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Firth, J. A., Verhelst, B. L., Crates, R. A., Garroway, C. J. and Sheldon, B. C. 2018. Spatial, temporal and individual-based differences in nest-site visits and subsequent reproductive success in wild great tits. – J. Avian Biol. 2018: e01740

Supplementary material

Appendix 1.

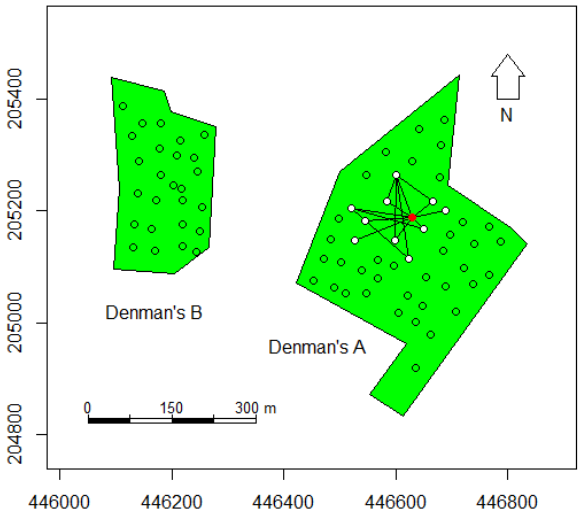

Figure A1. The study area 500m south of the main Wytham woodland. Denman's Copses comprises of (i) a 5 hectarce site containing 26 nestboxes at coordinates 51°44'38.2"N 1°19'56.8"W (left-hand side) and 9 hectare site containing 48 nestboxes at coordinates 51°44'35.9"N 1°19'35.7"W (right-hand side). An example visitation pattern of a single bird (juvenile male) is shown. The red dot shows the individual's 'most visited box' and the lines indicate movement between boxes (in the order in which they were observed).

