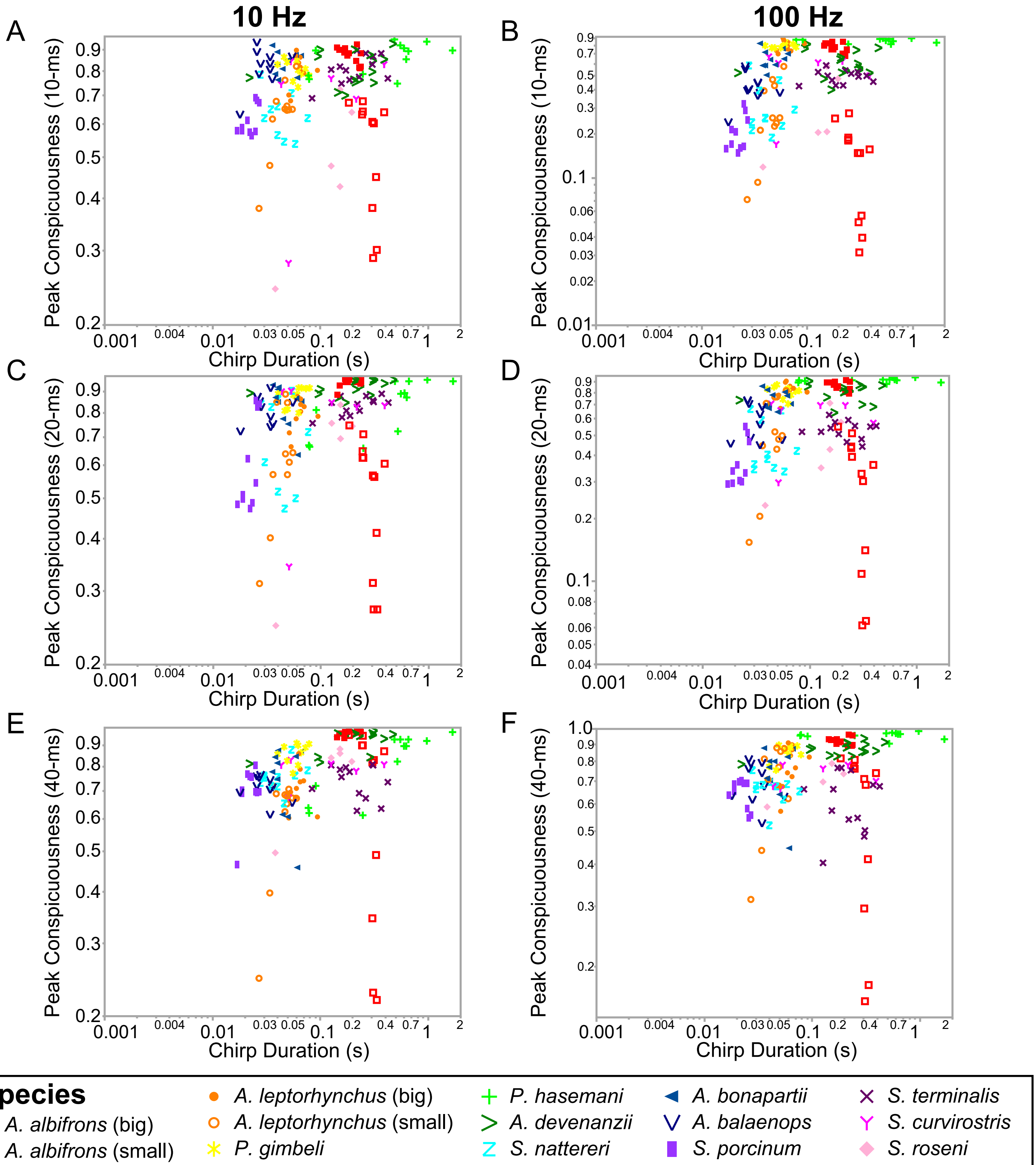
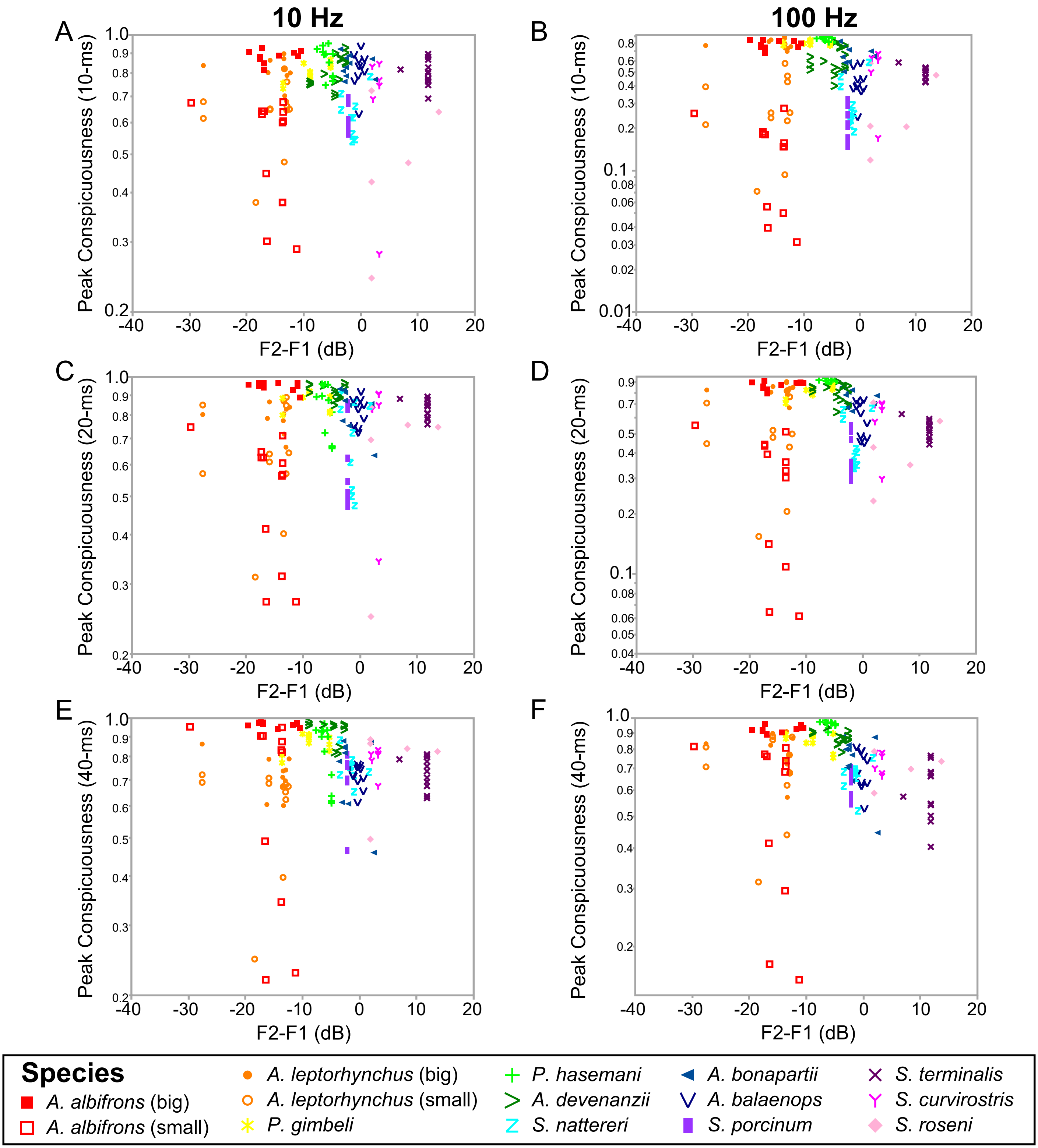
