The selection of anthropogenic habitat by wildlife as an ecological consequence of rural exodus: empirical examples from Spain

A. Martínez–Abraín, X. Ferrer, J. Jiménez, I. C. Fernández–Calvo

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Abstract

The selection of anthropogenic habitat by wildlife as an ecological consequence of rural exodus: empirical examples from Spain. The increasing urbanization of the landscape is a major component of global change worldwide. However, it is puzzling that wildlife is selecting anthropogenic habitats despite the availability of apparently high–quality semi–natural (i.e. less intensively modified) habitats. Definitive explanations for this process are still lacking. We have previously suggested that colonization of the urban habitat is initially triggered by ecological processes that take place outside urban areas as a consequence of past rural exodus. Here we present a diverse array of examples of selection of several types of anthropogenic habitat by wildlife in Spain (including transportation infrastructure, human–exclusion areas, urban areas under construction, cities, reservoirs, quarries and landfills) in support of this idea. Wildlife is moving out of its historical ecological refuges and losing fear of harmless urban humans. Mesopredators are rebounding by mesopredator release, due to ceased human persecution, and shrubs and trees are claiming former agricultural habitats. Together, these factors force many species to move to urbanized areas where they find open habitats, food associated with these habitats, and protection against predation. Hence, the classical balance of costs and benefits that takes place once inside urban areas, would actually be a second step of the process of colonization of urban areas. A better understanding of the initial triggers of urban colonization could help us increase the biological value of human–made habitats for wildlife in the future.

Key words: Changed human attitudes, Mesopredator release, Loss of fear, Human depopulation, Shrub and tree encroachment, Urban areas

Resumen

La fauna silvestre selecciona hábitats antropógenos como consecuencia ecológica del éxodo rural: ejemplos empíricos de España. Uno de los principales componentes del cambio global en todo el mundo es el aumento de la urbanización del territorio. Sin embargo, es desconcertante que la fauna silvestre seleccione hábitats antropógenos a pesar de que existan hábitats seminaturales (modificados con menor intensidad) aparentemente de buena calidad. Todavía no existe una explicación definitiva para este proceso. Se ha sugerido con anterioridad que la colonización de los hábitats urbanos se produce en una primera fase a causa de procesos ecológicos que tienen lugar fuera de las zonas urbanas, como consecuencia del éxodo rural del pasado. Para respaldar esta idea, en este estudio presentamos una serie de ejemplos en los que diversas especies de fauna silvestre de España seleccionan varios tipos de hábitats antropogénicos (infraestructuras de transporte, zonas de acceso restringido, zonas urbanas en construcción, ciudades, embalses, canteras y vertederos) por razones asociadas al despoblamiento del rural. La fauna silvestre está saliendo de sus refugios ecológicos y está perdiendo el miedo a los humanos inofensivos de las zonas urbanas. Los mesodepredadores están repuntando debido a la liberación del mesodepredador y al cese de la persecución humana, y la vegetación espontánea está volviendo a colonizar los antiguos hábitats agrícolas. Estos factores obligan a muchas especies a desplazarse a zonas urbanas donde encuentran hábitats abiertos, alimento asociado a estos hábitats y protección contra la depredación. Por consiguiente, el balance de costes y beneficios en el seno de las zonas urbanas, sería en realidad un segundo componente del proceso. Entender mejor los factores iniciales que desencadenan la colonización del medio urbano podría ayudarnos a dar más valor biológico para la fauna silvestre a los hábitats creados por los seres humanos.

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Alejandro Martínez–Abraín, Universidade da Coruña, Facultade de Ciencias, Campus da Zapateira s/n, 15008 A Coruña, Spain.– Xavier Ferrer, Department of Evolutionary Biology, Ecology, and Environmental Sciences, Faculty of Biology, Universitat de Barcelona, Spain; Biodiversity Research Institute (IRBIO), Universitat de Barcelona, Av. Diagonal 643, 08028 Barcelona, Spain.– Juan Jiménez, Servicio de Vida Silvestre, Generalitat Valenciana, Ciutat Administrativa 9 d'Octubre, Torre 1, c/ Democracia 77, 46018 Valencia, Spain.– I. C. Fernández–Calvo, Sociedad Española de Ornitología (SEO/BirdLife), Delegación Territorial de Cantabria, Avenida de Chiclana 8, 39610 Astillero, Spain.

