Supplementary material

Aleksi Lehikoinen*, Alison Johnston & Dario Massimino 2021:
Climate and land use changes: similarity in range and abundance changes of birds in Finland and Great Britain and structure of a breeding.
— Ornis Fennica 98: 1–15.

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Supplementary Table 1. Annual rate of range size change and shift in mean weighted latitude of 56 species in Britain and Finland, that were used in distribution analyses. The main habitat type (Hab; F = forest, W = wetland, O = open), mean northerness in terms of latitude of distribution (Lat) as well as taxonomy (Genus, Family and Order) of species are given.

Species	Range change		Distribution shift		Hab	Lat	Genus	Family	Order
	Britain	Finland	Britain	Finland					
Mute Swan *Cygnus olor*	1.002	1.038	0.828	2.536	W	0.271	Cygnus	Anatidae	Anseriformes
Canada Goose *Branta canadensis*	1.024	1.155	2.482	3.781	W	0.244	Branta	Anatidae	Anseriformes
Gadwall *Anas strepera*	1.039	1.105	–1.095	2.453	W	0.309	Mareca	Anatidae	Anseriformes
Garganey *Anas querquedula*	1.01	0.997	2.91	2	W	0.292	Spatula	Anatidae	Anseriformes
Shoveler *Anas clypeata*	0.999	1.017	0.067	3.328	W	0.361	Spatula	Anatidae	Anseriformes
Pochard *Aythya ferina*	0.988	0.997	–1.862	0.958	W	0.295	Aythya	Anatidae	Anseriformes
Common Scoter *Melanitta nigra*	0.991	1.03	–1.241	–1.743	W	0.801	Melanitta	Anatidae	Anseriformes
Willow / Red Grouse *Lagopus lagopus*	0.994	0.992	2.428	3.332	O	0.596	Lagopus	Phasianidae	Galliformes
Ptarmigan *Lagopus muta*	0.997	1.019	0.308	–0.596	O	0.834	Lagopus	Phasianidae	Galliformes
Grey Partridge *Perdix perdix*	0.988	1.025	–0.015	3.328	O	0.326	Perdix	Phasianidae	Galliformes
Quail *Coturnix coturnix*	1.019	1.104	6.997	0.121	O	0.308	Coturnix	Phasianidae	Galliformes
Great Crested Grebe *Podiceps cristatus*	1.007	1.006	–1.154	1.525	W	0.295	Podiceps	Podicipedidae	Podicipediformes
Bittern *Botaurus stellaris*	1.022	1.07	0.956	3.589	W	0.211	Botaurus	Ardeidae	Pelecaniformes
Honey Buzzard *Pernis apivorus*	1.049	1.017	0.082	1.317	F	0.308	Pernis	Accipitridae	Accipitriformes
Marsh Harrier *Circus aeruginosus*	1.06	1.063	–0.195	5.374	W	0.290	Circus	Accipitridae	Accipitriformes
Hen Harrier *Circus cyaneus*	1.006	1.01	–1.849	–2.343	O	0.539	Circus	Accipitridae	Accipitriformes
Northern Goshawk *Accipiter gentilis*	1.07	1.016	–3.282	2.638	F	0.403	Accipiter	Accipitridae	Accipitriformes
Golden Eagle *Aquila chrysaetus*	1.001	1.017	0.482	0.777	O	0.706	Aquila	Accipitridae	Accipitriformes
Merlin *Falco columbarius*	1.003	1.026	2.092	–2.004	O	0.598	Falco	Falconidae	Falconiformes
Hobby *Falco subbuteo*	1.036	1.024	0.697	1.789	O	0.281	Falco	Falconidae	Falconiformes
Spotted Crake *Porzana porzana*	1	1.016	0.703	2.181	W	0.349	Porzana	Rallidae	Gruiformes
Moorhen *Gallinula chloropus*	0.998	1.011	–0.218	1.309	W	0.294	Gallinula	Rallidae	Gruiformes

Supplementary Table 1. Continues...

