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Living in the concrete jungle: a review and socio-ecological perspective of urban raptor habitat quality in Europe

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Abstract
Raptors can be important components of urban ecosystems due to their role as apex predators, the presence of which may bring benefits to people. Urban environments may provide good quality habitats, and the raptors' ability to utilize resources found here can contribute to their success. However, urban environments are socio-ecological systems and such mechanisms shaping habitats and ecological resources therein are less understood. This paper explores how raptors utilize urban resources, and the socio-ecological processes influencing their quality and availability. It begins with a systematic mapping of the literature to summarize the utility of urban resources by raptors with European distributions. Eighteen species were documented in the literature successfully exploiting novel hunting and/or nesting opportunities in both green and built-up locations of urban areas. We discuss how these may be consequential of human activities, some of which intentionally provided as subsidies, and how their utility by raptors create opportunities for human-raptor interactions further shaping public perception and decisions which potentially affect the raptors. Finally, we demonstrate these concepts by drawing on our experience from an urban peregrine falcon (*Falco peregrinus*) conservation site in London, UK. The paper concludes with a call for urban raptor conservation and research to consider social and ecological aspects together, appropriately reflecting urban environments as socio-ecological systems.

Keywords Socio-ecological systems · Human-animal interactions · Urban wildlife · Habitat use · Urban ecology

Introduction

Birds are important components of urban biodiversity (Wiklund 1982; Bogliani et al. 1999; Quinn and Kokorev 2002; Ueta 2007; Whelan et al. 2015), among which highly-abundant and synurbic species such as the common pigeon (*Columba livia*) are perhaps the clearest examples of birds that thrive in urban environments. Urban bird communities can also include raptors, which provide a suite of important ecosystem services. Raptor scavenging activity reduces the risk of disease transmission, bringing potential savings in healthcare costs (Markandya et al. 2008). Interactions with birds not only positively shape healthy human relationships and support human wellbeing (Wolch 1998; Fuller et al. 2007; Dallimer et al. 2012; Clayton and Myers 2015; Cox et al. 2017), but also the wellbeing of nature – charismatic raptors are often used as flagship species to attract resources in support of conservation programs (Clayton and Myers 2015; Donázar et al. 2016; Arent et al. 2018). The landscape of fear created by raptor predation limits prey activity and density (Abramsky et al. 1996; Preisser et al. 2005; Laundré et al. 2010; Kross 2012; Atkins et al. 2017). This form of natural pest control may be desirable to reduce maintenance costs associated with, for example, corrosive pigeon excrement (Solonen 2008; Pagel et al. 2018). These apex predators act as sentinels, indicating the health of an ecosystem through their relationship with other organisms. The absence of this group can lead to trophic cascades when food webs are modified as a result of altered predation pressure, evident in the density of synurbic or pest species found in cities (Mueller et al. 2016; Donázar et al. 2016).

Raptors historically cohabited alongside humans in towns and cities since the Medieval period (Donázar et al. 2016;

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Bildstein and Therrien 2018) and their increasing use of current urban environments follows their global recovery from substantial population declines, despite urban environments traditionally considered by some to be poor quality, degraded habitats (Brown 1977; Bildstein et al. 1998; Thiollay 2006), partly due to the risk of chemical toxicity in the food chain (Hofer et al. 2010; Kekkonen et al. 2012; Elliott et al. 2015). However, higher raptor productivity here – although a simplistic measure that overlooks post-fledging survival – can indicate urban environments to be of better quality than less developed surrounding habitats (Newton 1998; Chace and Walsh 2006; Solonen 2008; Cooke et al. 2018; Kettel et al. 2018). The greater productivity has been attributed to their ability to exploit urban prey (Chace and Walsh 2006; Chamberlain et al. 2009; Jokimäki et al. 2016; Kettel et al. 2018), resulting in earlier or bigger clutches (Rutkowski et al. 2006; Solonen 2008), or higher fledging rates (Salvati et al. 2002; Rutkowski et al. 2006). The urban raptors' choice of nest sites may also confer reproductive advantages (Chace and Walsh 2006; Papp 2011; Dykstra 2018; James Reynolds et al. 2019) and while typically novel or anthropogenic in nature, these sites can be more numerous and diverse with urbanisation (Mainwaring 2015).

Suitable nest sites and prey availability are typically considered to be the key determinants of successful raptor populations in urban environments (Solonen 2008; Newton 2010; Mannan and Steidl 2018), but urban ecosystems are socio-ecological systems (Francis and Chadwick 2013) and people can also influence raptor feeding and nesting opportunities. Some examples include religious practices subsidizing the diets of the thriving black kite (*Milvus migrans*) communities in Delhi, India, with food offerings (Kumar et al. 2019), pest control measures limiting the availability of rodents for red-tailed hawks (*Buteo jamaicensis*) in Philadelphia, USA (Hunold 2017), and sympathetic citizens protecting wild animals' safe use of their breeding territories (Gullo et al. 1998; OtterWatch 2017; Hunold 2017; Darke 2017; Crowley et al. 2019). Given the roles raptors play, it is important to facilitate their conservation by appreciating the full range of resources and mechanisms supporting the needs of urban raptor populations. However, there is a gap in our understanding of the socio-ecological processes as these tend to be neglected in urban raptor research to date, apart from studies reporting antagonistic interactions such as aggression towards humans or illegal persecution of raptors (Galeotti 1994; Papp 2011; Cianchetti-Benedetti et al. 2016; Kunca and Yosef 2016). This is in line with a bias towards the exploration of human-wildlife conflict across wider literature despite socio-ecological processes encompassing more than antagonistic relationships (Gullo et al. 1998; Soulsbury and White 2015). Urban avian studies in general also tend to cover a broad range of species without a particular focus on raptors, while there is a geographical bias towards North American populations for urban raptor research (Bird et al. 1996; Poppleton 2016; Boal and

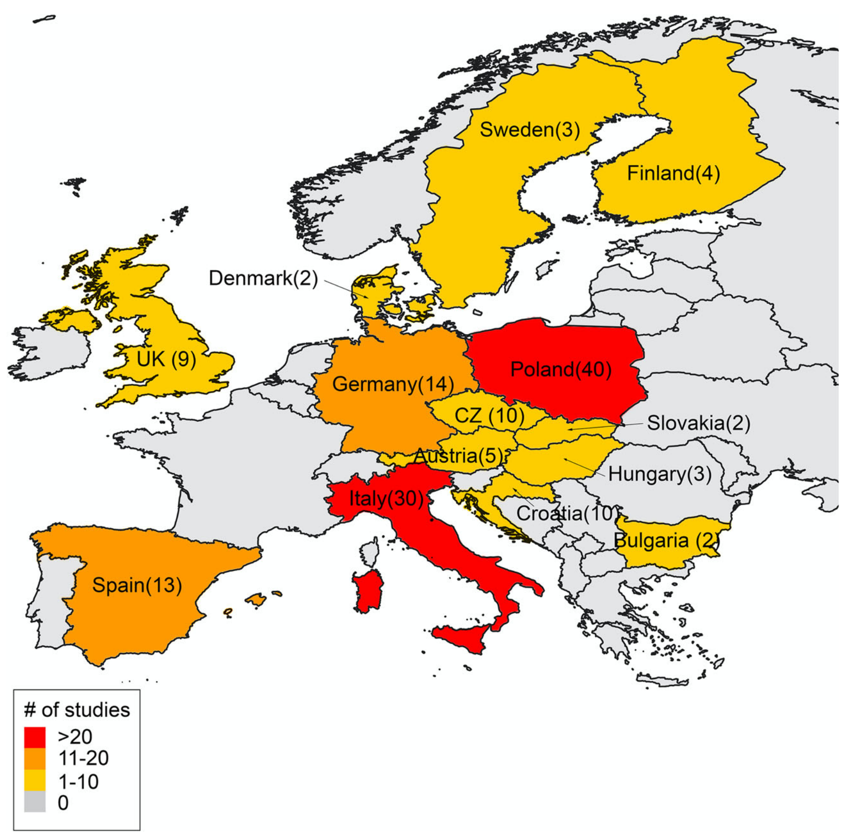


Fig. 1 Foci of published urban raptor studies in Europe, with number of studies per country in brackets

Dykstra 2018; Kettel et al. 2018). In this review, we ask: *What urban resources do raptors in Europe use and how may their availability and quality (as indicated by the raptors' productivity) be linked to socio-ecological mechanisms?* To answer this, we use a systematic literature search to map the extent of our knowledge on the ecological requirements of urban raptors in Europe. We then demonstrate how socio-ecological processes may underpin the availability and quality of urban raptor habitat in our case study of urban peregrine falcon (*Falco peregrinus*) conservation in London, UK.

