Supplementary information accompanying “A test of the Acoustic Adaptation Hypothesis in three types of tropical forest: degradation of male and female Rufous-and-white Wren song elements”

Brendan A. Graham, Luis A. Sandoval, Torben Dabelsteen, & Daniel J. Mennill

Supplementary Methods: Filters used in Adobe Audition (Version 3.0) to isolate male and female sounds.

Male sounds: introductory element 1: 0.5-1.0 kHz; introductory element 2: 1.2-2.2 kHz; introductory element 3: 1.2-2.0 kHz; introductory element 4: 1.0-1.5 kHz; introductory element 5: 0.5-1.4 kHz; introductory element 6: 1.5-2.1 kHz; trill element 1: 0.5-1.1 kHz; trill element 2: 0.5-1.2 kHz; trill element 3: 0.9-1.2 kHz; trill element 4: 0.9-1.5 kHz; trill element 5: 0.5-1.2 kHz; trill element 6: 0.5-1.3; terminal element 1: 1.8-2.6 kHz; terminal element 2: 1.0-3.0 kHz; terminal element 3: 2.8-3.2 kHz; terminal element 4: 0.5-1.5 kHz; terminal element 5: 2.1-2.8 kHz; terminal element 6: 1.0-1.8 kHz; Dry Forest song 1: 0.5-2.4 kHz; Dry Forest song 2: 0.5-3.0 kHz; Wet Forest song 1: 0.5-2.6 kHz; Wet Forest song 2: 0.5-2.1 kHz; Montane Forest song 1: 0.5-2.9 kHz; Montane Forest song 2: 0.5-2.8 kHz.

Female sounds: introductory element 7: 1.1-2.1 kHz; introductory element 8: 0.9-1.2 kHz; introductory element 9: 1.0-1.8 kHz; introductory element 10: 2.0-3.0 kHz; introductory element 11: 1.5-2.0 kHz; introductory element 12: 1.8-2.0 kHz; introductory element 13: 3.0-3.8 kHz; trill element 7: 0.9-1.2 kHz; trill element 8: 0.9-1.2 kHz; trill element 9: 1.0-1.5 kHz; trill element 10: 1.0-1.2 kHz; trill element 11: 0.5-1.8 kHz; trill element 12: 0.8-1.3 kHz; terminal element 7: 1.2-3.0 kHz; terminal element 8: 1.2-2.0 kHz; terminal element 9: 1.2-2.0 kHz; terminal element 10: 2.5-3.2 kHz; terminal element 11: 1.0-3.0 kHz; terminal element 12: 1.0-1.8 kHz; terminal element 13: 1.0-1.9 kHz; Dry Forest song 3: 0.9-3.2 kHz; Dry Forest song 4: 0.7-2.2 kHz; Wet Forest song 3: 0.8-3.0 kHz; Wet Forest song 4: 0.9-3.2 kHz; Montane Forest song 3: 0.8-3.8 kHz; Montane Forest song 4: 0.7-2.2 kHz.