Coot *Fulica atra*	0.999	1.005	–0.864	2.091	W	0.308	Fulica	Rallidae	Gruiformes
Little Ringed Plover *Charadrius dubius*	1.019	1.002	2.446	0.808	O	0.315	Charadrius	Charadriidae	Charadriiformes
Dotterel *Charadrius morinellus*	1.015	1.002	4.072	1.038	O	0.770	Charadrius	Charadriidae	Charadriiformes
Golden Plover *Pluvialis apricaria*	0.994	1.015	1.085	–1.966	O	0.635	Pluvialis	Charadriidae	Charadriiformes
Dunlin *Calidris alpina*	0.997	0.999	0.895	0.996	O	0.723	Calidris	Scolopacidae	Charadriiformes
Whimbrel *Numenius phaeopus*	0.993	1.014	3.582	–1.298	O	0.800	Numenius	Scolopacidae	Charadriiformes
Greenshank *Tringa nebularia*	1	1.014	1.71	–0.283	O	0.673	Tringa	Scolopacidae	Charadriiformes
Red–necked Phalarope *Phalaropus lobatus*	0.996	0.988	–0.274	1.174	O	0.863	Phalaropus	Scolopacidae	Charadriiformes
Stock Dove *Columba oenas*	1	1.017	0.292	1.97	O	0.267	Columba	Columbidae	Columbiformes
Turtle Dove *Streptopelia turtur*	0.983	0.946	–2.646	3.811	O	0.246	Streptopelia	Columbidae	Columbiformes
Long–eared Owl *Asio otus*	0.995	1.024	–0.11	0.287	F	0.352	Asio	Strigidae	Strigiformes
Short–eared Owl *Asio flammeus*	0.983	1.006	–0.087	0.057	O	0.540	Asio	Strigidae	Strigiformes
Nightjar *Caprimulgus europaeus*	0.986	1.004	–3.392	–0.091	F	0.225	Caprimulgus	Caprimulgidae	Caprimulgiformes
Kingfisher *Alcedo atthis*	1	0.981	2.415	0.894	W	0.232	Alcedo	Alcedinidae	Coraciiformes
Great Spotted Woodpecker *Dendrocopos major*	1.003	1.015	0.649	4.589	F	0.398	Dendrocopos	Picidae	Piciformes
Lesser Spotted Woodpecker *Dendrocopos minor*	0.987	1.027	1.056	–1.989	F	0.278	Dryobates	Picidae	Piciformes
Woodlark *Lullula arborea*	0.994	1.039	3.151	1.653	O	0.161	Lullula	Alaudidae	Passeriformes
Black Redstart *Phoenicurus ochropus*	1.018	1.089	3.654	3.513	O	0.196	Phoenicurus	Muscicapidae	Passeriformes
Ring Ouzel *Turdus torquatus*	0.986	1.013	–0.067	–0.442	O	0.719	Turdus	Turdidae	Passeriformes
Reed Warbler *Acrocephalus scirpacaeus*	1.008	1.012	2.654	1.072	W	0.212	Acrocephalus	Acrocephalidae	Passeriformes
Marsh Warbler *Acrocephalus palustris*	1.017	1.047	8.79	1.694	O	0.190	Acrocephalus	Acrocephalidae	Passeriformes
Blackcap *Sylvia atricapilla*	1.005	1.027	3.469	2.755	F	0.291	Sylvia	Sylviidae	Passeriformes
Garden Warbler *Sylvia borin*	1.003	1.008	1.192	1.592	F	0.355	Sylvia	Sylviidae	Passeriformes

Supplementary Table 1. Continues...

Lesser Whitethroat *Sylvia communis*	1.007	1.011	2.672	1.883	O	0.340	Sylvia	Sylviidae	Passeriformes
Common Whitethroat *Sylvia curruca*	1	1.012	0.908	1.808	F	0.323	Sylvia	Sylviidae	Passeriformes
Chiffchaff *Phylloscopus collybita*	1.004	1.007	3.467	1.596	F	0.360	Phylloscopus	Phylloscopidae	Passeriformes
Jay *Garrulus glandarius*	1.004	1.014	1.931	3.128	F	0.332	Garrulus	Corvidae	Passeriformes
Jackdaw *Corvus monedula*	0.999	1.03	–0.918	4.275	O	0.327	Corvus	Corvidae	Passeriformes
Rook *Corvus frugilegus*	0.999	1.051	–0.656	0.755	O	0.381	Corvus	Corvidae	Passeriformes
Tree Sparrow *Passer montanus*	0.987	1.142	1.097	3.687	O	0.331	Passer	Passeridae	Passeriformes
Goldfinch *Carduelis carduelis*	1.003	1.04	2.746	1.404	O	0.262	Carduelis	Fringillidae	Passeriformes
Hawfinch *Coccotraustes coccotraustes*	0.964	1.09	–0.259	0.06	F	0.255	Coccothraustes	Fringillidae	Passeriformes
Snow Bunting *Plectrophenax nivalis*	1.023	1.006	0.226	0.97	O	0.828	Plectrophenax	Calcariidae	Passeriformes
Yellowhammer *Emberiza citrinella*	0.995	1.005	–1.569	0.506	O	0.387	Emberiza	Emberizidae	Passeriformes

