

Table S1: Estimating phylogenetic signals for single traits using Pagel's λ and Blomberg's K. $P_{(\lambda=0)}$ states the significance level of no phylogenetic signal and $P_{(\lambda=1)}$ the significance level of a strong phylogenetic signal.

| | Pagel's λ | $P_{(\lambda=0)}$ | $P_{(\lambda=1)}$ | Blomberg's K | P |
|-----------------------------|-------------------------------------|-------------------------------------|-------------------------------------|---------------------|----------|
| Temperature (°C) | 0.36 | 0.29 | 0.03 | 0.46 | 0.12 |
| Intensity (dB SPL) | 0 | 1 | < 0.001 | 0.3 | 0.93 |
| Effective calling rate (Hz) | 0 | 1 | < 0.001 | 0.28 | 0.98 |
| Pulse rate (Hz) | 0 | 1 | < 0.001 | 0.31 | 0.91 |
| Chirp/trill duty cycle | 0 | 1 | < 0.001 | 0.32 | 0.84 |
| Pronotum width (mm) | 1 | < 0.001 | 1 | 1.06 | 0.001 |

Table S2: Bivariate correlation analysis: comparison between results of the linear model and phylogenetic generalized least squares model (PGLS).

| <i>Bivariate correlation</i> | Linear model | | | PGLS | | |
|------------------------------------|-----------------------|----------------|----------|-----------------------|----------------|----------|
| | <i>R</i> ² | <i>t value</i> | <i>P</i> | <i>R</i> ² | <i>t value</i> | <i>P</i> |
| Temperature~Intensity | 0.46 | 4.14 | <0.001 | 0.51 | 4.52 | <0.001 |
| Temperature~Effective calling rate | 0.44 | 3.93 | <0.001 | 0.55 | 4.93 | <0.001 |
| Temperature~Body size | 0.26 | 2.48 | 0.020 | 0.35 | 3.08 | 0.006 |
| Intensity~Body size | 0.28 | 2.62 | 0.018 | 0.32 | 2.90 | 0.01 |
| Effective calling rate~Body size | 0.02 | 0.62 | 0.55 | 0.02 | 0.61 | 0.55 |
| Pulse rate~Body size | 0.03 | -0.70 | 0.50 | 0.03 | -0.72 | 0.48 |
| Chirp/trill duty cycle~Body size | 0.10 | 1.43 | 0.17 | 0.10 | 1.45 | 0.16 |

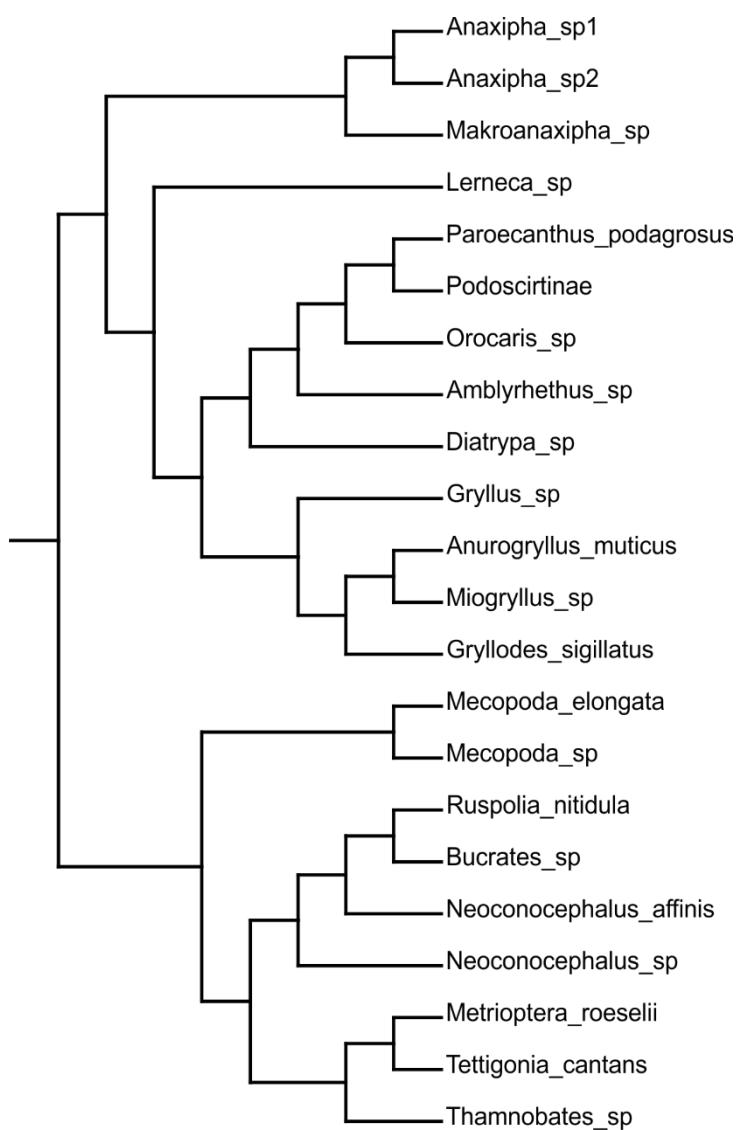


Figure S1: Species tree used in the analysis testing for phylogenetic signal.