Montane Forest	43.03 (b)	0.85	-17.45 (a)	0.53	0.107 (a)	0.009	22.79 (a)	0.85
Wet Forest	46.36 (a)	0.68	-15.47 (a)	0.50	0.104 (a)	0.006	26.51 (a)	0.47
Dry Forest	45.53 (a,b)	0.53	-17.37 (a)	0.49	0.102 (a)	0.005	26.54 (a)	0.37
Source Population x Distance								
5								
Montane Forest	45.07 (a)	0.37	-21.76 (a)	0.79	0.034 (a)	0.002	22.69 (a)	0.40
Wet Forest	44.76 (a)	0.42	-22.17 (a)	0.44	0.056 (a)	0.014	22.52 (a)	0.34
Dry Forest	42.41 (a)	0.55	-20.99 (a)	0.50	0.039 (a)	0.003	22.65 (a)	0.43
10								
Montane Forest	40.09 (a)	0.36	-17.85 (a)	0.40	0.053 (a)	0.004	21.25 (a)	0.45
Wet Forest	40.22 (a)	0.39	-18.01 (a)	0.53	0.054 (a)	0.004	20.25 (a)	0.48
Dry Forest	38.02 (a)	0.53	-16 (a)	0.55	0.05 (a)	0.004	21.27 (a)	0.47
20								
Montane Forest	30.67 (a)	0.54	-13.93 (a)	0.66	0.079 (a)	0.005	32.68 (a)	0.45
Wet Forest	31.34 (a)	0.59	-12.7 (a)	0.47	0.087 (a)	0.008	31.79 (a)	0.46
Dry Forest	29.15 (a)	0.66	-11.91 (a)	0.36	0.085 (a)	0.008	32.71 (a)	0.48
40								
Montane Forest	28.78 (a)	0.33	-12.05 (a)	0.59	0.084 (a)	0.006	31.01 (a)	0.47
Wet Forest	27.07 (a)	0.42	-10.8 (a)	0.50	0.114 (a)	0.025	31.85 (a)	0.55
Dry Forest	25.79 (a)	0.58	-9.24 (a)	0.52	0.098 (a)	0.009	32.47 (a)	0.52
Source Population x Element Type								
<i>Introductory Elements</i>								
Montane Forest	36.38 (a)	0.60	-21.91 (a,b)	0.75	0.022 (a,b)	0.004	24.24 (a)	0.57
Wet Forest	38.08 (a)	0.65	-22.01 (a,b)	0.61	0.041 (a,b)	0.004	24.02 (a,b)	0.54
Dry Forest	33.63 (a)	0.81	-20.24 (a)	0.55	0.043 (a,b)	0.004	22.72 (a,b,c)	0.64
<i>Trill Elements</i>								
Montane Forest	35.17 (a)	0.60	-20.41 (a)	0.57	0.032 (a,b)	0.003	21.43 (c)	0.48
Wet Forest	34.83 (a)	0.64	-20.10 (a)	0.38	0.061 (a)	0.017	21.41 (c)	0.55
Dry Forest	35.28 (a)	0.60	-22.16 (a,b)	0.59	0.001 (b)	0.004	22.13 (a,b,c)	0.52
<i>Terminal Elements</i>								
Montane Forest	38.79 (a)	0.63	-22.89 (a,b)	0.50	0.050 (a,b)	0.004	20.90 (c)	0.55
Wet Forest	36.58 (a)	0.67	-24.22 (b)	0.56	0.067 (a)	0.007	20.78 (c)	0.56
Dry Forest	34.84 (a)	0.69	-20.51 (a)	0.43	0.066 (a)	0.007	21.56 (b,c)	0.55
Element Type x Distance								
<i>Introductory Elements</i>								
5	43.46 (b)	0.59	-21.48 (a)	0.67	0.035 (e,f)	0.003	24.05 (a)	0.47
10	40.13 (c)	0.53	-17.56 (a)	0.58	0.038 (d,e,f)	0.002	21.86 (a)	0.42
20	30.30 (d)	0.66	-12.90 (a)	0.70	0.072 (c,d)	0.005	34.39 (a)	0.48

40	27.79 (e)	0.57	-11.24 (a)	0.60	0.071 (c,d,e)	0.006	32.76 (a)	0.54
<i>Trill Elements</i>								
5	43.54 (b)	0.31	-20.89 (a)	0.60	0.034 (e,f)	0.013	22.24 (a)	0.35
10	38.72 (c)	0.36	-16.69 (a)	0.43	0.027 (f)	0.002	20.63 (a)	0.43
20	30.03 (d)	0.55	-12.52 (a)	0.37	0.048 (d,e,f)	0.005	31.03 (a)	0.41
40	26.40 (e)	0.36	-9.61 (a)	0.58	0.074 (c,d,e)	0.023	31.52 (a)	0.55
<i>Terminal Elements</i>								
5	45.22 (a)	0.44	-22.53 (a)	0.49	0.061 (c,d,e,f)	0.004	21.54 (a)	0.30
10	39.45 (c)	0.41	-17.59 (a)	0.49	0.093 (b,c)	0.005	20.27 (a)	0.53
20	30.92 (d)	0.58	-13.18 (a)	0.37	0.141 (a)	0.010	31.66 (a)	0.44
40	27.58 (e)	0.48	-11.44 (a)	0.41	0.133 (a,b)	0.008	31.02 (a)	0.41

Table S2: Results for the four measurements of degradation of female song elements for remaining main effects and two-way interactions not presented in the main body of the text. Values presented are mean $\pm$ standard error. Results of post-hoc test are presented in brackets; within each separate section of the table, values are significantly different from each other are exhibit a different letter.

