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Diet of Peregrine Falcons *(Falco peregrinus)* in relation to temporal and spatial variation in racing pigeon availability in Wales

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Abstract The relative frequency of Common Pigeons *Columba livia* in the diet of Peregrine Falcons differed across three areas of south-central Wales in line with racing pigeon availability. Peregrines exhibited a functional response to spatial and temporal availability of racing pigeons. During the pigeon-racing season (April–September), pigeons comprised 63% of kills in South Wales where pigeons were most available, 43% in the Brecon Beacons with intermediate availability and 30% in Central Wales, where availability was lowest. The corresponding values outside the pigeon-racing season were 18%, 6% and 5% respectively. We estimate that 92% of pigeons killed by Peregrines were racing pigeons, 7% were feral pigeons and the remainder were other domestic pigeon varieties.

Keywords: *Columba livia*, predator-prey, functional response, human-wildlife conflict

Összefoglalás A vándorsólyom étrendjében három dél-közép-walesi területen eltérést mutat a parlagi/házi galamb *Columba livia* hozzávetőleges gyakorisága, összefüggésben a galambászok által tenyésztett példányok elérhetőségével. A vándorsólymok funkcionális választ mutatnak az ilyen galambok térbeli és időbeli elérhetőségére. A galamb-versenyek időszakában (április-szeptember) Dél-Walesben, ahol a versenyekre tenyésztett galambok száma a legmagasabb, az elejtett prédák 63%-a volt galamb, Brecon Beacons térségében 43%, míg ahol a legkevesebb ilyen galamb volt (Közép-Wales), csupán 30% volt ez az arány. Ugyanezen területeken a versenyidőszakon kívül az arányok 18%, 6% és 5% körül alakultak. Felméréseink alapján elmondható, hogy az elejtett galambok 92%-át versenyekre tenyésztették, 7%-a vadon élő volt, a többi pedig más, háziasított formákból származott.

Kulcsszavak: *Columba livia*, ragadozó-préda, funkcionális válasz, ember és vadon élő állatok közti konfliktus

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Introduction

In the United Kingdom, Common Pigeons *Columba livia* comprise a significant proportion of the Peregrine diet in many regions (Ratcliffe 1993, Drewitt & Dixon 2008). Ratcliffe (1993) proposed that high Peregrine breeding densities found in Snowdonia, Lakeland and Galloway reflected the large, but seasonal supply of racing pigeons that pass through these areas. In South Wales, it has been suggested that Peregrines are largely dependent on racing pigeons for successful breeding (Richards & Shrubb 1999). Euphemistically described as 'domestic' or 'feral', the pigeons killed by Peregrines comprise mostly racing pigeons (Dixon & Richards 2003, Dixon *et al.* 2003, Parrott *et al.* 2008), to the extent that changes in

racing pigeon availability is considered a causal factor of Peregrine population changes in some UK regions (Dixon *et al.* 2010, Wilson *et al.* 2018). While the influence of racing pigeons on Peregrine ecology is of interest to ornithologists, the potential impact of Peregrine predation on racing pigeons is of concern to pigeon racing enthusiasts (Scottish Homing Union 1998), creating a human-wildlife conflict (Shawyer *et al.* 2000, Dixon 2002, Henderson *et al.* 2004).

Common Pigeons exist in various forms and most studies on the diet of Peregrines do not distinguish between them. There is the 'wild-type', the Rock Dove, which has a very restricted range in Britain as a result of inter-breeding with domesticated varieties (Gibbons *et al.* 1993). Rock Doves have largely been replaced by 'feral pigeons', most of which are wild-bred rather than captive-bred pigeons living a feral existence (Shawyer *et al.* 2000). Feral pigeons have a predominantly coastal and urban distribution, though there is some evidence of an expansion into rural arable areas (Gibbons *et al.* 1993). Captive-bred varieties of Common Pigeon, can often be identified by leg-rings and are kept as decorative pets in dovecotes or as sporting pigeons in the form of racers, show-pigeons, tipplers and rollers; the most abundant of these various 'domestic pigeons' is the racing pigeon. Racing pigeons can occur either on passage or as strays in most areas of Britain during the race season (April–September) and home lofts are widespread with concentrations in certain areas.

In this paper we describe the diet of Peregrines inhabiting south-central Wales, focussing particularly on spatial and temporal variation in the availability of racing pigeons. We also examine spatial variation in the 'home origin' of racing pigeons killed at a regional level in south-central Wales and at a finer local scale within South Wales.

