Supporting Information. Winkler, D.W., K.K. Hallinger, T.M. Pegan, C.C. Taff, M.A. Verhoeven, D. Chang van Oordt, M. Stager, J.J. Uehling, M.N. Vitousek, M.J. Andersen, D.R. Ardia, A. Belmaker, V. Ferretti, A.M. Forsman, J.R. Gaul, P.E. Llambias, S.C. Orzechowski, J.R. Shipley, M. Wilson, and H.S. Yoon. 2020. Full lifetime perspectives on the costs and benefits of lay date variation in tree swallows. Ecology.

Appendix S1

Table S1: Full model selection results for *clutch size* of all older female attempts (n = 612). The best-supported model is shaded in grey. A detailed summary of the best-supported model is presented below the model selection results.

Model	K	ΔAIC	l_i	w_i
Current Abs	6	0	1.00	0.57
Current Abs + Current Abs^2	7	0.8	0.67	0.38
Current Rel	6	6.2	0.05	0.03
Current Rel + Current Rel^2	7	6.6	0.04	0.02
Previous Rel + Previous Rel^2	7	35.8	0.00	0.00
Intercept Only (Null)	5	36.0	0.00	0.00
Yearling Rel + Yearling Rel^2	7	37.3	0.00	0.00
Yearling Abs	6	37.4	0.00	0.00
Previous Abs	6	37.6	0.00	0.00
Yearling Rel	6	37.7	0.00	0.00
Previous Rel	6	37.9	0.00	0.00
Previous Abs + Previous Abs^2	7	38.3	0.00	0.00
Yearling Abs + Yearling Abs^2	7	39.2	0.00	0.00

	ß ± SE	t-value	*P*
Intercept	6.18 ± 0.12	64.05	<0.0001
Current Abs	-0.035 ± 0.006	-6.28	<0.0001
Random Effects		Var (SD)	
Band	Intercept	0.27 (0.52)	
Birth year	Intercept	0.01 (0.09)	R^2 (marginal) = 0.06
Current year	Intercept	0.01 (0.10)	R^2 (conditional) = 0.48
Current site	Intercept	0.02 (0.13)	
Residual		0.38 (0.62)	

Table S2: Full model selection results for *fledging success* of all older female attempts (n = 493). The best-supported model is shaded in grey. A detailed summary of the best-supported model is presented below the model selection results.

Model	K	ΔAIC	l_i	w_i
Yearling Abs + *clutch size*	7	0	1.00	0.20
Yearling Abs + Yearling Abs^2 + *clutch size*	8	0.3	0.86	0.17
clutch size (Null)	6	0.4	0.82	0.16
Current Rel + *clutch size*	7	2.0	0.37	0.07
Current Abs + *clutch size*	7	2.1	0.35	0.07
Previous Abs + *clutch size*	7	2.1	0.35	0.07
Previous Rel + *clutch size*	7	2.3	0.32	0.06
Yearling Rel + *clutch size*	7	2.3	0.32	0.06
Previous Abs + Previous Abs^2 + *clutch size*	8	3.8	0.15	0.03
Current Rel + Current Rel^2 + *clutch size*	8	4.0	0.14	003
Current Abs + Current Abs^2 + *clutch size*	8	4.1	0.13	0.03
Yearling Rel + Yearling Rel^2 + *clutch size*	8	4.1	0.13	0.03
Previous Rel + Previous Rel^2 + *clutch size*	8	4.1	0.13	0.03

	ß ± SE	z-value	*P*
Intercept	1.36 ± 0.75	1.83	0.07
clutch size	-0.023 ± 0.126	0.18	0.85
Random Effects		Var (SD)	
Band	Intercept	0.00 (0.00)	
Birth year	Intercept	0.00 (0.01)	R^2 (marginal) = 0.00
Current year	Intercept	0.04 (0.63)	R^2 (conditional) = 0.07
Current site	Intercept	0.00 (0.00)	
Residual		N/A	

Table S3: Full model selection results for seasonal *number fledged* of all successful older female attempts (n = 374). Models receiving the most support are shaded in grey. Detailed summaries of the best-supported models are presented below the model selection results.

