DENSITY OF DOMESTIC PIGEONS (*Columba livia domestica* GMELIN, 1789) IN THE NEW PUBLIC MARKET OF SINCELEJO, SUCRE, COLOMBIA

DENSIDAD DE PALOMA DOMÉSTICA (*Columbia livia domestica* GMELIN, 1789) EN EL NUEVO MERCADO PÚBLICO DE SINCELEJO, SUCRE, COLOMBIA

Carmen Villalba-Sánchez[1], Alejandro De La Ossa-Lacayo[2], Jaime De La Ossa V.[3]

[1] Zootecnista, Maestría en Ciencias Ambientales. Universidad de Sucre – SUE, Caribe, Colombia, e-mail: carmenvillabasanchez@gmail.com; [2] Ecólogo, Magister, Grupo de Investigación en Biodiversidad Tropical. Universidad de Sucre, Colombia, e-mail: alejandrodelaossa@yahoo.com; [3] Ph.D., Grupo de Investigación en Biodiversidad Tropical, Facultad de Ciencias Agropecuarias. Universidad de Sucre, Colombia, calle 13 A N° 20-45, Apto. 402. Edif. El Cairo. Barrio Ford. Sincelejo, Sucre, Colombia, e-mail: jaimedelaossa@yahoo.com

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SUMMARY

The present study determined the population density of *Columba livia domestica* in the new market of Sincelejo, Sucre, Colombia. It is known that, when populations of this species increase excessively, a serious public health problem is created that must be dealt with in order to avoid the transmission of zoonotic diseases. In the city of Sincelejo, especially in the study area, the magnitude of this species' population is unknown, as is the case in many cities in Colombia where this bird has become a serious environmental threat. For ten continuous days, between 06:00 and 08:00, fixed point sampling was used with timed counts; likewise, measurements were taken for the noise levels found in the study area. There were no statistical differences for the population detected in each sampling site for the ten sampling days or the study sites and hours. The estimated population was 257 individuals with a SD= 10.7; the estimated density was 574 ind/km^2; the peak noise levels fluctuated between 68.2 and 83.5 decibels. The calculated density was lower when compared to other studies but higher than the density that has been established as harmful for this species in urban populations. During the sampling hours, the noise levels found in the population were high but tolerable. Population studies of this species in urban environments are necessary in order to implement management plans and programs that prevent the possible proliferation of zoonotic diseases.

Key words: Abundance, Columbiformes, urban environment, Sucre.

RESUMEN

El presente trabajo determinó la densidad poblacional de *Columba livia domestica* en el nuevo mercado de la ciudad de Sincelejo, Sucre, Colombia. Se conoce que cuando las poblaciones de esta especie se incrementan desmedidamente, se convierte en un serio problema de salud pública, que debe ser atendido, para evitar la transmisión de enfermedades zoonóticas. En Sincelejo, especialmente en la zona de estudio, se tenía desconocimiento de la magnitud de su población, al igual que sucede para muchas otras ciudades de Colombia, en donde esta ave es una seria amenaza ambiental. Durante diez días continuos, entre las 06:00 y las 08:00 horas, con conteos cronometrados, se aplicó el método de muestreos en punto fijo; igualmente, se hicieron medidas de los niveles de ruido existente en el área de trabajo. No se determinaron diferencias estadísticas para la población detectada en cada sitio de muestreo, ni durante los diez días de muestreo, ni entre los sitios de trabajo y los horarios. La población estimada fue 257 individuos, con una DS= 10,7, la densidad estimada fue de 574 ind/km^2; los niveles sonoros máximos oscilaron entre 68,2 y 83,5 decibeles. La densidad calculada es menor al compararla con otros estudios, pero sobrepasa la densidad establecida como nociva, para esta especie, en poblaciones urbanas; durante el horario de muestreo, los niveles de ruido que soportó la población se establecen como altos y tolerables. Los estudios poblacionales de esta especie, en ambientes urbanos, se hacen necesarios para poder implementar planes o programas de manejo, que eviten posibles proliferaciones zoonóticas.

Palabras clave: Abundancia, columbiformes, ambiente urbano, Sucre.