Female Elements	Signal-to-Noise Ratio		Tail-to-Signal Ratio		Blur Ratio		Excess Attenuation	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Distance								
5	44.54 (a)	0.25	-19.79 (a)	0.25	0.036 (a)	0.002	22.07 (a)	0.20
10	39.22 (b)	0.30	-16.04 (b)	0.24	0.055 (b)	0.003	20.25 (b)	0.25
20	30.52 (c)	0.35	-10.85 (c)	0.25	0.089 (c)	0.004	31.58 (c)	0.34
40	27.16 (d)	0.28	-10.06 (d)	0.28	0.088 (d)	0.004	31.60 (c)	0.28
Playback Site x Distance								
5								
Montane Forest	40.81 (c)	0.43	-18.63 (e)	0.51	0.039 (d,e)	0.004	18.44 (d)	0.43
Wet Forest	44.69 (b)	0.34	-19.06 (e)	0.38	0.046 (d)	0.004	23.96 (c)	0.29
Dry Forest	48.12 (a)	0.37	-21.67 (f)	0.40	0.023 (e)	0.002	23.82 (c)	0.21
10								
Montane Forest	37.18 (d)	0.50	-16.68 (d)	0.48	0.055 (c,d)	0.004	14.99 (e)	0.64
Wet Forest	37.99 (d)	0.48	-15.23 (d)	0.40	0.053 (c,d)	0.004	23.24 (c)	0.19
Dry Forest	42.49 (c)	0.46	-16.15 (d)	0.38	0.056 (c,d)	0.004	22.53 (c)	0.22
20								
Montane Forest	23.77 (f)	0.44	-10.59 (b,c)	0.46	0.102 (a)	0.007	29.14 (b)	0.61
Wet Forest	30.70 (e)	0.41	-9.98 (c)	0.42	0.088 (a,b)	0.006	35.06 (a)	0.57
Dry Forest	37.10 (d)	0.41	-11.97 (c)	0.40	0.070 (b,c)	0.006	30.58 (a)	0.46
40								
Montane Forest	25.96 (f)	0.46	-11.92 (b,c)	0.61	0.063 (b,c,d)	0.008	28.21 (b)	0.53
Wet Forest	25.39 (f)	0.50	-8.31 (a)	0.48	0.093 (a)	0.007	33.27 (a)	0.47
Dry Forest	30.13	0.34	-9.95 (a,b)	0.38	0.092 (a)	0.006	33.25 (a)	0.39
Playback Site x Element Type								
<i>Introductory Elements</i>								
Montane Forest	42.02 (d)	0.72	-12.66 (a)	0.46	0.078 (a)	0.01	22.73 (a)	0.74
Wet Forest	44.34 (b,c)	0.58	-12.59 (a)	0.41	0.069 (a)	0.00	28.22 (a)	0.52
Dry Forest	48.38 (a)	0.55	-13.45 (a)	0.42	0.067 (a)	0.00	27.25 (a)	0.50
<i>Trill Elements</i>								
Montane Forest	37.08 (e)	0.66	-14.51 (a)	0.46	0.032 (a)	0.00	21.69 (a)	0.71
Wet Forest	44.21 (b,c,d)	0.62	-13.37 (a)	0.42	0.042 (a)	0.00	27.81 (a)	0.54
Dry Forest	45.93 (b,c)	0.49	-14.82 (a)	0.37	0.026 (a)	0.00	27.44 (a)	0.31

Terminal Elements

Montane Forest	44.34 (c,d)	0.71	-16.34 (a)	0.58	0.098 (a)	0.01	22.85 (a)	0.73
Wet Forest	45.52 (b)	0.62	-15.65 (a)	0.50	0.091 (a)	0.01	28.24 (a)	0.45
Dry Forest	50.06 (a)	0.58	-17.22 (a)	0.50	0.089 (a)	0.01	27.10 (a)	0.39

Source Population x Distance

5

Montane Forest	45.09 (a)	0.49	-20.67 (a)	0.60	0.022 (d)	0.003	23.24 (a)	0.37
Wet Forest	45.29 (a)	0.36	-19.79 (a)	0.33	0.038 (c,d)	0.003	21.34 (a)	0.31
Dry Forest	44.91 (a)	0.48	-19.43 (a)	0.37	0.049 (b,c)	0.003	23.11 (a)	0.37

10

Montane Forest	40.07 (a)	0.55	-17.04 (a)	0.49	0.035 (c,d)	0.003	21.23 (a)	0.45
Wet Forest	39.29 (a)	0.46	-15.08 (a)	0.38	0.065 (c,d)	0.004	20.19 (a)	0.41
Dry Forest	39.32 (a)	0.55	-15.86 (a)	0.37	0.064 (c,d)	0.005	21.30 (a)	0.43