Materials and methods

Study area

Peregrine sites within our south-central Wales study region were allocated to three areas i.e. South Wales, the Brecon Beacons and Central Wales *(Figure 1)*. The South Wales area is the main centre of pigeon racing in Wales and holds approximately 2350 racing pigeon lofts distributed across most of

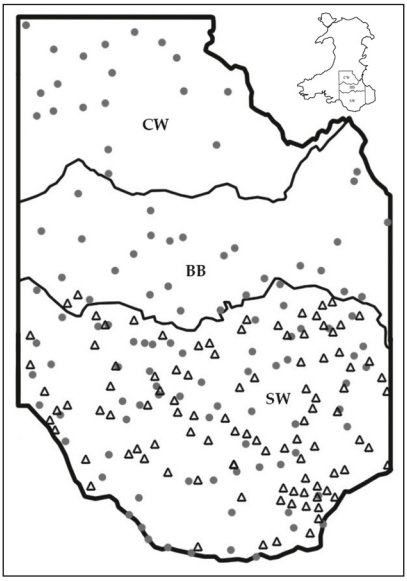

Figure 1. Map showing the division of south-central Wales into three regions; Central Wales (CW), Brecon Beacons (BB) and South Wales (SW). Grey circles mark Peregrine breeding sites and triangles show the location of racing pigeon clubs

1. ábra Dél-Közép-Wales területi felosztásának térképe: Közép-Wales (CW), Brecon Beacons (BB) és Dél-Wales (SW). A szürke körök a vándorsólymok költőhelyeit, a háromszögek a sportgalambász egyesületek elhelyezkedését jelölik

the valley towns. Individual lofts in a local area are organised into clubs; the distribution of these local clubs in south-central Wales is shown in *Figure 1*. The Brecon Beacons area includes Peregrine breeding sites within the boundary of the Brecon Beacons National Park. The Brecon Beacons area holds few pigeon lofts (probably less than 50). The Central Wales area lies to the north of the Brecon Beacons National Park and holds very few racing pigeon lofts (probably less than 10).

Racing pigeon availability

The racing pigeon population in Britain varies in time and space which makes quantitative assessment difficult. The abundance of racing pigeons not only varies seasonally between the race season and the off-season, but also within the race season on a daily basis because most races take place on weekends. In addition to this temporal variation, the abundance of racing pigeons varies spatially depending on the geographical location of lofts, training routes and race routes. Nevertheless, it is still possible to make a qualitative assessment of their availability as prey for Peregrines. The availability of pigeons as prey is related to their activity. We have designated four activities to describe the circumstances of racing pigeons that are available as prey for Peregrines. (1) Pigeons on race flights, (2) pigeons on training flights, (3) pigeons exercising around the loft and (4) stray pigeons that have failed to return to lofts. The availability of racing pigeons in each of these four classes differed between study areas *(Table 1)*.

Pigeons on race flights are normally only available on weekends along routes between the liberation point and the home loft. Race distances vary in length and pigeons can deviate significantly from a direct flight route yet still home successfully (Dall 'Antonia *et al.* 1999). Thus, pigeons on races have an ephemeral, but potentially very widespread, availability. Training flights are of shorter length and occur more frequently than races, but are normally conducted at the same bearing from the home loft. Thus, pigeons on training flights have more frequent but less widespread availability than pigeons on races. During the race season, pigeons are normally released daily from their lofts for exercise flights in the local area. Pigeons on exercise flights have a very frequent but spatially restricted availability. Finally, stray racing pigeons can potentially occur anywhere at any time, though their availability may vary both in time and space. It is likely that there are more strays in the environment immediately following a race weekend and that some of these birds eventually make their way home. Furthermore, it is possible that strays are attracted

Table 1. Qualitative assessment of the availability of racing pigeons as prey within three study areas of south-central Wales

1. táblázat Minőségi értékelés a versenyzésre tenyésztett galambok, mint prédaállatok elérhetőségéről a három vizsgálati területen, Dél-Közép-Walesben

Study Region	Pigeon Availability	Circumstance of Availability
South Wales	Highest	Exercising : Training : Racing : Stray
Brecon Beacons	Intermediate	Training : Racing : Stray
Central Wales	Lowest	Racing: Stray

to particular areas, perhaps to localities where there are large aggregations of lofts or arable areas with a rich food supply. We had no means of assessing the relative availability of stray pigeons between our study areas, but we believe that they were more abundant in South Wales, possibly having been attracted to the area by resident pigeons returning home from races.

Peregrine diet

Over the period 1985–2018, we identified the remains of avian prey at Peregrine breeding ranges in south-central Wales. Prey remains consisted of plucked feathers and partially eaten carcasses. In most cases, in the absence of whole or partially eaten carcases, we categorized the remains based on the condition and number of feathers found at plucking sites, judging them to be either 'recent kills' allocated to the month when they were found or else killed within one of two seasons, 'summer' (April–September; corresponding with the timing of the pigeon race season in Britain) or 'winter' (October–March). Avian prey remains that could not be allocated to a particular month or season were not included in our analyses.

The use of prey remains to characterise raptor diets has a number of potential biases (e.g. Newton & Marquiss 1982). However, as we are only using prey remains to compare the relative frequency of prey species between study areas our approach should not be biased in any particular direction. In order to account for variation in sampling effort, for major prey species, we calculated their percentage of total prey items in each month of the year.