Corresponding author: A. Martínez–Abraín. E–mail: a.abrain@udc.es

Introduction

One of the components of global change is the increasing urbanization of the landscape (Gil and Brumm, 2014; Murgui and Hedblom, 2017), with likely negative consequences for many animal species. Surprisingly, wildlife is selecting anthropogenic habitats made with no wildlife conservation purposes, even where natural or seminatural habitats of apparent high–quality are available (Martínez–Abraín et al. 2020). An indirect proxy of this trend is the increasing number of papers devoted to the study of the use of anthropogenic habitats or human landscapes by wildlife during the last decade, compared to the general growth of the study of wildlife ecology (fig. 1). The causes behind this phenomenon are not well known.

To date, attempts to explain the presence of wildlife in anthropogenic habitats have focused on analysing the main anatomical correlates of species living in urban areas, such as brain size (Sayol et al., 2020) or on analysing the balance between costs and benefits of urban life (Møller and Díaz, 2018a, 2018b). Loss of fear to humans has also been identified as an instrumental feature of species or populations living in urban areas (Guerting et al., 2012; Sih, 2013).

We analyse here a diverse set of Iberian case studies of selection of anthropogenic habitats by wildlife with the aim of providing empirical support to the idea that colonization of anthropogenic landscapes is, in first instance, an ecological consequence of the human depopulation of the rural areas in the near past. This process has led to loss of open habitat by shrub and tree encroachment, departure from ecological refuges, loss of fear to humans and importantly to mesopredator release, due to lack of direct persecution of wildlife by humans (Martínez–Abraín et al., 2009, 2019, 2020). According to Flannery (2018), in Europe humans have been substituting the role of lost Pleistocene top–predators (including lions, hyenas, leopards, bears and saber–toothed cats) during the last 14,000 years (long before the advent of agriculture) and hence the current lack of persecution of intermediate predators by humans is expected to have profound consequences on ecosystems. Already Møller and Ibáñez–Álamo (2012) showed that predation avoidance is related with colonization of urban environments. More recently, Samia et al. (2017) and Jokimäki et al. (2020) also revisited the link between urbanization and lower predation risk.

Selection of anthropogenic habitats: case–studies

Transportation infrastructure

Wild rabbits (*Oryctolagus cuniculus*) are a keystone prey in Mediterranean ecosystems. Conservation of some charismatic threatened predators in Spain, such as the Iberian lynx (*Lynx pardinus*) and the Spanish imperial eagle (*Aquila adalberti*), depend on the availability of healthy rabbit populations (Delibes–Mateos et al., 2007, 2008). However, wild rabbits have been jeopardized by infectious diseases. They have also experienced habitat loss due to shrub and tree encroachment in open agricultural land, after rural exodus started in the country six decades ago. Many attempts to restock rabbit populations have been implemented but have failed to reverse the decline in natural areas (Carro et al., 2019). On the contrary, wild rabbits thrive in some anthropic areas, building communal dens in apparently low–quality places such as the banks of roads and railways or the median strips of highways (Planillo and Malo, 2017), even inside large cities such as Madrid. Two explanations are possible for this puzzling situation: a) fenced highways and high–speed railways provide protection against predators, and b) road and highway verges create open areas where grass grows. Indeed, a lot of energy is put annually into maintaining communication infrastructure verges free of tall vegetation, and this routine is exploited by rabbits to obtain food. Human services for the maintenance of roads and highways (often paradoxically called 'conservation services', Martínez–Abraín, 2019) could have great conservation value within a landscape matrix in which open land is increasingly scarce due to shrub and tree encroachment. This is not only true for vertebrates (rabbits, corvids, birds of prey) (Dean and Milton, 2009), but also for plants and invertebrates (Jakobsson et al., 2018). Another animal species commonly associated with road verges in Spain is the white stork (*Ciconia ciconia*). It selects the metal poles of traffic signals and electronic signboards within highways to place its nests (sometimes close to traffic) in spite of the abundance of trees in the surroundings. Causes behind this seemingly poor habitat selection are most likely related to avoidance of predators. Scavengers are another animal group that is clearly favoured by communication infrastructures. For example, both black and red kites (*Milvus migrans* and *M. milvus*), and sometimes griffon vultures (*Gyps fulvus*), as well as many corvid species, take advantage of roads, highways and railways and their associated vehicles that act as novel predators, providing carcasses (Morelli et al., 2014). This is not free of risk as scavenging birds are sometimes accidentally run over (Husby, 2016).

