

Supplementary material

Appendix 1

Table A1. Description of measured song characteristics included in our analyses.

Acoustic traits	Description/Definition
Note lowest frequency	Lower frequency bound of the note
Note highest frequency	Upper frequency bound of the note
Note bandwidth	Spectral range of the entire note, calculated as Highest Frequency minus Lowest Frequency of note
Note peak frequency	Frequency at which peak energy (maximum power) occurs across the note
Note peak time	Time at which peak energy occurs as a fraction of note duration
Note duration	Interval between onset and offset of a note (calculated for all notes in the song)
Note diversity	Number of distinct note types divided by the total number of notes
Note rate	Number of notes in the entire song divided by the song duration
Longest note	Duration of the longest note in the entire song calculated in seconds
Note number	Total number of notes in a song
Song lowest frequency	Lower frequency bound of the song
Song highest frequency	Upper frequency bound of the song
Song bandwidth	Spectral range of the entire song, calculated as Highest Frequency minus Lowest Frequency of song
Song peak frequency	Frequency at which peak energy (maximum power) occurs across the song
Song peak time	Time at which peak energy occurs as a fraction of song duration
Song duration	Interval between the onset of the first note and the offset of the final note
Frequency slope	Frequency bandwidth divided by song duration

Table A2. Factor loadings from phylogenetically corrected PCA of morphological traits and % of variability explained by the first two PC axes. Loadings larger than 0.5 are highlighted in bold. Phylogenetic signal $\lambda = 0.64$.

	PC1 (75.8 %)	PC2 (8.6 %)
Beak length	-0.92	0.31
Beak width	-0.88	0.07
Beak depth	-0.88	0.03
Wing length	-0.64	0.12
Tail length	-0.88	-0.45

Table A3. Factor loadings from phylogenetically corrected PCA of LM hue and MS hue and % of variability explained by the first two PC axes. Loadings larger than 0.5 are highlighted in bold. Phylogenetic signal $\lambda = 0.62$ in LM hue and $\lambda = 0.27$ in MS hue.

	LM hue		MS hue	
	PC1 (39.9 %)	PC2 (23.9 %)	PC1 (55.9 %)	PC2 (19.2 %)
Belly	-0.72	0.52	-0.84	-0.26
Breast	-0.53	0.40	-0.89	-0.22
Under tail coverts	-0.47	0.65	-0.84	-0.43
Crown	-0.79	-0.54	-0.79	0.57
Forehead	-0.81	-0.47	-0.76	0.60
Cheek	-0.86	-0.45	-0.80	0.55
Mantle	-0.72	0.58	-0.86	-0.24
Nape	-0.51	-0.53	-0.64	0.31
Wing tip (primaries)	-0.30	-0.37	-0.43	-0.44
Tail tip	0.05	0.28	-0.54	-0.41
Rump	-0.60	0.64	-0.80	-0.31
Throat	-0.82	-0.36	-0.81	0.49
Wing coverts	-0.50	0.39	-0.51	-0.59

Table A4. Factor loadings from phylogenetically corrected PCA of song characteristics and % of variability explained by the first three PC axes. Loadings larger than 0.5 are highlighted in bold. Phylogenetic signal $\lambda < 0.01$.

	PC1 (51.1 %)	PC2 (16.9 %)	PC3 (14.4 %)
Frequency slope	-0.59	0.67	0.30
Song bandwidth	-0.51	0.33	-0.12
Song lowest frequency	-0.75	-0.32	0.14
Song highest frequency	-0.74	0.06	0.02
Song peak frequency	-0.65	-0.12	0.10
Note bandwidth	-0.62	-0.02	0.09
Note lowest frequency	-0.72	-0.21	-0.03
Note highest frequency	-0.78	-0.13	0.05
Note peak frequency	-0.78	-0.14	-0.03
Song duration	-0.03	-0.10	-0.97
Note duration	-0.67	-0.66	0.04
Longest note	-0.56	-0.67	-0.18
Song peak time	-0.02	-0.01	-0.95
Note peak time	-0.88	-0.39	0.04
Note rate	0.88	-0.32	0.21
Note diversity	-0.24	-0.24	0.24
Note number	0.60	0.32	-0.64