Supplementary Table 2. Annual growth rates and speed of density shifts of 40 species in Britain and Finland, that were used in abundance analyses. The main habitat (Hab) type (F = forest, O = open), mean northerness in terms of latitude of distribution (Lat) as well as taxonomy (Genus, Family and Order) of species are given.

Species	Growth rates		Density shift		Hab	Lat	Genus	Family	Order
	UK	Finland	Britain	Finland					
Common Buzzard *Buteo buteo*	0.041	–0.05	0.459	–9.313	O	0.351	Buteo	Accipitridae	Accipitriformes
Lapwing *Vanellus vanellus*	–0.038	0.012	–6.364	–1	O	0.432	Vanellus	Charadriidae	Charadriiformes
Curlew *Numenius arquata*	–0.023	–0.005	–6.52	–2.563	O	0.481	Numenius	Scolopacidae	Charadriiformes
Stock Dove *Columba oenas*	0.005	–0.003	0.007	–0.014	O	0.177	Columba	Columbidae	Columbiformes
Wood Pigeon *Columba palumbus*	0.021	0.023	–0.434	–0.438	O	0.246	Columba	Columbidae	Columbiformes
Eurasian Cockoo *Cuculus canorus*	–0.032	0.014	–0.631	1.75	F/O	0.394	Cuculus	Cuculidae	Cuculiformes
Common Swift *Apus apus*	–0.03	–0.018	11.335	–2.563	O	0.274	Apus	Apodidae	Apodiformes
Great Spotted Woodpecker *Dendrocopos major*	0.031	0.017	–2.668	6.438	F	0.268	Dendrocopos	Picidae	Piciformes
Skylark *Alauda arvensis*	–0.018	–0.012	4.898	2.125	O	0.301	Alauda	Alaudidae	Passeriformes
Barn Swallow *Hirundo rustica*	0.014	–0.016	0.056	–1.375	O	0.318	Hirundo	Hirundinidae	Passeriformes
House Martin *Delichon urbicum*	–0.028	–0.053	8.259	–3.563	O	0.304	Delichon	Hirundinidae	Passeriformes
Meadow Pipit *Anthus pratensis*	–0.017	–0.011	2.751	4.875	O	0.666	Anthus	Motacillidae	Passeriformes
White Wagtail *Motacilla alba*	–0.007	0	–3.315	3.25	O	0.342	Motacilla	Motacillidae	Passeriformes
Winter Wren *Troglodytes troglodytes*	0.007	0.03	5.186	–3.125	F/O	0.286	Troglodytes	Troglodytidae	Passeriformes
Dunnock *Prunella modularis*	0.002	0.007	2.094	3.25	F/O	0.279	Prunella	Prunellidae	Passeriformes
Eurasian Robin *Erithacus rubecula*	0.011	0.017	2.463	2.875	F	0.288	Erithacus	Muscicapidae	Passeriformes
Eurasian Blackbird *Turdus merula*	0.002	0.043	1.621	2.375	F	0.215	Turdus	Turdidae	Passeriformes
Song Thrush *Turdus philomelos*	–0.008	0.006	1.487	8.313	F/O	0.290	Turdus	Turdidae	Passeriformes
Mistle Thrush *Turdus viscivorus*	–0.025	0.05	7.141	1	F/O	0.357	Turdus	Turdidae	Passeriformes
Common Whitethroat *Sylvia communis*	0.027	–0.001	2.082	–0.875	O	0.218	Sylvia	Sylviidae	Passeriformes
Garden Warbler *Sylvia borin*	0.001	0.002	2.385	–0.875	F	0.259	Sylvia	Sylviidae	Passeriformes
Blackcap *Sylvia atricapilla*	0.036	0.016	2.897	–0.563	F	0.187	Sylvia	Sylviidae	Passeriformes

Supplementary Table 2. Continues...