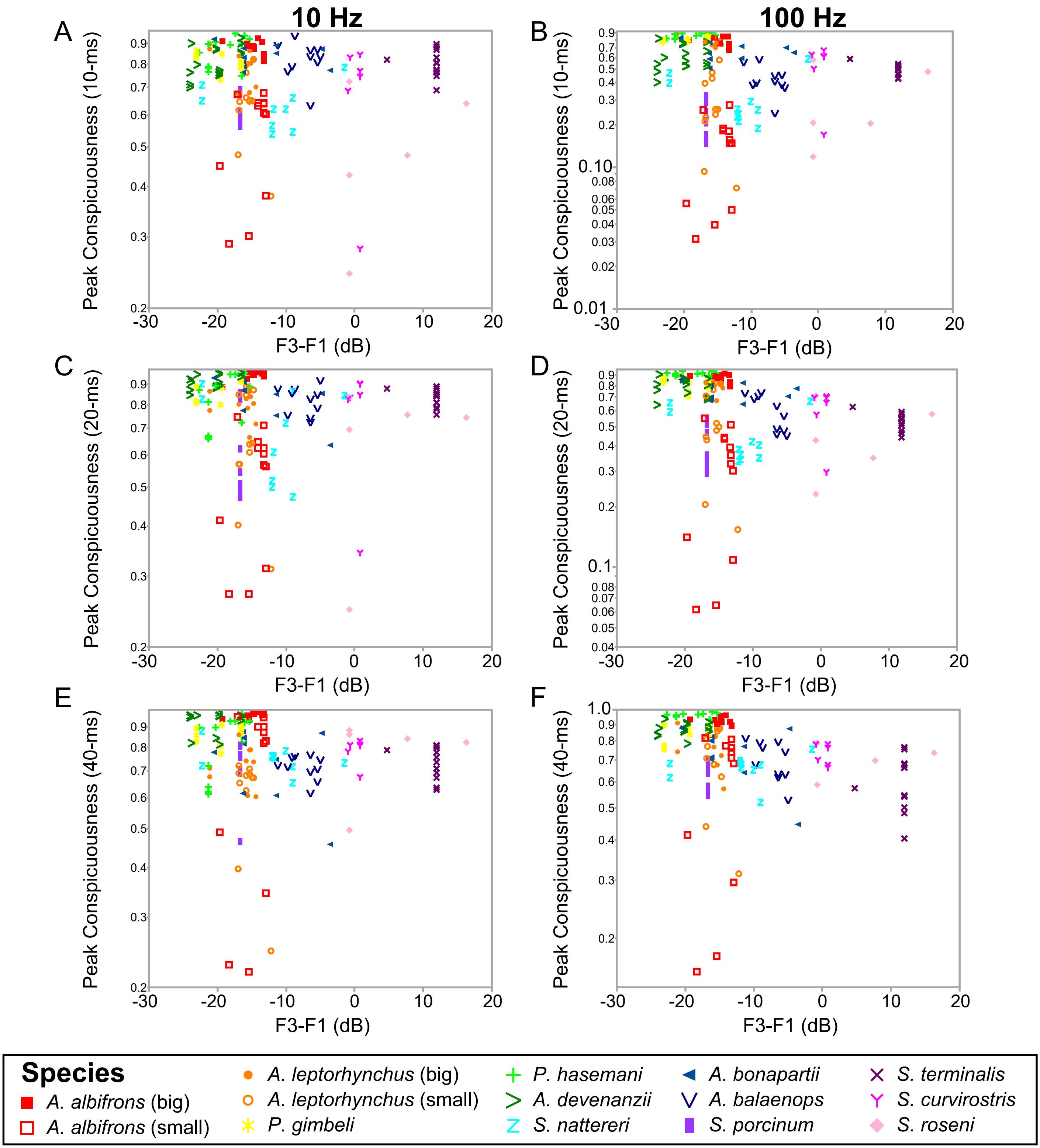