Results

Diet of Peregrines in south-central Wales

We identified 95 species killed by Peregrines in our study areas *(Appendix 1)*, including three that could not be assigned to a specific season i.e. Manx Shearwater *Puffinus puffinus*, Sandwich Tern *Thalasseus sandvicensis* and Canary *Serinus canaria* (the former two being vagrants in south-central Wales and the latter an escaped exotic). In South Wales we identified 79 species from 2869 prey remains, in the Brecon Beacons 60 species from 1215 prey remains and in Central Wales 61 species from 922 prey remains. Common Pigeons were the most important prey species in all three study areas. Apart from Common Pigeons, Jackdaws *Coloeus monedula*, were frequently killed throughout the year, comprising more than 5% of prey by frequency and weight in summer and winter across all three study areas. Starlings were also an important prey species, comprising more than 5% of prey by frequency in both seasons in each study area. In winter across all three study areas, Wood Pigeons *Columba palumbus* and Woodcock *Scolopax rusticola* comprised more than 5% of prey by weight, while Fieldfare *Turdus pilaris*, Redwing *T. iliacus* and Blackbird *T. merula* comprised more than 5% of prey by frequency.

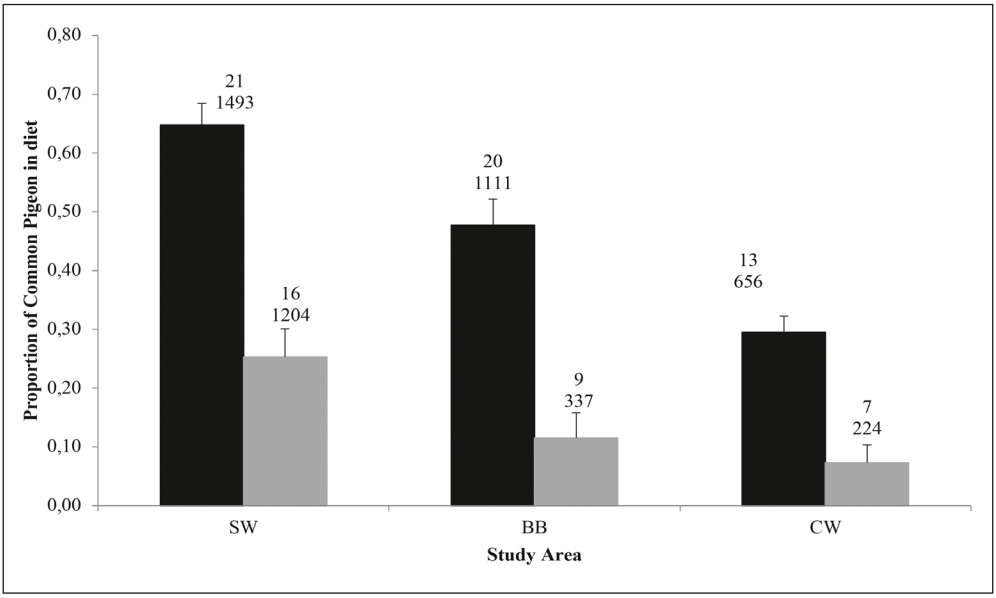

Figure 2. Proportion of Common Pigeons in the diet of Peregrines in each of the three study areas (SW = South Wales, BB = Brecon Beacons, CW = Central Wales). Black columns represent summer period and grey columns winter period. Values above SE bars refer to the number of Peregrine territories sampled and the number of prey items identified

2. ábra A parlagi/házi galamb gyakoriság a vándorsólymok étrendjében a három vizsgálati területen (SW = Dél-Wales, BB = Brecon Beacons, CW = Közép-Wales). A fekete oszlopok a nyári, a szürkék pedig a téli időszakot jelentik. A hibaértékeket jelölő sávok fölötti értékek a vizsgált vándorsólyom territóriumok számát és az azonosított prédák számát mutatják

The frequency of Common Pigeons in prey remains in south-central Wales varied significantly throughout the year. Pigeons are killed much more frequently during the pigeon race season than outside it (Fisher's exact test $P < 0.0001$), highlighting the importance of racing pigeons in the diet. During the pigeon race season, there was a significant difference in the frequency of pigeons killed in South Wales (63% of kills), the Brecon Beacons (43%) and Central Wales (30%; $\chi^2 = 238$, 2 *df*, $P < 0.00001$) *(Figure 2)*. In terms of prey mass the corresponding percentages were 84%, 67% and 50% respectively. Outside the pigeon race season, the frequency of common pigeons killed was lower overall, but still significantly higher in South Wales (18% of kills), than the Brecon Beacons (6%) and Central Wales (5%; $\chi^2 = 57$, 2 *df*, $P < 0.00001$) *(Figure 2)*; in terms of prey mass, the corresponding percentages were 38%, 14% and 14% respectively.

The proportion of Common Pigeons in the diet increased and decreased sharply in April and September respectively *(Figure 3a)*. The proportion of Jackdaws in the diet ranged from 5% to 17% of monthly prey items *(Figure 3b)*, Starlings were killed most frequently in June and during the winter months *(Figure 3c)*. Fieldfare and Redwing appeared in the diet in October, peaked in December and were last found among prey remains in May *(Figure 3d)* and the proportion of Woodcock in the diet exhibited a similar pattern *(Figure 3e)*.