INTRODUCTION

The domestic pigeon (*Columba livia domestica*) is a columbiform that has a average size between 30.5 and 35.5cm, with a medium-sized tail that has a blackish tip and a creamy-white base, reddish or pinkish paws, and amber eyes, and that are dark when juvenile. The color of the plumage can vary greatly between individuals and there is no sexual dimorphism between males and females. The base pattern is gray with two large, black bands on the wings, a black band at the tip of the tail, a white rump and purple and green iridescence on the neck. However, the majority of individuals have other colors, from white or whitish with irregular red or black markings on the primary feathers and a white tail. The weight oscillates between 180 and 355g (Del Hoyo *et al*. 1997; Gómez de Silva *et al*. 2005). It is a diurnal species found in natural habitats and nests in coastal cliffs or high inland areas. In urban environments, it tends to congregate in flocks that can number in the hundreds. Habitually, they move, fly, and perch together. They stay on roofs, ledges, drainage ducts, lofts, and attics, where they construct nests of dry branches and grass that are placed on a simple base. The male protects the female and the nest, ensuring the survival of the offspring (Johnston, 1992; Olalla *et al*. 2009).

Reproductively, it is known that, eight to twelve days after mating, the female lays one or two eggs that hatch eighteen days later. The offspring leave the nest at six weeks of age. These short reproductive periods, added to the ability to mate year-round, explain, in part, the abundance of this species' populations (Olalla *et al*. 2009).

According to Del Hoyo *et al*. (1997), this species originated from a wide area of Eurasia and Africa; specifically, its original distribution in Africa was: Cape Verde, Guinea, Mauritania, and Senegambia; in Asia: China: Gansu, Jilin and Shanxi; in Europe: Spain, the Canary islands, Great Britain, Portugal, the Madeira Islands, and the Azores Islands; in the Pacific: Australia and New Zealand (Gómez de Silva *et al*. 2005). This species, also known as the common pigeon or rock pigeon, is considered an introduced species that has been domesticated and raised in homes as an ornamental bird (Escalante *et al*. 1996; Ojasti, 2001; Méndez-Mancera *et al*. 2013).

Nevertheless, after being domesticated in captivity, they have returned to the wild, seeking refuge and food in diverse locations (Méndez-Mancera *et al*. 2013). According to the IUCN, this species is listed as of least concern; it has no special status under the US Migratory Bird Act, the US Federal List, or CITES. However, according to Mathews (2005), it is identified as one of the worst urban birds of the world due to its effects, which include structural damage and zoonotic risks. Bernal *et al*. (2012) concluded that, among the bigger problems caused by pigeons, there is the corrosion caused by the accumulation of excrement, which affects the historical architecture of cities. In addition, this species can carry around 40 zoonotic diseases, with 30 diseases that can be transmitted to humans and 10 diseases that be transmitted to domestic animals, causing public health problems (Pfeiffer & Ellis, 1992; Ordóñez & Castañeda, 1994). Generally, these diseases are transmitted by the dry excrement, through transport by air or direct contact (Pfeiffer & Ellis, 1992; Ordóñez & Castañeda, 1994).

The domestic pigeon is a carrier for more than 60 ectoparasites, which include siphonaptera and mites, possibly contaminating and affecting human health with their feathers and dust. Some of the diseases that are related to pigeons include salmonellosis, psittacosis, cryptococcosis, aspergillosis, listeriosis, staphylococci and dermatosis, among others (Caicedo *et al*. 1996; Toro, 2000; Olalla *et al*. 2009).

Since they group together in large flocks, generally in zones of high human traffic such as plazas or markets, they affect motor and foot traffic. Their nesting in residential roofs produces bothersome noise that can even affect nighttime rest (CONABIO, 2012). In addition, this bird presents a medium risk for airports (Garmendia-Zapata *et al*. 2011).

According to Olalla *et al*. (2009), pigeons have fulfilled a role as messengers along with use in recreation, tourism, therapy and decoration, when the populations were controlled, that is to say: low number of individuals, ideal locations, and optimal health conditions. On the other hand, when they are found in large numbers in urban areas, they become a pest capable of transmitting disease, contaminating food and damaging structures, resulting in large economic losses. The common pigeon has created a serious urban problem, leading to it being called a "rat with wings." This species is considered a harmful vertebrate (CONABIO, 2012). Nevertheless, in Chile, they contribute to the dispersion of some thistle species, whose fruits they consume (Mann, 2008).