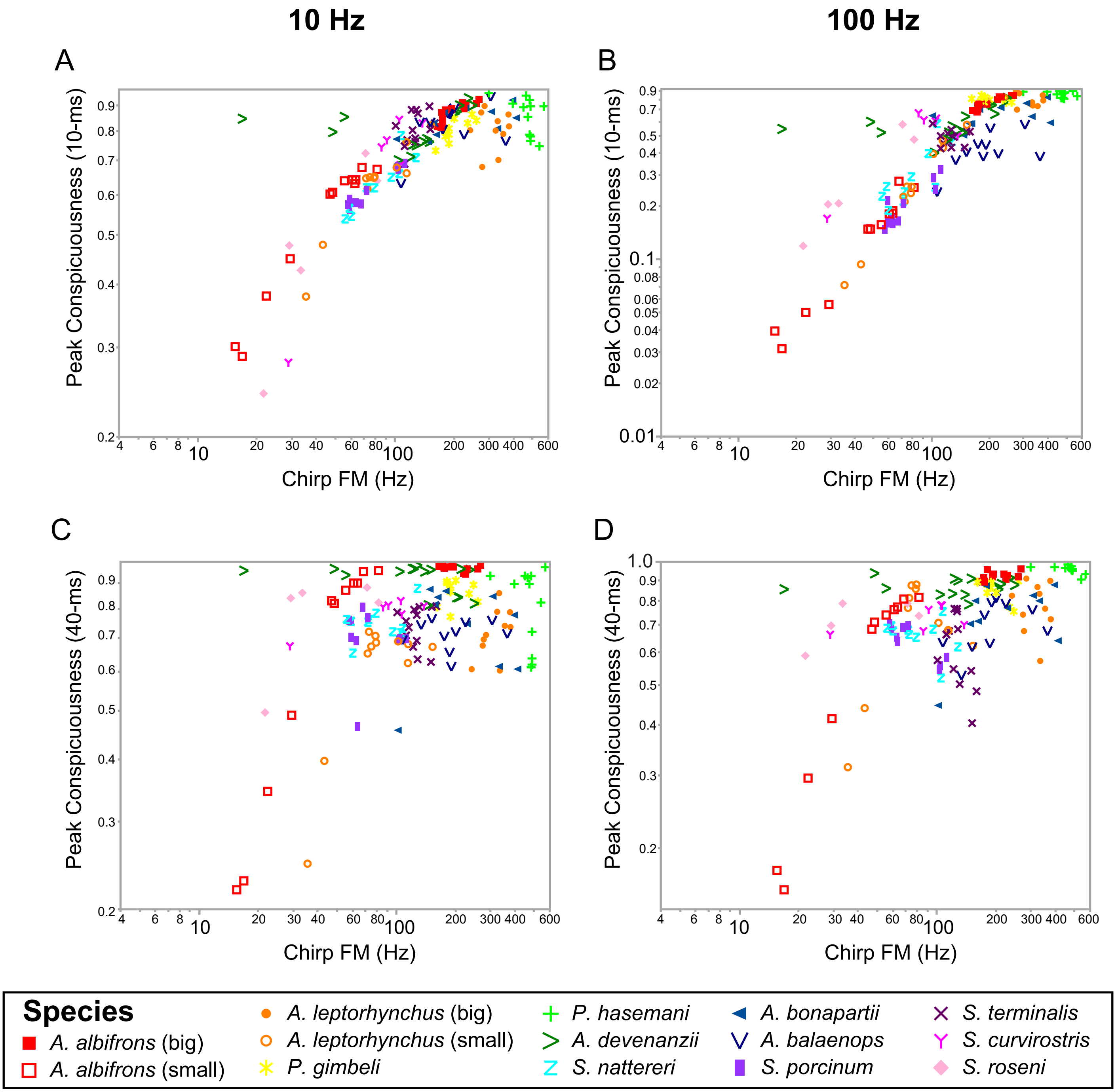
Supplemental Fig 1. Contribution of chirp duration to peak conspicuousness of natural chirps analyzed using a 10-ms window (A,B), a 20-ms window (C,D), and a 40-ms window (E,F) on 10 Hz beats (A,C,E) and 100 Hz beats (B,D,F). Chirp duration (log-transformed) was not strongly associated with peak conspicuousness when analyzed using either a 10-ms or 20-ms windows (partial correlations<0.1, p>0.30). Chirp duration was included in the stepwise regression model of peak conspicuousness using the 40-ms window, but the association was not statistically significant (partial correlation: 0.09, p=0.11). In general, longer duration chirps tended to be more conspicuous with the 40-ms window. The notable exception was the *A. albifrons* small chirps, which have moderately long durations but are relatively inconspicuous, perhaps because they have little FM.



