

Diet and prey selection of urban-dwelling Peregrine Falcons in southwest England

Edward J.A. Drewitt and Nick Dixon

ABSTRACT Despite extensive research on city-dwelling Peregrine Falcons *Falco peregrinus* in mainland Europe and other parts of the world, little has been undertaken and published in the UK. We analysed the diet of Peregrines in three cities in southwest England – Bristol, Bath and Exeter – between 1998 and 2007. The wide range of prey species taken included many species associated with a variety of non-urban habitats. Some prey species appear to be hunted at night, while on migration. This paper summarises the diet of Peregrines in urban areas and reviews their night-time hunting behaviour.

The diet of Peregrine Falcons *Falco peregrinus* in the UK is best known from the analysis of prey remains collected from nest-sites in habitats such as sea cliffs, moorland, upland crags and lowland quarries (Ratcliffe 1993), but little has been published on the diet of Peregrines in urban areas. The results of the most recent national survey showed that about 4% of the UK's breeding Peregrines are found in towns and cities throughout the year, along with an increasing number of non-breeding and wintering individuals (Dixon 2000; Crick *et al.* 2003). Until recently, information about their diet has been fragmented, and the assumption has been that they feed predominantly on urban species, especially Feral Pigeons *Columba livia* (Ratcliffe 1993; Tully 1997). However, the accessibility of some urban nest-sites allows comprehensive samples of prey debris to be obtained throughout the year and in this paper we describe the prey remains collected from three cities in southwest England over a 6–9 year period.

Study sites and their use by Peregrine Falcons

Urban-dwelling Peregrines were studied in the

cities of Bristol, Bath (Somerset) and Exeter (Devon). In Bristol, Peregrines regularly roost on the tallest office buildings in the city and on one of the University buildings. Both adults and immatures were present throughout the year, although only sporadically during the mid-summer months. In Bath, a pair regularly roosts on St John's Church in the city centre and prey remains were also recovered from Bath Abbey. Peregrines have been using Bath as a non-breeding site since the late 1990s. A pair showed signs of breeding behaviour in 2000, but first bred in 2006, following the erection of a nestbox by the Hawk and Owl Trust in 2004. In 2006, four chicks were hatched and three fledged successfully; two chicks fledged in 2007. Peregrines have been using a church tower in Exeter since 1987 and have bred there since 1997 (Dixon & Drewitt 2002); the pair has fledged young successfully each year since then. Peregrines are often faithful to their wintering sites and those studied in Bristol and Bath during the non-breeding seasons may have been the same birds visiting annually (van Dijk 2000; Taranto 2007).

A wide range of habitats are found within an



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47. The prey taken by urban-dwelling Peregrine Falcons *Falco peregrinus* in Britain comprises an extraordinarily wide range of species, many of which are not generally associated with urban habitats.

8-km radius of each of the three cities. Bristol (city population 410,500) contains parkland, rivers, many trees and other green open spaces. Bath and its surroundings (population 175,600) has rivers, parkland, mixed agricultural land and woodland within 8 km of the centre. Exeter (population 119,600) and its environs contains more diverse habitats, including four river systems and associated water meadows, tidal reaches and mudflats on the estuary, deciduous and coniferous forest and mixed agricultural land as well as urban, suburban and industrial areas (all data from National Statistics www.statistics.gov.uk).

Methods

Prey debris (see below) was collected at regular intervals at the Peregrines' roosting and breeding sites over the following periods: from October 1998 to December 2005 in Bristol; from March 2000 to July 2007 in Bath; and from June 1997 to July 2007 in Exeter. Weekly visits to three sites in Bristol and two sites in Bath were made from mid September to April, while monthly visits were made from May to August. In 2006 and 2007, both sites in Bath were visited daily. The Exeter site, which supports a breeding pair with year-round occupation, was visited weekly throughout the study period. Here, in addition to the weekly collections, there was an annual clearance of the

gulleys, gutters and drainpipes of the church in November.

At all sites, a careful search for prey debris was carried out below the buildings used for roosting/breeding, and on ground areas and roofs/gutters within approximately 20 m of the roost/nest-site. Sites were walked in the same pattern on each visit. A wider search (up to 50 m from the roost/nest-site) was carried out following strong winds.

Debris collected included carcasses (whole or incomplete), heads, skulls, legs, feet, wings, feathers, rings and pellets (see Oro & Tella 1995). Remains were dried after each collection for subsequent analysis. Prey species were identified mostly with the help of reference material (chiefly Jenni & Winkler 1994, Brown *et al.* 2003, www.ups.edu/x5662.xml, www.michelklemann.nl/verensite/start/index.html). Occasionally, items were confirmed only after comparison with museum specimens, either at the Natural History Museum (Tring) or at Bristol's City Museum & Art Gallery.

To avoid duplication, careful identification of remains was required over a period of days and sometimes a week or more after a particular item was discovered. Some prey is cached by Peregrines and eaten over a period of time and sometimes the remains of individual items were found on more than one day. The minimum number of individuals was estab-

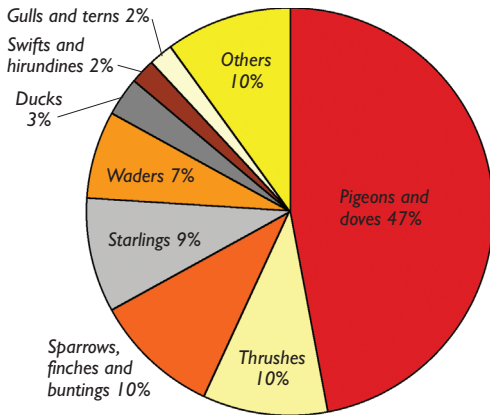


Fig. 1. Prey composition of Peregrine Falcons *Falco peregrinus* in Bristol, Bath and Exeter, 1998–2007 (n=5,275).

lished by checking, for example, for duplication of the same wing feathers or legs as well as for feathers from birds of a different age or sex class. Feather condition and weather-related damage was important in assessments of how fresh the remains were.