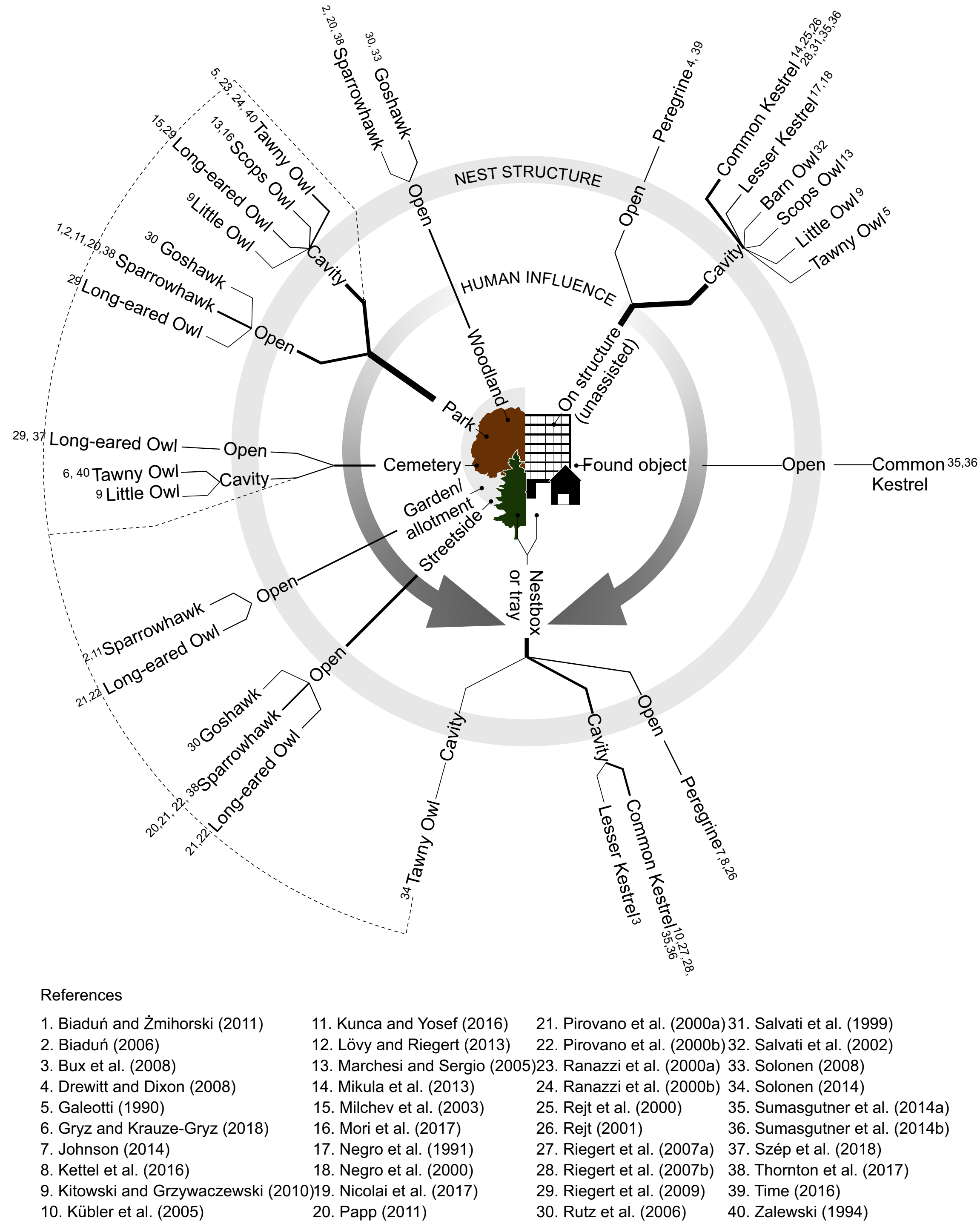
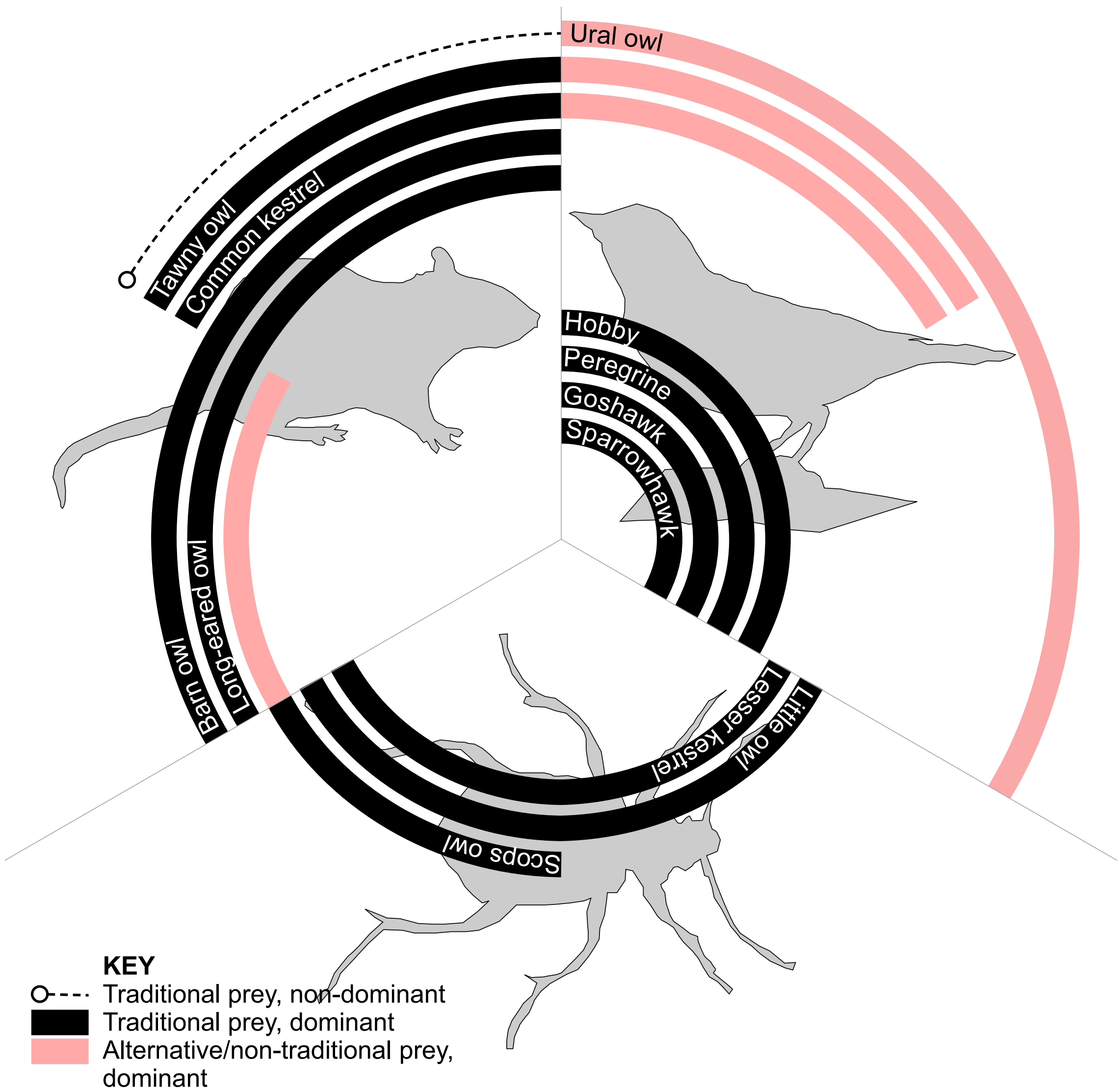