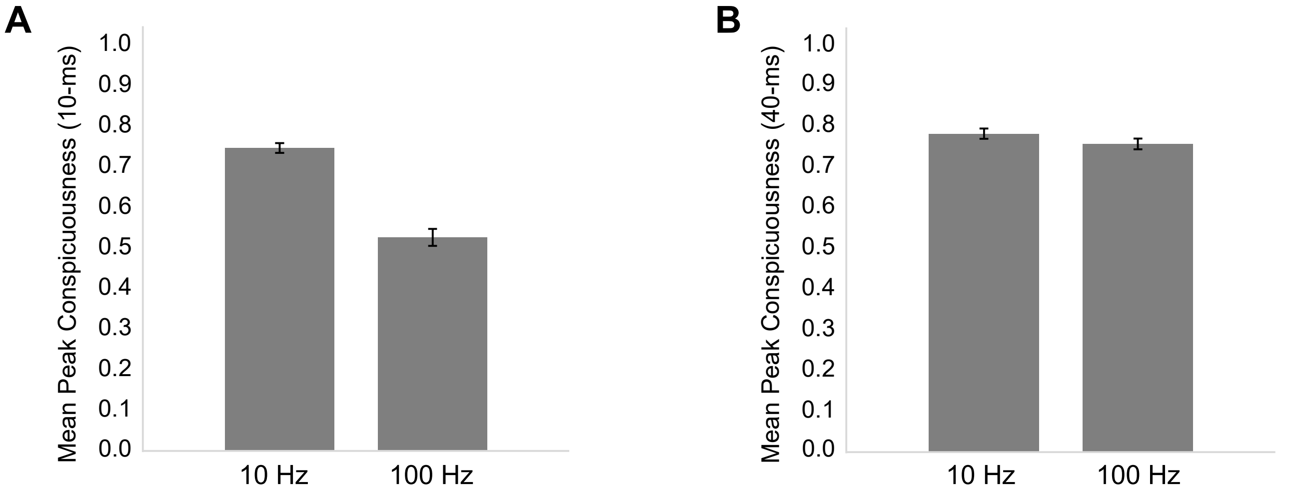
Supplemental Fig 2. Contribution of the waveform complexity variable F2-F1to peak chirp conspicuousness of natural chirps on 10 Hz beats (A,C,E) and 100 Hz beats (B,D,F) analyzed with the 10-ms (A,B), 20-ms (C,D), and 40-ms (E,F) windows. Unlike for sum chirp conspicuousness (Fig. 10), F2-F1 was not correlated with peak conspicuousness at any window size (10-ms partial correlation: 0.006, p=0.92; 20-ms partial correlation: -0.002, p=0.97; 40-ms partial correlation:-0.04, p=0.54).



