatoes within each line (table 1). We defined lines as contiguous plants parallel to the same furrow. We also estimated the number of tomatoes per plant in each field, by randomly sampling 20 plants within each field and averaging the number of tomatoes among them. Total damage was then estimated by extrapolating the average number of tomatoes per plant to the total of plants and computing on that value the percentage of damage recorded in the sampled units. The percentage of damage was computed within each field and then averaged for all the fields.

The study area contained 17 fields of corn, used for livestock. All these fields were sampled. The estimated number of plants, counting the number of plants along the perimeter and extrapolating it to the total area, was 34,700, of which we sampled 18% (table 1). The area also included fields of popcorn. However, these fields were small (< 20 plants) and were only for farmers' personal use; no damage was recorded on these plants (pers. comm. by farmers), and we did not include them in the analyses. Most plants contained only one cob. Plants were sampled at random in lines of 20 or 50 plants, depending on the size of the field (see below). We sampled an average of five lines of plants per field, this figure varying from two to 10 according to the size of fields and thus, to the length of lines. Fields varied from 120 to 12,000 plants, large fields containing > 1,000 plants and small fields having < 800 plants. No field was available at intermediate values. We considered the size of a field with respect to number of plants rather than to the geometric size because potential damage is proportional to the number of plants rather than to the true size. In the 5 largest fields (> 1,200 plants up to 12,000), we distinguished between exterior (from the fourth line outwards) and interior (from the fourth line inwards) parts. We performed repeated measures ANOVA (RMANOVA) with the % of damage (arcs in square root transformed) as variable response to test whether border and inner plants within each field differed in the degree of damage.

Regarding orchards, the study area contained a total of 191 trees made up of five species (table 1). We randomly sampled 13% of these trees (table 1). For each tree, we randomly sampled two high branches (> 2 m above ground) and two low branches, counting the total number of fruits present and the total number damaged by parakeets. Damage by parakeets was, in general, very conspicuous and unmistakable because of the triangular marks they typically exert on the fruits and vegetables (fig. 2). We considered that a fruit was damaged if it had one or more bites, as any damage at all makes the fruit unsuitable for commercialization. We did not examine damage to fruit on the ground because of sampling difficulties.

Fig. 1. Location of the Baix Llobregat region, within Catalonia (NE Spain), and the four municipalities surveyed. We focused on vegetable gardens (935 ha) and orchards (89 ha), marked in colour on the map, from the map provided at Agroterritori web page. (Detailed data on the use and composition of fields Idescat web page.)

Fig. 1. Localización de la región del Baix Llobregat, en Cataluña (NE de España) y los cuatro municipios estudiados. Nos centramos en los huertos (935 ha) y las huertas (89 ha), marcados en color, obtenidos del mapa disponible en la página web Agroterritori. (Los datos detallados sobre la utilización y la composición de los campos se pueden encontrar en la página web Idescat.)

Table 1. Description of fields and plants sampled to estimate damage to crops caused by monk parakeets in the metropolitan area of Barcelona: Total. Total number of plants/trees; P/t. Plants/tree sampled; Av. Average damage (%); SE. Standard error damage (%); Min. Minimum damage (%); Max. Maximum damage (%); Est. Estimated number of fruits demaged. As for tomatoes and corn, we estimated the total production of the fields in the study area, and additionally provide an estimation of the total damage.

Tabla 1. Descripción de los campos y las plantas muestreados para estimar los daños producidos en los cultivos por la cotorra de pecho gris en el área metropolitana de Barcelona. Calculamos la producción total de tomate y maíz en los campos de la zona de estudio, y proporcionamos también una estimación de los daños totales. (Para las abreviaturas, véase arriba.)

Crop	Total	P/t	Av	SE	Min	Max	Est
Tomato (*Solanum lycopersicum*)	458,751	4,348	0.42	0.22	0	5	36,931
Corn (*Zea mays*)	34,700	6,310	28.1	6.4	0	74	9,748
Red plum (*Prunus domestica*)	150	8	8.8	4.0	0	32	–
Round plum (*Prunus domestica*)	8	2	35.8	29.0	7	65	–
Pear (*Pyrus communis*)	25	6	36.6	7.1	20	69	–
Persimmon (*Diospyros kaki*)	6	6	17.1	3.3	9	29	–
Quince (*Cydonia oblonga*)	2	2	6.5	0.2	6.3	6.7	–

Results

The average percentage of tomatoes damaged per field was 0.4% (table 1). Tomato plants produced on average of 19.2 tomatoes (SE = 3.1; N = 26 fields; 520 plants). Given the total number of plants in the study area (see table 1), this resulted in an estimated total damage of 36,931 tomatoes. However, the percentage of damaged plants per field was not evenly distributed (fig. 3), and the percentage of fields attacked was 38%. When considering only attacked fields, damage rose to 1.1% of tomatoes.

The average percentage of corn cobs damaged per field was 28% (table 1). This resulted in total damage of 9,748 corn cobs (table 1). Damage, however, was not homogeneous. Using paired data, we found that damage was greater in the outer edges of the fields than in the interior areas (exterior: 0.41% (SE = 0.10); interior: 0.19% (SE = 0.08); RMANOVA ($F_{1,4}$ = 15.4, p = 0.02). The percentage of fields attacked was 75%.

Damage to fruit trees varied depending on species, ranging from 6% of quinces to 37% of pears (table 1). Within the same fruit species, damage also varied according to the tree variety, so that while damage to red plums was only 9%, it increased to 36% for round plums (table 1, fig. 2).

