

## Supplementary material

### Appendix 1

Species list and the number of times each species was registered on moorland and farmland habitat, detection function group, detection function terms and detectability factor covariates (Cue and/or Habitat) used in density estimation. ‘Detection function’ lists the species for which individual detection functions were developed, and the categories (Corvid, Wader, Non-passerine, Passerine) used to calculate densities for the remaining, less frequently encountered species. Note that strictly taxonomic definitions of these categories were not used. No densities were calculated for an additional five species (cormorant *Phalacrocorax carbo*, common gull *Larus canus*, herring gull *Larus argentatus*, lesser spotted woodpecker *Dendrocopos minor*, wood warbler *Phylloscopus sibilatrix*) which were encountered solely as flying individuals or at sufficient distance from the survey transect to preclude them from density estimation.

Species	Common name	Detection function	Detection function terms (Key/Expansion)	Detectability covariates	Registrations (moorland/farmland)
<i>Ardea cinerea</i>	Grey heron	Non-passerine	Hazard-Rate/Simple	Cue	0/6
<i>Anser anser</i>	Greylag goose	Non-passerine	Hazard-Rate/Simple	Cue	0/1
<i>Brent canadensis</i>	Canada goose	Non-passerine	Hazard-Rate/Simple	Cue	6/18
<i>Anas platyrhynchos</i>	Mallard	Individual	Half-normal/Cosine	None	10/63
<i>Aythya fuligula</i>	Tufted duck	Non-passerine	Hazard-Rate/Simple	Cue	0/2
<i>Accipiter nisus</i>	Sparrowhawk	Non-passerine	Hazard-Rate/Simple	Cue	1/0
<i>Buteo buteo</i>	Buzzard	Non-passerine	Hazard-Rate/Simple	Cue	2/0
<i>Pandion haliaetus</i>	Osprey	Non-passerine	Hazard-Rate/Simple	Cue	1/0
<i>Falco tinnunculus</i>	Kestrel	Non-passerine	Hazard-Rate/Simple	Cue	2/9
<i>Lagopus lagopus</i>	Red grouse	Individual	Hazard-rate/Cosine	Seen	241/6
<i>Alectoris rufa</i>	Red-legged partridge	Non-passerine	Hazard-Rate/Simple	Cue	2/10
<i>Perdix perdix</i>	Grey partridge	Non-passerine	Hazard-Rate/Simple	Cue	0/4
<i>Phasianus colchicus</i>	Pheasant	Individual	Hazard-rate/Cosine	Cue/Habitat	19/105
<i>Gallinula chloropus</i>	Moorhen	Non-passerine	Hazard-Rate/Simple	Cue	0/3
<i>Fulica atra</i>	Coot	Non-passerine	Hazard-Rate/Simple	Cue	0/1
<i>Haematopus ostralegus</i>	Oystercatcher	Wader	Half-normal/Cosine	Cue/Habitat	0/2
<i>Pluvialis apricaria</i>	Golden plover	Individual	Half-normal/Cosine	Cue	73/9
<i>Vanellus vanellus</i>	Lapwing	Individual	Half-normal/Cosine	None	11/227
<i>Gallinago gallinago</i>	Snipe	Individual	Hazard-rate/Cosine	Cue	19/58
<i>Numenius arquata</i>	Curlew	Individual	Half-normal/Cosine	Cue/Habitat	148/191
<i>Actitis hypoleucos</i>	Common sandpiper	Wader	Half-normal/Cosine	Cue/Habitat	0/2
<i>Larus ridibundus</i>	Black-headed gull	Non-passerine	Hazard-Rate/Simple	Cue	0/6
<i>Larus fuscus</i>	Lesser black-backed gull	Non-passerine	Hazard-Rate/Simple	Cue	0/2
<i>Columba livia</i>	Feral pigeon	Non-passerine	Hazard-Rate/Simple	Cue	0/12
<i>Columba oenas</i>	Stock dove	Non-passerine	Hazard-Rate/Simple	Cue	0/6
<i>Columba palumbus</i>	Woodpigeon	Individual	Half-normal/Cosine	None	5/147
<i>Streptopelia decaocto</i>	Collared dove	Non-passerine	Hazard-Rate/Simple	Cue	0/4
<i>Cuculus canorus</i>	Cuckoo	Non-passerine	Hazard-Rate/Simple	Cue	2/3