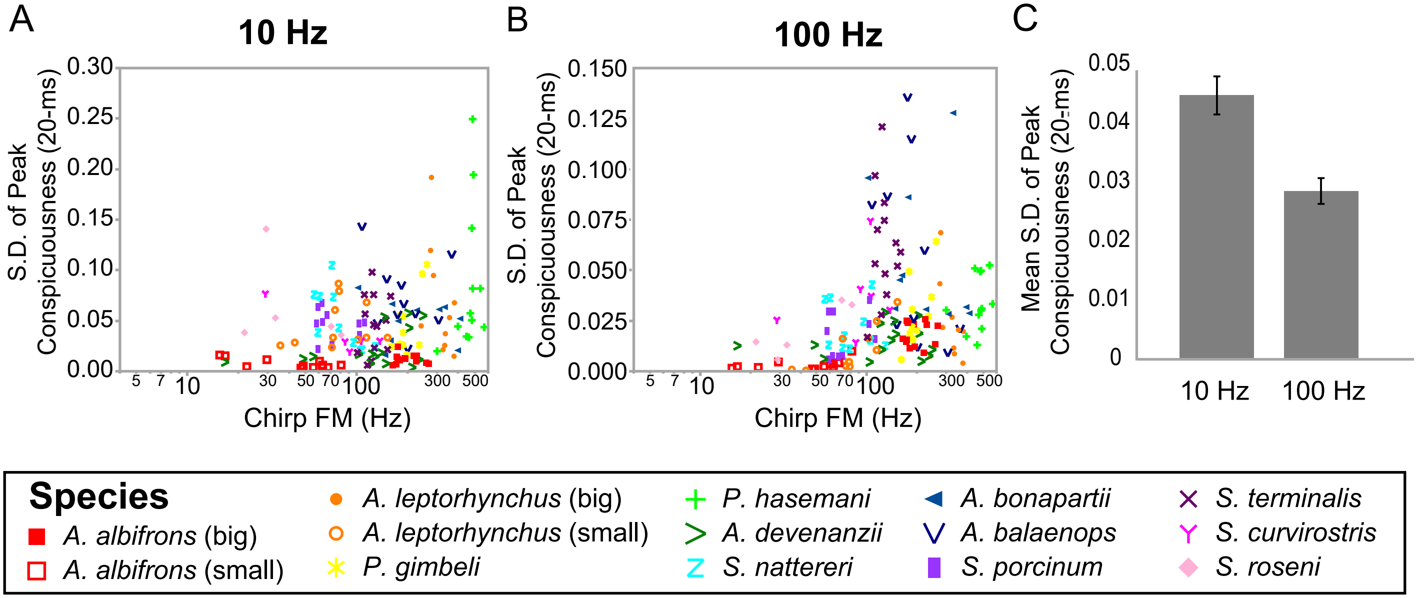
Supplemental Fig 3. Contribution of the waveform complexity variable F3-F1to peak chirp conspicuousness of natural chirps on 10 Hz beats (A,C,E) and 100 Hz beats (B,D,F) analyzed with the 10-ms (A,B), 20-ms (C,D), and 40-ms (E,F) windows. The waveform variable F3-F1 was not correlated with peak conspicuousness for the 10-ms and 20-ms window sizes (10-ms partial correlation: 0.08, p=0.17; 20-ms partial correlation: 0.005, p=0.94). However, F3-F1 was negatively correlated with peak conspicuousness at the largest window size (40-ms partial correlation: -0.16, p=0.006).