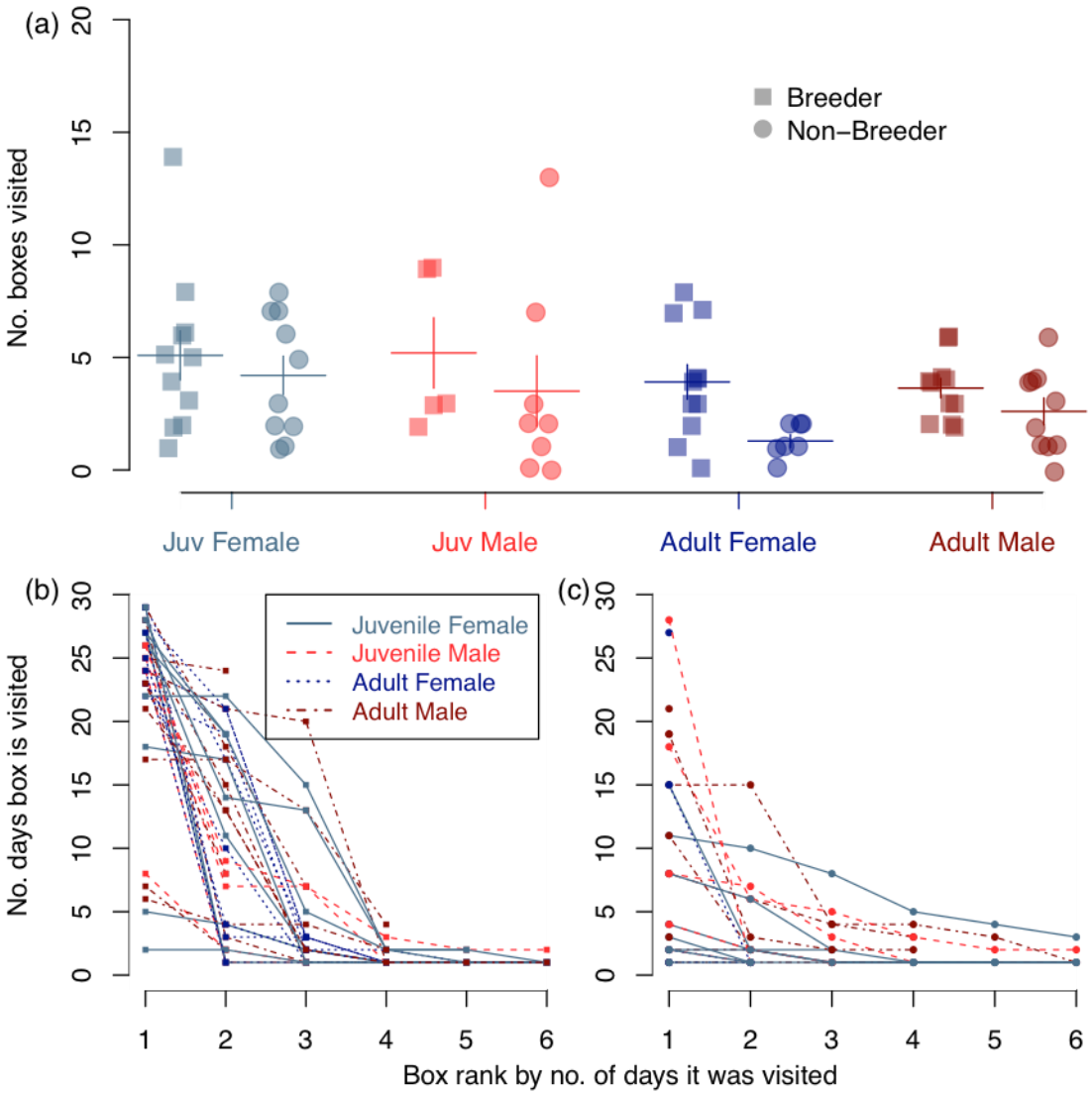

Figure A2. (a) Total number of boxes visited per individual by age and sex (also denoted by colour). Data only includes boxes visited 30 days before the individuals laydate, where individuals not recorded laying where assigned the mean laydate. Breeders are shown as squares (left) and non-breeders as circles (right). Points are semi-transparent and slightly jittered to show overlap. Horizontal lines show the mean of the raw data and the vertical lines show standard error around this. (b) Distribution of daily visits over the boxes visited by birds recorded breeding and (c) birds not recorded breeding. A steep decline in visits indicates that a bird's visits are particularly concentrated over a few boxes while making only occasional visits to others. Conversely, a slow decline reflects a rather even distribution of visits across boxes.