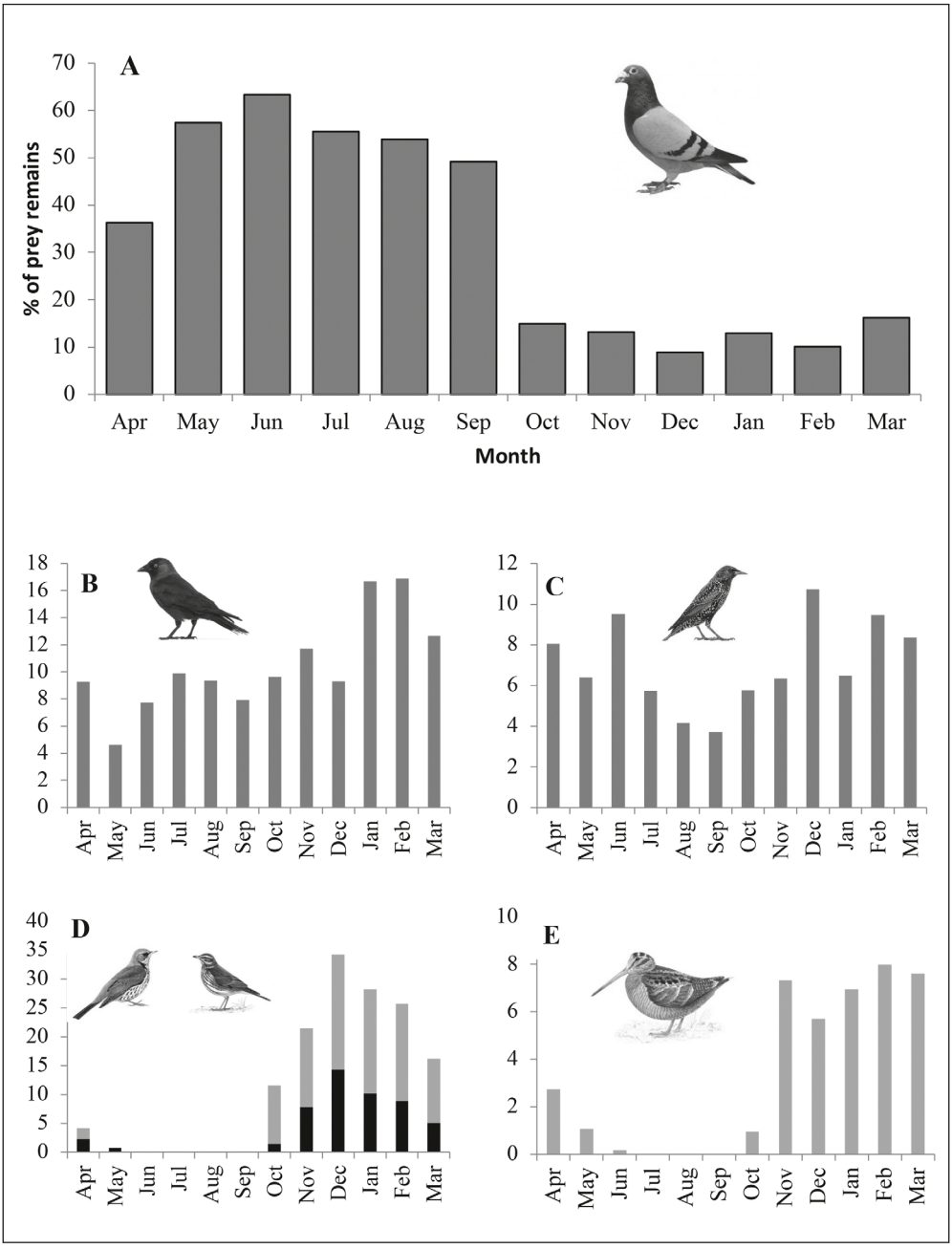

Figure 3. Proportion of Common Pigeon (A), Jackdaw (B), Starling (C), Fieldfare (black column) and Redwing (grey column) (D) and Woodcock (E) in the diet during each month of the year across south-central Wales

3. ábra. A parlagi/házi galamb (A), a csóka (B), a seregély (C), a fenyőrigó (fekete oszlop) és a szőlőrigó (szürke oszlop) (D), valamint a szalonka (E) aránya a vándorsólymok táplálékában hónapokra lebontva, Dél-Közép-Wales területén

Types of Common Pigeon killed by Peregrines

Of 30 Common Pigeon carcasses with both legs present, 28 were ringed indicating that in south-central Wales nearly 7% of pigeon kills were 'feral pigeons' and 93% were domestic pigeons. All but two of these carcasses, both of which were ringed domestic pigeons, were found during the pigeon race season and both feral pigeons were found at Peregrine sites in South Wales.