In Colombia, there are few studies related to this species (Méndez-Mancera *et al*. 2013) and the current population of most cities is unknown (Baptiste & Múnera, 2010). Villalba-Sánchez & De La Ossa-Lacayo (2014) confirmed that there still exists a lack of information for this species in anthropic environments, which must be remedied for epidemiological and ecological areas to deal with the negative consequences this bird can generate.

The present study determined the population density of *C. livia domestica* in the new market of Sincelejo, Sucre, Colombia, as a first step in creating subsequent guidelines for the environmental management that has become necessary due to the possible effects this bird can generate.

MATERIALS AND METHODS

Study area. This study was carried out in the new public market in Sincelejo, Sucre, Colombia. This market constructed in 2000, is located at 9°17′41´´N and 75°23´11´´W in the south of the city, and has a total area of 44,800m^2, with an open area of 14,000m^2 represented by broad causeways (Figure 1). This area, like in all of Sincelejo, does not have an environmental plan in place for the control of domestic pigeon populations or for the sanitation of said populations.

Sampling. Total sampling was used (Feninger, 1983; Geupel *et al*. 1992; Gregory *et al*. 2004; Torres *et al*. 2006) for ten days in the dry season between the 1st and 10th of January, 2015 in four strategic sites with simultaneous sampling (Figure 1) using open areas where the birds usually look for food. One session was used per day, between 06:00 and 08:00, with three counts at 06:00, 07:00, and 08:00 and one observer per site at a distance of 15m. The study hours were chosen based on the fact that the majority of feeding activity occurs early in the morning (Olalla *et al*. 2009) and that the feeding rhythms are more robust than the locomotion rhythms (Chabot & Menaker, 1992).

According to Verner & Milne (1989), simultaneous and timed sampling in fixed points guarantees the absence of samples moving between the sampling sites, in addition it takes into account the gregarious nature of this species, which demonstrates a high degree of congregation and the permanence of individuals within the groups (Olalla *et al*. 2009). At the same time, during the ten days of the study, the noise levels were measured in the study area with two daily readings at 07:00 and 08:00 using a Svan 971 ® sound level meter.

Figure 1. New Market. The numbers refer to the fixed sampling points (Google earth, free-version 5.0).

Data analysis. The comparison of the density between the sampling sites, study days and hours was carried out with an ANOVA of the repeated measurements and a Kruskal-Wallis test with a significance level of 0.05. Likewise, the gross density was estimated (Krebs, 1989; Zar, 1998; Marques *et al*. 2007), for which the total population was established with the sum of the means of each sampling site multiplied by the total number of sampling sites, for an area of 44,800m^2.

RESULTS AND DISCUSSION

The number of individuals registered per hour and per sampling site can be seen in table 1.

When applying the ANOVA for the repeated measurements, there were no statistically significant differences for the number of individuals in the four sampling sites $F(36, 42.092)=1.3411$, $p=0.17916$; there were also no significant variations in the number of individuals for the sampling sites during the study when the Kruskal-Wallis test was applied: (H (10, $N=$ 11) $=10.00$, $p=0.4405$). When comparing the study hours with the population detected in each of the four sampling sites, no statistical differences were determined with the Kruskal – Wallis test: (H (2, $N=$ 3) $=2.00$, $p=0.3679$.

According to the registered means, there was a population of 257 individuals (SD=10.7). The estimated total density

Table 1. Number of pigeons registered per hour, day, and sampling site for the new market in Sincelejo.