Airports and other human exclusion zones

Bird strikes are a growing threat to the safety of aviation nowadays. Great efforts are devoted to creating bird–free areas around major airports (DeVault et al., 2013; Pfeiffer et al., 2020). Paradoxically, airports themselves may generate good conditions for the occurrence of some wildlife species, especially grassland birds (Blackwell et al., 2013). Airports, being fenced open areas, with low densities of potential predators, and highly controlled human presence, favour the establishment of ground–nesting birds. In the case of Spanish airports, the list of bird species present therein includes some rare species such as little bustards (*Tetrax tetrax*), stone curlew (*Burhinus oedicnemus*), along with 50 others (Zugasti, 2004). Predator and human exclusion also fosters the establishment of dispersing and migrant birds (Milne, 2006), as well as the presence of bird roosts at airports. Unintended

positive effects of human exclusion by fencing also occur in other anthropogenic habitats such as military training camps. One remarkable case is that of recolonizing wolves in Germany. Their success is due to the use of army land property, in a country with a human population density high (233 inhabitants/km^2) (Reinhardt et al., 2019).

Urban areas under construction

Ground–nesting waterbird species are associated with the initial stages of ecological succession in wetlands and dune fields for nesting. They need ample visibility and low vegetation cover to avoid predators (Gómez–Serrano and López–López, 2014, 2016). Once vegetation grows, they need to move elsewhere for breeding, favouring the evolution of a nomadic behaviour (Martínez–Abraín et al., 2003). The occurrence of herbivory in the past (by domestic livestock or extirpated large wild ungulates) likely favoured the long–term occupancy of breeding habitats by ground–nesting birds. This is the case for little terns (*Sterna albifrons*) or Audouin's gulls (*Ichthyaetus audouinii*), originally linked to river deltas, dune fields, beaches and salt marshes. Surprisingly, in recent years these species have colonized port docks, during their construction and even fenced industrial areas (fig. 1s in supplementary material). Nowadays, 40 % of the world population of Audouin's gull breeds in ports and harbours, whilst populations of Audouin's gulls from small Mediterranean islets have declined rapidly (Martínez–Abraín and Jiménez, 2016; Oro, 2020). These open anthropic habitats may functionally resemble newly formed land–bridge islands. Just like their original unstable habitats, areas under construction are temporary, and hence ground–nesting birds can only use them over a limited time. Another example is that of little ringed plovers (*Charadrius dubius*) that have been reported to nest successfully in parking lots, landfills and plots of land during the initial phases of urban development (Fernández–Calvo and González–Sánchez, 2008) (fig. 1s in supplementary material). Paradoxically, plovers performed much worse in some sites specifically restored for the species by conservation practitioners than in highly modified areas (Fernández–Calvo and González–Sánchez, 2008). Plovers were able to occupy human–made sites during several seasons as long as that they had a base made of cement, concrete, stone or asphalt, preventing shrub and tree encroachment. If the base substrate was softer and plants colonized the area, plovers rapidly deserted the site. Little ringed plovers may also use flat roofs for nesting (Baumann, 2006). Roofs are readily used by waterbirds as substitutes of original habitat to nest when the available habitat is of lower quality (e.g. there is a high risk of nest predation). In fact, several species of terns use flat roofs for nesting worldwide (Fisk, 1978; Fernández–Canero and González–Redondo, 2010). In Europe, there are records of common terns (*S. hirundo*) nesting on roofs in Finland, Estonia, United Kingdom, Ireland, Netherlands and France (Source: https://www.birdlife.org/europe–and–central–asia).

Cities

Cities have become excellent foraging and breeding grounds for many bird species. The long list of species now making use of cities in Europe cannot be fully approached in our analysis. We cite here only the paradigmatic case of the peregrine falcon (*Falco peregrinus*) that started colonizing cities as early as the 19th century (Ferrer, 2016) and is now present in a large number of large towns and cities worldwide (see table 1s in supplementary material for a summary of major cities used in Spain). Some threatened bird species are now only found in cities, as is the case of the Hispaniolan amazon (*Amazona ventralis*) and the Hispaniolan parakeet (*Psittacara chloropterus*) in the Dominican Republic (Luna et al., 2018), both of which have benefited from the non–aggressive attitude of today's city dwellers, contrary to their intense persecution in rural areas. Importantly the first Special Protection Areas created in urban centres in Spain were declared in November 2020 for the protection of lesser kestrels (*Falco naumanni*).