Results

Prey species taken at each of the three sites are given in Appendix 1. A total of 98 species were recorded, ranging in size from Goldcrest *Regulus regulus* to Mallard *Anas platyrhynchos*,

which emphasises the diversity of prey taken and the opportunistic nature of hunting Peregrines in our towns and cities. A total of 5,275 individual prey items were identified.

Feral Pigeons were the most important prey species, comprising 42% of prey by frequency and 63% by weight. Other significant prey species were Common Starling *Sturnus vulgaris* (9% by frequency and 3% by weight), Collared Dove *Streptopelia decaocto* (4% and 4%), Redwing *Turdus iliacus* (4% and 1%), Greenfinch *Carduelis carduelis* (4% and 1%) and Eurasian Teal *Anas crecca* (2% and 4%) (see fig. 1).

Fig. 2 shows the variation in the most frequent prey species eaten throughout the year in Exeter. Over half of the Starlings eaten in the summer months were juveniles. Along with Collared Doves and Blackbirds *Turdus merula*, Common Swifts *Apus apus* were an important component of summer diet, comprising 9% of prey.

Fig. 3 shows a selection of nocturnal migrants and how the numbers we recorded among Peregrine remains at all three sites varied across the year. As might have been expected, most species show a peak during migration seasons and in winter; the one obvious exception is Blackbird, which was most important between March and August, illustrating the greater importance of local Black-

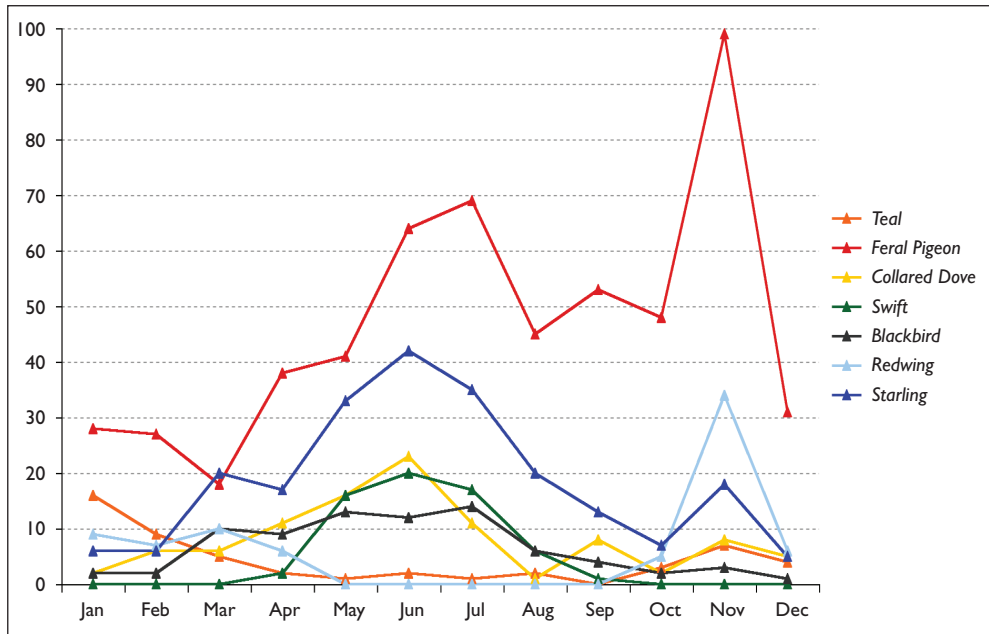


Fig. 2. Seasonal variation in prey composition of Peregrine Falcons *Falco peregrinus* in Exeter, 1998–2007. Figures show number of individual items identified in each month during the study period.

birds (particularly young) in the Peregrine diet compared with migrants (although the peak month is March, which presumably includes many migrants).

Discussion

Our study amalgamates data from three separate urban areas in Britain and we believe that the large sample of prey recorded makes it representative of the diet of urban Peregrines across Britain. Prey remains examined by us from other, smaller-scale studies elsewhere in the UK (including the cities of Coventry, Derby, London, Taunton and Worcester) support this. Appendix 1 confirms that the diet of urban Peregrines is remarkably diverse and that these raptors regularly hunt prey species that are rarely encountered in urban environments. The finding that Feral Pigeon is the most frequent prey species is consistent with other studies of city-dwelling Peregrines (Sömmer 1989; Ratcliffe 1993; Schneider & Wilden 1994; Tully 1998; Rejt 2001; Serra *et al.* 2001; Carter *et al.* 2003; Marconot 2003; Rejt & Sielicki 2007).

The prey remains retrieved are merely a record of what was brought back to the urban sites we monitored and may under-represent the full complement of prey that is caught or taken to other feeding sites, unknown and less regu-

larly used. In addition, the indirect sampling method may over-represent certain species, particularly larger birds. Loss of remains due to scavenging, weather, height of the buildings used (all 60 m or more in our study), street cleaning, etc. may also bias or limit the results (Oro & Tella 1995; Rogers *et al.* 2005; Ruddock 2007).

Feral Pigeons

The proportion of Feral Pigeons in the diet of Peregrines in our study (42% of 5,275 items) is higher than for most other urban sites in Europe. The percentage composition throughout the year is 32% (of 486 items) in Warsaw, Poland; 16% ($n=268$) in Belfort, France; 11% ($n=624$) and 26.6% ($n=128$) at two different sites in Berlin, Germany; 30% ($n=46$) in Florence, Italy, where Peregrine Falcons just winter; and 40.2% ($n=107$) in Plzeň, Czech Republic, in the summer (Sömmer 1989; Schneider & Wilden 1994; Mlíkovský & Hruška 2000; Rejt 2001; Serra *et al.* 2001; Marconot 2003). This higher representation may be due partly to our large sample size, but probably also reflects differences in population size and availability of Feral Pigeons among the cities mentioned.