In a sample of 5049 domestic pigeon rings collected at Peregrine sites in south-central Wales 98.7% (N = 4984) were from racing pigeons, 0.8% (n = 40) were from tipplers, 0.3% (n = 15) were rollers, 0.2% (n = 10) were show pigeons. Most tippler rings were recovered from Peregrine nesting sites in the Swansea, Neath and Port Talbot districts (73%).

Discussion

Diet of Peregrines in south-central Wales

The diet of Peregrines in south-central Wales varied in line with spatial and temporal variation in the availability of racing pigeons: where and when racing pigeons were most available they comprised a greater proportion of the diet. Peregrines respond to changes in relative availability of racing pigeons and thus behave like opportunistic generalist avian predators, but it remains an unanswered question as to whether Peregrines selectively specialized on racing pigeons (e.g. Dawson *et al.* 2011). Fixation by Peregrines on particular prey species may lead to increased skill in capture, while certain species may be particularly vulnerable prey because of their mass, flight behaviour and their occurrence in unfamiliar habitats (White *et al.* 2002). Racing pigeons, with a typical mass of 435 g (Irvine *et al.* 2007), fall within the range of 50–500 g suggested to represent optimal prey mass for Peregrines (Ratcliffe 1993, White *et al.* 2002) and are selectively bred to home accurately and rapidly, and thus are unlikely to exhibit the range of predator avoidance strategies found in wild birds, or find refuges from attack when in unfamiliar habitats on long distance races or if they have strayed from the loft region.

Despite the wide range of prey species killed by Peregrines, the main part of the diet in south-central Wales comprises a relatively small number of species. In summer, in Central Wales where racing pigeons are less available, corvids are an important component of the diet, particularly Jackdaws but also Magpie *Pica pica* and Rook *Corvus frugilegus*, along with Wood Pigeon, Mistle Thrush *Turdus viscivorus* and Starling. In winter, when racing pigeons are less available across all regions, the same species are important with the addition of species that winter in south-central Wales, especially migratory thrushes such as Fieldfare, Redwing and Blackbird, along with Woodcock.

The monthly proportion of Common Pigeons in the diet varied in line with the timing of the pigeon race season, as would be expected when most Common Pigeons killed are racing pigeons. Jackdaws are the next most important prey species for Peregrines in south-central Wales, killed in relatively consistent proportions across the year. Starlings were killed

most frequently in June when post-fledging summer flocks were formed and during winter when resident flocks were augmented by winter migrants. Migrant thrushes and Woodcock are important prey species that arrive in south-central Wales at the end of the pigeon season and make up, at least partially, for the loss of racing pigeon biomass from the environment.

Types of Common Pigeon killed by Peregrines

There is little arable land in any of our three study areas to attract roving flocks of feral pigeons, thus their distribution is mainly restricted to human settlements. Feral pigeons are abundant in most of the larger towns throughout South Wales (Tyler *et al.* 1987, Hurford & Lansdown 1995). They are less abundant in the Brecon Beacons and Central Wales, but they do occur in many of the larger towns within these regions (Gibbons *et al.* 1993). Most of the Common Pigeons killed were racing pigeons, though there were a few other varieties of domestic pigeon represented in our ring sample, mainly tipplers, rollers and show pigeons. Their occurrence was highly localised to Peregrine sites in the Swansea, Neath and Port Talbot districts. Tippler pigeons, whose purpose is to fly high above the loft for long periods, must be particularly susceptible to predation. Musgrove (1994) reported that in Bristol, tippler flying all but ceased following colonisation of the city by Peregrines. We note that a similar decline in tippler flying in the Swansea area was reflected in the decreasing frequency of tippler rings recovered from local Peregrine sites over time (tipplers comprised 1.3% of domestic pigeons ringed between 1992–1996 and only 0.5% that were ringed between 1997–2001).

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Appendix 1. Prey species identified at Peregrine breeding sites in the Central Wales, Brecon Beacons and South Wales study areas during summer (April–September) and winter (October–March). %N is the percentage of prey items by frequency (N = number of prey items) and % wt. is the percentage of total prey mass for each species

1. függelék Azonosított prédafajok a vándorsólyom költőhelyeken a közép-walesi, Brecon Beaconsi és dél-walesi vizsgálati területeken a nyári (április-szeptember) és téli (október-március) időszak alatt. A % N a zsákmányállatok aránya gyakoriság szerint (N = zsákmányállatok száma), a % wt. pedig a teljes zsákmány tömegének százalékos aránya minden fajra