<i>Athene noctua</i>	Little owl	Non-passerine	Hazard-Rate/Simple	Cue	0/6
<i>Strix aluco</i>	Tawny owl	Non-passerine	Hazard-Rate/Simple	Cue	0/1
<i>Apus apus</i>	Swift	Passerine	Hazard-Rate/Simple	Cue	0/1
<i>Picus viridis</i>	Green woodpecker	Passerine	Hazard-Rate/Simple	Cue	0/4
<i>Dendrocopos major</i>	Great spotted woodpecker	Passerine	Hazard-Rate/Simple	Cue	0/10
<i>Alauda arvensis</i>	Skylark	Individual	Half-normal/Cosine	Cue	229/230
<i>Hirundo rustica</i>	Swallow	Individual	Hazard-rate/Cosine	None	1/89
<i>Delichon urbica</i>	House martin	Passerine	Hazard-Rate/Simple	Cue	0/12
<i>Anthus trivialis</i>	Tree pipit	Passerine	Hazard-Rate/Simple	Cue	3/0
<i>Anthus pratensis</i>	Meadow pipit	Individual	Half-normal/Cosine	Habitat	1237/371
<i>Motacilla cinerea</i>	Grey wagtail	Passerine	Hazard-Rate/Simple	Cue	4/5
<i>Motacilla alba</i>	Pied wagtail	Individual	Hazard-rate/Cosine	None	0/103
<i>Cinclus cinclus</i>	Dipper	Passerine	Hazard-Rate/Simple	Cue	1/1
<i>Troglodytes troglodytes</i>	Winter wren	Individual	Hazard-rate/Cosine	Cue	278/195
<i>Prunella modularis</i>	Dunnock	Individual	Half-normal/Cosine	Cue	2/45
<i>Erithacus rubecula</i>	Robin	Individual	Half-normal/Cosine	Cue	11/133
<i>Phoenicurus phoenicurus</i>	Redstart	Passerine	Hazard-Rate/Simple	Cue	1/19
<i>Saxicola torquata</i>	Stonechat	Passerine	Hazard-Rate/Simple	Cue	17/2
<i>Oenanthe oenanthe</i>	Wheatear	Individual	Half-normal/Cosine	None	8/24
<i>Turdus torquatus</i>	Ring ouzel	Passerine	Hazard-Rate/Simple	Cue	2/3
<i>Turdus merula</i>	Blackbird	Individual	Hazard-rate/Cosine	Cue	3/123
<i>Turdus pilaris</i>	Fieldfare	Passerine	Hazard-Rate/Simple	Cue	0/4
<i>Turdus philomelos</i>	Song thrush	Individual	Hazard-rate/Cosine	Cue	3/38
<i>Turdus viscivorus</i>	Mistle thrush	Individual	Half-normal/Cosine	Cue	2/32
<i>Acrocephalus schoenobaenus</i>	Sedge warbler	Passerine	Hazard-Rate/Simple	Cue	0/2
<i>Sylvia curruca</i>	Lesser whitethroat	Passerine	Hazard-Rate/Simple	Cue	0/1
<i>Sylvia communis</i>	Whitethroat	Passerine	Hazard-Rate/Simple	Cue	2/5
<i>Sylvia borin</i>	Garden warbler	Passerine	Hazard-Rate/Simple	Cue	2/6
<i>Sylvia atricapilla</i>	Blackcap	Passerine	Hazard-Rate/Simple	Cue	0/7
<i>Phylloscopus collybita</i>	Chiffchaff	Passerine	Hazard-Rate/Simple	Cue	0/13
<i>Phylloscopus trochilus</i>	Willow warbler	Individual	Hazard-rate/Cosine	Cue	68/145
<i>Regulus regulus</i>	Goldcrest	Passerine	Hazard-Rate/Simple	Cue	0/1
<i>Muscicapa striata</i>	Spotted flycatcher	Passerine	Hazard-Rate/Simple	Cue	0/2
<i>Ficedula hypoleuca</i>	Pied flycatcher	Passerine	Hazard-Rate/Simple	Cue	0/2
<i>Aegithalos caudatus</i>	Long-tailed tit	Passerine	Hazard-Rate/Simple	Cue	0/26
<i>Parus ater</i>	Coal tit	Passerine	Hazard-Rate/Simple	Cue	0/23
<i>Parus caeruleus</i>	Blue tit	Individual	Half-normal/Cosine	Cue	3/142
<i>Parus major</i>	Great tit	Individual	Hazard-rate/Cosine	Cue	0/105
<i>Sitta europaea</i>	Nuthatch	Passerine	Hazard-Rate/Simple	Cue	0/8
<i>Certhia familiaris</i>	Treecreeper	Passerine	Hazard-Rate/Simple	Cue	0/5
<i>Garrulus glandarius</i>	Jay	Corvid	Half-normal/Cosine	None	1/7
<i>Pica pica</i>	Magpie	Individual	Half-normal/Cosine	None	1/62
<i>Corvus monedula</i>	Jackdaw	Individual	Hazard-rate/Cosine	None	2/114
<i>Corvus frugilegus</i>	Rook	Individual	Half-normal/Cosine	None	2/44
<i>Corvus corone</i>	Carrion crow	Individual	Half-normal/Cosine	None	29/287
<i>Corvus corax</i>	Raven	Corvid	Half-normal/Cosine	None	3/6
<i>Sturnus vulgaris</i>	Starling	Individual	Half-normal/Cosine	None	2/35
<i>Passer domesticus</i>	House sparrow	Individual	Half-normal/Cosine	Cue	0/33
<i>Fringilla coelebs</i>	Chaffinch	Individual	Hazard-rate/Cosine	Cue	21/326
<i>Carduelis chloris</i>	Greenfinch	Individual	Half-normal/Cosine	None	1/41