Chiffchaff *Phylloscopus collybita*	0.048	–0.006	4.104	1.813	F	0.206	Phylloscopus	Phylloscopidae	Passeriformes
Willow Warbler *Phylloscopus trochilus*	–0.022	–0.01	6.37	0.313	F	0.443	Phylloscopus	Phylloscopidae	Passeriformes
Goldcrest *Regulus regulus*	–0.014	–0.013	4.372	–0.063	F	0.322	Regulus	Regulidae	Passeriformes
Coal Tit *Periparus ater*	0.006	0.005	0.517	–1.188	F	0.316	Periparus	Paridae	Passeriformes
Blue Tit *Cyanistes caeruleus*	0.005	0.065	1.277	–0.875	F	0.236	Cyanistes	Paridae	Passeriformes
Great Tit *Parus major*	0.012	0.023	1.429	0.563	F	0.280	Parus	Paridae	Passeriformes
Eurasian Jay *Garrulus glandarius*	0.001	–0.008	3.042	2.438	F	0.219	Garrulus	Corvidae	Passeriformes
Eurasian Magpie *Pica pica*	0.005	–0.001	3.032	–1.25	O	0.219	Pica	Corvidae	Passeriformes
Jackdaw *Corvus monedula*	0.017	0.052	–0.808	4.25	O	0.244	Corvus	Corvidae	Passeriformes
Carrion/Hooded Crow *Corvus corone*	0.011	–0.009	2.926	–0.188	O	0.314	Corvus	Corvidae	Passeriformes
Eurasian Starling *Sturnus vulgaris*	–0.054	–0.026	10.523	–6.625	O	0.262	Sturnus	Sturnidae	Passeriformes
House Sparrow *Passer domesticus*	–0.017	–0.029	–0.308	3.813	O	0.267	Passer	Passeridae	Passeriformes
Chaffinch *Fringilla coelebs*	0.004	0	1.295	3	F/O	0.301	Fringilla	Fringillidae	Passeriformes
Greenfinch *Carduelis chloris*	–0.004	0.063	0.141	–0.063	O	0.278	Chloris	Fringillidae	Passeriformes
Linnet *Carduelis cannabina*	–0.013	0.004	5.212	6.25	O	0.218	Linaria	Fringillidae	Passeriformes
Bullfinch *Pyrrhula pyrrhula*	–0.002	0.007	4.093	1.5	F	0.352	Pyrrhula	Fringillidae	Passeriformes
Yellowhammer *Emberiza citrinella*	–0.025	–0.002	1.351	0.563	O	0.296	Emberiza	Emberizidae	Passeriformes
Reed Bunting *Emberiza schoeniclus*	0.007	–0.021	–5.586	9.313	O	0.455	Emberiza	Emberizidae	Passeriformes

Supplementary Table 3. Full models explaining range size change in Great Britain with various phylogenic random structures (genus, family and order written in syntax of lmer function in R) ranked based on the AIC. The AICc difference (∆AICc), AIC weight (w) and evidence ratio (ER) are shown.

Model	*∆AICc*	*w*	*ER*
(1|Family/Genus)	0	0.682	1.00
(1|Order/Family/Genus)	3.26	0.134	5.09
(1|Genus)	3.63	0.111	6.14
No phylogeny	4.48	0.073	9.34

Supplementary Table 4. Full models explaining range shifts in Great Britain with various phylogenic random structures (genus, family and order written in syntax of lmer function in R) ranked based on the AIC. The AICc difference (∆AICc), AIC weight (w) and evidence ratio (ER) are shown.

Model	*∆AICc*	*w*	*ER*
(1|Genus)	0	0.785	1.00
(1| Family/Genus/)	2.95	0.180	4.36
(1|Order/Family/Genus/)	6.20	0.035	22.43
No phylogeny	25.46	0	>10000

Supplementary Table 5. Full models explaining population trends in Great Britain with various phylogenic random structures (genus, family and order written in syntax of lmer function in R) ranked based on the AIC. The AICc difference (∆AICc), AIC weight (w) and evidence ratio (ER) are shown.

Model	*∆AICc*	*w*	*ER*
No phylogeny	0	0.798	1.0
(1|Genus)	3.15	0.165	4.8
(1|Family/Genus)	6.50	0.031	25.7
(1|Order/Family/Genus)	10.09	0.005	159.6

Supplementary Table 6. Full models explaining speed in density shifts of birds Great Britain with various phylogenic random structures (genus, family and order written in syntax of lmer function in R) ranked based on the AIC. The AICc difference (∆AICc), AIC weight (w) and evidence ratio (ER) are shown.