Reservoirs

Reservoirs flood vast areas and interrupt the natural flow of rivers. Hence they are a threat for biodiversity conservation. However, reservoirs can also provide unintended benefits for many animal species. This delicate balance leans on the side of conservation when they are built on land that has low value for terrestrial fauna or/and where natural wetlands are scarce or absent. Some 880 reservoirs (functionally equivalent to lakes) were built during the 20th century throughout Spain, where natural lakes are rare. The population expansion of some formerly scarce species in the Iberian Peninsula, such as great crested grebes (*Podiceps cristatus*) and Eurasian otters (*Lutra lutra*) is linked to some extent to reservoirs (see e.g. Llinares et al., 2019). For example, in the Mediterranean river basins of Spain, reservoirs with signs of otter presence increased from 32 % in 1994–1996 to 77 % in 2015–2016, whereas the confirmed presence in rivers was 59 % and 53 % respectively, with a similar sampling effort in both periods (see sources in Martínez–Abraín and Jiménez, 2016). Likewise, the occurrence of Great crested grebes breeding in the Comunidad Valenciana (Eastern Spain) has greatly increased in inland reservoirs over the last few decades. In 1984, no grebes were known to nest on inland reservoirs (the bulk of the population was present at natural coastal wetlands), but in 2017 ca. 30 % of the breeding pairs in the region were reservoir birds (Source: unpublished data; http://www.agroambient.gva.es/es/web/biodiversidad). Large artificial irrigation ponds located in semi–arid regions of Spain are known to play a relevant substitutive role for many aquatic bird species from coastal wetlands (see e.g. Sánchez–Zapata et al., 2005) as do major reservoirs. Osprey (*Pandion haliaetus*) have also discovered the advantages of this novel habitat as a food provider (Casado and Ferrer, 2005). Counts of wintering osprey in Spain between 1984 and 1996 showed that out of 522 individuals, 49 (9 %) were detected in reservoirs

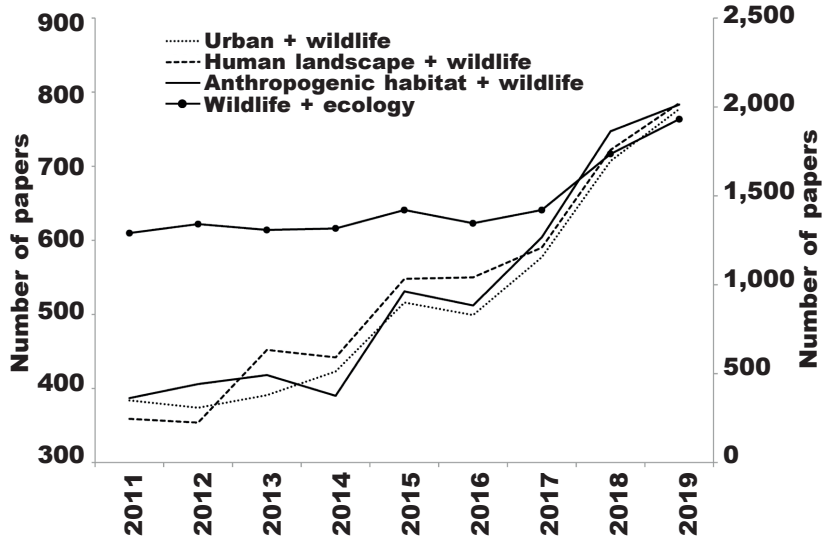

Fig. 1. Number of papers detected by a literature search in the Web of Science (2010–2020) under the headings 'urban + wildlife', 'human landscape + wildlife' and 'anthropogenic habitat + wildlife', compared to a control search under 'wildlife + ecology'.

Fig. 1. Número de artículos encontrados en una búsqueda bibliográfica en la Web of Science (2010-2020) con los temas "fauna silvestre + urbano", "paisaje humano + fauna silvestre" y "hábitat antropogénico + vida silvestre" en comparación con una búsqueda de control de "vida silvestre + ecología".

