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Differential risk perception of rural and urban Burrowing Owls exposed to humans and dogs

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ABSTRACT

Urban areas expose wildlife to an array of novel predators, amongst which, humans and dogs are highly frequent. Thus, wild animals living in urban areas are forced to invest more time and energy in defence behaviours, which depend on how the risk is perceived and assessed. We experimentally tested whether Burrowing owls coming from rural and urban habitats showed differences in behavioural responses when facing humans and domestic dogs. We measured flight initiation distances (FIDs), nest returning, and aggressiveness level when owls faced a human and a human with a dog walking towards them. Our results showed that urban owls recognise a human with a dog as a greater threat than a human alone, thus indicating that fear of domestic animals should be considered as affecting owls' settlement in cities and towns. On the other hand, rural owls perceived human and dogs as similar threats, but showed higher FIDs, less aggressiveness, and lower tendency to return to the nest than urban owls in both treatments. These findings emphasize the importance of modified habitats in modelling the response of urban and rural owls to predators and represent another step in the explanation of how wild animals assess and respond to threats associated with living in urbanized environments.

1. Introduction

Human activities often have negative impacts on wildlife. Effects are diverse, ranging from local extinction to changes in behaviour, life history traits, and physiology (Ditchkoff et al., 2006; Møller, 2008; Partecke et al., 2006; Tuomainen and Candolin, 2011). The capacity of animals to survive in human disturbed habitat depends on their abilities to cope with and adapt to the resulting new conditions (Carrol et al., 2007). One of the main consequences of human population growth is the increase of urbanized areas (Vitousek et al., 1997). Urban development has significant effects on wildlife density, distribution and behaviour (Palmer, 2003; Shanahan et al., 2014). While a great number of local species reduce their abundance and occurrence in response to increasing urbanization, a smaller number can survive in these highly disturbed areas. Thus, wildlife in urban habitats are usually tolerant species that are able to cope and adapt to high levels of human stimuli (Samia et al., 2015).

The capacity to live in urbanized areas has been widely studied in several bird species (e.g. Mikula, 2014; Partecke et al., 2006; Sol et al., 2013). Such studies show that these species perceive urban habitats as ecological opportunities, which allow them to proliferate and expand their distributions (Sol et al., 2013). Usually modification of behaviour (i.e. by learning) is the first response to habitat changes. Thus, the ability to adjust their behavioural repertory rapidly to changing conditions (i.e. altered habitat selection, changes on vigilance rate, and changes on resource use) ultimately prevents individuals from suffering fitness losses (Sih et al., 2010; Sol et al., 2013; Tuomainen and Candolin, 2011).

Since species living in cities and towns are regularly confronted by humans, risk perception is an important aspect of their behaviour, given that human represents a form of predation risk (Frid and Dill, 2002; Jiménez et al., 2013). However, human presence might be also perceived as nonthreatening if a species can habituate to frequent harmless confrontations reducing their responses through a learning process (Rankin et al., 2009). Alternatively, a growing body of literature suggests that, within a population, only those individuals that are preconditioned to be tolerant to novel settings and thus capable of dealing with their challenges (e.g. constant human presence), succeed and thrive in

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habitats with high human influence (Carrete and Tella, 2010, 2013; Sih et al., 2012; Sol et al., 2013). However, most behaviour is determined by a mixture of both innate (genetically fixed) and learned features and the combination that best tracks and cope with environmental changes will result in the optimal behaviour phenotype (Brown, 2012).

In addition to increased human density, urban landscapes show considerable variation in assemblages of predators compared to rural and native landscapes (Møller and Ibañez-Alamo, 2012). While urban habitats contain a high density of domestic animals that prey on wildlife [e.g. cats (*Felis catus*) and dogs (*Canis lupus familiaris*); Møller and Ibáñez-Álamo, 2012; Randler, 2006], rural habitats hold a larger diversity of native predators (Shanahan et al., 2014) such as carnivores and raptors (Ditchkoff et al., 2006; Møller and Ibañez-Álamo, 2012). The change in predator assemblages between rural and urban areas could have important consequences for the development of anti-predatory behaviours (Mikula, 2014; Møller and Ibañez-Álamo, 2012). In this sense, animals should be able to recognise if novel predators are real or potential threats and only display an anti-predatory behaviour when it is appropriate to do so to avoid energetic losses (Lima and Dill, 1990).

Birds usually react to predators by adopting escape behaviours (Blumstein, 2014; Møller and Ibañez-Alamo, 2012), and such behaviours provide insight about species risk-perception. Flight initiation distance (FID), which is defined as the distance at which a bird flies due to the presence of an approaching stimulus, provides a standardized estimate of the risk that an individual is willing to take when facing a real or potential predator (Blumstein, 2006). This kind of stress response is costly if it is elicited frequently. For that reason, if human and domestic animals are perceived as a threat and prompt birds to fly whenever they are detected, living in urban areas might become energetically too costly and urban environments might attract individuals with reduced sensitivity to frequent stressors (Kenney and Knight, 1992). Thus, the study of the variations in risk perception measured as FID provides information about the ability of animals to adapt to changing environmental conditions such as those emerging in urban environments (Blumstein, 2006; Møller, 2008).