Model	K	ΔAIC	l_i	w_i
Current Rel + *clutch size*	7	0	1.00	0.15
Current Abs + *clutch size*	7	0.1	0.95	0.15
Yearling Abs + *clutch size*	7	0.3	0.86	0.13
clutch size (Null)	6	0.8	0.67	0.10
Current Rel + Current Rel^2 + *clutch size*	8	0.9	0.64	0.10
Current Abs + Current Abs^2 + *clutch size*	8	1.4	0.50	0.08
Yearling Rel + *clutch size*	7	1.6	0.45	0.07
Previous Abs + *clutch size*	7	2.2	0.33	0.05
Yearling Abs + Yearling Abs^2 + *clutch size*	8	2.2	0.33	0.05
Previous Rel + *clutch size*	7	2.4	0.30	0.05
Yearling Rel + Yearling Rel^2 + *clutch size*	8	3.1	0.21	0.03
Previous Abs + Previous Abs^2 + *clutch size*	8	4.2	0.12	0.02
Previous Rel + Previous Rel^2 + *clutch size*	8	4.3	0.12	0.02

	ß ± SE	t-value	*P*
Intercept	1.20 ± 0.51	2.36	0.02
clutch size	0.55 ± 0.08	6.52	<0.0001
Random Effects		Var (SD)	
Band	Intercept	0.00 (0.00)	
Birth year	Intercept	0.08 (0.28)	R^2 (marginal) = 0.10
Current year	Intercept	0.07 (0.27)	R^2 (conditional) = 0.20
Current site	Intercept	0.06 (0.25)	
Residual		1.81 (1.34)	

Table S4: Full model selection results for *nestling mass* of fledged offspring for all older female breeding attempts (n = 167). The best-supported model is shaded in grey. A detailed summary of the best-supported model is presented below the model selection results.

Model	K	ΔAIC	l_i	w_i
Current Abs + Age Measured + *number fledged*	8	0	1.00	0.38
Current Rel + Age Measured + *number fledged*	8	1.7	0.43	0.16
Current Abs + Current Abs^2 + Age Measured + *number fledged*	9	1.7	0.43	0.16
Current Rel + Current Rel^2 + Age Measured + *number fledged*	9	2.8	0.25	0.09
Age Measured + *number fledged* (Null)	7	3.5	0.17	0.06
Previous Abs + Age Measured + *number fledged*	8	5.2	0.07	0.03
Previous Rel + Age Measured + *number fledged*	8	5.2	0.07	0.03
Yearling Abs + Age Measured + *number fledged*	8	5.3	0.07	0.03
Yearling Rel + Age Measured + *number fledged*	8	5.5	0.06	0.02
Previous Abs + Previous Abs^2 + Age Measured + *number fledged*	9	6.9	0.03	0.01
Yearling Abs + Yearling Abs^2 + Age Measured + *number fledged*	9	7.1	0.03	0.01
Previous Rel + Previous Rel^2 + Age Measured + *number fledged*	9	7.2	0.03	0.01
Yearling Rel + Yearling Rel^2 + Age Measured + *number fledged*	9	7.4	0.02	0.01

	ß ± SE	t-value	*P*
Intercept	13.71 ± 2.36	5.80	<0.0001
Age Measured	0.68 ± 0.19	3.59	0.0005
number fledged	-0.11 ± 0.15	-0.78	0.43
Current Abs	-0.10 ± 0.04	-2.41	0.02
Random Effects		Var (SD)	
Band	Intercept	0.71 (0.84)	
Birth year	Intercept	0.00 (0.00)	R^2 (marginal) = 0.16
Current year	Intercept	2.70 (1.64)	R^2 (conditional) = 0.46
Current site	Intercept	0.00 (0.00)	
Residual		6.07 (2.46)	

Table S5: Full model selection results for *future return* following all older female breeding attempts (n = 493). Models receiving the most support are shaded in grey. Detailed summaries of the best-supported models are presented below the model selection results.