Species	Central Wales				Brecon Beacons				South Wales			
	Summer		Winter		Summer		Winter		Summer		Winter	
	%N (N)	% wt.	%N (N)	% wt.	%N (N)	% wt.	%N (N)	% wt.	%N (N)	% wt.	%N (N)	% wt.
Willow Grouse *Lagopus lagopus*	0.2 (1)	0.4	0.0 (0)	0.0	0.1 (1)	0.3	0.5 (2)	1.6	0.0 (0)	0.0	0.0 (0)	0.0
Red-legged Partridge *Alectoris rufa*	0.0 (0)	0.0	0.4 (1)	1.2	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	0.1	0.0 (0)	0.0
Pheasant *Phasianus colchicus*	0.2 (1)	0.7	0.4 (1)	2.9	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	0.4
Mallard *Anas platyrhynchos*	0.3 (2)	1.2	0.0 (0)	0.0	0.1 (1)	0.5	0.0 (0)	0.0	0.1 (1)	0.2	0.2 (3)	1.2
Teal *Anas crecca*	0.3 (2)	0.4	1.5 (4)	3.2	0.1 (1)	0.1	0.7 (3)	1.3	0.0 (0)	0.0	0.2 (2)	0.2
Tufted Duck *Aythya fuligula*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	0.3
Common Pigeon Columba livia	29.5 (195)	50.4	5.0 (13)	13.7	42.5 (328)	67.1	5.8 (24)	13.9	63.2 (1005)	83.9	17.9 (228)	37.7
Stock Dove *Columba oenas*	0.0 (0)	0.0	0.4 (1)	0.7	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	0.1	0.2 (3)	0.3
Wood Pigeon *Columba palumbus*	4.2 (28)	**7.5**	2.7 (7)	**7.7**	2.0 (16)	3.3	2.4 (10)	**6.0**	1.8 (29)	2.5	3.9 (50)	8.5
Collared Dove *Streptopelia decaocto*	0.2 (1)	0.1	0.4 (1)	0.5	0.3 (2)	0.2	0.2 (1)	0.3	0.3 (4)	0.2	0.5 (6)	0.5
Common Swift *Apus apus*	1.4 (9)	0.2	0.0 (0)	0.0	0.9 (7)	0.1	0.0 (0)	0.0	0.6 (9)	0.1	0.0 (0)	0.0
Common Cuckoo *Cuculus canorus*	0.5 (3)	0.2	0.0 (0)	0.0	0.3 (2)	0.1	0.0 (0)	0.0	0.3 (4)	0.1	0.0 (0)	0.0
Eurasian Coot *Fulica atra*	0.2 (1)	0.5	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0
Grey Heron *Ardea cinerea*	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	0.7	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0
Oystercatcher *Haematopus ostralegus*	0.0 (0)	0.0	0.4 (1)	1.3	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0
Lapwing *Vanellus vanellus*	0.6 (4)	0.5	0.0 (0)	0.0	0.4 (3)	0.3	1.2 (5)	1.5	0.3 (5)	0.2	0.9 (11)	1.0
Golden Plover Pluvialis apricaria	1.5 (10)	1.3	1.9 (5)	2.7	0.0 (0)	0.0	1.2 (5)	1.5	0.1 (1)	<0.1	1.2 (15)	1.2
Grey Plover Pluvialis squatarola	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	0.1
Woodcock *Scolopax rusticola*	1.4 (9)	1.5	4.6 (12)	**8.2**	0.5 (4)	0.5	**7.7 (32)**	**11.9**	0.5 (8)	0.4	**6.1 (78)**	8.2
Common Snipe *Gallinago gallinago*	0.8 (5)	0.3	0.4 (1)	0.3	0.4 (3)	0.2	1.7 (7)	1.0	0.2 (3)	0.1	1.9 (24)	1.0
Curlew *Numenius arquata*	0.3 (2)	1.1	0.0 (0)	0.0	0.4 (3)	1.2	0.0 (0)	0.0	0.1 (1)	0.2	0.0 (0)	0.0