20

Montane Forest	31.53 (a)	0.65	-12.23 (a)	0.56	0.067 (b)	0.005	32.05 (a)	0.62
Wet Forest	30.64 (a)	0.52	-10.05 (a)	0.36	0.095 (a,b)	0.006	30.98 (a)	0.48
Dry Forest	30.45 (a)	0.64	-11.08 (a)	0.38	0.098 (a)	0.007	31.75 (a)	0.66

40

Montane Forest	28.5 (a)	0.53	-11.08 (a)	0.64	0.039 (c,d)	0.004	32.01 (a)	0.51
Wet Forest	27.73 (a)	0.42	-9.06 (a)	0.33	0.097 (a)	0.007	31.48 (a)	0.41
Dry Forest	27.45 (a)	0.50	-10.14 (a)	0.49	0.112 (a)	0.008	33.51 (a)	0.56

Source Population x Element Type*Introductory Elements*

Montane Forest	42.36 (d)	0.71	-14.07 (a)	0.38	0.039 (c)	0.005	26.76 (a)	0.66
Wet Forest	46.17 (a,b)	0.55	-17.51 (a)	0.37	0.034 (c)	0.004	25.6 (a)	0.49
Dry Forest	46.20 (a,b)	0.67	-20.96 (a)	0.41	0.048 (b,c)	0.004	27.29 (a)	0.66

Trill Elements

Montane Forest	43.06 (c,d)	0.62	-18.96 (a)	0.42	0.026 (c,d)	0.003	26.39 (a)	0.52
Wet Forest	42.64 (d)	0.64	-19.36 (a)	0.41	0.006 (d,e)	0.003	24.94 (a)	0.53
Dry Forest	41.52 (d)	0.66	-20.26 (a)	0.41	0.005 (a)	0.003	26.93 (a)	0.55

Terminal Elements

Montane Forest	48.34 (a)	0.69	-28.33 (a)	0.43	0.010 (c,d)	0.002	26.78 (a)	0.55
Wet Forest	45.33 (b,c)	0.58	-21.895 (a)	0.43	0.090 (a,b)	0.005	25.88 (a)	0.46
Dry Forest	45.25 (b,c)	0.74	-16.778 (a)	0.41	0.070 (a)	0.006	26.87 (a)	0.59

Distance x Element Type

5

Introductory Elements	45.47 (a)	0.40	-17.72 (a)	0.38	0.040 (f,g)	0.003	22.7 (a)	0.40
Trill Elements	43.07 (a)	0.39	-19.64 (a)	0.31	0.013 (h)	0.001	22.13 (a)	0.34

Terminal Elements 10	46.52 (a)	0.45	-22.42 (a)	0.48	0.055 (e,f)	0.004	22.43 (a)	0.31
Introductory Elements	40.27 (a)	0.47	-14.41 (a)	0.38	0.060 (d,e)	0.004	20.54 (a)	0.42
Trill Elements	37.03 (a)	0.36	-15.76 (a)	0.30	0.028 (g,h)	0.002	21.03 (a)	0.45
Terminal Elements 20	40.95 (a)	0.60	-17.49 (a)	0.49	0.076 (c,d)	0.005	20.96 (a)	0.43
Introductory	30.81 (a)	0.55	-9.21 (a)	0.39	0.097 (b)	0.006	31.96 (a)	0.68
Trill Elements	28.89 (a)	0.60	-11.06 (a)	0.35	0.046 (e,f,g)	0.004	30.58 (a)	0.55
Terminal Elements 40	32.59 (a)	0.60	-12.58 (a)	0.48	0.117 (a)	0.007	31.99 (a)	0.50
Introductory Elements	28.18 (a)	0.41	-8.98 (a)	0.43	0.088 (b,c)	0.006	32.73 (a)	0.56
Trill Elements	25.46 (a)	0.38	-9.49 (a)	0.44	0.041 (e,f,g)	0.004	31.68 (a)	0.49
Terminal Elements	29.96 (a)	0.54	-11.55 (a)	0.54	0.120 (a)	0.009	32.34 (a)	0.41

Table S3: Main effects and two-factor interactions for the linear mixed models analyzing the full songs of males (top) and females (bottom) for each measurement of degradation.