Seasonal changes in the proportion of Feral Pigeons in the Peregrine's diet may be related to variation in local populations of both breeding

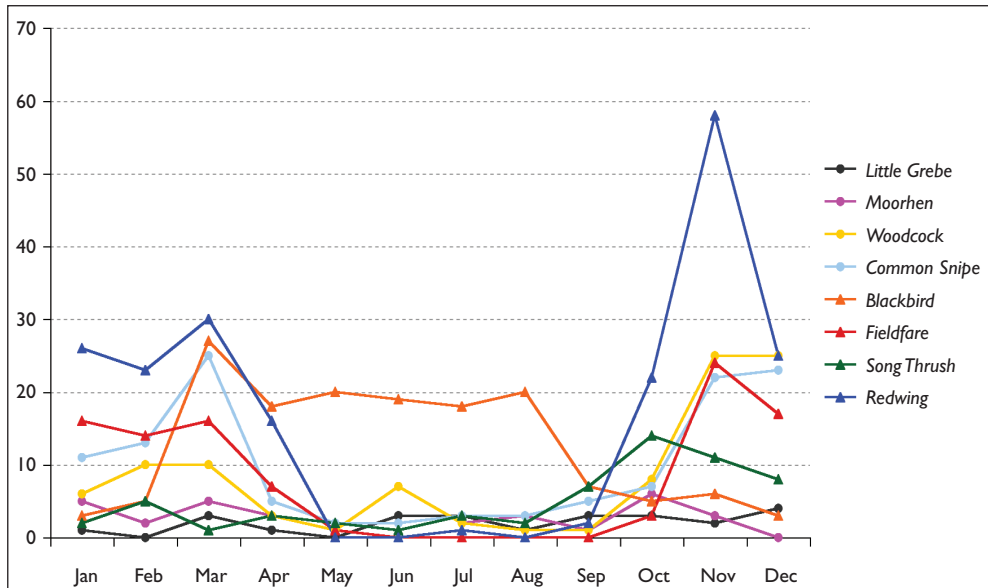


Fig. 3. Seasonal variation in prey composition of Peregrine Falcons *Falco peregrinus* in Bristol, Bath and Exeter, 1998–2007, showing certain key species (note that Feral Pigeon *Columba livia* is excluded to emphasise the patterns of the other species). Figures show number of individual items identified in each month during the study period.

feral and exercising domestic (e.g. racing) pigeons, increased demand for food to feed chicks and the presence or absence of alternative prey. A pattern similar to that shown by our results was found in Warsaw where, between June and September, Feral Pigeons comprised 43% of the diet, falling to only 10% between October and December (Rejt 2001).

Common Starlings

Starlings are an important part of the diet of British Peregrines, particularly during the breeding season, when many juveniles are taken. Although the proportions vary seasonally, the overall value of 9% (of 5,275 items) is a little lower than that for Belfort (11%) and Berlin (15%) (Sömmer 1989; Marconot 2003), which may reflect the decline in the Starling population of southern England (Robinson *et al.* 2005). In the breeding season, Starlings account for 19% of the diet in Exeter, very similar to the 18% found in Berlin but much higher than 6% in Warsaw and 0.9% in Plzeň (Schneider & Wilden 1994; Mlíkovský & Hruška 2000; Rejt 2001).

Common Swifts

Common Swifts appear to be an important component of the diet in the breeding season in southern England (9% of 689 items) and are taken in similar proportions in Warsaw (9%), Berlin (9.4%) and Florence (14%); in Plzeň they comprised just 2.8% of the summer diet (Schneider & Wilden 1994; Mlíkovský & Hruška 2000; Rejt 2001; Serra *et al.* 2001).

Distances travelled

Tracking Peregrines from regular roosts or breeding sites has shown that foraging flight distances range from less than 2 km to 43 km, with the exception of one extraordinary flight of 79 km in one trip (Ratcliffe 1993; Enderson & Craig 1997). Recent radio-tracking studies of Peregrines in Canada have shown similar daily movements of urban-breeding birds (Peregrine Foundation 2006 www.peregrine-foundation.ca/trackem.html). Recent work in Italy suggests that urban Peregrines do not hunt in the vicinity of the nest, that hunting occurs predominantly 1–5 km from the nest and that local populations of Feral Pigeons, Collared Doves, Blackbirds, Western Jackdaws *Corvus monedula* and Starlings were not affected by Peregrine predation (Taranto 2007). In Florence, Peregrines take

many birds flying over the city and have a particular preference for high-flying rather than mid- or low-flying species (Serra *et al.* 2001).

Nocturnal migrants

Some of the prey species recorded in our study are normally shy and secretive, typically flying only short distances and then mostly at night or at dawn and dusk, and migrate mostly at night. These include Common Quail *Coturnix coturnix*, Little Tachybaptus *ruficollis* and Black-necked Grebe *Podiceps nigricollis*, Water Rail *Rallus aquaticus*, Corn Crane *Crex crex*, Moorhen *Gallinula chloropus*, Common Snipe *Gallinago gallinago*, Jack Snipe *Lymnocyptes minimus* and Woodcock *Scolopax rusticola*. Other, less secretive prey, including Turtle Dove *Streptopelia turtur*, thrushes, Northern Wheatear *Oenanthe oenanthe* and Brambling *Fringilla montifringilla*, will also migrate at night (Rejt 2001; Wernham *et al.* 2002). In addition, Dunnocks *Prunella modularis* have been taken in large numbers during the autumn, hinting at a rather large and poorly known movement of Dunnocks at this time of year.