(Migres Foundation, unpublished information). More recent data (winter 2016–17) suggest an increase in the use of reservoirs by wintering osprey of up to 17 % (Martín et al., 2019).

Quarries

Quarries are intrinsically associated with the destruction of habitat as rock or sand extraction is a consumptive activity. However, quarries can bring unintended benefits for wildlife as they generate artificial cliffs that can be used by obligate and facultative cliff–nesting birds in areas where cliffs are absent, scarce, have low quality or have become saturated. This is, for example,the case of ravens (*Corvus corax*), a species that used to nest in coastal cliffs in western France, most likely due to human persecution during the second half of the 20th century. But starting in the 1970s, ravens began to leave their coastal ecological refuges and colonize mainland quarries in the region, so that by 2003 ca. 45% of the population was nesting in quarries (Quelennec, 2004). In northern Spain it was observed that 73 % of abandoned quarries and 39 % of active quarries (n = 73) were occupied by birds of 12 species, including corvids and diurnal (three species) and nocturnal raptors (four species) (Castillo et al., 2008). Interestingly, the authors reported that several projects addressing the environmental restoration of quarries had negative consequences for wildlife. Limestone quarries in the Mediterranean side of the Iberian Peninsula are readily colonized by cliff–nesting songbirds such as black wheatear *Oenanthe leucura* and blue rock thrushes *Monticola solitarius*. These species currently have a declining trend in NE Spain due to the abandonment of traditional rural practices and shrub and tree encroachment (Prodon, 2020). However, the proliferation of quarries in recent decades has created suitable habitat and most territories are now located in coastal quarries (Noguera et al., 2014). Sand quarries provide good substitution habitats for the collared sand martin (*Riparia riparia*) and European bee–eaters (*Merops apiaster*). For example, out of 132 collared sand martin colonies detected at Comunidad Valenciana during 2010–2018, 51 % were found in sand quarries, 21 % in excavations for construction purposes and 20 % in artificial walls. Only 8% of the colonies were located in natural substrates. Interestingly, all collared sand martin colonies in sand quarries were located in active quarries (Servicio de Vida Silvestre, 2019) suggesting predator avoidance as a major driver of selection besides the scarcity of suitable habitat.

Landfills and scavenging wildlife

Landfills are increasingly used by many species to obtain food (Oro et al., 2013; Meffert, 2017). Small landfills were traditionally used in Spanish rural areas by scavenging raptors, corvids and canids (foxes and wolves), whereas large city landfills started being used in mass by gulls and other bird species from the 1970s on. The four major landfills around Madrid

Table 1. Summary of examples analysed in the text of selection of anthropogenic habitats by wildlife and likely main causes of habitat selection.

Tabla 1. Resumen de los ejemplos analizados en el texto de selección de hábitats antropógenos por la fauna silvestre y principales causas probables de la selección del hábitat.

Type of anthropogenic habitat	Species affected	Benefits for wildlife
Transportation infrastructure	*Oryctolagus*, *Ciconia*, *Milvus*, *Gyps*, Corvids	Anti–predatory defense Food
Airports and other human–exclusion areas	*Tetrax*, *Burhinus*	Anti–predatory defense
Urban areas under construction	*Sterna* spp., *Larus* spp., *Charadrius*	Anti–predatory defense
Cities	*Falco*, *Psittacara*, *Amazona*	Food Defense from rural people Anti–predatory defense
Reservoirs	*Lutra*, *Pandion*, aquatic birds	Food
Quarries under exploitation	*Corvus*, *Oenanthe*, *Monticola*, *Riparia*, *Merops*	Anti–predatory defense
Landfills	*Larus*, *Bubulcus*, *Gyps*, *Aegypius*, *Neophron*	Food

city are used on a daily basis during the winter by up to 65,000 black–headed gulls (*Larus ridibundus*) (Del Moral et al., 2002). Over the years they have been discovered as food sources by other species and now represent a major food source for black and red kites, white storks, cattle egrets (*Bubulcus ibis*) and even griffon (*Gyps fulvus*) and black vultures (*Aegypius monachus*) (fig. 2s in supplementary material). The Spanish population of white storks grew from ca. 7,600 pairs in 1995 to ca. 31,000 pairs in 2004, to a large extent, due to the use of landfills as foraging grounds (Molina and Del Moral, 2005). White storks may nest inside and around landfills on poles, constructions and antennas, what might be seen as an optimal cost/benefit situation (fig. 2s in supplementary material). Landfills and reservoirs are also connected by daily activity of birds. For example, more than 10,000 lesser black–backed gulls (*Larus fuscus*) overnight at the Santillana reservoir around Madrid in winter (Del Moral et al., 2002).