Male Full Songs	Signal-to-Noise Ratio			Tail-Signal Ratio			Blur Ratio			Excess Attenuation		
	df	F	p	df	F	p	df	F	p	df	F	p
Model	23	43.15	<0.001	23	14.63	<0.001	23	24.07	<0.001	23	43.29	<0.001
Playback Site	2	15.42	<0.001	2	0.25	0.782	2	3.87	0.021	2	37.6	<0.001
Source Population	2	0.49	0.614	2	2.78	0.063	2	0.71	0.492	2	0.95	0.386
Distance	3	245.7	<0.001	3	88.59	<0.001	3	103.76	<0.001	3	252.25	<0.001
Playback site*Source Population	4	0.77	0.545	4	2.05	0.086	4	5.22	<0.001	4	0.95	0.433
Playback site*Distance	6	6.97	<0.001	6	1.34	0.237	6	15.06	<0.001	6	6.87	<0.001
Source Population*Distance	6	0.56	0.764	6	0.55	0.77	6	4.31	<0.001	6	0.5	0.811
Female Full Songs												
	df	F	p	df	F	p	df	F	p	df	F	p
Model	23	40.54	<0.001	23	24.72	<0.001	23	17.43	<0.001	23	28.93	<0.001
Playback Site	2	19.81	<0.001	2	9.21	<0.001	2	4.17	0.016	2	18.81	<0.001
Source Population	2	2.69	0.069	2	0.84	0.433	2	3.05	0.048	2	3.51	0.031
Distance	3	192.15	<0.001	3	159.71	<0.001	3	70.25	<0.001	3	174.56	<0.001
Playback Site*Source Population	4	1.82	0.124	4	1.4	0.232	4	1.18	0.317	4	0.13	0.971
Playback Site*Distance	6	8.62	<0.001	6	2.52	0.021	6	3.33	0.003	6	2.67	0.015
Source Population*Distance	6	0.94	0.467	6	0.23	0.968	6	4.76	<0.001	6	0.16	0.987

Table S4: Results for the four measurements of degradation of male full songs for all main effects and two-way interactions. Values presented are mean $\pm$ standard error. Results of post-hoc test are presented in brackets; within each separate section of the table, values are significantly different from each other are exhibit a different letter. Whereas the main text focuses on analyses of playback of isolated elements of wren songs, this analysis focuses on playback of entire songs.

Male Full Songs	Signal-to-Noise Ratio		Tail-to-Signal Ratio		Blur Ratio		Excess Attenuation	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Playback Site								
Montane Forest	28.76 (b)	0.63	-23.59 (a)	0.74	0.050 (a,b)	0.006	16.97 (a)	0.66
Wet Forest	34.40 (a)	0.62	-22.28 (a)	0.44	0.072 (b)	0.006	23.52 (b)	0.51
Dry Forest	33.24 (a)	0.58	-23.87 (a)	0.48	0.044 (a)	0.006	23.19 (b)	0.29
Source Population								
Montane Forest	24.95 (a)	0.61	-22.06 (a)	0.40	0.126 (a)	0.006	25.07 (a)	0.49
Wet Forest	25.43 (a)	0.68	-24.80 (a)	0.60	0.088 (a)	0.004	25.24 (a)	0.51
Dry Forest	24.23 (a)	0.64	-22.81 (a)	0.57	0.114 (a)	0.007	25.61 (a)	0.53
Distance								
5	32.13 (a)	0.59	-28.81(a)	0.67	0.056 (a)	0.003	21.23 (a)	0.33
10	26.40 (b)	0.36	-23.85 (b)	0.30	0.093 (b)	0.004	20.19 (a)	0.44
20	19.39 (c)	0.51	-19.67 (c)	0.43	0.145 (c)	0.006	30.70 (b)	0.41
40	15.96 (d)	0.41	-18.37 (c)	0.41	0.174 (d)	0.012	29.58 (b)	0.52
Playback Site x Source Population								
<i>Montane Forest</i>								
Montane Forest	20.17 (a)	1.25	-23.18 (a)	0.80	0.071 (a,b,c)	0.013	21.83 (a)	1.21
Wet Forest	21.17 (a)	1.01	-23.73 (a)	1.94	0.044 (a,b,c)	0.005	21.05 (a)	1.13
Dry Forest	20.57 (a)	1.05	-23.88 (a)	0.69	0.035 (b,c)	0.009	21.14 (a)	1.12
<i>Wet Forest</i>								
Montane Forest	25.46 (a)	1.02	-20.43 (a)	0.67	0.061 (a,b,c)	0.008	26.93 (a)	0.81
Wet Forest	26.36 (a)	0.98	-24.29 (a)	0.62	0.074 (a,b)	0.009	27.66 (a)	0.89
Dry Forest	24.06 (a)	1.19	-22.12 (a)	0.90	0.082 (a)	0.011	28.2 (a)	0.94
<i>Dry Forest</i>								
Montane Forest	27.69 (a)	0.78	-22.84 (a)	0.57	0.049 (a,b,c)	0.012	25.51 (a)	0.48
Wet Forest	27.45 (a)	1.27	-25.99 (a)	0.59	0.027 (c)	0.006	25.85 (a)	0.53
Dry Forest	26.92 (a)	0.90	-22.72 (a)	1.16	0.058 (a,b,c)	0.013	26.29 (a)	0.52
Source Population x Distance								
<i>5</i>								
Montane Forest	28.78 (b)	0.49	-28.54 (a)	1.84	0.050 (f,g)	0.003	16.97 (f)	0.56