In our study, these species appear to be taken chiefly during the months when they normally migrate into or through southern England, or are involved in localised movements (Wernham *et al.* 2002). Most are present in Peregrine diet during the autumn/winter months and again in February/March as they migrate north. With the notable exception of Blackbird, most are effectively absent from the diet in midsummer. Redwings are predated most heavily in November, and Common Snipe in March and November–December, when their winter populations probably peak in southwest England (Wernham *et al.* 2002). During this period, Peregrines may catch more prey than they need to survive and cache the surplus (Ratcliffe 1993). Little Grebes are taken in small numbers all through the year, suggesting that they are moving at night between stretches of water throughout the year and so are not caught solely during spring and autumn migration. Similar findings with respect to Quails and Corn Crakes have been reported from France, Poland and the Czech Republic (Mlíkovský & Hruška 2000; Rejt 2001; Marconot 2003).

Nocturnal hunting

Evidence that Peregrines hunt nocturnally in Britain is relatively recent (Tully 1997). Else-

where, however, Peregrines are known to hunt at night at various times of the year and their increasing presence in towns and cities is creating further evidence for this behaviour (DeCandido & Allen 2006). Nocturnal hunting behaviour of urban-dwelling Peregrines has been recorded in North America, Hong Kong, Taiwan, Australia and across Europe (Sömmer 1989; Olsen *et al.* 1998; Ferguson-Lees & Christie 2001; Serra *et al.* 2001; DeCandido & Allen 2006).

Our study has highlighted several prey species that are most likely to have been caught at night. Black-necked Grebes, for example, fly predominantly at night and are already rested on water before first light (Jordan 2001). Other species, such as Woodcock, may have been taken at dusk or dawn but were more likely to have been caught at night – there are no roding Woodcocks in the vicinity of our study areas (Farrell *et al.* 2001; Rose 2005). Such birds may be drawn to city lights in the same way that migrants are attracted to lighthouses (Rejt 2001; Marconot 2003; DeCandido & Allen 2006).

Evidence of nocturnal hunting behaviour illustrates just how well adapted Peregrines are to the urban environment, since they are well able to maximise feeding opportunities there. Studies in France, Germany and The Netherlands describe how Peregrines use artificial light directed onto buildings at night to their advantage, attacking prey at short distances and using the shadows to avoid being dazzled while looking for a potential kill (Kladny 2001; Marconot 2003). During the peak migration period of quarry species in Berlin and New York, Peregrines are not observed hunting until after sunset (Sömmer 1989; DeCandido & Allen 2006). In southern Taiwan, Peregrines use a tall bridge tower which is illuminated at night and return with live or freshly killed prey; peak return rates are during 05.00–09.00 hrs and 19.00–23.00 hrs. During 140 hours of filming, 79.5% of the 44 prey items recorded were brought in between 19.00 and 20.00 hrs and only 20.5% during daylight hours (Huang & Severinghaus 2005).

In The Netherlands, a Peregrine cache on an industrial chimney contained hundreds of birds, mainly Moorhens, Water Rails, Eurasian Teals and Common Snipes. The site, illuminated at night, is on a main migration route for these species and it is thought that they were probably taken at night while on passage (Van Geneijen 2000). In Warsaw, studies of breeding

urban Peregrines have shown that more than 10% of all feeding or prey deliveries to young take place at night, particularly between midnight and 04.00 hrs (Rejt 2004).

Direct observations from the Empire State Building, New York, have revealed Peregrines regularly hunting nocturnal migrants such as Yellow-billed Cuckoo *Coccyzus americanus* and Baltimore Oriole *Icterus galbula*. The presence of at least three Peregrines at any one time was significantly more likely on evenings when more than 50 migrants were counted passing over during the night and most observations were noted in October (DeCandido & Allen 2006). In Binghamton, New York State, nocturnal migrants such as American Woodcock *Scolopax minor*, Virginia Rail *Rallus limicola* and 'Wilson's Snipe' *G. g. delicata* have all been found as prey items (Robert DeCandido pers. comm.).

Nocturnal behaviour in non-urban habitats

Nocturnal behaviour in non-urban habitats has also been recorded. Ancient Murrelets *Synthliboramphus antiquus*, Cassin's Auklets *Ptychoramphus aleuticus*, Fork-tailed Storm-petrels *Oceanodroma furcata* and Leach's Storm-petrels *O. leucorhoa* in North America are hunted over the sea at night or during crepuscular hours (Ratcliffe 1993; Rejt 2004). At cliff sites in Co. Down, the hunting of bats (Chiroptera), begging calls from chicks and movements to retrieve what is thought to be cached prey have been recorded at night (Marc Ruddock pers. comm.). Radio-tracked Peregrines in Somerset have also shown evidence of flying and probably hunting at night (Nick Williams pers. comm.). Woodcock has appeared in over 70% of prey lists across Britain (Ratcliffe 1993). In southern Scotland, Woodcock comprises 4% of the winter diet, while in Northumberland it is as high as 6% by frequency and 13% by weight (Mearns 1982; Dixon 2005). In South Wales, between October and May, Woodcock comprises 2.1% of the diet (n=1,541), the majority probably being taken at night, though a proportion may be taken at dawn and dusk between March and May, during roding flights (Dixon & Richards 2005).

Countershading plumages and their possible effects on predation

Many of the key migratory species taken by Peregrines at night are waterbirds with 'counter-

shading plumages' (Bretagnolle 1993; McNaught & Owens 2002; Ruxton *et al.* 2004; Speed *et al.* 2005). A pale belly and dark back may work well when birds are on the water, camouflaging them from aerial predators above and food such as fish and invertebrates from below, but may be counter-productive when flying at night in artificially illuminated areas. Under such conditions, pale underparts are strikingly obvious from below, while Peregrines perched on high vantage points will see low-flying migrants as dark silhouettes against the illumination.