Selection of anthropogenic habitat as a two–step process

Specifically, the success of ground–nesting bird species in areas in process of urban development may result from a strategy to avoid high levels of predation in the countryside after the rebound of terrestrial mesopredators and raptors (Díaz et al., 2013) and/or scarcity of high–quality open habitats due to shrub and tree encroachment. This is most likely also the case of birds linked to sand quarries, although those linked to quarries under exploitation are also benefiting from predator avoidance. Cases of successful use of reservoirs may reflect the movement of some species out of their ecological refuges, where they had been secluded due to human persecution and alteration of their habitat, and the discovery of reservoirs as food–rich habitats (i.e. reservoirs are full of exotic crustaceans, molluscs and fish species that become a new resource when discovered by native species). Examples of landfills as food sources for scavenging species most likely reflect the scarcity of carcasses of livestock and wild ungulates. Even rare vulture species in Europe, such as the black vulture and the Egyptian vulture (*Neophron percnopterus*) are known to make extensive use of landfills when food from natural sources is scarce or absent (Gangoso et al., 2012; Martínez–Abraín et al., 2012; Tauler–Ametller et al., 2017). A network of small landfills scattered in the territory (imitating more closely the unpredictable distribution of carrion in nature) could be a good transition measure along the road towards closing major open–air landfills as promoted by the environmental policy of the European Union (Cortés–Avizanda et al., 2010).

The ultimate causes of all case studies analysed are consistent with our hypothesis linking human depopulation of rural areas with colonization of urban areas by wildlife (Martínez–Abraín et al., 2019, 2020).

Most of the examples analysed here come from Spain where rural exodus started relatively late within the European context, some six decades ago. Its effects are becoming evident only now, after a non–linear period of gestation. During this multidecadal period, human depopulation of rural areas has radically altered a status quo that had not experienced substantial changes over centuries or even millennia. Consequences of these changes include the movement of wildlife out of the historical refuges to which they were forced by rural human activities, loss of fear to humans, the growth of mesopredator populations by mesopredator release (where rural humans were the top predator) and of large mammalian herbivores, as well as shrub and tree encroachment, as advanced in our introduction.

Importantly, all these ecological factors would not have had any practical effect if it were not for the changed human attitudes of modern urban people who do not perceive wildlife as competitors or enemies and cease to persecute wildlife, a remarkable historical landmark (Martínez–Abraín et al., 2008, 2009, 2019). Once in anthropogenic environments urban people unintentionally further protect wildlife against predation by means of the scarecrow effect (Leighton et al., 2010). Moreover, trophic opportunities are multiplied due to the role of humans as managers of large amounts of exo–somatic energy that translate in large quantities of discarded surplus food (Oro et al., 2013). Although bold individuals (with less fear and more exploratory momentum) are known to be more prone to colonizing anthropogenic areas (Díaz et al., 2013; Riyahi et al., 2015), these habitats in turn select for fearless individuals generating a positive feed–back loop (Miranda, 2017). We think that the loss of fear to humans is most likely the most relevant condition allowing approach and close coexistence with humans in human landscapes. A condition that most likely is necessary, although not sufficient. What ornithologists have traditionally labelled as 'urban birds' for many decades are most likely those species that are more prone to losing fear to humans along a gradient. Time has shown than many other species, formerly not considered as 'urban', may also colonize urban areas given the right conditions. In summary, we suggest that colonization of urban environments can be seen as a sequential two–step process. The first step occurs outside the urban environment and is triggered as an ecological consequence of the human depopulation of rural areas (Martínez–Abraín et al., 2020). The second step takes place inside urban landscapes as the result of a balance of costs and benefits of urban life (Møller and Díaz, 2018a, 2018b).