Species	Central Wales				Brecon Beacons				South Wales			
	Summer		Winter		Summer		Winter		Summer		Winter	
	%N (N)	% wt.	%N (N)	% wt.	%N (N)	% wt.	%N (N)	% wt.	%N (N)	% wt.	%N (N)	% wt.
Common Redshank *Tringa totanus*	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	0.1	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0
Greenshank *Tringa nebularia*	0.2 (1)	0.1	0.0 (0)	0.0	0.3 (2)	0.2	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0
Little Stint *Calidris minuta*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1
Dunlin *Calidris alpina*	0.2 (1)	<0.1	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1	0.0 (0)	0.0
Sanderling *Calidris alba*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.2 (2)	<0.1
Kittiwake *Rissa tridactyla*	0.0 (0)	0.0	0.4 (1)	1.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0
Black-headed Gull *Chroicocephalus ridibundus*	0.9 (6)	1.0	0.8 (2)	1.4	1.4 (11)	1.4	0.7 (3)	1.1	0.1 (2)	0.1	0.5 (7)	0.8
Common Gull *Larus canus*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.2 (1)	0.5	0.0 (0)	0.0	0.0 (0)	0.0
Common Tern *Sterna hirundo*	0.2 (1)	0.1	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1	0.0 (0)	0.0
Arctic Tern *Sterna paradisaea*	0.0 (0)	0.0	0.0 (0)	0.0	0.3 (2)	0.1	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1
Barn Owl *Tyto alba*	0.0 (0)	0.0	0.8 (2)	1.4	0.0 (0)	0.0	0.2 (1)	0.4	0.3 (5)	0.3	0.2 (2)	0.2
Tawny Owl *Strix aluco*	0.2 (1)	0.3	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0
Long-eared Owl *Asio otus*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	0.1
Short-eared Owl *Asio flammeus*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	0.1
Eurasian Sparrowhawk *Accipiter nisus*	0.0 (0)	0.0	0.0 (0)	0.0	0.4 (3)	0.3	0.2 (1)	0.3	0.1 (2)	0.1	0.0 (0)	0.0
Kingfisher *Alcedo atthis*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1
Great Spotted Woodpecker *Dendrocopos major*	2.7 (18)	0.9	0.4 (1)	0.2	2.9 (23)	0.9	2.6 (11)	1.2	0.9 (15)	0.2	1.8 (23)	0.7
Green Woodpecker *Picus viridis*	0.9 (6)	0.7	0.4 (1)	0.4	1.0 (8)	0.7	1.2 (5)	1.2	0.8 (12)	0.4	1.2 (15)	1.0
Common Kestrel *Falco tinnunculus*	0.0 (0)	0.0	0.0 (0)	0.0	0.3 (2)	0.2	0.0 (0)	0.0	0.1 (1)	<0.1	0.1 (1)	0.1
Merlin *Falco columbarius*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	0.1
Hobby *Falco subbuteo*	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	0.1	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0
Cockatiel *Nymphicus hollandicus*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (2)	<0.1	0.2 (2)	0.1
Budgerigar *Melopsittacus undulatus*	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1	0.0 (0)	0.0	0.3 (5)	0.1	0.0 (0)	0.0
Rosy-faced Lovebird *Agapornis roseicollis*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1	0.0 (0)	0.0
Jay *Garrulus glandarius*	1.4 (9)	0.9	0.4 (1)	0.4	1.6 (13)	1.0	1.4 (6)	1.3	0.9 (14)	0.4	1.6 (21)	1.3

Species	Central Wales				Brecon Beacons				South Wales			
	Summer		Winter		Summer		Winter		Summer		Winter	
	%N (N)	% wt.	%N (N)	% wt.	%N (N)	% wt.	%N (N)	% wt.	%N (N)	% wt.	%N (N)	% wt.
Eurasian Magpie *Pica pica*	3.3 (22)	2.9	1.2 (3)	1.6	1.3 (10)	1.0	4.8 (20)	**5.9**	1.1 (17)	0.7	3.6 (46)	3.8
Jackdaw *Coloeus monedula*	12.0 (79)	10.7	11.6 (30)	16.6	11.3 (90)	9.3	17.1 (71)	21.4	7.2 (114)	5.0	13.2 (168)	14.4
Rook *Corvus frugilegus*	3.2 (21)	3.9	0.4 (1)	0.8	0.4 (3)	0.4	1.0 (4)	1.6	0.0 (0)	0.0	0.0 (0)	0.0
Carrion Crow *Corvus corone*	1.1 (7)	2.1	0.4 (1)	1.2	1.0 (8)	1.8	1.4 (6)	4.0	0.3 (4)	0.4	0.5 (7)	1.3
Coal Tit *Periparus ater*	0.3 (2)	<0.1	1.9 (5)	0.1	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1	0.2 (3)	<0.1
Great Tit *Parus major*	0.0 (0)	0.0	0.0 (0)	0.0	0.3 (2)	<0.1	0.0 (0)	0.0	0.0 (0)	0.0	0.2 (2)	<0.1
Blue Tit *Cyanistes caeruleus*	0.3 (2)	<0.1	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0
Skylark *Alauda arvensis*	1.5 (10)	0.2	0.8 (2)	0.2	2.1 (17)	0.3	0.7 (3)	0.2	1.5 (24)	0.2	0.7 (9)	0.1
Sand Martin *Riparia riparia*	0.2 (1)	<0.1	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0
Barn Swallow *Hirundo rustica*	0.6 (4)	<0.1	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.3 (5)	<0.1	0.1 (1)	<0.1
House Martin *Delichon urbicum*	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1	0.0 (0)	0.0	0.1 (2)	<0.1	0.0 (0)	0.0
Willow Warbler *Phylloscopus trochilus*	0.2 (1)	<0.1	0.0 (0)	0.0	0.4 (3)	<0.1	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0
Goldcrest *Regulus regulus*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1	0.2 (2)	<0.1
Wren *Troglodytes troglodytes*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (2)	<0.1	0.2 (2)	<0.1
Nuthatch *Sitta europaea*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1
Treecreeper *Certhia familiaris*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1	0.0 (0)	0.0
Starling *Sturnus vulgaris*	**7.9 (52)**	2.6	**12.4 (32)**	**6.5**	**8.4 (67)**	2.6	**9.1 (38)**	4.2	**6.9 (109)**	1.8	**6.6 (84)**	2,7
Ring Ouzel *Turdus torquatus*	0.2 (1)	0.1	0.0 (0)	0.0	0.4 (3)	0.2	0.2 (1)	0.2	0.1 (1)	<0.1	0.1 (1)	<0.1
Blackbird *Turdus merula*	**5.8 (38)**	2.3	**6.9 (18)**	4.4	4.8 (38)	1.8	**5.0 (21)**	2.8	3.3 (53)	1.0	4.2 (54)	2.1
Fieldfare *Turdus pilaris*	1.7 (11)	0.7	**12.4 (32)**	**8.5**	0.3 (2)	0.1	**9.9 (41)**	**5.9**	0.2 (3)	0.1	**7.2 (92)**	3.8
Redwing *Turdus iliacus*	0.8 (5)	0.2	**20.1 (52)**	**8.2**	0.6 (5)	0.1	**13.9 (58)**	**5.0**	0.2 (2)	<0.1	**12.9 (164)**	4.0
Song Thrush *Turdus philomelos*	1.8 (12)	0.6	2.3 (6)	1.2	2.3 (18)	0.7	2.9 (12)	1.3	1.1 (18)	0.3	2.3 (29)	0.9
Mistle Thrush *Turdus viscivorus*	**5.8 (38)**	2.8	3.5 (9)	2.7	3.8 (30)	1.7	2.6 (11)	1.8	1.0 (16)	0.4	1.6 (21)	1.3
Robin *Erithacus rubecula*	0.2 (1)	<0.1	0.0 (0)	0.0	0.1 (1)	<0.1	0.2 (1)	<0.1	0.1 (1)	<0.1	0.1 (1)	<0.1
Black Redstart *Phoenicurus ochruros*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1
Redstart *Phoenicurus phoenicurus*	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1	0.0 (0)	0.0	0.1 (1)	<0.1	0.0 (0)	0.0