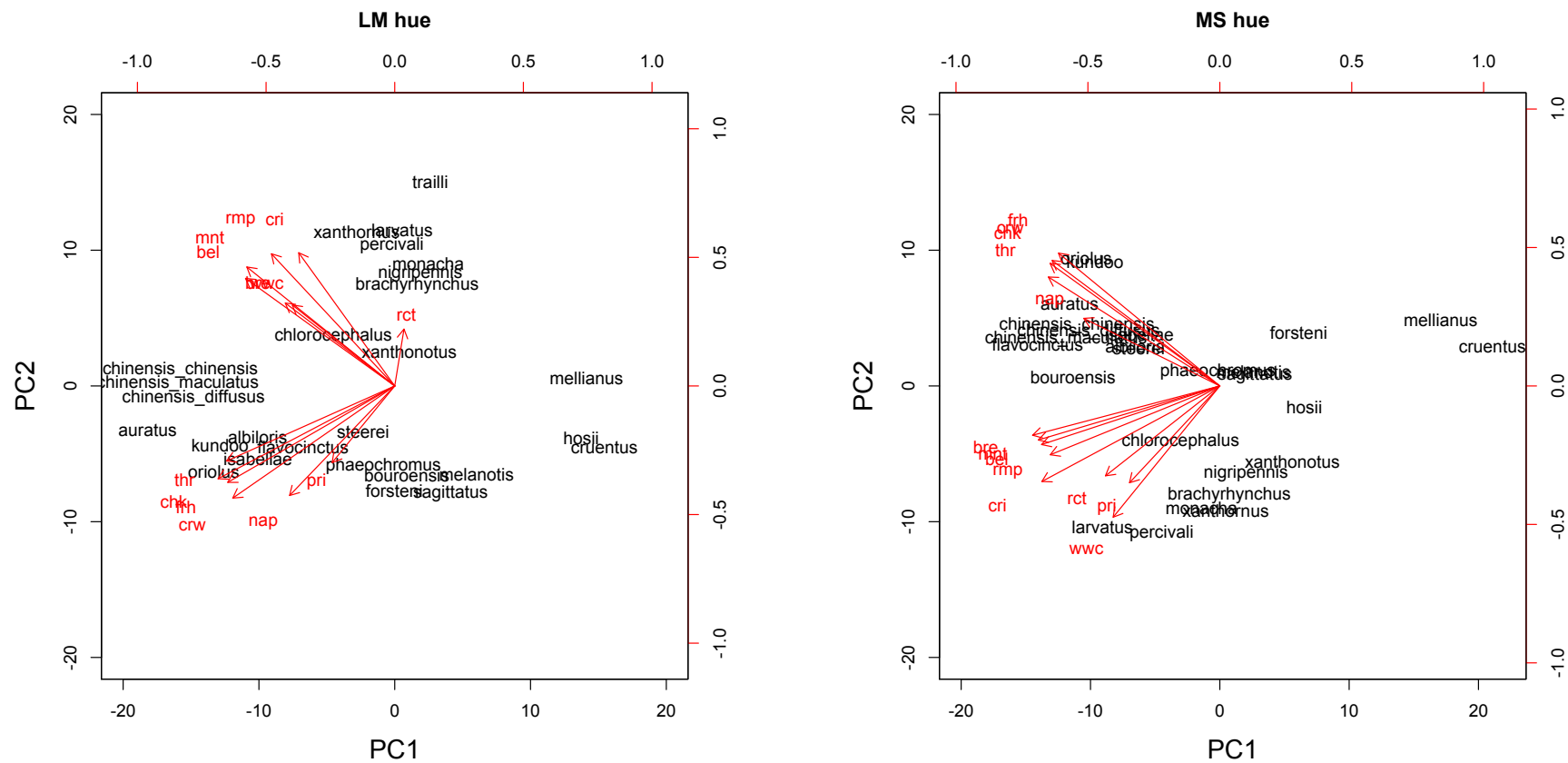


Fig. A1. Biplots of the first two axes from the phylogenetic Principal Components Analyses of LM hue and MS hue. Variability explained by these axes was 39.9 % (PC1) and 23.9 % (PC2) in LM hue and 55.9 % (PC1) and 19.2 % (PC2) in MS hue.