Bats

The presence of bats in the Peregrine's diet is occasionally recorded in continental Europe, Africa and North America (Cramp & Simmons 1980; Ratcliffe 1993; Jenkins & Avery 1999; Mlíkovský & Hruška 2000; van Dijk 2000; Ferguson-Lees & Christie 2001; Lee & Kuo 2001; Serra *et al.* 2001; Carter *et al.* 2003; Rejt 2004; Peter Wegner pers. comm.; Mátyás Prommer pers. comm.). In our study, Peregrines caught Noctule Bats *Nyctalus noctula* in both Exeter and Bath and this is probably linked to the habit of hunting at dawn/dusk or at night.

Acknowledgments

The research was partially funded by Bristol Zoo/National Lottery Millennium Awards Scheme and the Hawk and Owl Trust. From the former, Stephen Woollard and Chris Sperring offered support and helped to raise awareness of the project. Thanks are due to everyone who has assisted and advised during the project, in particular Rainer Altenkamp, Nigel Ball, Andy Baxter, Axel Bräunlich, Nick Brown, Robert DeCandido, Andrew Dixon, Graeme Goodall, Father Tom Gunning, Louisa Hazelton, Denzil Large, Graham Roberts, Colin Shawyer, John Tully, Philip Wright and John Yates. Thanks are due to Edmund Flach at Whipsnade Zoo for supplying Corn Crane feathers for reference. Mike Bailey, Marc Ruddock and Dr Rob Thomas provided statistical assistance and along with Richard Bland, Elizabeth Drewitt and John Tully gave helpful comments on earlier drafts of the manuscript.

References

- Bretagnolle, V. 1993. Adaptive significance of seabird coloration: the case of Procellariiformes. *Am. Nat.* 142: 141–173.
- Brown, R., Ferguson, J., Lawrence, M., & Lees, D. 2003. *Tracks and Signs of the Birds of Britain and Europe: an identification guide*. 2nd edn. Christopher Helm, London.
- Carter, K. M., Lacki, M. J., Dzialak, M. R., Burford, L. S., & Bethany, R. O. 2003. Food habits of Peregrine Falcons in Kentucky. *J. Raptor Res.* 37: 344–349.
- Cramp, S., & Simmons, K. E. L. (eds.) 1980. *Handbook of the Birds of Europe, the Middle East and North Africa: The Birds of the Western Palearctic*. Vol. 2. OUP, Oxford.
- Crick, H., Banks, A., & Coombes, R. 2003. Findings of the National Peregrine Survey 2002. *BTO News* 248: 8–9.
- DeCandido, R., & Allen, D. 2006. Nocturnal hunting of Peregrine Falcons at the Empire State Building, New York City, NY. *The Wilson Journal of Ornithology*. 118: 53–58.
- Dixon, A. 2005. The prey of Peregrine Falcons *Falco peregrinus* at breeding territories in Northumberland. *Trans. Nat. Hist. Soc. Northumbria*. 64(3): 111–120.
- & Richards, C. 2005. Peregrine *Falco peregrinus* predation of Woodcocks *Scolopax rusticola*: evidence of nocturnal hunting. *Welsh Birds* 4: 221–226.
- Dixon, N. 2000. A new era for Peregrines – buildings, bridges and pylons as nest sites. *BTO News* 229: 10–11.
- & Drewitt, E. 2002. Prey selection by urban nesting Peregrine Falcons in 2001. *Devon Bird Report*: 210–213.
- Enderson, J. H., & Craig, G. R. 1997. Wide ranging by nesting Peregrine Falcons (*Falco peregrinus*) determined by radiotelemetry. *J. Raptor Res.* 31: 333–338.
- Farrell, I., Hibbert, R., & Reay, R. (eds.) 2002. *Devon Bird Report 2001*. Devon Bird Watching and Preservation Society.
- Ferguson-Lees, J., & Christie, D. A. 2001. *Raptors of the World*. Christopher Helm, London.
- Huang, K. Y., & Severinghaus, L. L. 2005. The nocturnal hunting behaviour of a diurnal raptor, the Peregrine Falcon, in southern Taiwan. *Fourth Asian Raptor Research and Conservation Network Symposium*. Taiping, Perak, Malaysia.
- Jenkins, A. R., & Avery, G. M. 1999. Diets of the Peregrine and Lanner Falcons in South Africa. *J. Raptor Res.* 33: 190–206.
- Jenni, L., & Winkler, R. 1994. *Moult and Ageing of European Passerines*. Academic Press, London.
- Jordan, R. 2001. Grebes: keeping watch on the fiery eyes. *BBC Wildlife* 19: 48–54.
- Kladny, M. 2001. Slechtvalk jaagt 's nachts op kokmeeuwen. [Peregrine Falcon hunts Black-headed Gulls at night] *Slechtvalk Nieuwsbrief: Dutch Peregrine Workgroup* 7(2): 11. [In Dutch]
- Lee, Y., & Kuo, Y. 2001. Predation on Mexican Free-tailed Bats by Peregrine Falcons and Red-tailed Hawks. *J. Raptor Res.* 35: 115–123.
- Marconot, B. 2003. [Nocturnal hunting behaviour of the Peregrine *Falco peregrinus* at Belfort.] *Ornithos* 10: 207–211. [In French]
- McNaught, M. K., & Owens, I. P. F. 2002. Interspecific variation in plumage colour among birds: species recognition or light environment? *J. Evol. Biol.* 15: 505–514.
- Means, R. 1982. Winter occupation of breeding territories and winter diet of Peregrines in South Scotland. *Ornis Scand.* 13: 79–83.
- Mlíkovský, J., & Hruška, J. 2000. Food of the Peregrine Falcon (*Falco peregrinus*) in Plzeň, Czech Republic. *Buteo* 11: 125–128.
- Olsen, P., Doyle, V., & Boulet, M. 1998. Variation in male provisioning in relation to brood size of Peregrine Falcons *Falco peregrinus*. *Emu* 98: 297–304.
- Oro, D., & Tella, J. L. 1995. A comparison of two methods for studying the diet of the Peregrine Falcon. *J. Raptor Res.* 29: 207–210.
- Ratcliffe, D. A. 1993. *The Peregrine Falcon*. 2nd edn. Poyser, London.
- Rejt, L. 2001. Feeding activity and seasonal changes in prey composition of urban Peregrine Falcons *Falco peregrinus*. *Acta Ornithologica* 36: 165–169.
- 2004. Nocturnal behaviour of adult Peregrines at the nest during nestling period. *Vestník Zoologii* 38: 87–90.
- & Sielicki, S. 2007. Feeding activity and seasonal changes in prey composition of Peregrines (*Falco p. peregrinus*) in Poland. *Peregrine Conference*. Piotrowo/Poznan, Poland.
- Robinson, R. A., Siriwardena, G. M., & Crick, H. Q. P. 2005.