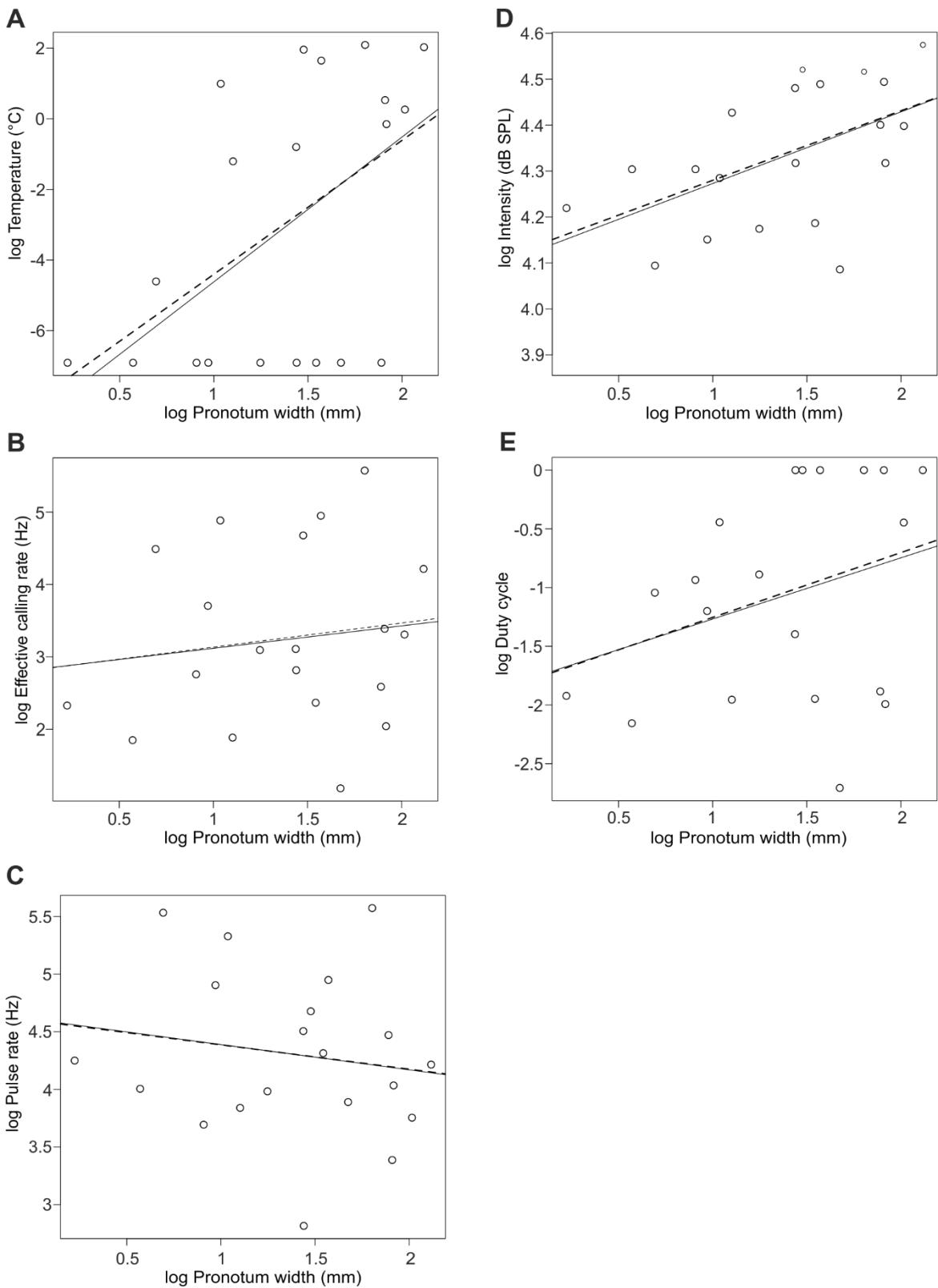


Figure S2: Effect of body size (i.e., pronotum width) on temperature (A) and call parameters (B-E) with regression lines of the linear model (dashed line) and PGLS model (solid line). Results of the respective models are stated in Table S2.

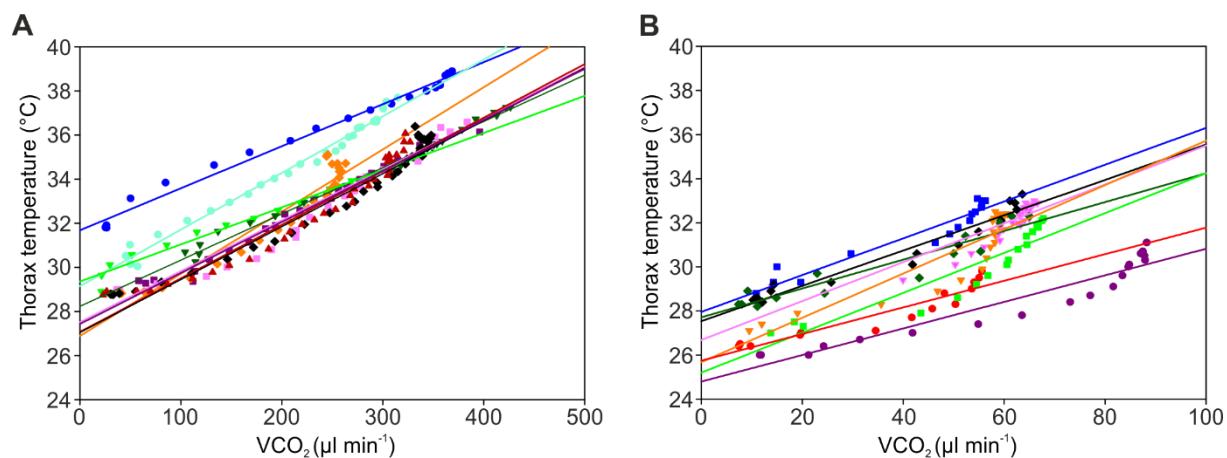


Figure S3: Linear relationship between CO_2 production rate and thoracic temperature obtained from nine *Mecopoda* sp. males (A) and eight *A. muticus* males (B). For more details, see Fig. 5 in the main manuscript.