Model	K	ΔAIC	l_i	w_i
Previous Rel + Previous Rel^2 + *fledging success* + current age	9	0	1.00	0.54
Previous Abs + Previous Abs^2 + *fledging success* + current age	9	0.4	0.82	0.44
Previous Abs + *fledging success* + current age	8	8.7	0.01	0.01
Current Abs + *fledging success* + current age	8	9.9	0.01	0.01
Yearling Abs + *fledging success* + current age	8	10.2	0.01	0.01
Yearling Rel + Yearling Rel^2 + *fledging success* + current age	9	10.5	0.01	0.01
Previous Rel + *fledging success* + current age	8	10.7	0.00	0.00
Current Rel + *fledging success* + current age	8	11.2	0.00	0.00
Yearling Abs + Yearling Abs^2 + *fledging success* + current age	9	11.6	0.00	0.00
Current Abs + Current Abs^2 + *fledging success* + current age	9	11.9	0.00	0.00
fledging success + current age (Null)	7	12.0	0.00	0.00
Yearling Rel + *fledging success* + current age	8	12.0	0.00	0.00
Current Rel + Current Rel^2 + *fledging success* + current age	9	13.1	0.00	0.00

	ß ± SE	z-value	*P*
Intercept	0.20 ± 0.64	0.31	0.76
fledging success	0.93 ± 0.25	3.73	0.0002
Current age	-0.23 ± 0.17	-1.35	0.18
Previous Rel	-0.12 ± 0.05	-2.61	0.009
Previous Rel^2	0.0042 ± 0.0014	3.03	0.002
Random Effects		Var (SD)	
Band	Intercept	0.07 (0.26)	
Birth year	Intercept	0.04 (0.21)	R^2 (marginal) = 0.10
Current year	Intercept	0.03 (0.17)	R^2 (conditional) = 0.16
Current site	Intercept	0.15 (0.38)	
Residual		N/A	

	ß ± SE	z-value	*P*
Intercept	0.63 ± 0.88	0.72	0.47
fledging success	0.90 ± 0.25	3.67	0.0002
Current age	-0.20 ± 0.16	-1.25	0.21
Previous Abs	-0.15 ± 0.06	-2.36	0.02
Previous Abs^2	0.0040 ± 0.0014	2.81	0.005
Random Effects		Var (SD)	
Band	Intercept	0.07 (0.26)	
Birth year	Intercept	0.01 (0.08)	R^2 (marginal) = 0.09
Current year	Intercept	0.06 (0.24)	R^2 (conditional) = 0.15
Current site	Intercept	0.15 (0.39)	
Residual		N/A	

Table S6: Full model selection results for *clutch size* for all yearling breeding attempts (n = 867). The best-supported model is shaded in grey. A detailed summary of the best-supported model is presented below the model selection results.

Model	K	ΔAIC	l_i	w_i
Current Abs + Current Abs^2	5	0	1.00	0.91
Current Abs	4	4.6	0.10	0.09
Current Rel + Current Rel^2	5	11.4	0.00	0.00
Current Rel	4	13.5	0.00	0.00
Intercept Only (Null)	3	91.0	0.00	0.00

		ß ± SE	t-value	*P*
Intercept		5.47 ± 0.19	28.12	<0.0001
Current Abs		0.0035 ± 0.016	0.22	0.83
Current Abs^2		-0.00088 ± 0.00030	-2.61	0.009
Random Effects		Var (SD)		
Current year	Intercept	0.00 (0.07)	R^2 (marginal) = 0.11	
Current site	Intercept	0.01 (0.09)	R^2 (conditional) = 0.12	
Residual		0.74 (0.86)		

Table S7: Full model selection results for *fledging success* for all yearling breeding attempts (n = 867). The best-supported model is shaded in grey. A detailed summary of the best-supported model is presented below the model selection results.