Fig. 2 Urban raptor nest habitats and types from literature reviewed. Open and cavity nests are found in trees in and out of green spaces, with different levels of human influence expected at each type of habitat. Raptors colonize buildings/structures with cavities/surfaces that are inherent or provided by people (e.g. nestboxes). Dotted lines indicate locations of tree nestboxes. Lineweights are commensurate with number of studies



References

Goshawk
Rutz (2003b)
Rutz et al. (2006b)

Sparrowhawk
Biaduń (2006)
Frimer (1989a)

Peregrine
Drewitt and Dixon (2008)
Rejt (2001)
Serra et al. (2001)
Leonardi and Mannino (2007)

Hobby
Fiuzynskí and Soemmer (2000)

Lesser kestrel
Tella et al. (1996)

Common kestrel
Kečkéšová and Noga (2008)
Piatella et al. (1999)

Common kestrel
Salvati et al. (1999)
Kübler et al. (2005)
Riegert and Fuchs (2004)
Riegert and Fuchs (2007a)
Riegert and Fuchs (2009)
Riegert and Fuchs (2011)
Kreiderits et al. (2016)
Sumasgutner et al. (2014a,b)
Yalden (1980)
Romanowski (1996)
Żmihorski and Rejt (2007)
Boratyński and Kasprzyk (2005)

Barn owl
Salvati et al. (2002)
Manganaro et al. (2001)

Ural owl
Dravecký and Obuch (2009)

Scops owl
Panzeri et al. (2014)

Tawny owl
Galeotti et al. (1991)
Goszczyński et al. (1993)
Gryz and Krauze-Gryz (2019)
Grzędzicka et al. (2013)
Zalewski (1994)

Long-eared owl
Dziemian et al. (2012)
Pirovano et al. (2000a)
Milchev et al. (2003)
Milchev and Ivanov (2016)
Fattorini et al. (1999)
Riegert et al. (2009)
Szép et al. (2018)

Little owl
Fattorini et al. (1999)
Fattorini et al. (2001)
Manganaro et al. (2001)
Kitowski and Grzywaczewski (2010)

Fig. 3 Main diet components of urban raptors from literature reviewed. Most species feed primarily on prey types they specialize in hunting (black bars) but some have populations switching to non-traditional prey types (red bars)

Fig. 4 Opaque film was fitted to Charing Cross hospital windows close to the nest to prevent the sight of people alarming the female peregrine. Photo: FaB Peregrines Facebook

Methods

Conceptual framework

This study takes a two-step approach utilizing a systematic mapping of literature and case study to answer our research question. The systematic mapping approach will first (1) highlight the raptor species that have been researched in urban environments, and then (2) outline their use of habitat components within the urban landscape to meet nesting and dietary needs. As human activity is likely to influence urban wildlife and their use of resources within these socio-ecological ecosystems (Hunold 2017; Khoo and Lee 2020), we will relate the urban raptors' ecological resource use with the ecological and human dimension from within and without the reviewed literature. Secondly, everyday human-animal interactions may be key to some of these socio-ecological processes, in which human and nonhuman activity perpetuate feedback loops that influence the success of urban wildlife (Gullo et al. 1998; Belaire et al. 2016; Cianchetti-Benedetti et al. 2016; Hunold 2017; Crowley et al. 2019). Thus, we will explore the dynamics between human-raptor interactions and the quality of available resources through our case study of urban peregrine conservation at Charing Cross Hospital in London, UK.

Systematic mapping

While 'raptors' can be a specialized term used to describe *Accipitriformes*, *Cathartiformes* and *Falconiforme*s, we use the term in a broader sense which includes *Strigiformes* as their nocturnal counterparts (sensu Chace and Walsh 2006; Campbell and Lack 2011; Boal and Dykstra 2018). We then identified 51 raptor species occurring in Europe as described in Voous and Thomson (1960) (see full list of species in Appendix 1 Table 1). For each species, we searched for literature on *Web of Science (Core Collection)* and *Google Scholar* using the terms 'urban' and the Latin binomial of the species (e.g. urban AND *Falco peregrinus*) as the topic. All records were considered, from the earliest articles incorporated in the databases (1900–2019). Our definition of urban raptors broadly includes species that utilize or dwell in urban environments (Fischer et al. 2015). We did not filter studies based on a singular definition of 'urban' and adopted the term as defined by the author(s) of each study which included both the built-up and green spaces contained within their study limits. Each study was scrutinized for (1) focal species, (2) topics covered and (3) study sites. Topics were categorized as 'population', 'habitat', 'feeding/hunting', 'reproduction' or 'others' to relate the raptors' activities to their use of habitat features. Where more than one species/topic was discussed in an individual study, the article was counted twice. See Appendix 2 Table 2 for a full breakdown of topics covered. These studies were then used to summarize current knowledge of habitat use by raptors in urban environments.

Case study

To understand how raptor habitat may be intertwined with socio-ecological processes over time, we conducted qualitative research using a combination of online resources and field observations/surveys (Hunold 2017). We identified the presence of peregrine falcons nesting at Charing Cross Hospital and the group Fulham and Barnes Peregrines, or FaB Peregrines, which cares for them, through an internet search. FaB Peregrines is one of, but connected to a wider network of, many amateur naturalist groups in London engaging in such activities. Commentary on FaB Peregrines' conservation-focused activities and the peregrines' lives alongside online interaction with and amongst the public, albeit curated by their page owners, can be found on their social media pages (FaB Peregrines 2020a, b) which provided raw material needed for our qualitative analysis. We canvassed Facebook posts of the 2018 and ongoing 2019 breeding seasons and every blog entry, with the latter documenting activity since 2007. This allowed us to construct a timeline of the site, the group and the peregrines' activities.