- Status and population trends of Starling *Sturnus vulgaris* in Great Britain. *Bird Study* 52: 252–260.
- Rogers, A. S., DeStefano, S., & Ingraldi, M. F. 2005. Quantifying Northern Goshawk diets using remote cameras and observations from blinds. *J. Raptor Res.* 39: 303–309.
- Rose, H. (ed.). 2005. *Avon Bird Report 2004*. Avon Ornithological Group, Bristol.
- Ruddock, M. 2007. The importance of Peregrine diet studies in resolving predator–prey conflicts. *Peregrine Conference*. Piotrowo/Poznan, Poland.
- Ruxton, G. D., Speed, M. P., & Kelly, D. J. 2004. What, if anything, is the adaptive function of countershading? *Anim. Behaviour* 68: 445–451.
- Schneider, R. & Wilden, I. 1994. Choice of prey and feeding activity of urban Peregrine Falcons *Falco peregrinus* during the breeding season. In: Meyburg B.-U., & Chancellor, R. D. (eds.), *Raptor Conservation Today*, 203–209. WWGBP, Berlin, London & Paris.
- Serra, G., Lucentini, M., & Romano, S. 2001. Diet and prey selection of nonbreeding Peregrine Falcons in an urban habitat of Italy. *J. Raptor Res.* 35: 61–64.
- Sömmer, P. 1989. The diet of the Berlin Peregrine pair. *Pica* 16: 120–128.
- Snow, D. W., & Perrins, C. M. 1998. *The Birds of the Western Palearctic – Concise Edition*. OUP, Oxford.
- Speed, M. P., Kelly, D. J., Davidson, A. M., & Ruxton, G. D. 2005. Countershading enhances crypsis with some bird species but not others. *Behav. Ecol.* 16: 327–334.
- Taranto, P. 2007. Patterns of urbanisation and hunting strategies of urban Peregrine Falcons in Italy. *Peregrine Conference*. Piotrowo/Poznan, Poland.
- Tully, J. 1998. The diet of urban Peregrines. *Avon Bird Report 1997*: 129–136. Avon Ornithological Group, Bristol.
- van Dijk, J. 2000. Zwolve Slechtvalken op middelbare leeftijd. [Wintering Peregrines from juvenile to middle age.] *Slechtvalk Nieuwsbrief: Dutch Peregrine Workgroup* 6(2): 6–10. [In Dutch]
- Van Geneijen, P. 2000. Slechtvalken jagen op nachtelijke trekvogels [Peregrines prey on night migrants]. *Slechtvalk Nieuwsbrief: Dutch Peregrine Workgroup*. 6(1): 6. [In Dutch]
- Wernham, C. V., Toms, M. P., Marchant, J. H., Clark, J. A., Siriwardena, G. M., & Baillie, S. R. (eds.) 2002. *The Migration Atlas: movements of the birds of Britain and Ireland*. Poyser, London.

Edward J. A. Drewitt, Bristol's City Museum & Art Gallery, Queen's Road, Bristol BS8 1RL; e-mail ed_drewitt@hotmail.com

Nick Dixon, Churchgate, Drewsteignton, Devon EX6 6QU



Appendix 1. Prey species identified from remains found at the roosting and/or nesting sites of Peregrine Falcons *Falco peregrinus* in Bristol, Bath and Exeter, 1998–2007. Average weights taken from Snow & Perrins (1998); all measurements of mass in g.