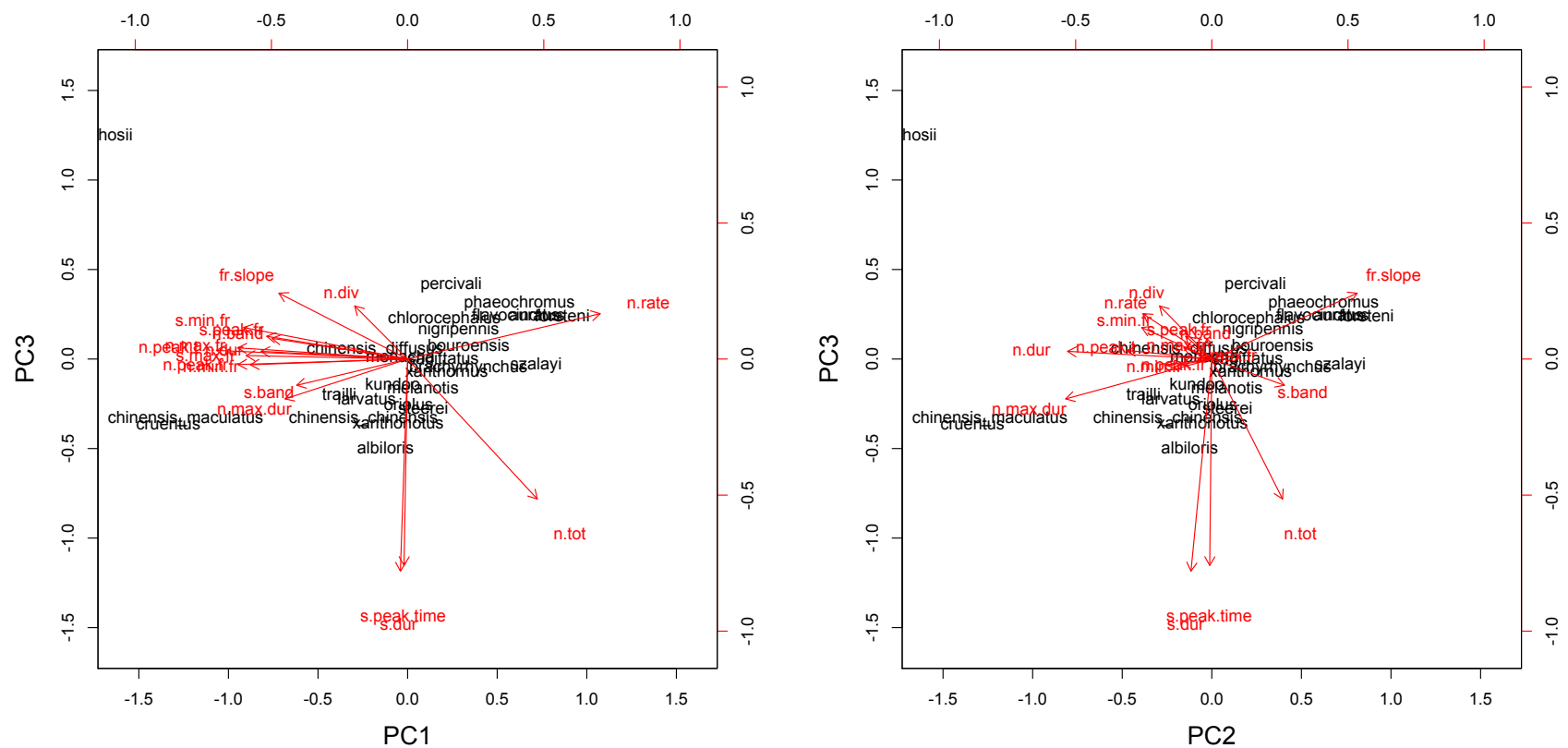


Fig. A2. Biplots of PC1 vs PC3 (left panel) and PC2 vs PC3 (right panel) from the phylogenetic Principal Components Analyses of 17 song characteristics. Variability explained by these axes was 51.1 % (PC1), 16.9 % (PC2), and 14.4 % (PC3). Individual characteristics of song are as in Fig. 2.