Model	K	ΔAIC	l_i	w_i
clutch size (Null)	4	0	1.00	0.40
Current Abs + *clutch size*	5	1.3	0.52	0.21
Current Rel + *clutch size*	5	1.4	0.50	0.20
Current Abs + Current Abs^2 + *clutch size*	6	2.5	0.29	0.12
Current Rel + Current Rel^2 + *clutch size*	6	3.1	0.21	0.08

		ß ± SE	z-value	*P*
Intercept		-0.19 ± 0.44	-0.43	0.67
clutch size		0.16 ± 0.08	1.99	0.05
Random Effects		Var (SD)		
Current year	Intercept	0.25 (0.50)	R^2 (marginal) = 0.00	
Current site	Intercept	0.00 (0.00)	R^2 (conditional) = 0.06	
Residual		N/A		

Table S8: Full model selection results for seasonal *number fledged* of all successful yearling breeding attempts (n = 567). Models receiving the most support are shaded in grey. A detailed summary of the best-supported model is presented below the model selection results.

Model	K	ΔAIC	l_i	w_i
Clutch Size (Null)	4	0	1.00	0.43
Current Abs + Current Abs^2 + *clutch size*	6	1.6	0.45	0.19
Current Rel + *clutch size*	5	2.0	0.37	0.16
Current Abs + *clutch size*	5	2.0	0.37	0.16
Current Rel + Current Rel^2 + *clutch size*	6	3.7	0.16	0.07

		ß ± SE	t-value	*P*
Intercept		1.65 ± 0.31	5.30	<0.0001
clutch size		0.43 ± 0.06	7.45	<0.0001
Random Effects		Var (SD)		
Current year	Intercept	0.06 (0.25)	R^2 (marginal) = 0.09	
Current site	Intercept	0.00 (0.00)	R^2 (conditional) = 0.12	
Residual		1.45 (1.20)		

Table S9: Full model selection results for *average mass* of fledged offspring for all yearling breeding attempts (n = 256). The best-supported model is shaded in grey. A detailed summary of the best-supported model is presented below the model selection results.

Model	K	ΔAIC	l_i	w_i
Age Measured + *number fledged* (Null)	5	0	1.00	0.34
Current Rel + Current Rel^2 + Age Measured + *number fledged*	7	0.3	0.86	0.29
Current Abs + Age Measured + *number fledged*	6	1.7	0.43	0.14
Current Rel + Age Measured + *number fledged*	6	1.8	0.41	0.14
Current Abs + Current Abs^2 + Age Measured + *number fledged*	7	2.6	0.27	0.09

		ß ± SE	t-value	*P*
Intercept		12.39 ± 1.41	8.78	<0.0001
Age Measured		0.71 ± 0.13	5.69	<0.0001
clutch size		-0.17 ± 0.13	-1.29	0.20
Random Effects		Var (SD)		
Current year	Intercept	1.01 (1.01)	R^2 (marginal) = 0.17	
Current site	Intercept	0.04 (0.20)	R^2 (conditional) = 0.28	
Residual		6.63 (2.57)		

Table S10: Full model selection results for *future return* following all yearling breeding attempts (n = 867). The best-supported model is shaded in grey. A detailed summary of the best-supported model is presented below the model selection results.

Model	K	ΔAIC	l_i	w_i
Current Abs + *fledging success*	5	0	1.00	0.29
fledging success (Null)	4	0.1	0.95	0.28
Current Rel + *fledging success*	5	0.5	0.78	0.23
Current Abs + Current Abs^2 + *fledging success*	6	1.8	0.41	0.12
Current Rel + Current Rel^2 + *fledging success*	6	2.5	0.29	0.08

		ß ± SE	z-value	*P*
Intercept		-1.32 ± 0.16	-8.29	<0.0001
fledging success		1.33 ± 0.17	7.93	<0.0001
Random Effects		Var (SD)		
Current year	Intercept	0.06 (0.25)	R^2 (marginal) = 0.09	
Current site	Intercept	0.00 (0.00)	R^2 (conditional) = 0.10	
Residual		N/A		

Table S11: Full model selection results for *lifetime fledging success* of all females (n = 867). In this analysis, missing reproductive success data were interpolated based on each affected female's mean deviance from the population mean fledgling production across all years that encompassed her lifespan (see text for details). The best-supported models are shaded in grey. A detailed summary of the best-supported models is presented below the model selection results.