	Bristol	Exeter	Bath	Unit mass	Number of items (%)	Total biomass (%)
Eurasian Wigeon <i>Anas penelope</i>		1	1	750	2 (0.04)	1,500 (0.14)
Eurasian Teal <i>Anas crecca</i>	28	52	46	325	126 (2.39)	40,950 (3.88)
Mallard <i>Anas platyrhynchos</i>	1		4	1,100	5 (0.09)	5,500 (0.52)
Ruddy Duck <i>Oxyura jamaicensis</i>	1			552.5	1 (0.02)	552.5 (0.05)
Common Quail <i>Coturnix coturnix</i>			1	105	1 (0.02)	105 (0.01)
Little Grebe <i>Tachybaptus ruficollis</i>	4	3	11	161.5	18 (0.68)	2,907 (0.52)
Black-necked Grebe <i>Podiceps nigricollis</i>			1	374	1 (0.02)	374 (0.04)
Leach's Storm-petrel <i>Oceanodroma leucorhoa</i>			1	45	1 (0.02)	45 (0.004)
Eurasian Sparrowhawk <i>Accipiter nisus</i>		4		226	4 (0.08)	904 (0.09)
Common Kestrel <i>Falco tinnunculus</i>		1		204	1 (0.02)	204 (0.02)
Water Rail <i>Rallus aquaticus</i>	1	2	6	130	9 (0.17)	1,170 (0.11)
Corn Crake <i>Crex crex</i>			1	160	1 (0.02)	160 (0.02)
Moorhen <i>Gallinula chloropus</i>	1	15	12	330	28 (0.53)	9,240 (0.87)
Common Coot <i>Fulica atra</i>		1		800	1 (0.02)	800 (0.08)
Oystercatcher <i>Haematopus ostralegus</i>		1		540	1 (0.02)	540 (0.05)
Avocet <i>Recurvirostra avosetta</i>		3		275	3 (0.06)	825 (0.08)
Ringed Plover <i>Charadrius hiaticula</i>		5		64	5 (0.09)	320 (0.03)
European Golden Plover <i>Pluvialis apricaria</i>	9	24	10	220	43 (0.82)	9,460 (0.90)
Grey Plover <i>Pluvialis squatarola</i>	2		1	235	3 (0.06)	705 (0.07)
Northern Lapwing <i>Vanellus vanellus</i>	13	27	18	230	58 (1.10)	13,340 (1.26)
Red Knot <i>Calidris canutus</i>		2		135	2 (0.04)	270 (0.03)
Dunlin <i>Calidris alpina</i>	2	14	13	47.5	29 (0.55)	1,377.5 (0.13)
Jack Snipe <i>Lymnocyptes minimus</i>		1	6	70.5	7 (0.13)	493.5 (0.05)

Appendix 1. (continued) Prey species identified from remains found at the roosting and/or nesting sites of Peregrine Falcons *Falco peregrinus* in Bristol, Bath and Exeter, 1998–2007. Average weights taken from Snow & Perrins (1998); all measurements of mass in g.

	Bristol	Exeter	Bath	Unit mass	Number of items (%)	Total biomass (%)
Common Snipe <i>Gallinago gallinago</i>	9	40	71	110	120 (2.27)	13,200 (1.25)
Woodcock <i>Scolopax rusticola</i>	10	30	46	300	86 (1.83)	25,800 (2.44)
Black-tailed Godwit <i>Limosa limosa</i>	1	15	1	320	17 (0.32)	5,440 (0.51)
Bar-tailed Godwit <i>Limosa lapponica</i>		3		340	3 (0.06)	1,020 (0.10)
Whimbrel <i>Numenius phaeopus</i>		6		480	6 (0.11)	2,880 (0.27)
Common Redshank <i>Tringa totanus</i>		5		117.5	5 (0.09)	587.5 (0.06)
Greenshank <i>Tringa nebularia</i>	1			200	1 (0.02)	200 (0.02)
Green Sandpiper <i>Tringa ochropus</i>		1		86	1 (0.02)	86 (0.01)
Common Sandpiper <i>Actitis hypoleucos</i>			2	55	2 (0.04)	110 (0.01)
Lesser Black-backed Gull <i>Larus fuscus</i>	1		2	810	3 (0.06)	2,430 (0.23)
Black-headed Gull <i>Chroicocephalus ridibundus</i>	13	11	46	300	70 (1.33)	21,000 (1.99)
Little Tern <i>Sterna albifrons</i>		1		56	1 (0.02)	56 (0.01)
Sandwich Tern <i>Sterna sandvicensis</i>		9	1	245	10 (0.19)	2,450 (0.23)
Common Tern <i>Sterna hirundo</i>		4		130	4 (0.08)	520 (0.05)
Roseate Tern <i>Sterna dougallii</i>		1		112.5	1 (0.02)	112.5 (0.01)
Little Auk <i>Alle alle</i>			1	165	1 (0.02)	165 (0.02)
Feral Pigeon <i>Columba livia</i>	161	1,038	1,009	300	2,208 (41.86)	662,400 (62.69)
Stock Dove <i>Columba oenas</i>			3	300	3 (0.046)	900 (0.09)
Wood Pigeon <i>Columba palumbus</i>	6	30	55	449	91 (1.73)	40,859 (3.87)
Collared Dove <i>Streptopelia decaocto</i>	10	105	81	205	196 (3.72)	40,180 (3.80)
Turtle Dove <i>Streptopelia turtur</i>	2	3	2	140	7 (0.13)	980 (0.09)
Common Cuckoo <i>Cuculus canorus</i>		8	3	117.5	11 (0.21)	1,292.5 (0.12)
Little Owl <i>Athene noctua</i>		2	2	180	4 (0.08)	720 (0.07)
Common Swift <i>Apus apus</i>	1	65	6	43.5	72 (1.36)	3,132 (0.30)
Common Kingfisher <i>Alcedo atthis</i>		3	9	40	12 (0.23)	480 (0.05)
Green Woodpecker <i>Picus viridis</i>	1	4	15	185	20 (0.38)	3,700 (0.35)
Great Spotted Woodpecker <i>Dendrocopos major</i>		23	36	85	59 (1.12)	5,015 (0.47)
Sky Lark <i>Alauda arvensis</i>	1	3	28	38	32 (0.61)	608 (0.12)
Sand Martin <i>Riparia riparia</i>		2		13.5	2 (0.04)	27 (0.003)
Barn Swallow <i>Hirundo rustica</i>		2		19	2 (0.04)	38 (0.004)
House Martin <i>Delichon urbicum</i>		5	1	19	6 (0.11)	114 (0.01)
Tree Pipit <i>Anthus trivialis</i>			1	23.5	1 (0.02)	23.5 (0.002)
Meadow Pipit <i>Anthus pratensis</i>		6	18	18.5	24 (0.45)	444 (0.04)
Grey Wagtail <i>Motacilla cinerea</i>	1	2		18	3 (0.06)	54 (0.01)
Pied Wagtail <i>Motacilla alba</i>		12	28	21	40 (0.76)	840 (0.08)
Dipper <i>Cinclus cinclus</i>		2		66.5	2 (0.04)	133 (0.01)
Wren <i>Troglodytes troglodytes</i>		1	2	9.5	3 (0.06)	28.5 (0.003)
Dunnock <i>Prunella modularis</i>		7	26	20.5	33 (0.63)	676.5 (0.06)
Robin <i>Erithacus rubecula</i>			4	17.5	4 (0.08)	70 (0.01)
Northern Wheatear <i>Oenanthe oenanthe</i>		1	3	23.5	4 (0.08)	94 (0.01)
Blackbird <i>Turdus merula</i>	3	97	57	102.5	157 (2.98)	16,092.5 (1.52)
Fieldfare <i>Turdus pilaris</i>	17	32	47	100	96 (1.82)	9,600 (0.91)