The Burrowing owl (*Athene cunicularia*) is a ground nesting raptor that can be found across American open landscapes such as treeless plains, grasslands, prairies, savannah, golf courses, road verges, airports, and vacant lots on residential and periurban areas (Poulin et al., 2011). This owl, at its southernmost distribution in central Argentina, is a year-round resident and excavates its own burrows (Marks et al., 1994). Mating pairs are territorial, highly conspicuous in the daylight and are easily located near their nests (Marks et al., 1994). The behavioural response of this owl to a predator stimulus can be easily measured by assessing an array of stereotyped behaviours, such as retreating underground in the burrow, flying away, making alarm calls, adopting threatening postures, diving attacks (Coulombe, 1971; Fisher et al., 2004; Thomsen, 1971). The analysis of the behavioural response to predators by Burrowing owls inhabiting urban and rural areas might provide valuable information to help understand the success of this species dwelling in urban habitats.

Although humans and dogs can be both perceived as threats for wildlife, it has been argued that most human activities represent potential, non-threatening stimuli (Ditchkoff et al., 2006; Steven et al., 2011), whereas dogs may represent a real threat with negative effects on birds (Banks and Bryant, 2007; Mainini et al., 1993). We hypothesize that the ability of the Burrowing owl to succeed in urban habitats is explained in part by its capacity to discriminate between real and potential threats. To test this, we designed a study to assess the effect of the type of predator (pedestrian and dog) on risk perception (i.e. estimated by their behavioural response) of Burrowing owl's individuals coming from rural and urban habitats. We predict that if owls are able to differentiate between frequent stressors and turn down their response (habituation hypothesis) then urban owls, which are exposed to a higher encounter rate of potential and real predators, would have lower responses (i.e., shorter FIDs, less aggressiveness) compared to rural owls. Alternatively, if owls living in urban habitats are the result of a selection process, then a fixed phenotype would be observed (i.e. shorter FIDs, higher aggressiveness levels). In addition, since predator type may be translated into the type of behavioural response elicited, we predict that the anti-predatory responses by Burrowing Owl will vary depending on the predation risk perception that each predator stimulus represents.

2. Material and methods

2.1. Study area

The study was conducted in urban and rural habitats in the southeastern Pampas region from Argentina. Different urban localities and rural areas were sampled between Mar Chiquita village (37° 44.6′ S; 57° 25.7′ W) and Mar del Plata city (38° 00.8′ S; 57° 33.1′ W). This area, dominated in the past by dunes, wetlands and grasslands, is nowadays a mosaic of different land-uses where agroecosystems (grazing fields, croplands, and pasturelands) and urbanizations dominate the landscape (Pedrana et al., 2008). The urban area encompasses 7950 ha and holds more than half a million inhabitants (366.6 habitants per km^2). During summer months (December–March), the study area receives between 2 and 3 million tourists (Bouvet et al., 2005), thus being the most populated coastal area in Argentina (Juárez and Mantobani, 2006). The climate of this region is mesothermal with the lowest monthly temperature in July (mean = 6.7 °C) and the highest in January (mean = 21.1 °C). Maximum rainfall occurs in January (mean = 124.2 mm) and minimum in June (mean = 21.5 mm) (Servicio Meteorológico Nacional). In this area, Burrowing owls inhabit rural habitats, sand dunes, and urban habitats (Cavalli et al., 2014a; Pedrana et al., 2008). In our study, we defined urban habitats as built-up areas where owls will regularly encounter humans. We consider as urban those owls which nests were surrounded by more than 35 houses in a radius of 200 m. Rural habitat comprised open farmlands, grazing fields, pastures, and croplands. Distance from owl nests to houses in rural habitats was always greater than 1 km. Thus, the rate of encounter with humans is greater for urban owls.

2.2. Sampling design and data collection

Sampling was carried out from late September to mid-October of 2012 and 2014. Prior to data collection, we located Burrowing owl nests by travelling the areas on foot or vehicle and visually detecting adult birds on their burrows in rural and urban habitats, and by on-line censuses (Cavalli et al., 2014b; Conway et al., 2008).

We monitored 17 nests (8 at rural and 9 at urban habitats) in 2012 and 19 nests (6 at rural and 13 at urban habitats) in 2014. We considered a nest occupied by owls if we saw either an owl or a sign of an owl (e.g. whitewash, pellets, manure, or other lining materials) at the nest burrow entrance. Rural nests were located in large extensions of grazing fields, pasturelands or croplands where human presence is extremely low since most areas belong to private properties and pedestrian are not allowed to walk freely through these fields. Urban nests were located in private and public gardens and parks where human presence is frequent.

We measured different behavioural indicators of nest defence: FIDs, escaping distance (the distance at which the owl flies away), owl nest returning (whether the owl returns to the nest), and aggressiveness of defence. We obtain FIDs measurements by walk-