Once we were familiar with the key events prior to the ongoing breeding season through our review of the social media data, we concurrently conducted qualitative research in person on new events as they occurred and to reflect on past ones. To do so, we contacted FaB Peregrines to identify ourselves and express our research interests. We then joined the group as volunteers for their Fledgewatch activities (when the group is most active) during the latter part of the 2019 breeding season (July and August) at Margravine Cemetery beside the hospital to conduct our field research. Field data collection involved unstructured interviews with the FaB Peregrines leader and two key members who provided information filling gaps in recent and older social media records (see Appendix 3). The interview process typically began with general questions about the peregrines' and group's recent activities occurring between our visits which we usually first learned of through their Facebook posts. This then led to spontaneous conversations on topics about the site and peregrines that we followed up with questions to seek their opinions on, whenever we felt their relevance to our research. We also observed spontaneous interactions between the group, other birders and non-birding members of the public which included hospital staff and visitors, a pigeon fancier and passersby who visited during Fledgewatch while we were on site. While these interactions included people from a broad demographic range, the core members were of white British nationality (the most populous group in the Hammersmith and Fulham borough), and middle-aged or older (above the median age of 32 years among residents of the borough (ONS 2011)). We joined the group on site 2–4 days per week, lasting up to 4 h each time at a 'regular spot' in the cemetery from where we watched the peregrines. To encourage participants to speak and act freely, we tried to build rapport and appear less conspicuous as newcomers by (1) adopting the position of volunteer-first, researcher-second, (2) choosing unstructured interviews and (3) recording field notes from memory only at the end of each session. All raw material from social media, interview data and observations were manually coded according to the activity of humans or peregrines, together with participants' sentiments towards the activity, which we organized in NVIVO 12 software (QSR International 2018). Data was collected under ethical approval from King's College London (project reference: MRS-18/19–13,499).

Results

Raptors occurring in the urban environment

A total of 112 studies met the criteria for this review, with 18 species reported in urban environments across Europe (Fig. 1). These are the Bonelli's eagle (*Hieraaëtus fasciatus*), booted eagle (*Hieraaëtus pennatus*), common buzzard (*Buteo buteo*), red kite (*Milvus milvus*), black kite (*Milvus migrans*), white-tailed Eagle (*Haliaeëtus albicilla*), northern goshawk (*Accipiter gentilis,* hereafter goshawk), sparrowhawk (*Accipiter nisus*), peregrine falcon (*Falco peregrinus,* hereafter peregrine), hobby (*Falco subbuteo*)*,* common kestrel (*Falco tinnunculus*), lesser kestrel (*Falco naumanni*), barn owl (*Tyto alba*), Ural owl (*Strix uralensis*)*,* tawny owl (*Strix aluco*)*,* scops owl (*Otus scops*)*,* long-eared owl (*Asio otus*), and little owl (*Athene noctua*)*.* More European raptor species with urban populations are likely to exist beyond the English language publications considered in this review or have not been the focus of research. In the studies we reviewed, the following topics were discussed: population (33 studies), habitat (29 studies), feeding/hunting (56 studies), reproduction (23 studies), and others (15 studies) (refer to Appendix 2 Table 2 for a full breakdown of studies).

Raptor habitat use in the urban environment

Nest sites Of 112 papers incorporated in the systematic mapping exercise, 40 contained information on raptor nesting sites. Twenty-one papers recorded 7 raptor species nesting in trees found in green space (urban woodland, parks, cemeteries, gardens and allotments) or beside streets, while 20 recorded 7 raptor species nesting within anthropogenic structures (e.g. monuments, rooftops, building openings, chimneys, attics, wall cracks, flowerpots, nestbox/trays; summarized in Fig. 2). Both types of sites support the breeding requirements of open and cavity nesters. In trees, open nests were predominantly used by hawk species (goshawks, sparrowhawks, red kites), while cavities – both naturally-occurring and those provided by nestboxes – were occupied by owls (tawny, scops, long-eared and little owls). Similarly, cavities in anthropogenic structures were mainly used by owls (barn, scops, little and tawny owls), both spontaneously and encouraged, while open nests here were mostly used by peregrines. Some cavity nesters (little, scops and tawny owls) were more flexible, occupying holes in trees and human structures.

These nesting opportunities highlighted by the raptors' site selection may be attributed to a combination of factors: the presence of other urban dwelling species, nesting ecology of the raptors, human activity and urban planning policies. Breeding birds in urban areas increase nesting opportunity for raptors by building nests which the raptors may later occupy. Common kestrels, long-eared and scops owls are some raptors observed in the literature usurping corvid or passerine nests in trees and buildings (Marchesi and Sergio 2005; Dziemian et al. 2012; Lövy and Riegert 2013; Sumasgutner et al. 2014b). Further nesting opportunities arise as a consequence of human activity, most clearly through the placement of nestboxes in buildings and trees (Fig. 2), but also indirectly through historical building preservation and citizens' biophilic tendencies. For example, the densest common kestrel population in Europe is attracted by the high nest availability within Vienna's urban core of historical architecture and window planters of residential blocks (Sumasgutner et al. 2014b). Similarly, peregrines, common kestrels, lesser kestrels, barn owls and scops owls tend to be found breeding in towers of churches and cathedrals which have architectural features supporting the raptors' needs (Tella et al. 1996; Negro et al. 2000; Taylor 2003; Marchesi and Sergio 2005; Drewitt and Dixon 2008; Sumasgutner et al. 2014b). Imprinted offspring raised at these sites may subsequently seek out similar nest sites of their own post-fledging, in a perpetual selection of these habitat types (Larson 2004; Sielicki and Sielicki 2009). The consequential inflation of nesting opportunities owing to the ecology of urban commensal avifauna and human preferences is particularly beneficial to falcons and owls since they do not construct nests, opportunistically occupying suitable sites in the landscape instead (Newton 2010). Incidentally, qualities of anthropogenic nests may be superior to more natural ones. Human-made materials are likely to better withstand degradation from natural processes (e.g. entrance enlargement by ring-necked parakeets (*Psittacula krameri*) [Orchan et al. 2013]), remaining viable for longer periods. Higher elevations typical of urban nests also make them less accessible to terrestrial predators (Tella et al. 1996; Negro et al. 2000; Charter et al. 2007) or recognizable (Fargallo et al. 2001; Carrillo and González-Dávila 2009; Vincze et al. 2017), although this is not always observed (Sumasgutner et al. 2014a). Additionally, nestboxes can be designed to increase reproductive success by limiting egg-rolling (Bird et al. 2018) and predation (Bailey and Bonter 2017). Finally, urban raptor site selection may be influenced by policies targetting human wellbeing. Urban green spaces designated for recreational use are unlikely to experience intensive disturbance and can provide refugia for wildlife (Khoo and Lee 2020). Raptors may be drawn to urban woodlands where nesting conditions are more stable compared to rural sites which may be used for forestry (Solonen 2008), while owls may select urban parks sheltering them from external noise pollution (Fröhlich and Ciach 2018, 2019).

The greatest number of studies, and species recorded therein, occurred in parks (15 studies, 7 species) and within spontaneously colonized anthropogenic structures (12 studies, 7 species) (Fig. 2). While indicating the sites' importance to breeding raptors, it potentially reflects a bias in sampling effort arising from their accessibility to the researchers and public as most of the studies required either physical inspection of the nest sites or for observations to be made from accessible locations (Rutz 2008; Sumasgutner et al. 2014b; Fröhlich and Ciach 2019). Raptors nesting around areas highly frequented by people, whether they are in green spaces or "out of place", are likely to draw citizens' attention (Philo and Wolch 1998; Khoo and Lee 2020), making them vulnerable to human disturbance (Chace and Walsh 2006; Sorace and Gustin 2010). However, their lower aggression suggests human-raptor interactions, while prevalent, are tolerable for the birds (Rutz 2003a; Dravecký and Obuch 2009; Papp 2011). This coexistence may be due to the tendency for regular users of green space to be more sensitive towards the nonhuman inhabitants of such areas (Clayton and Myers 2015). Additionally, the prevalence of raptors allowed to remain in anthropogenic sites – building openings, monuments or flowerpots unintended for nesting, where raptors culturally do not belong – as opposed to being flushed out by people, together with the provision of nestboxes, suggest that the collective extension of goodwill from citizens, or at least their indifference towards the raptors, is potentially driving the availability of suitable nest sites (Mainwaring 2015; Hunold 2017; James Reynolds et al. 2019). Such a link between public sentiment towards urban avifauna in general and providing for them is already evident in the popularity of household nestboxes (Gaston et al. 2005). Actions that encourage raptor persistence in human spaces will reinforce opportunities for interactions across species (Clayton and Myers 2015; Belaire et al. 2015, 2016). These in turn reconnect urban citizens with nature, as we undergo an extinction of experience whereby succeeding human generations grow up in a world lacking particular species, communities or ecological conditions (Soga and Gaston 2016). Such interactions are crucial for engendering public support for broader urban biodiversity conservation (Miller 2005; Soga and Gaston 2016; James Reynolds et al. 2019). Therefore, urban raptor persistence requires their nest sites to be ecologically suitable *and* for their presence to be culturally accepted (Johnson 2014), which we will demonstrate in our case study.