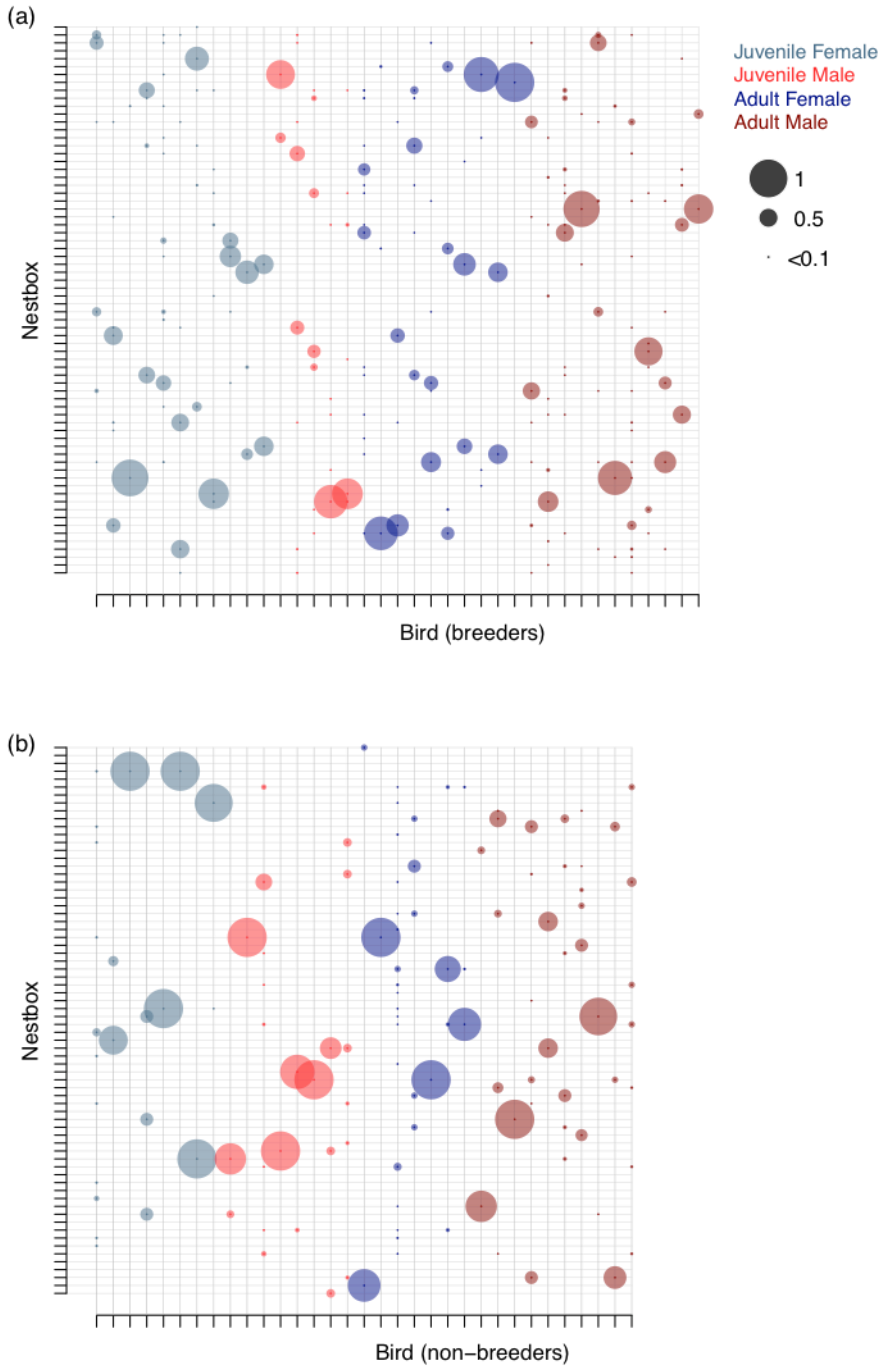

Figure A3. Distribution of proportions of each bird's (grid columns) daily visits to each of the 70 nestboxes (gird rows) through March 2012. Circle size represents the proportion of visits and circle colour shows the individual age and sex (see legend). Birds subsequently recorded breeding are shown in panel (a) and non-breeders are shown in panel (b). The nestboxes (grid row order) are consistent across both panels. Nestbox figure structure taken from Sánchez-Tójar et al. (2017).