Model	K	ΔAIC	l_i	w_i
Yearling Abs + Ave *clutch size*	4	0	1.00	0.40
Yearling Rel + Ave *clutch size*	4	1.1	0.58	0.23
Yearling Abs + Yearling Abs^2 + Ave *clutch size*	5	1.9	0.39	0.16
Yearling Rel + Yearling Rel^2 + Ave *clutch size*	5	3.0	0.22	0.09
Ave *clutch size* (Null)	3	4.5	0.11	0.04
Ave Rel + Ave *clutch size*	4	5.4	0.07	0.03
Ave Abs + Ave *clutch size*	4	5.8	0.06	0.02
Ave Rel + Ave Rel^2 + Ave *clutch size*	5	7.4	0.02	0.01
Ave Abs + Ave Abs^2 + Ave *clutch size*	5	7.6	0.02	0.01

		ß ± SE	z-value	*P*
Intercept		-1.65 ± 0.60	-2.75	0.006
Ave *clutch size*		0.38 ± 0.09	4.07	<0.0001
Yearling Abs		0.027 ± 0.011	2.50	0.01
Random Effects		Var (SD)		
Birth year	Intercept	0.21 (0.45)	R^2 (marginal) = 0.02	
Residual		N/A	R^2 (conditional) = 0.06	

		ß ± SE	z-value	*P*
Intercept		-1.41 ± 0.56	-2.49	0.01
Ave *clutch size*		0.38 ± 0.09	4.01	<0.0001
Yearling Rel		0.024 ± 0.011	2.27	0.02
Random Effects		Var (SD)		
Birth year	Intercept	0.23 (0.48)	R^2 (marginal) = 0.02	
Residual		N/A	R^2 (conditional) = 0.07	

Table S12: Full model selection results for *lifetime fledging success* of all females (n = 770). In this analysis, females missing reproductive success data in at least one year were omitted from the data set prior to analysis (see text for details). The best-supported model is shaded in grey. A detailed summary of the best-supported model is presented below the model selection results.

Model	K	ΔAIC	l_i	w_i
Yearling Abs + Ave *clutch size*	4	0	1.00	0.25
Yearling Rel + Ave *clutch size*	4	0.5	0.78	0.20
Ave *clutch size* (Null)	3	0.9	0.64	0.16
Yearling Abs + Yearling Abs^2 + Ave *clutch size*	5	1.9	0.39	0.10
Ave Rel + Ave *clutch size*	4	2.4	0.30	0.10
Ave Abs + Ave *clutch size*	4	2.4	0.30	0.10
Yearling Rel + Yearling Rel^2 + Ave *clutch size*	5	2.4	0.30	0.10
Ave Rel + Ave Rel^2 + Ave *clutch size*	5	4.3	0.12	0.04
Ave Abs + Ave Abs^2 + Ave *clutch size*	5	4.4	0.11	0.04

		ß ± SE	z-value	*P*
Intercept		-0.98 ± 0.51	-1.91	0.06
Ave *clutch size*		0.33 ± 0.09	3.54	0.0004
Random Effects		Var (SD)		
Birth year	Intercept	0.32 (0.57)	R^2 (marginal) = 0.02	
Residual		N/A	R^2 (conditional) = 0.08	

Table S13: Full model selection results for *lifetime number fledged* by females with at least one successful nest (n = 616). In this analysis, missing reproductive success data were interpolated based on each affected female's mean deviance from the population mean fledgling production across all years that encompassed her lifespan (see text for details). The best-supported model is shaded in grey. A detailed summary of the best-supported model is presented below the model selection results.