Wet Forest	34.40 (a)	0.43	-28.65 (a)	0.47	0.072 (e,f,g)	0.006	23.52 (e)	0.41
Dry Forest	32.23 (a)	1.41	-29.25 (a)	1.22	0.045 (g)	0.004	23.19 (e)	0.33
10								
Montane Forest	22.36 (c,d)	0.52	-24.75 (a)	0.68	0.119 (c,d)	0.009	15.11 (f)	1.26
Wet Forest	27.72 (b)	0.42	-23.09 (a)	0.47	0.086 (d,e,f)	0.006	22.98 (e)	0.19
Dry Forest	29.12 (b)	0.46	-23.72 (a)	0.44	0.075 (e,f,g)	0.005	22.48 (e)	0.16
20								
Montane Forest	14.25 (f)	0.89	-19.71 (a)	1.18	0.155 (b,c)	0.012	28.63 (c,d)	0.35
Wet Forest	19.53 (d,e)	0.57	-18.4 (a)	0.52	0.166 (b)	0.011	33.96 (a)	1.04
Dry Forest	24.38 (c)	0.56	-21 (a)	0.46	0.114 (d)	0.006	29.52 (b,c,d)	0.22
40								
Montane Forest	15.18 (e,f)	0.59	-20.04 (a)	0.72	0.104 (c,d,e)	0.005	26.05 (d,e)	0.43
Wet Forest	14.08 (f)	0.51	-15.64 (a)	0.38	0.191 (a,b)	0.010	32.21 (a,b)	0.94
Dry Forest	18.61 (d,e)	0.61	-19.48 (a)	0.67	0.223 (a)	0.025	30.47 (b,c)	0.60

Source Population x Distance

5								
Montane Forest	33.14 (a)	0.57	-28.49 (a)	0.30	0.060 (f,g)	0.003	21.3 (a)	0.54
Wet Forest	32.50 (a)	1.55	-30.43 (a)	1.39	0.048 (g)	0.005	21.54 (a)	0.63
Dry Forest	32.03 (a)	0.70	-27.62 (a)	1.40	0.059 (f,g)	0.007	22.44 (a)	0.55
10								
Montane Forest	26.59 (a)	0.56	-22.11 (a)	0.29	0.118 (c,d)	0.006	20.88 (a)	0.77
Wet Forest	27.58 (a)	0.55	-25.53 (a)	0.39	0.076 (e,f,g)	0.005	20.83 (a)	0.77
Dry Forest	26.44 (a)	0.73	-23.69 (a)	0.68	0.086 (d,e,f)	0.008	20.43 (a)	0.79
20								
Montane Forest	19.69 (a)	1.02	-18.29 (a)	0.44	0.165 (a,b)	0.011	30.44 (a)	0.63
Wet Forest	21.05 (a)	0.78	-21.21 (a)	1.02	0.123 (c,d)	0.008	30.43 (a)	0.76
Dry Forest	18.72 (a)	0.85	-19.73 (a)	0.56	0.147 (c,d)	0.010	31.28 (a)	0.74
40								
Montane Forest	16.45 (a)	0.63	-16.9 (a)	0.53	0.198 (a)	0.021	29.73 (a)	0.83
Wet Forest	16.81 (a)	0.58	-19.88 (a)	0.54	0.118 (c,d,e)	0.012	30.1 (a)	0.90
Dry Forest	14.89 (a)	0.90	-17.32 (a)	0.90	0.206 (a)	0.022	30.8 (a)	1.00

Table S5: Results for the four measurements of degradation of female full songs for all main effects and two-way interactions. Values presented are mean $\pm$ standard error. Results of post-hoc test are presented in brackets; within each separate section of the table, values are significantly different from each other are exhibit a different letter. Whereas the main text focuses on analyses of playback of isolated elements of wren songs, this analysis focuses on playback of entire songs.