It is encouraging to know that bird assemblages in highly urbanized environments are now only 20 % less functional than those in surrounding natural habitats (Sol et al., 2020). If this happens with the current low levels of interest in finding technical solutions to promote the role of anthropogenic landscapes as biodiversity–rich areas this means that there is a lot of room for future improvement. Obviously the approach of wildlife to urban areas will also create new fronts for human–wildlife conflict (see e.g. Barrett et al., 2019).

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Supplementary material

Table 1s. Spanish cities in which the regular presence of peregrine falcon (*Falco peregrinus*) has been detected as a breeder or using the city as a foraging habitat. Sources of information for this table are diverse, including Del Moral and Molina (2009), but also grey information from unpublished reports, internet searches and personal communications from knowledgeable naturalists.

Tabla 1s. Ciudades españolas donde se ha detectado la presencia habitual del halcón peregrino (*Falco peregrinus*) como reproductor o utilizando la ciudad como hábitat alimentario: Las fuentes de información de esta tabla son diversas, por ejemplo, Del Moral y Molina (2009), pero también información contenida en informes no publicados, búsquedas en Internet y comunicaciones personales de naturalistas expertos.

Province	City	# Inhabitants in 2018–2019
Lugo	Lugo	99,600
Pontevedra	Vigo	293,300
A Coruña	A Coruña	246,100
A Coruña	Santiago de Compostela	97,000
Cantabria	Santander	178,400
Asturias	Oviedo	226,000
Asturias	Avilés	78,700
Vizcaya	Bilbao	351,600
Navarra	Pamplona	197,600
La Rioja	Nájera	8,050
Salamanca	Salamanca	144,400
Salamanca	Peñaranda de Bracamonte	6,300
Burgos	Burgos	179,900
Valladolid	Olmedo	3,650
Madrid	Madrid	3,233,000
Madrid	Alcalá de Henares	203,900
Madrid	Parla	124,200
Madrid	Leganés	187,100
Madrid	Fuenlabrada	198,100
Barcelona	Barcelona	1,121,000
Barcelona	L'Hospitalet de Llobregat	257,000
Barcelona	Sant Adrià del Besós	34,200
Girona	Girona	101,800
Tarragona	Tarragona	133,900
Valencia	Valencia	797,000
Zaragoza	Zaragoza	679,600
Sevilla	Sevilla	702,300
Málaga	Málaga	567,400
Málaga	Ronda	34,000
Granada	Granada	239,000
Cáceres	Cáceres	96,000
Zamora	Zamora	66,300

Fig. 1s. Upper panel: Audouin's gull (*Ichthyaetus audouinii*) breeding colonies at a harbour dock under construction in Castellón (E Spain) (left) (author: J. Greño), and in a coastal industrial area in Barcelona city (Zona Franca) (right) (author: Manolo García). In both cases gulls chose a fenced open area close to a fishing port. Lower panel: location of a Little ringed plover (*Charadrius dubius*) nest in an area under urban development (left) and close up of the nest (right). These areas are beneficial for plovers because they have poor vegetation cover (author: Ignacio Fernández–Calvo).

*Fig. 1s. Imágenes superiores: colonias reproductoras de gaviota de Audouin (*Ichthyaetus audouinii*) en un muelle portuario en construcción en Castellón (España oriental) (izquierda) (autor: J. Greño) y en una zona industrial costera de la ciudad de Barcelona (Zona Franca) (derecha) (autor: Manolo García). En ambos casos, las gaviotas eligieron una zona despejada vallada cerca de un puerto pesquero. Imágenes inferiores: ubicación de un nido de chorlitejo chico (*Charadrius dubius*) en una zona en desarrollo urbano (izquierda) y primer plano del nido (derecha). Estas zonas son beneficiosas para los chorlitejos porque tienen poca cubierta vegetal (autor: Ignacio Fernández–Calvo).*

Fig. 2s. Landfill in northern Madrid intensively visited by white storks, black kites, griffon vultures (right panel) and black vultures, what reflects scarcity of carcasses and livestock in the countryside. White storks breed inside the landfill (left panel) (author: Alejandro Martínez–Abraín).

Fig. 2s. Vertedero al norte de Madrid visitado frecuentemente por cigüeñas blancas, milanos negros, buitres leonados (imagen derecha) y buitres negros, lo que refleja la escasez de cadáveres y de ganado en el campo. Las cigüeñas blancas se reproducen dentro del vertedero (imagen izquierda) (autor: Alejandro Martínez–Abraín).