Model	K	ΔAIC	l_i	w_i
Ave Abs + Ave *clutch size*	4	0	1.00	0.61
Ave Abs + Ave Abs^2 + Ave *clutch size*	5	0.9	0.64	0.39
Ave Rel + Ave *clutch size*	4	52.4	0.00	0.00
Ave Rel + Ave Rel^2 + Ave *clutch size*	5	51.7	0.00	0.00
Yearling Abs + Ave *clutch size*	4	104.6	0.00	0.00
Yearling Abs + Yearling Abs^2 + Ave *clutch size*	5	103.5	0.00	0.00
Yearling Rel + Ave *clutch size*	4	108.0	0.00	0.00
Ave *clutch size* (Null)	3	115.9	0.00	0.00
Yearling Rel + Yearling Rel^2 + Ave *clutch size*	5	110.0	0.00	0.00

		ß ± SE	z-value	*P*
Intercept		1.73 ± 0.14	12.07	<0.0001
Ave *clutch size*		0.13 ± 0.02	6.52	<0.0001
Ave Abs		-0.030 ± 0.003	-10.49	<0.0001
Random Effects		Var (SD)		
Birth year	Intercept	0.03 (0.18)	R^2 (marginal) = 0.26	
Residual		N/A	R^2 (conditional) = 0.40	

Table S14: Full model selection results for *lifetime number fledged* by females with at least one successful nest (n = 522). In this analysis, females missing reproductive success data in at least one year were omitted from the data set prior to analysis (see text for details). The best-supported model is shaded in grey. A detailed summary of the best-supported model is presented below the model selection results.

Model	K	ΔAIC	l_i	w_i
Ave Abs + Ave *clutch size*	4	0	1.00	0.71
Ave Abs + Ave Abs^2 + Ave *clutch size*	5	1.8	0.41	0.29
Ave Rel + Ave *clutch size*	4	42.9	0.00	0.00
Ave Rel + Ave Rel^2 + Ave *clutch size*	5	43.4	0.00	0.00
Yearling Abs + Ave *clutch size*	4	69.8	0.00	0.00
Yearling Rel + Ave *clutch size*	4	71.2	0.00	0.00
Yearling Abs + Yearling Abs^2 + Ave *clutch size*	5	71.7	0.00	0.00
Yearling Rel + Yearling Rel^2 + Ave *clutch size*	5	72.4	0.00	0.00
Ave *clutch size* (Null)	3	72.6	0.00	0.00

		ß ± SE	z-value	*P*
Intercept		1.41 ± 0.16	8.68	<0.0001
Ave *clutch size*		0.15 ± 0.02	6.73	<0.0001
Ave Abs		-0.027 ± 0.003	-8.38	<0.0001
Random Effects		Var (SD)		
Birth year	Intercept	0.05 (0.23)	R^2 (marginal) = 0.22	
Residual		N/A	R^2 (conditional) = 0.41	

Table S15: Full model selection results for *fledgling recruitment* to study population (n = 3205). Models receiving the most support are shaded in grey. Detailed summaries of the best-supported models are presented below the model selection results.

Model	K	ΔAIC	l_i	w_i
Current Rel + Maternal Age	5	0	1.00	0.40
Current Abs + Maternal Age	5	1.4	0.50	0.20
Current Abs + Current Abs^2 + Maternal Age	6	1.7	0.43	0.17
Current Rel + Current Rel^2 + Maternal Age	6	1.8	0.41	0.17
Maternal Age (Null)	4	4.1	0.13	0.05

		ß ± SE	z-value	*P*
Intercept		-2.46 ± 0.25	-9.91	<0.0001
Maternal Age (yearling)		-0.07 ± 0.17	-0.41	0.68
Current Rel		-0.030 ± 0.013	-2.37	0.02
Random Effects		Var (SD)		
Nest	Intercept	0.65 (0.81)		
Birth Year	Intercept	0.04 (0.21)		R^2 (marginal) = 0.00
Birth Site	Intercept	0.10 (0.32)		R^2 (conditional) = 0.05
Residual		N/A		

		ß ± SE	z-value	*P*
Intercept		-2.35 ± 0.29	-8.13	<0.0001
Maternal Age (yearling)		-0.05 ± 0.17	-0.29	0.77
Current Abs		-0.028 ± 0.013	-2.09	0.04
Random Effects		Var (SD)		
Nest	Intercept	0.65 (0.81)		
Birth Year	Intercept	0.05 (0.22)		R^2 (marginal) = 0.00
Birth Site	Intercept	0.10 (0.32)		R^2 (conditional) = 0.05
Residual		N/A		