Foraging sites Urban raptors forage inside green spaces (8 studies, 7 species) and outside of it (8 studies, 5 species). Green spaces include cemeteries, ruins, gardens and playing fields which are analogous to natural open hunting grounds commonly used by barn owls, tawny owls, long-eared owls and little owls (Goszczyński et al. 1993; Salvati et al. 2002; Kitowski and Grzywaczewski 2010; Szép et al. 2018). Even in built-up areas, raptors do not need to spend much time finding prey, reflecting the ease at which they can hunt (Rutz 2006). A number of factors may contribute to their use of such sites and the accessibility of prey.

Buildings provide vantage points (or perches) from which prey can be easily spotted, while concealing raptors on the move from their targets. This element of surprise leads to significantly greater hunting success (Rutz 2004, 2006) and is evident in the adoption of perch-hunting techniques among raptors which do not traditionally hunt this way (Kübler et al. 2005; Mikula et al. 2013; Time 2016). Artificial illumination can help raptors locate their prey at night, while allowing the predators to remain hidden (Negro et al. 2000; Rejt 2001; Vrezec 2001; Rutz 2006; Johnson 2014). The consistent hunting opportunities associated with these features may lead to their adoption within the raptors' habits. Lesser kestrels cease hunting and roost only after building lights are turned off (Negro et al. 2000), which highlights how raptor activity can become intertwined with ours when human activities or preferences strongly influence their prey communities. Artificial illumination attracts assemblages of bats, insects and birds (Negro et al. 2000; Rejt 2001; Vrezec 2001; Rutz 2006), similarly with garden birdfeeders and skyrise greenery attracting songbirds (Cannon et al. 2005; Fuller et al. 2008; Belcher et al. 2018), and consequently their predators. This may underlie common kestrels' preference for nesting in buildings close to green backyards, where they can prey on visiting songbirds (Sumasgutner et al. 2014b). Furthermore, our idealisations of nature, manifesting in routine grass trimming, make hidden prey more accessible for the raptors hunting in green recreational spaces such as playing fields (Kitowski and Grzywaczewski 2010). However, human food subsidies can contribute to the use of urban environments even amongst non-resident raptors. For example, a substantial portion of red Kites in Reading, UK are supported by sympathetic individuals feeding them in private gardens (Orros and Fellowes 2015). This is in line with general bird feeding being one of the most popular forms of human-wildlife interactions in urban environments, benefitting humans and birdlife (Fuller et al. 2008), as may religious practices that leave food offerings consumed by wild raptors (Kumar et al. 2019). Raptors may also be foraging where human food waste is consistently available (Kübler et al. 2005). The viability of urban foraging sites however requires tolerance for the inconveniences accompanying their usage, especially in areas highly frequented by people. Discarded food and prey remains may be deemed unsightly while the sight of prey being killed and dismembered can be disturbing to onlookers increasingly unaccustomed to such processes (Miller 2005; Rutz et al. 2006a). Additionally, the act of feeding wild raptors, regardless of its benefits may come with social or legal ramifications that need to be overcome by individuals (Jones and Howard 2006; Jones and Reynolds 2008). Therefore, like their nest sites, raptor feeding opportunities can be entangled with human activities and once apparent their availability may be influenced by social norms.

Prey Urban raptors consume various types of prey. Of 112 papers, 22 recorded mammals as the primary prey (5 species), 22 recorded mainly birds (7 species) and 5 found mainly insects (3 species) (Fig. 3). Three species had multiple dominant prey types, including ones not traditionally taken, while one species was recorded primarily consuming non-traditional prey (Fig. 3). Their dietary breadths are narrow and skew towards the abundant commensal species available in cities (Manganaro et al. 2001; Rutz et al. 2006a). Among them are common urban dwelling birds which have become an important component of their diets, taken even by species specialized in hunting other types of prey (Fig. 3). The literature we reviewed indicate that among urban raptors which have birds as their numerically dominant prey, house sparrows (*Passer domesticus*) are the most frequently taken among common kestrels, comprising 13.1–73.9% of diets (Yalden 1980; Salvati et al. 1999; Piatella et al. 1999; Kübler et al. 2005); 53% for hobbies, (Fiuczynski and Soemmer 2000); 22.1% for sparrowhawks (Frimer 1989a); and 25.4–88.7% for tawny owls (Goszczyński et al. 1993; Gryz and Krauze-Gryz 2019). Similarly, feral pigeons (*Columba livia domestica*) are the most frequent avian prey in some populations of tawny owls, forming 18.1% of their diets (Galeotti et al. 1991); 36.4% for goshawks (Rutz 2004); and 30.4–80% for peregrines (Rejt 2001; Serra et al. 2001; Leonardi and Mannino 2007; Drewitt and Dixon 2008; Johnson 2014).

These commensal avian prey supplies are more stable throughout the year, with their availability fluctuating less than other prey types (Goszczyński et al. 1993; Riegert et al. 2007b; Solonen and Ursin 2008; Riegert and Fuchs 2011), and can provide alternatives in the absence of traditional prey (Zalewski 1994; Dravecký and Obuch 2009; Kreiderits et al. 2016). However, their predation of urban birds may not be benign. These prey may be not be optimal, considering their lower nutritional value (Liker et al. 2008; Sumasgutner et al. 2014a; López 2017) and difficulty of capture for maladapted or inexperienced raptors (Krone et al. 2005; Kunca et al. 2015). Furthermore, they may carry disease (Krone et al. 2005; Kunca et al. 2015) or contain heavy metals (Hofer et al. 2010; Kekkonen et al. 2012). Diurnal raptors preying on rodents, especially rats, face reduced prey availability due to their nocturnal activity combined with suppression from effective pest control measures which also expose raptors to secondary poisoning risks (Sumasgutner et al. 2014a; Hunold 2017; Lohr 2018). These have fitness costs on breeding raptors, and can turn habitats into population sinks (Sumasgutner et al. 2014a). Raptor predation takes on a social dimension when their lethality becomes apparent. Negative sentiment can be provoked by the raptors' indiscriminatory predation on financially or culturally valuable animals. Depredation of ornamental fish and house sparrows, which are in decline, are some examples we found in the literature reviewed that may be unpopular or escalate conflict (Bell et al. 2010; Mester and Mérő TO 2018). While their ability to control feral pigeon populations may bring welcomed benefits to some (Solonen 2008; Pagel et al. 2018), their inability to discern feral and racing pigeons has become contentious among others, leading to much attention on the subject (Rutz et al. 2006a; UK Raptor Working Group 2019). Similarly, synurbic species provide many urban citizens most of their daily contact with nature which they may become attached to (Bell et al. 2010; Francis and Chadwick 2013; Crowley et al. 2019), and witnessing harm to these individual animals as a result of predation may make the raptors unpopular. These dynamics shape support for provisions or activities that influence habitat quality which will be demonstrated in the next section.

Implications for breeding site quality from human-raptor entanglements: an urban peregrine case study.