Appendix 1. (continued) Prey species identified from remains found at the roosting and/or nesting sites of Peregrine Falcons *Falco peregrinus* in Bristol, Bath and Exeter, 1998–2007. Average weights taken from Snow & Perrins (1998); all measurements of mass in g.

	Bristol	Exeter	Bath	Unit mass	Number of items (%)	Total biomass (%)
Song Thrush <i>Turdus philomelos</i>	1	33	26	82.5	60 (1.14)	4,950 (0.47)
Redwing <i>Turdus iliacus</i>	10	88	110	62.5	208 (3.94)	13,000 (1.23)
Mistle Thrush <i>Turdus viscivorus</i>		5	3	125	8 (0.15)	1,000 (0.09)
Blackcap <i>Sylvia atricapilla</i>		1	9	23.5	10 (0.19)	235 (0.02)
Common Whitethroat <i>Sylvia communis</i>		2	3	19	5 (0.09)	95 (0.01)
Common Chiffchaff <i>Phylloscopus collybita</i> Willow Warbler <i>Phylloscopus trochilus</i>			5	9	5 (0.09)	45 (0.004)
Goldcrest <i>Regulus regulus</i>		1	2	5.75	3 (0.06)	17.25 (0.002)
Blue Tit <i>Cyanistes caeruleus</i>		5	11	11	16 (0.30)	176 (0.02)
Great Tit <i>Parus major</i>		9	14	18	23 (0.44)	414 (0.04)
Coal Tit <i>Periparus ater</i>			1	9	1 (0.02)	9 (0.001)
Eurasian Jay <i>Garrulus glandarius</i>		11	19	165	30 (0.57)	4,950 (0.47)
Magpie <i>Pica pica</i>	1	14	13	227	28 (0.53)	6,356 (0.60)
Western Jackdaw <i>Corvus monedula</i>	1	8	40	220	49 (0.93)	10,780 (1.02)
Rook <i>Corvus frugilegus</i>		1		310	1 (0.02)	310 (0.03)
Carrion Crow <i>Corvus corone</i>		3	1	510	4 (0.08)	2,040 (0.19)
Common Starling <i>Sturnus vulgaris</i>	10	252	219	75	481 (9.12)	36,075 (3.41)
House Sparrow <i>Passer domesticus</i>		28	96	31	124 (2.35)	3,844 (0.36)
Common Chaffinch <i>Fringilla coelebs</i>		31	44	23.5	75 (1.42)	1,762.5 (0.17)
Brambling <i>Fringilla montifringilla</i>		1	3	23.5	4 (0.08)	94 (0.01)
Greenfinch <i>Carduelis chloris</i>	4	63	135	88.5	202 (3.83)	5,757 (0.54)
Goldfinch <i>Carduelis carduelis</i>		18	56	16.5	74 (1.40)	1,221 (0.12)
Siskin <i>Carduelis spinus</i>		2	1	14.5	3 (0.06)	43.5 (0.004)
Linnet <i>Carduelis cannabina</i>		2	10	18.5	12 (0.23)	222 (0.02)
Lesser Redpoll <i>Carduelis cabaret</i>			1	10.5	1 (0.02)	10.5 (0.001)
Bullfinch <i>Pyrrhula pyrrhula</i>		6	9	21	15 (0.28)	315 (0.03)
Yellowhammer <i>Emberiza citrinella</i>		1	2	30.5	3 (0.06)	91.5 (0.01)
Reed Bunting <i>Emberiza schoeniclus</i>		1	4	20.5	5 (0.09)	102.5 (0.01)
Escaped cagebirds						
Cockatiel <i>Nymphicus hollandicus</i>		14		90	14 (0.27)	1,260 (0.12)
Budgerigar <i>Melopsittacus undulatus</i>		10	2	28	12 (0.23)	336 (0.03)
Rose-ringed Parakeet <i>Psittacula krameri</i>		3		117.5	3 (0.06)	352.5 (0.03)
Canary <i>Serinus canaria</i>		1		28	1 (0.02)	28 (0.003)
Unidentified birds						
Unidentified wader		3	1	110	4 (0.08)	440 (0.04)
Unidentified passerine			5	32	5 (0.09)	160 (0.02)
Mammals						
Grey Squirrel <i>Sciurus carolinensis</i>		1		550	1 (0.02)	550 (0.05)
Brown Rat <i>Rattus norvegicus</i>		2	2	397.5	4 (0.08)	1,590 (0.15)
Noctule Bat <i>Nyctalus noctula</i>	1	1		29.5	2 (0.02)	59 (0.003)
Unidentified mammal			1	40	1 (0.02)	40 (0.004)
TOTAL	326	2,354	2,595		5,275 (100)	1,056,579.75 (100)