Analyses of apparent survival and recapture probabilities using Program MARK

MARK METHODS

We used Cormack-Jolly-Seber (CJS) models in Program MARK (White and Burnham 1999) to evaluate the relative support for each of 14 models representing different hypotheses concerning the relationship between timing of breeding and survival in adult female tree swallows (Table S16). Each model involved the estimation of two types of parameters: annual apparent survival (ϕ) – the probability that an individual alive and captured in the study area at time t survives to time t + 1 – and recapture rate (p) – the probability that an individual alive and present in the study area at time t is actually detected. The utility of CJS models lies in their ability to distill variation in return rate down to its principal causes – individuals that are uncaptured in a given sampling period may have died (or permanently left the study area) since the previous sampling period or they may have survived the sampling interval and been present in the study area, but simply failed to be detected.

By employing CJS models in the analysis of our timing of breeding data, we provide here an additional check on our annual survival analysis (based on corrected return rates) to ensure that it was not subject to severe bias resulting from low recapture probabilities. Such an approach has the benefit of adding additional statistical robustness to interpretation of our return rate data, but suffers from the loss of some detail incorporated into our return rate analysis (e.g. information on the success/failure of individual nesting attempts, random variation in survival that is attributable to variation in birth year or site). While it is tempting to include such detail here, doing so in Program MARK would require immense statistical power and a much larger data set than we have. Therefore, we have chosen to focus on variation in apparent survival as it relates to the different lay date variants outlined in our paper, while also allowing for annual variation in apparent survival in the majority of our candidate models. Absolute and relative Yearling, current, and previous lay dates in each year were coded as individual covariates in our candidate model set. Wherever we lacked information on timing of breeding (either because an individual was not captured or did not breed in a particular year), we assigned to that individual the average lay date for all other swallows who bred in that year. We held recapture probability constant in all candidate models, as sampling effort was broadly consistent between 2002 and 2016. As is customary, our "null" candidate model ($\phi_{.}\, p_{.}$) held both apparent survival and recapture rate constant across all years of study.

We used numerical likelihood to estimate ϕ and p and information theory to evaluate the relative support for each candidate model (Burnham and Anderson 2004). We assessed goodness-of-fit for the most parameterized model that did not include individual covariates ($\phi_{year}\, p_{.}$) using the median c-hat procedure in Program MARK. We then ranked models by quasi Akaike's information criterion corrected for small sample size and overdispersion ($QAIC_c$), with lower-scoring models receiving relatively more support. Models with a $QAIC_c$ within 2 of the lowest-scoring model ($\Delta QAIC_c \leq 2$) were considered to be well-supported, while models with $\Delta QAIC_c > 2$ received less support.

MARK RESULTS

We recorded 1490 capture events of 867 marked individuals between 2002 and 2016. Goodness-of-fit testing revealed that our most parameterized model fit our data well and only required an adjustment of c-hat from 1.00 to 1.05 for each of our candidate models. Comparison of $QAIC_c$ scores revealed three models that were well-supported (i.e. that received $\Delta QAIC_c \leq 2$)

and that collectively amassed a model weight of 0.51 (Table S16). Across these three models, estimates of annual apparent survival varied between 0.21 and 0.58 in different study years. Importantly, recapture probability was consistently high (Models 1-3: $p = 0.92 \pm 0.02$). In addition to reflecting annual variation in apparent survival, each of these models indicated an important effect of timing of breeding on the likelihood that an individual would survive to the following year. As in the analysis of older females presented in the main text, two of these models indicated that a female's lay date in year *x* was an important predictor of whether she would survive to year *x + 2*, while the third indicated that a female's Yearling lay date influenced her subsequent survival. We suspect that the message from this third model is really very similar to that from the other two: given that most females do not live past their second year as a breeder, previous year lay dates and Yearling lay dates are one and the same for a majority of the birds in the dataset. In both models in which previous lay date was implicated, beta estimates indicated a positive quadratic effect of a female's previous lay date on future survival (Model 1: $\beta \pm SE = 0.002 \pm 0.001$, Model 3: $\beta \pm SE = 0.002 \pm 0.001$), while the third well-supported model indicated a positive linear effect of a female's Yearling lay date on future survival (Model 2: $\beta \pm SE = 0.014 \pm 0.007$).