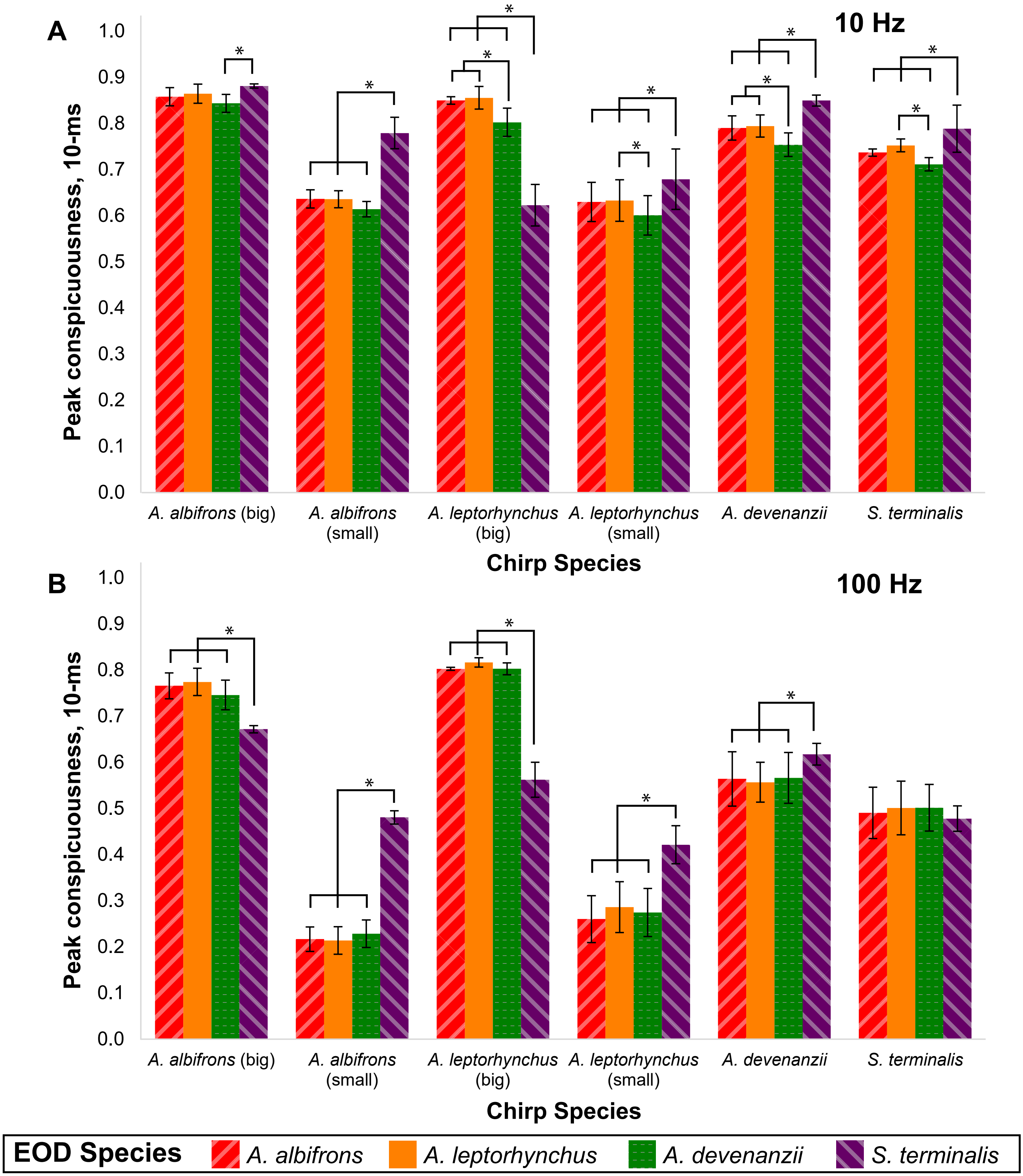
Supplemental Fig 4. Contribution of chirp FM to peak conspicuousness of natural chirps analyzed with a 10-ms window (A,B) and a 40-ms window (C,D) on 10 Hz beats (A,C) and 100 Hz beats (B,D). Chirp FM (log-transformed) was strongly associated with peak conspicuousness when using a 10-ms analysis window. Chirps with large frequency excursions were more conspicuous (partial correlation: 0.74, $p<0.0001$). A similar but somewhat less robust pattern emerges for the relationship between chirp FM and peak conspicuousness when using the 40-ms analysis window (partial correlation: 0.44, p $p<0.0001$).