<i>Carduelis carduelis</i>	Goldfinch	Individual	Half-normal/Cosine	None	4/63
<i>Carduelis spinus</i>	Siskin	Passerine	Hazard-Rate/Simple	Cue	0/1
<i>Carduelis cannabina</i>	Linnet	Individual	Half-normal/Cosine	Cue	18/48
<i>Carduelis flavirostris</i>	Twite	Passerine	Hazard-Rate/Simple	Cue	0/1
<i>Carduelis flammea</i>	Lesser redpoll	Passerine	Hazard-Rate/Simple	Cue	0/1
<i>Pyrrhula pyrrhula</i>	Bullfinch	Passerine	Hazard-Rate/Simple	Cue	0/5
<i>Emberiza citrinella</i>	Yellowhammer	Passerine	Hazard-Rate/Simple	Cue	1/16
<i>Emberiza schoeniclus</i>	Reed bunting	Individual	Half-normal/Cosine	None	33/21

---

## Appendix 2

Conservation status for all birds recorded on 37 farmland and moorland paired sites in the Peak District, northern England. Species which are Red or Amber listed (Gregory et al. 2002), together with species that are Biodiversity Action Plan species in the UK (Biodiversity Reporting and Information Group 2007) and those that are qualifying features for the South Pennines Moors Special Protection Area (Stroud et al. 2001), were included in the species group 'Conservation concern'. 'Upland specialists' are those species that have a predominantly upland breeding distribution in the UK (Gibbons et al. 1993). 'Shared species' are the 43 species that were found on at least one farm and at least one moor site.

Species	Common name	Shared species	Conservation concern	Upland specialists
<i>Ardea cinerea</i>	Grey heron			
<i>Anser anser</i>	Greylag goose		✓	
<i>Brent canadensis</i>	Canada goose	✓		
<i>Anas platyrhynchos</i>	Mallard	✓		
<i>Aythya fuligula</i>	Tufted duck			
<i>Accipiter nisus</i>	Sparrowhawk			
<i>Buteo buteo</i>	Buzzard			✓
<i>Pandion haliaetus</i>	Osprey		✓	
<i>Falco tinnunculus</i>	Kestrel	✓	✓	
<i>Lagopus lagopus</i>	Red grouse	✓	✓	✓
<i>Alectoris rufa</i>	Red-legged partridge	✓		
<i>Perdix perdix</i>	Grey partridge		✓	
<i>Phasianus colchicus</i>	Pheasant	✓		
<i>Gallinula chloropus</i>	Moorhen			
<i>Fulica atra</i>	Coot			
<i>Haematopus ostralegus</i>	Oystercatcher		✓	
<i>Pluvialis apricaria</i>	Golden plover	✓	✓	✓
<i>Vanellus vanellus</i>	Lapwing	✓	✓	
<i>Gallinago gallinago</i>	Snipe	✓	✓	✓
<i>Numenius arquata</i>	Curlew	✓	✓	✓
<i>Actitis hypoleucos</i>	Common sandpiper			✓
<i>Larus ridibundus</i>	Black-headed gull		✓	
<i>Larus fuscus</i>	Lesser black-backed gull		✓	
<i>Columba livia</i>	Feral pigeon			
<i>Columba oenas</i>	Stock dove		✓	
<i>Columba palumbus</i>	Woodpigeon	✓		
<i>Streptopelia decaocto</i>	Collared dove			
<i>Cuculus canorus</i>	Cuckoo	✓	✓	
<i>Athene noctua</i>	Little owl			
<i>Strix aluco</i>	Tawny owl			
<i>Apus apus</i>	Swift			
<i>Picus viridis</i>	Green woodpecker		✓	
<i>Dendrocopos major</i>	Great spotted woodpecker			
<i>Alauda arvensis</i>	Skylark	✓	✓	
<i>Hirundo rustica</i>	Swallow	✓	✓	
<i>Delichon urbica</i>	House martin		✓	
<i>Anthus trivialis</i>	Tree pipit		✓	✓
<i>Anthus pratensis</i>	Meadow pipit	✓	✓	✓
<i>Motacilla cinerea</i>	Grey wagtail	✓	✓	✓
<i>Motacilla alba</i>	Pied wagtail			
<i>Cinclus cinclus</i>	Dipper	✓		✓