Collectively, these results are in excellent agreement with those return rates reported in the main text. A female's timing of breeding prior to the current year has the greatest impact on her future likelihood of survival, with later past lay dates corresponding to enhanced future return.

Table S16: Full model selection results for the effect of lay date on annual apparent survival (ϕ) and recapture probability (p) in adult female tree swallows (n = 867).

Model	K	$\Delta QAIC_c$	l_i	w_i
ϕ year + previous relative lay date + previous relative lay date^2 p.	17	0.00	1.00	0.25
ϕ year + yearling absolute lay date p.	16	1.23	0.54	0.13
ϕ year + previous absolute lay date + previous absolute lay date^2 p.	17	1.28	0.53	0.13
ϕ year + yearling relative lay date p.	16	2.18	0.34	0.08
ϕ year + previous absolute lay date p.	16	2.31	0.31	0.08
ϕ year + previous relative lay date p.	16	2.32	0.31	0.08
ϕ year p.	15	3.13	0.21	0.05
ϕ year + yearling absolute lay date + yearling absolute lay date^2 p.	17	3.22	0.20	0.05
ϕ year + yearling relative lay date + yearling relative lay date^2 p.	17	3.91	0.14	0.04
ϕ year + current absolute lay date p.	16	4.13	0.13	0.03
ϕ year + current relative lay date p.	16	4.13	0.13	0.03
ϕ year + current relative lay date + current relative lay date^2 p.	17	4.41	0.11	0.03
ϕ year + current absolute lay date + current absolute lay date^2 p.	17	5.05	0.08	0.02
ϕ. p.	2	35.13	0.00	0.00

Analyses of repeatability of, and parent-offspring influences on, relative lay date

Repeatability of relative lay date for all attempts was 0.14 ± 0.04 (95% CI: 0.07-0.21, LRT: P < 0.0001). Repeatability of relative lay date for all older female attempts was 0.26 ± 0.06 (95% CI: 0.14-0.37, LRT: P < 0.0001).

Table S17: Determinants of yearling relative lay date (n = 113 mother-daughter pairs):

		ß ± SE	t-value	*P*
Intercept		-5.16 ± 39.70	-0.13	0.90
Maternal yearling rel		0.20 ± 0.10	1.90	0.07
Natal temperature		0.0054 ± 0.4153	0.01	0.99
Breeding temperature		0.26 ± 0.31	0.85	0.42
Random Effects		Var (SD)		
Mother	Intercept	10.95 (3.31)		
Current Year	Intercept	15.53 (3.94)		R^2 (marginal) = 0.06
Current Site	Intercept	0.33 (0.57)		R^2 (conditional) = 0.46
Residual		36.62 (6.05)		

Table S18: Determinants of older female (2 years old) relative lay date (n = 32 mother-daughter pairs):

		ß ± SE	t-value	*P*
Intercept		1.28 ± 50.69	0.03	0.98
Maternal second rel		0.21 ± 0.34	0.63	0.54
Natal temperature		0.015 ± 0.625	0.02	0.98
Breeding temperature		0.13 ± 0.54	0.24	0.81
Random Effects		Var (SD)		
Mother	Intercept	1.32 (1.15)		
Current Year	Intercept	8.42 (2.90)		R^2 (marginal) = 0.02
Current Site	Intercept	29.06 (5.39)		R^2 (conditional) = 0.45
Residual		50.05 (7.08)		

LITERATURE CITED

Burnham, K. P. and D. R. Anderson. 2004. Multimodal inference: understanding AIC and BIC in model selection. Sociological Methods and Research 33:261-305.

White, G. C. and K. P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study 46 Supplement:120-138.