Situated close to a large cemetery, wetlands and the River Thames which provide plenty of foraging opportunities, London's Charing Cross hospital could be considered an ecologically stable, high quality habitat for breeding peregrines with 16 young having successfully fledged from its roof since the arrival of its first pair in 2007. However, closer scrutiny into the history and workings of the site reveals the many socio-ecological mechanisms involved in its making. Initial attempts at nesting by the peregrines on the hospital's roof ledge failed, as although the ledge appeared structurally suitable, it was vulnerable to heavy rainfall. This prompted FaB Peregrines to facilitate the installation of a bespoke nestbox in 2010. The peregrines' acceptance of this human provision, intended to improve the poor breeding conditions that would have otherwise turned this site into an ecological trap, led to the resident pair's consistent breeding success in subsequent years. However, this process was not straightforward – accepting (and encouraging) peregrines breeding on their roof meant the hospital ceded their rights to part of their property under conservation legislation (Wildlife and Countryside Act 1981) for the duration of the peregrines' persistence, which can be antagonizing – and FaB Peregrines needed to mediate on behalf of the resident falcons as their de facto representatives given their ecological expertise.

Conditions constantly evolve and common across groups caring for wildlife is the ability to detect potential risks emerging in the landscape apparent only to the animals (Hunold 2017; Darke 2017). Using their intimate familiarity with the falcons' routines, FaB Peregrines "thinks like a peregrine" when interpreting behavioral cues unusual to the falcons' daily patterns, in order to identify potential threats (Wolch 1998). For example, in 2019 the group observed how a new female falcon which had arrived late in the breeding season was poorly habituated to human activity within the building and was frequently provoked by the sight of hospital staff seen through windows close to its nest. FaB Peregrines conveyed the falcon's alarm to the hospital, which eventually led to the offending windows being modified to obstruct its view (Fig. 4), and the distress stopped – a compromise allowing the needs of both peregrines and humans to be met without detriment to each other had been found. The group's deep knowledge of the peregrines' ecology stems from their routine monitoring of the resident falcons throughout the year, using CCTVs installed around the nest and also from the ground with binoculars and telescopes. This vigilance combined with help elicited from the public through posters and social media allows inexperienced juveniles that become grounded or trapped in obstacles during fledging season to be rapidly located and returned to the nest before they are taken by potential predators.

Acts of passive animal watching by individuals growing into extensive networks of enthusiasts actively entangled in their natural processes have been similarly documented elsewhere (Hunold 2017; Darke 2017; Khoo and Lee 2020). Such everyday engagements with the peregrines, from casual bird watching to intervening in potentially life-threatening events for the falcons, emotionally bond the human attendants to peregrines and keep the community cohesive (Crowley et al. 2019). Even for passive observers, the common sight (and sound) of peregrines from within the hospital, together with FaB Peregrines' presence standing in as their proxy, elevate the peregrines' profile amongst hospital staff, for many of whom the raptors have become a desired element of the work environment and embedded in their identities. We were approached by staff on their way to and from work to check in on the peregrines or share personal sightings, during which we were made aware of peregrine-themed social events at work. Their popularity may have contributed to the willingness of the building managers to accept accommodations benefitting the peregrines but yield no tangible returns for the hospital. More importantly, affection for the resident peregrines may provide them additional protection (Crowley et al. 2019), as hospital staff have previously helped stop suspected illegal persecution attempts.

However, as we have discussed throughout the paper, some elements of the peregrines' activities may not be universally welcomed. For building managers, the legislation protecting raptors from disturbance during the breeding season – which FaB Peregrines monitors compliance of – introduces obstacles for access to, and use of, the roof for substantial periods, imposing potential operational and financial challenges on the hospital. As recounted in the blogpost titled *History – Oct 2007 to Sep 2011* (FaB Peregrines 2012), these restrictions initially dampened the hospital's willingness to cooperate with FaB Peregrines (and therefore accommodate the raptors' needs). Additionally, the hospital may become a contested site when facing pressure from external actors negatively impacted by the presence of peregrines, with negative exposure challenging their readiness to host peregrines thus undermining the stability of the habitat (Peregrine Network, personal communication). Pigeon racing groups, or pigeon fanciers, are one such group that views raptors as a threat due to their perceived risk of depredation, despite actual losses from peregrines being relatively minor (Rutz et al. 2006a; UK Raptor Working Group 2019), and are opposed to urban raptor conservation to protect their interests (Raptor Alliance 2012; UK Raptor Working Group 2019). We observed this hostility towards peregrine conservation when pigeon fanciers disparaged the FaB Peregrines community on Facebook (which led to censoring *en masse*) and in person as we were conducting our fieldwork. Pigeon fanciers' activities share many similarities with that of other animal interest groups (e.g. Gullo et al. 1998; Hunold 2017; Crowley et al. 2019), namely engaging the public through advocacy work favorable to their cause but detrimental to urban raptor populations in general. This includes lobbying and support for culling of antagonistic raptors (e.g. Pigeon Racing UK and Ireland 2019; Royal Pigeon Racing Association 2019), as well as efforts to erode the popularity of peregrines which have led to the removal of nestboxes at other host sites (Peregrine Network, personal communication). While not yet apparent, potential conflicts may emerge in the future from the peregrines' ongoing predation of other sensitive or charismatic species, such as house sparrows which are facing population declines (Bell et al. 2010) or parakeets (the preferred prey of the current breeding peregrine pair at Charing Cross hospital – FaB Peregrines community leader, pers. comm.) which also have dedicated interest groups of their own internationally (Crowley et al. 2019). The responses of these actors will dynamically shape the life chances of predator and prey, legally or otherwise, and require careful management. In these ways, the quality of the peregrines' habitat, as indicated by their ability to persist and raise successive broods here, is the product of ecological viability consequential of urbanization *and* a human dimension which includes the efforts of social networks motivated by collective experiences and perceptions of the peregrines alongside the normative laws governing human activity (Gullo et al. 1998; Belaire et al. 2016; Hunold 2017; Crowley et al. 2019; Khoo and Lee 2020).

Conclusion

In this paper, we have identified the habitat components and resources commonly found in urban environments across European cities utilized by raptor populations to breed and/or feed. We have found that these features tend to be primarily intended for human use but are also capable of being exploited by opportunistic raptors. Suitable nest sites can be found in buildings and trees (themselves located in both built-up areas and green spaces), within which the presence of pre-built nests are especially useful to the secondary nesting owl and falcon species (Newton 2010). In addition to the nesting opportunities, the anthropogenic objects or structures found therein provide novel hunting opportunities which the predatory birds use to their advantage when seeking out (the usually abundant urban dwelling) prey. However, many of their activities may be responses to human actions, or vice versa, potentially creating feedback loops (e.g. use of nestboxes and food provided by humans; people respond to predation with persecution) (Clayton and Myers 2015; Belaire et al. 2016). As urban environments are socio-ecological systems it is inadequate to analyze ecological and social aspects of the raptors' habitat decoupled from each other, particularly given the proximity at which humans and raptors live that result in their entanglements (Francis and Chadwick 2013; Soulsbury and White 2015). As we have demonstrated in our case study, Charing Cross hospital exemplifies the extent to which the quality of the raptors' breeding habitat is one that is continually shaped by the diverse interests of human citizens and resident peregrines (through their attendants), intentionally or otherwise, and that human-raptor interactions arising from shared use of urban spaces motivate specific decisions influencing the quality of the habitat. While this is rarely reflected in the literature we have reviewed, the socio-ecological processes that make Charing Cross hospital an ideal habitat for breeding raptors is not unique. Compassionate human groups are known to actively engage in activities that improve the survival of urban wildlife, even if their presence and activities are polarizing (Gullo et al. 1998; Hunold 2017; Crowley et al. 2019; Khoo and Lee 2020). These examples highlight the potential for human-animal interaction to positively contribute to the success of raptors in urban environments through their resource use/availability but are difficult to quantify, as reflected in the bias towards human-animal conflicts in research (Soulsbury and White 2015). As conservation efforts shift towards the adoption of reconciliation ecology in cities (Rosenzweig 2003; Francis and Lorimer 2011), resulting in human and animal biomes becoming intertwined, we stress the importance of assessing these habitats ecologically and socially in tandem. Others have already illustrated how the efforts of individual citizens, whether disparately or collectively, incite broader impacts at the population scale, and their contribution whether as resource managers or spokespeople/informal conservationists should be recognized (Belaire et al. 2016; Hunold 2017; Crowley et al. 2019). Communities like FaB Peregrines are important not only for their tangible contributions to improving breeding sites and arresting raptor mortality, but also for their public-facing role as accessible intermediaries between the wild raptors and bewildered citizens. Their in-depth vernacular knowledge of the biology and movements of local populations can complement i) expert research activities limited by challenges in collecting field data and, ii) the suite of existing technocratic urban wildlife conservation initiatives (Sielicki and Sielicki 2009; Soulsbury and White 2015).