Species	Central Wales				Brecon Beacons				South Wales			
	Summer		Winter		Summer		Winter		Summer		Winter	
	%N (N)	% wt.	%N (N)	% wt.	%N (N)	% wt.	%N (N)	% wt.	%N (N)	% wt.	%N (N)	% wt.
Whinchat *Saxicola rubetra*	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0
Stonechat *Saxicola rubicola*	0.2 (1)	<0.1	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1	0.1 (1)	<0.1
Northern Wheatear *Oenanthe oenanthe*	0.9 (6)	0.1	0.0 (0)	0.0	0.9 (7)	0.1	0.0 (0)	0.0	0.4 (6)	<0.1	0.1 (1)	<0.1
Dipper *Cinclus cinclus*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.2 (1)	0.1	0.0 (0)	0.0	0.0 (0)	0.0
House Sparrow *Passer domesticus*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1
Dunnock *Prunella modularis*	0.0 (0)	0.0	0.4 (1)	0.1	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0
White Wagtail *Motacilla alba*	0.3 (2)	<0.1	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.2 (3)	<0.1	0.1 (1)	<0.1
Meadow Pipit *Anthus pratensis*	1.4 (9)	0.1	1.2 (3)	0.1	3.4 (27)	0.2	0.5 (2)	0.1	1.6 (25)	0.1	1.6 (21)	0.2
Rock Pipit *Anthus petrosus*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1	0.0 (0)	0.0
Chaffinch *Fringilla coelebs*	2.0 (13)	0.2	1.5 (4)	0.2	0.8 (6)	0.1	1.4 (6)	0.2	1.6 (25)	0.1	2.6 (33)	0.3
Brambling *Fringilla montifringilla*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1
Greenfinch *Carduelis chloris*	0.2 (1)	0.1	0.4 (1)	0.2	0.1 (1)	<0.1	0.0 (0)	0.0	0.1 (1)	<0.1	0.0 (0)	0.0
Siskin *Carduelis spinus*	0.2 (1)	<0.1	0.8 (2)	0.1	0.0 (0)	0.0	0.2 (1)	<0.1	0.1 (2)	<0.1	0.4 (5)	<0.1
Goldfinch *Carduelis carduelis*	0.3 (2)	<0.1	0.4 (1)	<0.1	0.0 (0)	0.0	0.2 (1)	<0.1	0.5 (8)	<0.1	0.3 (4)	<0.1
Common Redpoll *Carduelis flammea*	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1	0.0 (0)	0.0	0.1 (1)	<0.1	0.0 (0)	0.0
Linnet *Carduelis cannabina*	0.2 (1)	<0.1	0.0 (0)	0.0	0.3 (2)	<0.1	0.0 (0)	0.0	0.2 (3)	<0.1	0.2 (2)	<0.1
Common Crossbill *Loxia curvirostra*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1	0.1 (1)	<0.1
Bullfinch *Pyrrhula pyrrhula*	0.3 (2)	<0.1	0.4 (1)	0.1	0.0 (0)	0.0	0.2 (1)	<0.1	0.1 (1)	<0.1	0.2 (3)	<0.1
Reed Bunting *Emberiza schoeniclus*	0.2 (1)	<0.1	0.0 (0)	0.0	0.3 (2)	<0.1	0.0 (0)	0.0	0.2 (3)	<0.1	0.2 (3)	<0.1
Snow Bunting *Plectrophenax nivalis*	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.0 (0)	0.0	0.1 (1)	<0.1