Discussion

The monk parakeet is generally considered a pests to crops (Mott, 1973; Canavelli et al., 2012, 2013). However, as estimates of monk parakeet damage to crops in Europe are non–existent, it is difficult to objectively evaluate conflict with farmers (Canavelli et al., 2012). Our data recorded in agricultural areas around Barcelona showed that crop damage by the monk parakeet is not negligible. Damage ranged from mean values of 0.4% to 37%, depending on crop type, with maximum values above 70% in some fields and for some crops. More studies are needed to understand the causes of this variability, such as the possible role of ripening status of the fruits, the presence of deterrent systems for birds, and the distance to breeding colonies (Canavelli et al., 2012). We should emphasize that the breeding population of monk parakeets in the study area was only 120 individuals (Domènech et al., 2003), while the crop area covered 1,024 Ha (fig. 1). Our results therefore support the view that even small populations can affect large areas. Foraging trips from the nearby parakeet population in Barcelona city (estimated around 1,500 individuals in 2001, Domènech et al., 2003) also seem plausible. In effect, in recent years we recorded two individuals originally ringed in Barcelona city centre (Parc Ciutadella) in the Baix Llobregat area (movements of > 10 km) (J. Oliver, pers. comm.). Currently, the local populations in Barcelona city and southern metropolitan areas have risen to > 5,000 birds (Molina et al., 2016), so damage to crops has probably increased.

Similar to findings in previous work (Canavelli et al., 2012), we found damage was more severe in the outer edges of corn fields than in the interior parts of the fields. We also found that some varieties of crops were more badly affected than others: round plums were targeted more than red plums, for example, and popcorn was not attacked at all while other corn varie-

Fig. 2. Examples of crops damaged by monk parakeets in the metropolitan area of Barcelona. The damage by parakeets was in general unmistakable because of the triangular marks they typically exert on the fruit and vegetables. In the case of corn, the monk parakeet is the only bird species able to break through the husk to extract grains: A. Red plums; B. Round plums; C. Pears; D. Quince; E: Tomato; and F. Corn.

Fig. 2. Ejemplos de cultivos dañados por la cotorra de pecho gris en el área metropolitana de Barcelona. En general, los daños producidos por la cotorra eran inconfundibles debido a las marcas triangulares que quedan en las frutas y verduras. En el caso del maíz, la cotorra de pecho gris es la única especie de ave capaz de romper la cáscara para extraer los granos: A. Ciruela claudia ovalada; B. Ciruela claudia redonda; C. Pera; D. Membrillo; E. Tomate; F. Maíz.

ties underwent heavy damage. These observations suggest changes in management principles may be a useful option to reduce parakeet damage, as suggested by Canavelli et al. (2012, 2013).

The economic consequences of damage are also crop–dependent. While in fruits and tomatoes any damaged piece must be discarded, independently of the degree of attack, the severity of the attack on

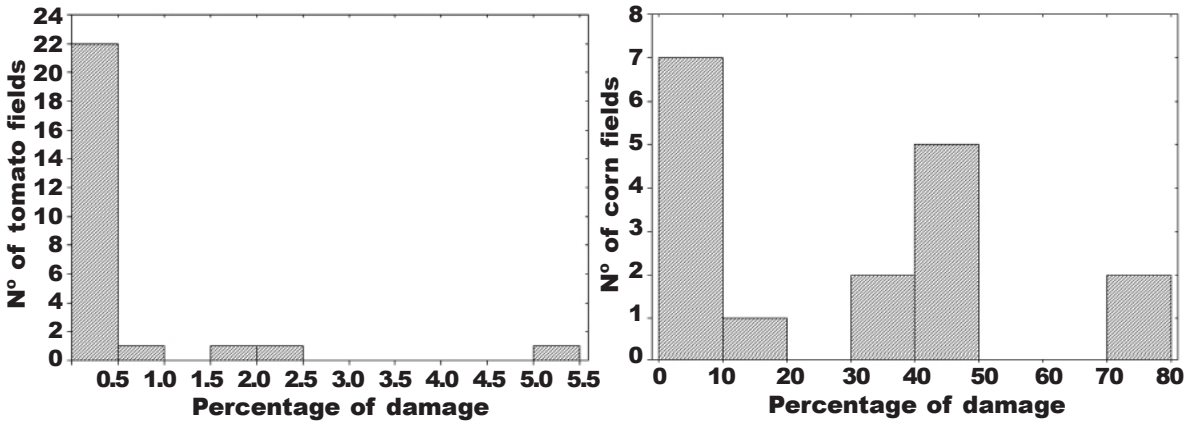

Fig. 3. Frequency distribution of damage to tomato and corn fields in the metropolitan area of Barcelona.

Fig. 3. Distribución de frecuencias de los daños producidos en los campos de tomate y de maíz en el área metropolitana de Barcelona.

corn is determined by the amount of grain left on the cob. Therefore, although corn showed some of the highest frequencies of damage, the economic losses could be lower than for other crops.

Our data show that monk parakeet damage to crops in invaded areas is no longer just 'potential' (Davis, 1974) but has become a real threat. This species is included on a 'black list' of invasive species whose eradication is recommended in particular situations (Capdevila et al., 2006). Our evaluation of crop damage thus contributes to understanding the role of this invasive species in agricultural ecosystems, providing data for future management policies for these populations. As findings suggest a wait–and–see approach is not the solution in such a situation (Conroy & Senar, 2009) policy makers should address issues related to the extent of damage, control feasibility and cost–benefit analysis, and public opinion (Strubbe et al., 2011) in order to control populations of this species and to avoid greater loss and damage.

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