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Declarations

Ethics approval and consent to participate Data was collected under ethical approval from King's College London (project reference: MRS-18/19–13,499) which conforms to standards of the UK ESRC.

Consent for publication All authors give their consent for publication.

Competing interests The authors have no conflicts of interest to declare.

Appendix 1

Table 1 European raptors. Bolded species have urban populations

Family	Species	Family	Species
Accipitridae	Egyptian Vulture *Neophron percnopterus*	*Accipitridae*	**Sparrowhawk *Accipiter nisus***
Accipitridae	Griffon Vulture *Gyps fulvus*	*Accipitridae*	Levant Sparrowhawk *Accipiter badius*
Accipitridae	Black Vulture *Aegypius monachus*	*Falconidae*	Gyr Falcon *F. rusticolus*
Accipitridae	Bearded Vulture *Gypaëtus barbatus*	*Falconidae*	Saker Falcon *F. cherrug*
Accipitridae	Golden Eagle *Aquila chrysaëtos*	*Falconidae*	Lanner Falcon *F. biarmicus*
Accipitridae	Tawny Eagle *Aquila rapax*	*Falconidae*	**Peregrine Falcon *F. peregrinus***
Accipitridae	Imperial Eagle *Aquila heliaca*	*Falconidae*	Eleonora's Falcon *F. eleonorae*
Accipitridae	Spotted Eagle *Aquila clanga*	*Falconidae*	**Hobby *F. subbuteo***
Accipitridae	Lesser Spotted Eagle *Aquila pomarina*	*Falconidae*	Merlin *F. columbarius*
Accipitridae	**Bonelli's Eagle *Hieraaëtus fasciatus***	*Falconidae*	Red-footed falcon *F. vespertinus*
Accipitridae	**Booted Eagle *Hieraaëtus pennatus***	*Falconidae*	**Kestrel *F. tinnunculus***
Accipitridae	Short-toed Eagle *Circaëtus gallicus*	*Falconidae*	**Lesser Kestrel *F. naumanni***
Accipitridae	Rough-legged Buzzard *Buteo lagopus*	*Tytonidae*	**Barn Owl *Tyto alba***
Accipitridae	**Buzzard *Buteo buteo***	*Strigidae*	Eagle Owl *Bubo bubo*
Accipitridae	Long-legged Buzzard *Buteo rufinus*	*Strigidae*	Snowy Owl *Nyctea scandiaca*
Accipitridae	**Red Kite *Milvus milvus***	*Strigidae*	Great Grey Owl *Strix nebulosa*
Accipitridae	**Black Kite *Milvus migrans***	*Strigidae*	**Ural Owl *Strix uralensis***
Accipitridae	Black-winged Kite *Elanus caeruleus*	*Strigidae*	**Tawny Owl *Strix aluco***
Accipitridae	**White-tailed Eagle *Haliaeëtus albicilla***	*Strigidae*	**Scops Owl *Otus scops***
Accipitridae	Palla's Sea Eagle *Haliaeëtus leucoryphus*	*Strigidae*	**Long-eared Owl *Asio otus***
Accipitridae	Honey Buzzard *Pernis apivorus*	*Strigidae*	**Short-eared Owl *Asio flammeus***
Accipitridae	Marsh Harrier *Circus aeruginosus*	*Strigidae*	Tengmalm's Owl *Aegolius funereus*
Accipitridae	Hen Harrier *Circus cyaneus*	*Strigidae*	Hawk Owl *Surnia ulula*
Accipitridae	Pallid Harrier *Circus macrourus*	*Strigidae*	Pygmy Owl *Glaucidium passerinum*
Accipitridae	Montagu's Harrier *Circus pygargus*	*Strigidae*	**Little Owl *Athene noctua***
Accipitridae	**Goshawk *Accipiter gentilis***		

Appendix 2

Table 2 Topics discussed in literature reviewed

Species	Location	Population	Reproduction	Habitat	Feeding/ hunting	Others	Reference
Bonelli's Eagle	Aragon (Spain)	✓					Martínez-Miranzo et al. (2016)
Booted Eagle	Madrid (Spain)	✓					Palomino and Carrascal (2007)
Buzzard	Wroclaw (Poland)	✓					Kopij (2018)
	Various (Spain)	✓					Patón et al. (2012)
Red Kite	Saxony-Anhalt (Germany)	✓		✓			Nicolai et al. (2017)
	Reading (UK)				✓		Orros and Fellowes (2015)
Black Kite	Various (Spain)	✓					Patón et al. (2012)
White-tailed Eagle	North Podlasie Region (Poland)	✓					Jankowiak et al. (2015)
Goshawk	Wroclaw (Poland)	✓					Kopij (2018)
	North Podlasie Region (Poland)	✓					Jankowiak et al. (2015)
	Cologne (Germany)				✓		Rutz et al. (2006b)
	Berlin (Germany)					✓	Krone et al. (2005)
	Hamburg (Germany)					✓	Rutz (2003a)
				✓	✓		Rutz (2003b)
				✓			Rutz et al. (2004)
			✓				Rutz (2005)
				✓	✓		Rutz (2006)
Goshawk	Hamburg (Germany)	✓		✓			Rutz (2008)
			✓		✓		Rutz (2012)
						✓	Rutz et al. (2004)
	Berlin, Hamburg, Cologne (Germany)	✓	✓	✓			Rutz et al. (2006a)
	Uusimaa (Finland)		✓				Solonen (2008)
Sparrowhawk	Gothenburg (Sweden)					✓ ✓	Ek et al. (2004a) Ek et al. (2004b)
	Aarhus (Denmark)			✓	✓		Frimer (1989a)
		✓	✓	✓			Frimer (1989b)
	Prague (Czech Rep.)					✓	Kunca et al. (2015)
						✓	Kunca and Yosef (2016)
	Dunaújváros, Godollo (Hungary)		✓	✓		✓	Papp (2011)
	Debrecen (Hungary)				✓		Mester and Mérő TO (2018)
	North Podlasie Region (Poland)	✓					Jankowiak et al. (2015)
	Wroclaw (Poland)	✓					Kopij (2018)
	Lublin (Poland)		✓	✓			Biaduń (2006)
		✓					Biaduń and Żmihorski (2011)
	Vienna (Austria)	✓					Schütz and Schulze (2018)
	Various (Spain)	✓					Patón et al. (2012)
	Edinburgh (UK)		✓				Thornton et al. (2017)
Peregrine	Bristol, Bath, Exeter (UK)				✓		Drewitt and Dixon (2008)
	London (UK)		✓	✓	✓		Johnson (2014)
	Nottingham (UK)				✓		Kettel et al. (2016)