<i>Troglodytes troglodytes</i>	Winter wren	✓		
<i>Prunella modularis</i>	Duncock	✓	✓	
<i>Erethacus rubecula</i>	Robin	✓		
<i>Phoenicurus phoenicurus</i>	Redstart	✓	✓	✓
<i>Saxicola torquata</i>	Stonechat	✓	✓	✓
<i>Oenanthe oenanthe</i>	Wheatear	✓		✓
<i>Turdus torquatus</i>	Ring ouzel	✓	✓	✓
<i>Turdus merula</i>	Blackbird	✓		
<i>Turdus pilaris</i>	Fieldfare		✓	
<i>Turdus philomelos</i>	Song thrush	✓	✓	
<i>Turdus viscivorus</i>	Mistle thrush	✓	✓	
<i>Acrocephalus schoenobaenus</i>	Sedge warbler			
<i>Sylvia curruca</i>	Lesser whitethroat			
<i>Sylvia communis</i>	Whitethroat	✓		
<i>Sylvia borin</i>	Garden warbler	✓		
<i>Sylvia atricapilla</i>	Blackcap			
<i>Phylloscopus collybita</i>	Chiffchaff			
<i>Phylloscopus trochilus</i>	Willow warbler	✓	✓	
<i>Regulus regulus</i>	Goldcrest		✓	
<i>Muscicapa striata</i>	Spotted flycatcher		✓	
<i>Ficedula hypoleuca</i>	Pied flycatcher			✓
<i>Aegithalos caudatus</i>	Long-tailed tit			
<i>Parus ater</i>	Coal tit			
<i>Parus caeruleus</i>	Blue tit	✓		
<i>Parus major</i>	Great tit			
<i>Sitta europaea</i>	Nuthatch			
<i>Certhia familiaris</i>	Treecreeper			
<i>Garrulus glandarius</i>	Jay	✓		
<i>Pica pica</i>	Magpie			
<i>Corvus monedula</i>	Jackdaw	✓		
<i>Corvus frugilegus</i>	Rook	✓		
<i>Corvus corone</i>	Carrion crow	✓		
<i>Corvus corax</i>	Raven	✓		✓
<i>Sturnus vulgaris</i>	Starling	✓	✓	
<i>Passer domesticus</i>	House sparrow		✓	
<i>Fringila coelebs</i>	Chaffinch	✓		
<i>Carduelis chloris</i>	Greenfinch	✓		
<i>Carduelis carduelis</i>	Goldfinch	✓		
<i>Carduelis spinus</i>	Siskin			✓
<i>Carduelis cannabina</i>	Linnet	✓	✓	
<i>Carduelis flavirostris</i>	Twite		✓	✓
<i>Carduelis flammea</i>	Lesser redpoll		✓	✓
<i>Pyrrhula pyrrhula</i>	Bullfinch		✓	
<i>Emberiza citrinella</i>	Yellowhammer	✓	✓	
<i>Emberiza schoeniclus</i>	Reed bunting	✓	✓	

## References

- Biodiversity Reporting and Information Group 2007. Report of the species and habitat review. Report to the UK Biodiversity Partnership. – JNCC.
- Gibbons, D. W. et al. 1993. The new atlas of breeding birds in Britain and Ireland: 1988–1991. – BTO.
- Gregory, R. D. et al. 2002. The population status of birds in the United Kingdom, Channel Islands and the Isle of Man: an analysis of conservation concern 2002–2007. – *Brit. Birds* 95: 410–450.
- Stroud, D. A. et al. 2001. The UK SPA network: its scope and content. – JNCC.