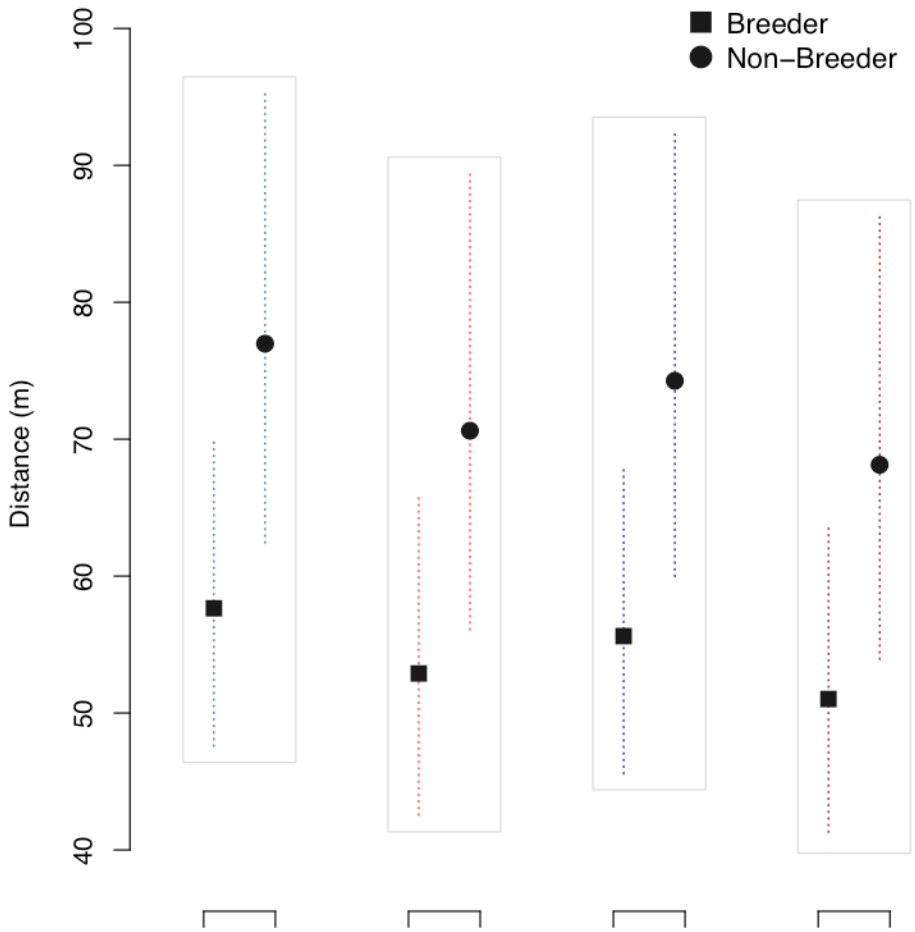

Figure A4. Distance between individuals' most visited nestbox (their i.e. 'preferred nestbox') and their other visited boxes per individual by age and sex (as denoted by line colour) and breeding status (as denoted by point shape). Points show LMM estimate controlling for number of boxes visited (Table 1) (where plotted points denote the estimated 'average' individual visiting the mean number of boxes) and dotted lines show standard error around this estimate.