Female Full Songs	Signal-to-Noise Ratio		Tail-to-Signal Ratio		Blur Ratio		Excess Attenuation	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Playback Site								
Montane Forest	31.43 (a)	0.68	-27.47 (a)	0.48	0.093 (a)	0.006	18.25 (a)	0.72
Wet Forest	34.14 (b)	0.63	-26.55 (a)	0.41	0.082 (a,b)	0.006	23.46 (b)	0.49
Dry Forest	37.98 (c)	0.54	-29.69 (b)	0.43	0.059 (b)	0.006	23.47 (b)	0.35
Source Population								
Montane Forest	29.16 (a)	0.70	-22.15 (a)	0.41	0.061 (a)	0.005	22.61 (a)	0.54
Wet Forest	27.87 (a)	0.60	-22.50 (a)	0.39	0.087 (a)	0.006	20.36 (b)	0.51
Dry Forest	26.44 (a)	0.66	-22.88 (a)	0.52	0.086 (a)	0.006	22.22 (a,b)	0.53
Distance								
5	34.51 (a)	0.45	-27.96 (a)	0.35	0.078 (a)	0.003	21.73 (a)	0.35
10	29.06 (b)	0.56	-22.93 (b)	0.34	0.096 (b)	0.004	19.61 (b)	0.41
20	22.42 (c)	0.65	-18.94 (c)	0.34	0.159 (c)	0.007	29.85 (c)	0.56
40	19.54 (d)	0.54	-17.16 (c)	0.38	0.174 (c)	0.010	30.26 (c)	0.46
Playback Site x Source Population								
<i>Montane Forest</i>								
Montane Forest	23.77 (a)	1.14	-22.09 (a)	0.68	0.094 (a)	0.008	22.57 (a)	1.28
Wet Forest	24.58 (a)	1.16	-22.22 (a)	0.70	0.133 (a)	0.008	20.37 (a)	1.23
Dry Forest	21.19 (a)	1.19	-22.94 (a)	1.10	0.149 (a)	0.011	21.79 (a)	1.27
<i>Wet Forest</i>								
Montane Forest	29.58 (a)	1.17	-22.29 (a)	0.60	0.075 (a)	0.007	26.47 (a)	0.86
Wet Forest	26.57 (a)	0.98	-22.62 (a)	0.69	0.141 (a)	0.011	25.11 (a)	0.85
Dry Forest	26.41 (a)	1.10	-21.86 (a)	0.83	0.134 (a)	0.011	26.64 (a)	0.86
<i>Dry Forest</i>								
Montane Forest	32.62 (a)	1.04	-22.09 (a)	0.77	0.086 (a)	0.010	26.49 (a)	0.66
Wet Forest	31.16 (a)	0.84	-22.61 (a)	0.64	0.139 (a)	0.011	25.04 (a)	0.55
Dry Forest	29.97 (a)	0.90	-23.66 (a)	0.82	0.131 (a)	0.008	26.81 (a)	0.60
Playback Site x Distance								
5								
Montane Forest	31.43 (b)	0.54	-27.47 (d,e)	0.81	0.093 (b,c,d)	0.007	18.25 (e)	0.86
Wet Forest	34.14 (b)	0.69	-26.55 (d)	0.50	0.082 (d)	0.005	23.46 (c,d)	0.45

Dry Forest 10	37.98 (a)	0.71	-29.69 (e)	0.47	0.059 (d)	0.004	23.47 (c,d)	0.32
Montane Forest	27.50 (c,d)	0.51	-23.53 (c)	0.59	0.088 (c)	0.005	14.76 (f)	1.17
Wet Forest	26.21 (c,d)	1.00	-21.93 (b,c)	0.57	0.104 (b,c)	0.008	22.69 (c,d)	0.25
Dry Forest 20	33.48 (b)	0.78	-23.51 (c)	0.57	0.097 (c)	0.007	21.36 (d,e)	0.19
Montane Forest	15.41 (g)	0.68	-18.83 (a)	0.69	0.173 (a)	0.010	27.69 (b)	1.05
Wet Forest	24.02 (d,e)	0.94	-18.85 (a)	0.69	0.149 (a)	0.017	33.01 (a)	1.43
Dry Forest 40	27.83 (c)	0.74	-19.10 (a,b)	0.45	0.154 (a,b)	0.012	30.09 (a,b)	0.44
Montane Forest	17.38 (g)	0.56	-18.89 (a,b)	0.70	0.143 (a,b)	0.014	26.69 (b,c)	0.40
Wet Forest	18.61 (f,g)	1.13	-16.87 (a)	0.69	0.188 (a)	0.021	31.30 (a,b)	1.03
Dry Forest	22.64 (e,f)	0.67	-16.61 (a)	0.56	0.190 (a)	0.015	31.51 (a)	0.51