Hour	Day	Sampling site			
		1	2	3	4
06:00	1	65	72	49	81
06:00	2	63	68	54	82
06:00	3	60	72	56	80
06:00	4	59	74	58	81
06:00	5	58	69	55	79
06:00	6	65	63	54	76
06:00	7	62	68	52	75
06:00	8	62	70	60	80
06:00	9	57	68	54	77
06:00	10	56	71	63	81
07:00	1	62	70	55	80
07:00	2	60	72	54	81
07:00	3	54	73	52	79
07:00	4	53	65	53	78
07:00	5	60	64	49	75
07:00	6	62	66	48	80
07:00	7	65	69	47	81
07:00	8	60	66	52	74
07:00	9	58	71	55	74
07:00	10	56	72	53	79
08:00	1	49	70	52	74
08:00	2	49	65	55	73
08:00	3	47	62	56	72
08:00	4	60	62	59	71
08:00	5	63	63	52	75
08:00	6	60	68	51	72
08:00	7	49	65	49	74
08:00	8	50	66	47	78
08:00	9	55	69	45	79
08:00	10	54	97	50	80
Mean		58	69	53	77
SD		5	6	4	3

was 57.36ind/ha. The density seen in this study was lower than the range of 75 to 225ind/ha determined for the city of Buenos Aires, Argentina (Feninger, 1983), but higher than the values reported by Senar & Sol (1991) for Barcelona, Spain, where 9.78ind/ha were seen with a non-stratified census along with a range of 8.14 to 28.49ind/ha with stratified sampling, without a correlation factor and with a correlation factor, respectively. Nevertheless, a density over 4ind/ha is considered harmful and presents a serious environmental problem; however, this number can vary according to the environmental characteristics of the location (Botanical on line, 2014).

In nature, the values vary notably. In Spain, the Proyecto Alas (Wings Project) by Nerpio (2013) estimated a density of 0.006ind/ha, which agreed with Olalla *et al*. (2009) and Bernal *et al*. (2012), who regarded this species as invasive, one that had successfully established itself in urban environments due to the fact that it had encountered suitable shelter and available food sources in these areas. Furthermore, according to Johnston (1992) and Olalla *et al*. (2009), the relative absence of predators has allowed large-scale increases in populations, as seen in the present research and in similar studies in urban zones (Feninger, 1983; Senar & Sol, 1991). The environmental conditions of a location influence the population abundance (Olalla *et al*. 2009; Bernal *et al*. 2012); the new market in Sincelejo offers food that enables a comparatively elevated density as seen in this study, which also occurs in other locations in this city, as well as in other cities in Colombia and the world (Gómez de Silva *et al*. 2005; Mann, 2008; Bernal *et al*. 2012).

The noise levels mainly result from automobiles. In the sampling hours and in the four study sites, the noise levels were similar and oscillated between 68.2 and 83.5 decibels. The noise level found in the present study area does not disturb the activity of the pigeons despite the high level. Feninger (1983) reported that the noise from motorized vehicles in a study area reached values between 80 and 110 decibels without provoking visible reactions in the mentioned species, which agrees with the results of the present study.

Taking into account the fact that *C. livia domestica* is regarded as a pest species that generates various negative effects, especially on human health (Pfeiffer & Ellis, 1992; Ordóñez & Castañeda, 1994; Bernal *et al*. 2012), recording its density, especially in areas such as public markets, is a priority for environmental management, which has become necessary for urban populations (Semarnat, 2009).

Without a doubt, the high population density that was recorded in the present study for the public market, a place that mostly contains foods, led to the conclusion that this population could have a large, negative impact on sanitation, especially since there are no control plans or population management strategies in place.

This study led to the recommendations that, in general, population control measures that are based on eliminating individuals are not very effective, rather, as indicated by Senar *et al*. (2009), it is better to focus on control methods based on the limiting factors of this species, that is, the availability of food and nesting areas. In order to make elimination an effective method, at least 30% of the population must be sacrificed (Senar *et al*. 2009).

For example, in Perugia, Italy, the pigeon population was reduced by 23% in one year by simply closing the ventilation openings in buildings with metal sheeting, thereby reducing the availability of nesting areas (Ragni *et al*. 1996). In Basel, Switzerland, controlling the amount of food offered by citizens reduced the pigeon population by 50% in one year (Haag–Wackernagel, 1995). In both cases, low-cost measures were taken that were effective and that could be applied to the new public market of Sincelejo.

Conflicts of interest: This manuscript was prepared and revised with the participation of all of the authors, who declare that there are no conflicts of interest that would affect the validity of the present results.

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