Table 2 (continued)

Species	Location	Population	Reproduction	Habitat	Feeding/ hunting	Others	Reference
Peregrine	Various (UK)	✓	✓				Wilson et al. (2018)
	Warsaw (Poland)				✓		Rejt (2001)
			✓				Rejt (2003)
	Wroclaw (Poland)	✓					Kopij (2018)
	Warsaw, Kraków (Poland)					✓	Sielicki and Sielicki (2009)
	Bryne (Finland)				✓		Time (2016)
	Gothenburg (Sweden)					✓	Ek et al. (2004a)
	Florence (Italy)				✓		Serra et al. (2001)
	Sicily (Italy)				✓		Leonardi and Mannino (2007)
Hobby	Berlin (Germany)				✓		Fiuczynski and Soemmer (2000)
Common Kestrel	Wroclaw (Poland)	✓					Kopij (2018)
	Warsaw (Poland)				✓		Rejt (2006)
					✓		Rejt et al. (2000)
						✓	Rejt et al. (2004)
			✓				Rejt et al. (2005)
			✓				Rejt and Raczycska (2003)
					✓		Romanowski (1996)
						✓	Rutkowski et al. (2006)
						✓	Rutkowski et al. (2010)
					✓		Kubacka et al. (2010)
					✓		Żmihorski and Rejt (2007)
	North Podlasie Region (Poland)	✓					Jankowiak et al. (2015)
	Various (Poland)				✓		Boratyński and Kasprzyk (2005)
	Bardejov (Slovakia)				✓		Mikula et al. (2013)
Common Kestrel	Milan (Italy)		✓				Belcher et al. (2018)
	Rome (Italy)				✓		Fattorini et al. (1999)
					✓		Fattorini et al. (2001)
					✓		Kečkéšová and Noga (2008)
					✓		Piatella et al. (1999)
			✓				Salvati (2002)
		✓	✓	✓	✓		Salvati et al. (1999)
	Berlin (Germany)		✓		✓		Kübler et al. (2005)
	České Budějovice (Czech Rep.)				✓		Riegert et al. (2007a)
				✓			Riegert et al. (2007b)
					✓		Riegert et al. (2009)
			✓	✓			Riegert et al. (2010)
					✓		Riegert and Fuchs (2004)
				✓			Riegert and Fuchs (2011)
	Vienna (Austria)		✓		✓		Kreiderits et al. (2016)
			✓	✓	✓		Sumasgutner et al. (2014a)
			✓	✓	✓		Sumasgutner et al. (2014b)
						✓	Sumasgutner et al. (2018)
	Various (Spain)	✓					Patón et al. (2012)

Table 2 (continued)

Species	Location	Population	Reproduction	Habitat	Feeding/ hunting	Others	Reference
	Manchester (UK)				✓		Yalden (1980)
Lesser Kestrel	Bari, Taranto (Italy)		✓	✓			Bux et al. (2008)
	Andalusia (Spain)	✓					Bustamante (1997)
				✓			Negro et al. (1991)
	Seville (Spain)				✓		Negro et al. (2000)
			✓	✓			Rodríguez et al. (2013)
Lesser Kestrel	Castro Verde, Guadiana (Spain)			✓			Franco et al. (2005)
	Various (Spain)	✓					Patón et al. (2012)
	Seville, Aragon (Spain)		✓		✓		Tella et al. (1996)
Barn Owl	Rome (Italy)				✓		Fattorini et al. (1999)
					✓		Manganaro et al. (2001)
		✓	✓	✓	✓		Salvati et al. (2002)
	Kraków (Poland)	✓					Fröhlich and Ciach (2019)
Ural Owl	Košice (Slovakia)			✓	✓		Dravecký and Obuch (2009)
	Kraków (Poland)	✓					Fröhlich and Ciach (2019)
Tawny Owl	Pavia (Italy)	✓					Galeotti (1990)
				✓		✓	Galeotti (1994)
					✓		Galeotti et al. (1991)
						✓	Galeotti et al. (1996)
	Rome (Italy)				✓		Fattorini et al. (1999)
					✓		Fattorini et al. (2001)
		✓					Ranazzi et al. (2000a)
			✓				Ranazzi et al. (2000b)
		✓					Ranazzi et al. (2002)
	Warsaw (Poland)				✓		Goszczyński et al. (1993)
			✓				Gryz and Krauze-Gryz (2018)
					✓		Gryz and Krauze-Gryz (2019)
					✓		Lesiński et al. (2009)
	Kraków (Poland)	✓					Fröhlich and Ciach (2018)
		✓					Fröhlich and Ciach (2018)
Tawny Owl	Kraków (Poland)	✓					Fröhlich and Ciach (2019)
	Toruń (Poland)				✓		Zalewski (1994)
	Helsinki (Finland)		✓				Solonen (2014)
	Uusimaa (Finland)		✓				Solonen and Ursin (2008)
Scops Owl	Pelješac (Croatia)	✓					Vrezec (2001)
	Grosseto (Italy)			✓	✓		Panzeri et al. (2014)
		✓		✓			Mori et al. (2017)
	Trento (Italy)	✓		✓			Marchesi and Sergio (2005)
Long-eared Owl	Kraków (Poland)	✓					Fröhlich and Ciach (2018)
		✓					Fröhlich and Ciach (2019)
	Rzeszów (Poland)				✓		Dziemian et al. (2012)
	Pecs (Hungary)				✓		Szép et al. (2018)
	České Budějovice (Czech Rep.)			✓			Lövy and Riegert (2013)
					✓		Riegert et al. (2009)

Table 2 (continued)

Species	Location	Population	Reproduction	Habitat	Feeding/ hunting	Others	Reference
	Milan (Italy)				✓		Pirovano et al. (2000a)
				✓			Pirovano et al. (2000b)
	Sofia (Bulgaria)				✓		Milchev et al. (2003)
	Dobrich (Bulgaria)				✓		Milchev and Ivanov (2016)
Short-eared Owl	Various (Spain)	✓					Patón et al. (2012)
Little Owl	Rome (Italy)				✓		Fattorini et al. (1999)
					✓		Fattorini et al. (2001)
					✓		Manganaro et al. (2001)
	Kraków (Poland)	✓					Fröhlich and Ciach (2019)
Little Owl	Łódź, Podlasie, Upper Silesia, Małopolska, Lublin, Chelm, Sub-Carpathian regions (Poland)	✓					Kitowski and Grzywaczewski (2010)

Appendix 3 Framework for initial interviews with FaB Peregrines

People

Demography

- Age
- Occupation/background
- Time given
- How big is the group?
- Who are members of core group?

Hardware

- What has been invested (CCTV, nest trays, etc)?
- Who installs/maintains hardware?

Organisation

Structure

- Hierarchy/ratio of volunteers (How many experts/ringers/amateur citizens)
- Types of roles
- Relationship with other bodies (volunteer groups, BTO, conservation groups, estate managers)

Data

- What data is collected?
- How/where does data flow
- Who holds what data?

Intervention/recoveries

- How involved are members in peregrine activities: rescue? Observe-only? What kinds of interventions are there?
- How frequent (many) are interventions?
- Who intervenes, steps of intervention
- How successful?

Activity

- When is group active – breeding/non-breeding season/all-year?
- What activities occur off-season?
- Are members/group active at other nest sites?

Peregrines

Ringing

- Are they ringed?
- If no, why not?

– Who rings them – are ringers part of group (dedicated) or "freelance"?
– How many ringers involved (in London)?

Challenges

– What difficulties groups face in urban context?

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