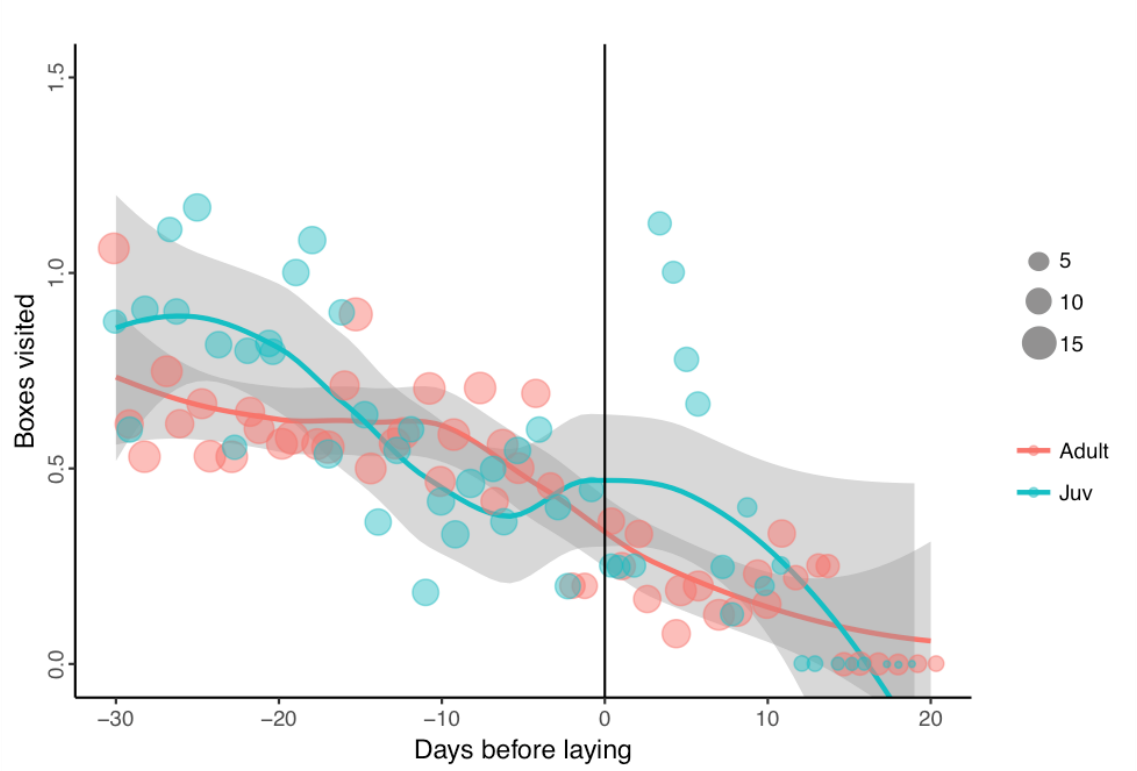

Figure A5. Temporal trends in visits from great tits to nestboxes, red indicates adult birds and blue indicates juveniles (first-year birds). The y-axis shows the mean number of boxes (excluding its own box) visited by individuals of each age group each day. Day is relative to the lay date at its own nest box (shown as the vertical black line), and includes days when the bird was not recorded on any box during the logging period. Points show the data as the mean value for each sex on each day and the size of the point represents sample size (i.e. number of individuals the mean was calculated over). To illustrate the temporal trend, smoothing lines (based on the raw data points) show local polynomial regression fit smoothing (by least squares) and associated standard error, with degree of smoothing and polynomials set as 0.75 and 2 respectively using ggplot2 (Wickham 2009).

Table A1. Full model results in relation to Figure A2. The relationship between individual characteristics and nestbox visiting behaviour for the 30 days prior to laying. Model outputs with the estimate (± standard error), and associated t (or z) value, and the p value for each factor. The breeding status estimate is shown in relation to non-breeders compared to breeders, the sex estimate for males compared to females, and the age estimate for adults compared to juveniles.

Response	*Factor*	*Estimate (±SE)*	*t/z*	*p*
(a) No. boxes visited	*Intercept*	1.67±0.141	11.86	<0.001
	Breeding Status	-0.446±0.167	-2.673	0.008
	Age	-0.353±0.165	-2.142	0.032
	Sex	0.008±0.164	0.048	0.962
(b) No. visits to preferred box	*Intercept*	2.948±0.201	14.66	<0.001
	Breeding Status	-1.074±0.171	-6.286	<0.001
	Age	0.14±0.148	0.946	0.344
	Sex	0.047±0.141	0.334	0.739
	No. boxes	0.021±0.028	0.752	0.452

Table A2. Full model results examining the temporal trends in breeders' visits to other nestboxes. Output shown for full GLMM (Poisson error structure) with individual as random effect. The sex estimate is shown in relation to males compared to females, and the age estimate is shown for adults compared to juveniles.

Factor	*Estimate*	*t/z*	*p*
Intercept	-0.086±0.373	-0.229	0.819
Days before lay	0.001±0.008	-0.066	0.947
Sex	-1.779±0.379	-4.700	<0.001
Age	-0.717±0.378	-1.895	0.058
*Days*Sex*	-0.058±0.008	-7.117	<0.001
*Days*Age*	-0.015±0.008	-1.824	0.068

Table A3. Additional supplementary models relating breeding birds' reproduction and nestbox visitation excluding (i) age, (ii) size and (iii) age and size. Following Table 2, models use laydate, clutch size, fledging success as response variables, each which includes all measures of nestbox visitation behaviours: Number of unique boxes visited ('No. Boxes'), number of visits to their breeding site ('Site Visits'), distance of other boxes visited from their breeding site 30 days before laying. Age estimate is shown for adults compared to juveniles. Size refers to a composite size measure considering wing and tarsus length and weight (see Methods). Table columns (a) gives results for females and table columns (b) gives results for males.

(i)		*(a) Female*			*(b) Male*		
Response	*Factor*	*Estimate*	*t/z*	*p*	*Estimate*	*t/z*	*p*
Lay-date	*Intercept*	73.56±25.81	2.85	0.01	133.57±71.95	1.86	0.11
	No. boxes	1.44±0.53	2.73	0.02	3.56±1.78	2	0.09
	Own box visits	-0.63±0.26	-2.42	0.03	-1.4±0.5	-2.79	0.03
	Distance	-13.2±6	-2.2	0.05	-25.39±17.41	-1.46	0.19
	Size	0.67±1.26	0.54	0.6	-4.71±3.34	-1.41	0.2
Clutch Size	*Intercept*	29.86±8.16	3.66	<0.001	-1.62±11.3	-0.14	0.89
	No. boxes	0.27±0.16	1.64	0.13	-0.44±0.29	-1.53	0.18
	Own box visits	-0.19±0.08	-2.42	0.03	0.11±0.09	1.22	0.27
	Distance	-4.47±1.74	-2.57	0.03	2.02±2.56	0.79	0.46
	Size	-0.25±0.31	-0.8	0.44	0.55±0.49	1.13	0.3
	Lay-date	-0.16±0.07	-2.22	0.05	0±0.05	-0.04	0.97
Fledging Success	*Intercept*	16.12±7.03	2.29	0.02	13.13±6.74	1.95	0.05
	No. boxes	0.06±0.14	0.42	0.67	0.04±0.18	0.24	0.81
	Own box visits	-0.09±0.06	-1.45	0.15	-0.13±0.06	-2.25	0.02
	Distance	-3.42±1.47	-2.33	0.02	-0.12±0.34	-0.36	0.72
	Size	-0.18±0.18	-1	0.32	-2.47±1.49	-1.66	0.1
	Lay-date	-0.09±0.05	-1.66	0.1	-0.05±0.03	-1.44	0.15