Source Population x Distance

5								
Montane Forest	35.32 (a)	0.94	-27.37 (a)	0.41	0.060 (a)	0.006	23.00 (a)	0.66
Wet Forest	35.73 (a)	0.56	-28.15 (a)	0.34	0.087 (a)	0.006	20.80 (a)	0.55
Dry Forest 10	33.65 (a)	0.77	-28.35 (a)	0.89	0.086 (a)	0.005	22.68 (a)	0.57
Montane Forest	30.59 (a)	1.19	-22.66 (a)	0.45	0.072 (a)	0.006	20.47 (a)	0.73
Wet Forest	29.09 (a)	0.72	-23.15 (a)	0.33	0.108 (a)	0.008	19.35 (a)	0.73
Dry Forest 20	28.14 (a)	0.94	-22.98 (a)	0.86	0.109 (a)	0.006	20.76 (a)	0.69
Montane Forest	24.01 (a)	1.25	-18.52 (a)	0.52	0.112 (a)	0.011	30.69 (a)	0.96
Wet Forest	22.72 (a)	0.99	-19.03 (a)	0.56	0.174 (a)	0.011	28.57 (a)	0.92
Dry Forest 40	20.71 (a)	1.10	-19.25 (a)	0.69	0.154 (a)	0.012	30.49 (a)	1.01
Montane Forest	22.77 (a)	1.22	-16.80 (a)	0.90	0.143 (a)	0.018	30.68 (a)	0.83
Wet Forest	19.73 (a)	0.58	-16.72 (a)	0.36	0.188 (a)	0.014	29.58 (a)	0.81
Dry Forest	18.65 (a)	0.85	-18.08 (a)	0.72	0.189 (a)	0.012	31.07 (a)	0.69

Table S6: Main effects for the linear mixed models analyzing comparisons of background noise during male (left) and female (right) full songs.

	Male Songs			Female Songs		
	df	F	p	df	F	p
Model	23	29.3	<0.001	12	20.59	<0.001
Playback Site	2	5.32	0.006	2	2.72	0.069
Source Population	2	0.02	0.98	2	0.04	0.965
Distance	3	125.05	<0.001	3	189.64	<0.001

Table S7: Results for background noise (in dB) during transmission of male and female full songs and song elements for all main effects. Values presented are mean $\pm$ standard error. Results of post-hoc test are presented in brackets; within each separate section of the table, values are significantly different from each other are exhibit a different letter.

	Male Song		Female Song		Male Elements		Female Elements	
	Mean (dB)	SE	Mean (dB)	SE	Mean (dB)	SE	Mean (dB)	SE
Playback Site								
Montane Forest	36.71 (a)	9.53	81.47 (a)	8.97	29.54 (a)	6.02	26.70 (a)	5.88
Wet Forest	8.15 (b)	5.60	35.36 (b)	4.57	7.26 (b)	2.61	6.81 (b)	2.13
Dry Forest	7.93 (b)	3.90	26.54 (b)	3.63	6.38 (b)	2.12	4.42 (b)	1.25
Source Population								
Montane Forest	53.40 (a)	7.37	48.41 (a)	6.89	38.77 (a)	3.73	36.92 (a)	3.86
Wet Forest	47.27 (a)	6.69	43.81 (a)	5.77	36.51 (a)	3.36	31.64 (a)	2.73
Dry Forest	52.13 (a)	7.36	39.32 (a)	5.74	44.31 (a)	4.37	43.07 (a)	4.19
Distance								
5	17.60 (c)	2.21	13.51 (a)	1.59	14.39 (c)	1.22	12.65 (a)	0.89
10	28.20 (c)	5.15	19.87 (a)	3.29	21.40 (c)	2.59	18.09 (a)	1.82
20	67.40 (b)	8.12	58.44 (b)	7.45	52.36 (b)	4.79	49.21 (b)	4.51
40	127.45 (a)	8.04	94.36 (c)	7.38	98.26 (a)	5.26	90.43 (c)	5.15
Element Type								
Introductory Elements	NA		NA		38.97 (a)	3.81	31.79 (a)	2.93
Trill Elements	NA		NA		52.18 (a)	4.64	52.13 (a)	5.15
Terminal Elements	NA		NA		28.37 (a)	2.61	28.59 (a)	2.19