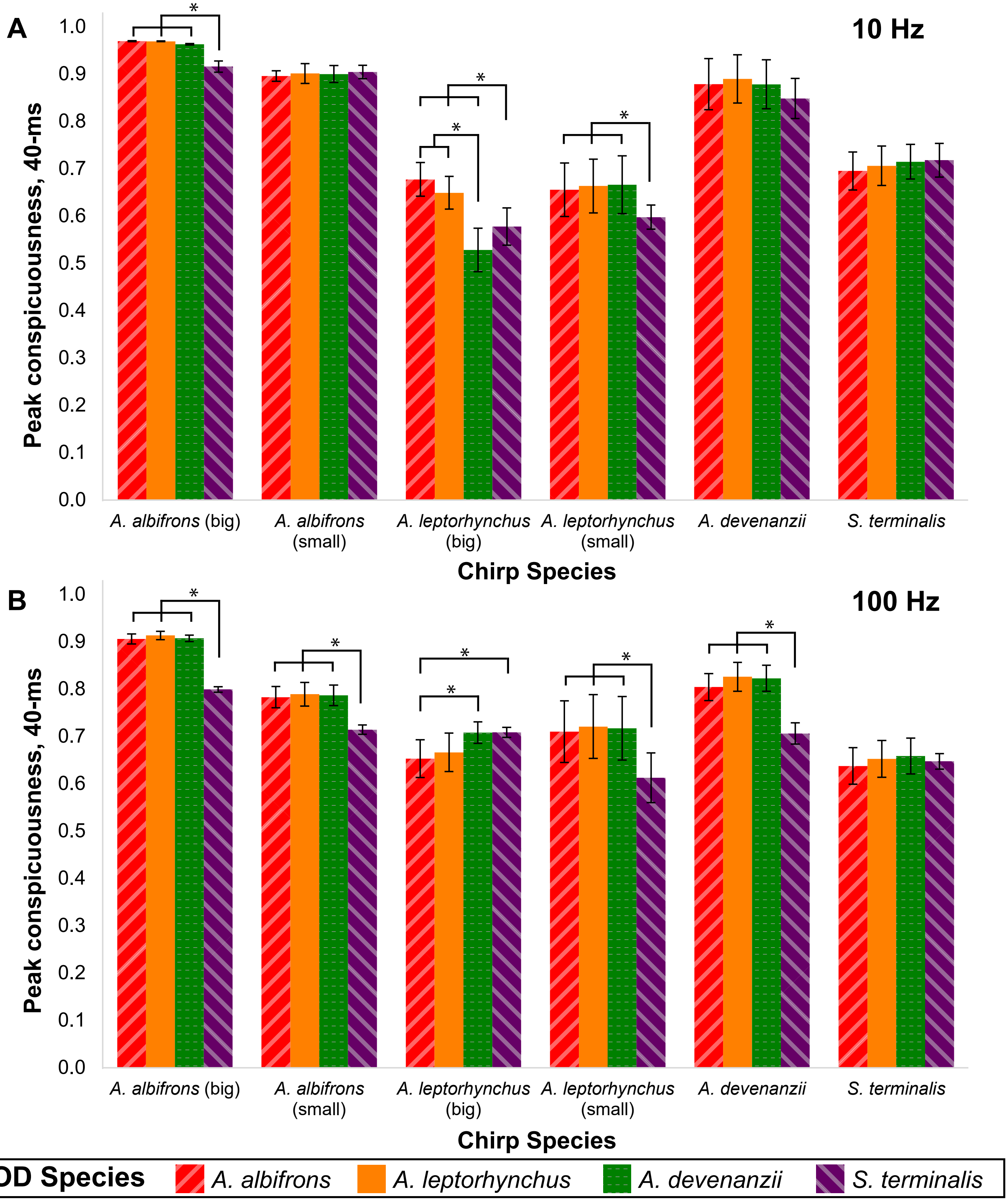
Supplemental Fig 5. Effect of DF on peak conspicuousness analyzed using a 10-ms window (A) or a 40-ms window (B). DF significantly affected peak conspicuousness when using the 10-ms window (partial correlation: -0.60, p<0. 001; 147 chirps). DF was included as a predictor in the 40-ms analysis but was not significant (partial correlation: -0.08, p=0.15; 147 chirps). Chirps tended to be more conspicuous on 10 Hz beats compared to 100 Hz beats. Error bars show one standard error from the mean.



