

APPENDIX 1

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Supplementary Tables

Table A1.1. Sample size and life history characteristics for species included in the mixed model analysis looking for evidence of change in fall migratory timing though our study location within and adjacent to Lackawanna State Park, Lackawanna County, Benton Township, northeastern Pennsylvania, USA (2006 – 2008, 2012, 2014 – 2018, 2021 - 2024). Life history information from Billerman et al. (2022).

Species	Scientific Name	n	Winter Location	Migration Distance	Diet	Number of Broods
Red-eyed Vireo	<i>Vireo olivaceus</i>	251	South America	Long	arthropod, fruit	1
Ruby-crowned Kinglet	<i>Corthylio calendula</i>	45	North America	Short	arthropod	1
Gray Catbird	<i>Dumetella carolinensis</i>	626	Central America	Long	arthropod, fruit	2
Veery	<i>Catharus fuscescens</i>	54	South America	Long	arthropod, fruit	1
Swainson's Thrush	<i>Catharus ustulatus</i>	31	South America	Long	arthropod, fruit	1
American Robin	<i>Turdus migratorius</i>	62	North America	Short	arthropod, fruit	2
White-throated Sparrow	<i>Zonotrichia albicollis</i>	282	North America	Short	arthropod, seed, fruit	1
Song Sparrow	<i>Melospiza melodia</i>	67	North America	Short	arthropod, seed, fruit	3
Ovenbird	<i>Seiurus aurocapilla</i>	194	Central America	Long	arthropod	1
Common Yellowthroat	<i>Geothlypis trichas</i>	298	Central America	Long	arthropod	1
American Redstart	<i>Setophaga ruticilla</i>	40	Central America	Long	arthropod	1
Magnolia Warbler	<i>Setophaga magnolia</i>	197	Central America	Long	arthropod	1
Chestnut-sided Warbler	<i>Setophaga pensylvanica</i>	34	Central America	Long	arthropod	1

Table A1.2. Monochromatic species and sample sizes captured within and adjacent to Lackawanna State Park, Lackawanna County, Benton Township, northeastern Pennsylvania, USA, (2006 – 2008, 2012, 2014 – 2018, 2021 - 2024) for which we determined sex using DNA.

Common Name	Scientific Name	<i>n</i>
Red-eyed Vireo	<i>Vireo olivaceus</i>	25
Gray Catbird	<i>Dumetella carolinensis</i>	214
Veery	<i>Catharus fuscescens</i>	17
Wood Thrush	<i>Hylocichla mustelina</i>	7
White-throated Sparrow	<i>Zonotrichia albicollis</i>	44

Table A1.3. Comparison of models using daily weather data from weather stations within 200 km cumulative increments, bounded by 70^0 W and 80^0 W from our study location within and adjacent to Lackawanna State Park, Lackawanna County, Benton Township, northeastern Pennsylvania, USA, (2006 – 2008, 2012, 2014 – 2018, 2021 - 2024). Data used for the distance 0 category come from the Avoca Airport, ~ 25 km south of our study site and are included in each interval estimate. Also included is the null model. AICc = Akaike information criterion.

Distance	K	AICc	Δ AICc
200	18	16,460.8	0.0
0	18	16,478.6	17.8
400	18	16,486.9	26.1
600	18	16,495.3	34.5
800	18	16,497.5	36.7
1000	18	16,498.6	37.8
1200	18	16,498.9	38.1
1400	18	16,499.2	38.3
Null	5	16,578.2	117.4

Table A1.4. Model output from generalized additive models examining multi-year change in temperature, and separately, precipitation during the fall migratory period (2006 – 2008, 2012, 2014 – 2018, 2021 - 2024). Data used in these analyses were downloaded from all weather stations within 200 km north of our study site located within and adjacent to Lackawanna State Park, Lackawanna County, Benton Township, northeastern Pennsylvania, bounded by 70° W and 80° W.

	r^2	Parametric variables	$\beta \pm SE$	t	P
Temperature	0.314	Intercept	15.41 ± 0.123	125.50	< 0.001
Precipitation	0.00	Intercept	0.23 ± 0.02	13.37	< 0.001
		Smooth terms	Effective df	F	P
Temperature		s(Date)	1.01	366.39	< 0.001
		s(Year)	2.85	6.33	< 0.001
Precipitation		s(Date)	1.99	0.99	0.45
		s(Year)	1.60	0.24	0.79

Table A1.5. Results of a linear mixed-effects model evaluating change in arrival day (2006 – 2008, 2012, 2014 – 2018, 2021 – 2024) for birds captured during fall migration at three sites in and around Lackawanna State Park, Lackawanna County, Benton Township, northeastern Pennsylvania, USA.

Predictors	Dependent Variable		
	Estimate	SE	P
Intercept	257.5889	5.1409	<0.001
Year	0.0651	0.1524	0.675
Sex (M)	2.3078	0.8957	0.010
Sex (U)	2.4943	0.9548	0.009
Age (HY)	-0.7403	0.5822	0.204
Number of Broods	-3.0501	4.2175	0.490
Body Molt Score 1	-3.9365	0.5549	<0.001
Winter (North America)	14.2820	6.0325	0.041
Diet (Arthropod and Fruit)	-0.9612	4.7157	0.844
Diet (Arthropod, Seed and Fruit)	3.2749	8.2571	0.701
Fall Migration Temperature	-1.0649	0.2485	<0.001
Fall Migration Precipitation	-1.1552	0.2873	<0.001
Random Effects			
σ^2	110.0410		
τ_{00} species	36.0214		
τ_{00} site	1.6250		
τ_{11} species.year_zero	0.1658		
ρ_{01} species	0.0089		
ICC	0.3942		
N species	13		
N site	3		
Observations	2181		
Marginal R ² / Conditional R ²	0.269 / 0.557		

Table A1.6. Species estimates of multi-year change in timing of fall migration at three sites in and around Lackawanna State Park, Lackawanna County, Benton Township, northeastern Pennsylvania, USA, (2006 – 2008, 2012, 2014 – 2018, 2021 - 2024). Rate of Change = β (slope parameter estimates), SE = standard error, CI = 95% confidence intervals.

Species	Rate of Change	SE	Lower 95% CI	Upper 95% CI	Change (Days per Decade)	CI Contains Zero?
Red-eyed Vireo	-0.4139	0.1073	-0.6242	-0.2037	-4.1394	No
Ruby-crowned Kinglet	0.5346	0.2048	0.1333	0.9359	5.3459	No
Gray Catbird	0.2945	0.0863	0.1254	0.4636	2.9452	No
Veery	0.1572	0.1840	-0.2035	0.5178	1.5716	Yes
Swainson's Thrush	0.2261	0.2108	-0.1871	0.6393	2.2609	Yes
American Robin	0.5064	0.2045	0.1055	0.9073	5.0639	No
White-throated Sparrow	0.2377	0.1283	-0.0137	0.4891	2.3768	Yes
Song Sparrow	0.4763	0.1933	0.0974	0.8552	4.7629	No
Ovenbird	-0.5656	0.1184	-0.7976	-0.3335	-5.6557	No
Common Yellowthroat	-0.1341	0.1130	-0.3556	0.0874	-1.3411	Yes
American Redstart	-0.0889	0.2191	-0.5184	0.3406	-0.8888	Yes
Magnolia Warbler	0.0479	0.1243	-0.1958	0.2915	0.4786	Yes
Chestnut-sided Warbler	-0.4313	0.2209	-0.8643	0.0017	-4.3130	Yes