(ii)		*(a) Female*			*(b) Male*		
Response	*Factor*	*Estimate*	*t/z*	*p*	*Estimate*	*t/z*	*p*
Lay-date	*Intercept*	60.41±23.95	2.52	0.03	42.07±42.24	1	0.34
	No. boxes	1.16±0.5	2.3	0.04	1.7±1.78	0.96	0.36
	Own box visits	-0.45±0.25	-1.8	0.1	-0.53±0.34	-1.55	0.15
	Distance	-10.18±5.54	-1.84	0.09	-5.36±10.94	-0.49	0.63
	Age	-3.43±2.78	-1.23	0.24	-1.9±6.55	-0.29	0.78
Clutch Size	*Intercept*	26.3±7.65	3.44	<0.001	5.46±6.27	0.87	0.41
	No. boxes	0.22±0.16	1.4	0.19	-0.3±0.22	-1.37	0.21
	Own box visits	-0.12±0.07	-1.67	0.12	0.04±0.05	0.72	0.49
	Distance	-3.84±1.63	-2.36	0.04	0.82±1.56	0.53	0.61
	Age	-0.47±0.77	-0.61	0.56	-0.49±0.96	-0.51	0.63
	Lay-date	-0.14±0.07	-1.87	0.09	-0.04±0.04	-1.02	0.34
Fledging Success	*Intercept*	20.78±6.24	3.33	<0.001	9.4±4.17	2.25	0.02
	No. boxes	0.14±0.13	1.04	0.3	-0.02±0.15	-0.14	0.89
	Own box visits	-0.11±0.06	-1.88	0.06	-0.1±0.04	-2.65	0.01
	Distance	-4.42±1.31	-3.37	<0.001	0.27±0.61	0.45	0.65
	Age	-0.21±0.44	-0.47	0.64	-1.77±1.02	-1.74	0.08
	Lay-date	-0.12±0.05	-2.44	0.01	-0.03±0.03	-1.14	0.25

(iii)		*(a) Female*			*(b) Male*		
Response	*Factor*	*Estimate*	*t/z*	*p*	*Estimate*	*t/z*	*p*
Lay-date	*Intercept*	58.12±24.31	2.39	0.03	43.01±40.32	1.07	0.31
	No. boxes	1.21±0.51	2.37	0.03	1.94±1.51	1.28	0.23
	Own box visits	-0.54±0.25	-2.16	0.05	-0.56±0.31	-1.78	0.1
	Distance	-9.62±5.62	-1.71	0.11	-6.01±10.25	-0.59	0.57
Clutch Size	*Intercept*	25.16±7.23	3.48	<0.001	5.98±5.89	1.02	0.34
	No. boxes	0.21±0.15	1.37	0.19	-0.27±0.2	-1.34	0.22
	Own box visits	-0.13±0.07	-1.77	0.1	0.04±0.05	0.76	0.47
	Distance	-3.62±1.55	-2.34	0.04	0.54±1.39	0.39	0.71
	Lay-date	-0.12±0.07	-1.81	0.09	-0.04±0.04	-0.95	0.37
Fledging Success	*Intercept*	21.15±6.44	3.29	<0.001	9.08±4.1	2.21	0.03
	No. boxes	0.14±0.13	1.08	0.28	-0.04±0.14	-0.27	0.79
	Own box visits	-0.12±0.06	-2.12	0.03	-0.1±0.04	-2.66	0.01
	Distance	-4.49±1.35	-3.33	<0.001	-1.61±0.95	-1.69	0.09
	Lay-date	-0.12±0.05	-2.4	0.02	-0.03±0.03	-1.27	0.2