Supplemental Fig 6. Contribution of chirp FM (A,B) to variation across phase. We calculated the standard deviation (S.D.) of the peak value (20-ms window) across four different phases of the beat in order to determine which chirp or EOD parameters have the greatest impact on variation in conspicuousness. Chirp FM (log-transformed) was the strongest predictor of peak conspicuousness S.D. (partial correlation: 0.39, $p<0.001$). Higher chirp FM led to more variation in chirp conspicuousness across phase. C) DF also influenced variability in chirp conspicuousness (partial correlation: -0.43, $p<0.001$; 147 chirps). Chirp conspicuousness varied more across phase on 10 Hz beats compared to 100 Hz beats. Error bars show one standard error from the mean.



Supplemental Fig 7. Peak conspicuousness of hybrid chirps on a A) 10 Hz beat and B) 100 Hz beat (10-ms window). Chirps from four species (including two different types of *A. leptorhynchus* and *A. albifrons* chirps, n=6 from each species/chirp type) were re-synthesized on the waveform of those four species, including the waveform of the species from which the chirp came. The bars are arranged from most sinusoidal (*A. albifrons*) to most complex (*S. terminalis*) EOD waveform. The chirps were combined with an EOD from the waveform donor species to measure peak conspicuousness. Asterisks indicate statistically significant differences ($p<0.05$, Fisher PLSD) between the conspicuousness of chirps on different species-specific EOD waveforms. Error bars show one standard error from the mean.



Supplemental Fig 8. Peak conspicuousness of hybrid chirps on a A) 10 Hz beat and B) 100 Hz beat (40-ms window). Chirps from four species (including two different types of *A. leptorhynchus* and *A. albifrons* chirps, n=6 from each species/chirp type) were re-synthesized on the waveform of four species, including the waveform of the species from which the chirp came. The bars are arranged from most sinusoidal (*A. albifrons*) to most complex (*S. terminalis*) EOD waveform. The chirps were combined with an EOD from the waveform donor species to measure peak conspicuousness. Asterisks indicate statistically significant differences ($p<0.05$, Fisher PLSD) between the conspicuousness of chirps on different species-specific EOD waveforms. Error bars show one standard error from the mean.

Supplemental Table 1. Partial correlations for natural chirp conspicuousness analysis (10-ms and 40-ms peak).

	Peak (10-ms window)[1]		Peak (40-ms window)[2]	
Signal parameter	Partial correlation	p	Partial correlation	p
Chirp duration	0.04	0.53	**0.09**[3]	**0.11**
Chirp FM	**0.74**	**<0.0001**	**0.44**	**<0.0001**
Chirp relative decay	**0.19**	**<0.001**	**0.19**	**0.001**
DF	**-0.60**	**<0.001**	**-0.08**	**0.15**
F2-F1	0.006	0.92	-0.04	0.54
F3-F1	**0.08**	**0.17**	**-0.16**	**0.006**

[1] $F(4, 289)=136.6$, $p<0.0001$, R^2 adj=0.65 for the multiple regression model

[2] $F(5, 288)=24.2$, $p<0.0001$, R^2 adj=0.28 for the multiple regression model

[3] Bold values indicate variables included in the respective multiple regression model.

Supplemental Table 2. Partial correlations stepwise regression using standard deviation of natural chirp peak values (20-ms window).

	SD of Peak (20-ms window)[1]	
Signal parameter	Partial correlation	p
Chirp duration	-0.02	0.75
Chirp FM	**0.39**[2]	**<0.001**
Chirp relative decay	**0.08**	**0.18**
DF	**-0.43**	**<0.001**
F2-F1	**0.08**	**0.18**
F3-F1	-0.05	0.39

[1] $F(4, 289)=136.6$, $p<0.0001$, R^2 adj=0.65 for the multiple regression model

[2] Bold values indicate variables included in the multiple regression model.

Supplemental Table 3. Synthetic chirps peak conspicuousness ANOVA table (10-ms window)

	d.f.	F	p
Chirp Species	5	25.80	<0.0001
DF	1	496.96	<0.0001
DF*Chirp Species	5	27.02	<0.0001
EOD Species	3	3.29	0.024
EOD Species*Chirp Species	15	16.47	<0.0001
DF*EOD Species	3	5.44	0.0018
DF*EOD Species*Chirp Species	15	8.46	<0.0001

Supplemental Table 4. Synthetic chirps peak conspicuousness ANOVA table (40-ms window)

	d.f.	F	p
Chirp Species	5	16.86	<0.0001
DF	1	15.38	0.0005
DF*Chirp Species	5	11.48	<0.0001
EOD Species	3	6.68	0.0004
EOD Species*Chirp Species	15	1.07	0.40
DF*EOD Species	3	6.82	0.0003
DF*EOD Species*Chirp Species	15	4.56	<0.0001