Model	*∆AICc*	*w*	*ER*
(1|Order/Family/Genus)	0	0.988	1.00
(1|Genus)	9.31	0.009	109.78
(1|Family/Genus)	12.46	0.002	494.00
No phylogeny	15.998	0.000	>10000

Supplementary Table 7. Models explaining range size change in Great Britain ranked with AICc. The AICc difference (∆AICc), AIC weight (w) and evidence ratio (ER) are shown. FinR is corresponding range size change in Finland, Hab is habitat type and mLat is mean latitude of species. Genus and family were the phylogenic random structures of the models (Table S3).

Model	*∆AICc*	*w*	*ER*
FinR+Hab+FinR*Hab	0	0.449	1.00
FinR+Hab+mLat+FinR*Hab	0.91	0.285	1.58
FinR+Hab+mLat+FinR*Hab+FinR*mLat	2.96	0.102	4.40
FinR	5.56	0.028	16.04
FinR+mLat	5.88	0.024	18.71
FinR+Hab	6.81	0.015	29.93
FinR+mLat+FinR*mLat	7.40	0.010	44.90
FinR+Hab+mLat	7.75	0.009	49.89
FinR+Hab+mLat+FinR*mLat	9.85	0.003	149.67
Intercept only (null model)	11.72	0.001	449.00

Supplementary Table 8. Models explaining range shifts in Great Britain ranked with AICc. The AICc difference (∆AICc), AIC weight (w) and evidence ratio (ER) are shown. FinS is corresponding range size shift in Finland, Hab is habitat type and mLat is mean latitude of species. Genus was the phylogenic random structure of the models (Table S4).

Model	*∆AICc*	*w*	*ER*
FinS+Hab	0	0.539	1.00
FinS+Hab+mLat	2.35	0.167	3.23
Intercept only (null model)	3.00	0.120	4.49
FinS	4.61	0.054	9.98
FinS+Hab+mLat+FinS*mLat	4.87	0.047	11.47
FinS+Hab+FinS*Hab	5.31	0.038	14.18
FinS+mLat	6.96	0.017	31.71
FinS+Hab+mLat+FinS*Hab	7.93	0.010	53.90
FinS+mLat+FinS*mLat	9.47	0.005	107.80
FinS+Hab+mLat+FinS*Hab+FinS*mLat	10.66	0.003	179.67

Supplementary Table 9. Models explaining population trends in Great Britain ranked with AICc. The AICc difference (∆AICc), AIC weight (w) and evidence ratio (ER) are shown. FinT is corresponding population trends in Finland, Hab is habitat type type and mLat is mean latitude of species. There were no phylogenic random structures in the models (Table S5).

Model	*∆AICc*	*w*	*ER*
FinT+mLat+FinT*mLat	0	0.389	1.0
FinT+Hab+mLat+FinT*mLat	0.28	0.338	1.2
FinT+Hab+mLat+FinT*Hab +FinT*mLat	1.01	0.234	1.7
FinT+mLat	6.67	0.014	27.8
FinT+Hab+mLat	7.18	0.011	35.4
Intercept only (null model)	8.56	0.005	77.8
FinT+Hab	9.75	0.003	129.7
FinT+Hab+mLat+FinT*Hab	9.91	0.003	129.7
FinT	10.02	0.003	129.7
FinT+Hab+FinT*Hab	12.35	0.001	389.0

Supplementary Table 10. Models explaining speed in density shifts of birds in Great Britain ranked with AICc. The AICc difference (∆AICc), AIC weight (w) and evidence ratio (ER) are shown. FinD is corresponding density shifts in Finland, Hab is habitat type type and mLat is mean latitude of species. Genus, family and order were the phylogenic random structures of the models (Table S6).

Model	*∆AICc*	*w*	*ER*
FinD	0	0.550	1.00
FinD+mLat	2.48	0.150	3.67
FinD+Hab	2.92	0.128	4.30
FinD+mLat+FinD*mLat	4.37	0.062	8.87
FinD+Hab+FinD*Hab	5.26	0.041	13.41
FinD+Hab+mLat	5.60	0.033	16.67
FinD+Hab+mLat+FinD*Hab	7.59	0.012	45.83
FinD+Hab+mLat+FinD*mLat	7.63	0.012	45.83
FinD+Hab+FinD*Hab+FinD*mLat	10.29	0.003	183.33
Intercept only (null model)	13.26	0.001	550.00