**Title: Using acoustic indices to monitor vertebrate biodiversity**

**Introduction**

**Methods**

*Study sites*

Don is writing?

*Figure x.* Map of study sites

*Vertebrate surveys*

Don is writing?

*Audio surveys*

Audio recorders as part of the A2O were deployed at each site (A2O refs). Each recorder recording continuously at a sampling rate of 22.05kHz in the FLAC file format (FrontierLabs; see Roe et al. 2021 for full details).

*Acoustic indices*

Acoustic indices were generated from the audio for the entire 7 days (12pm on day of first spotlighting survey – 12pm on the day of last bird survey) at a 1-min resolution using Kaleidoscope Pro (Wildlife Acoustics; version 5.4.1) and QUT Ecoacoustics Audio Analysis Software (version ???? ). Ten acoustic indices were calculated: the acoustic complexity index (ACI), the acoustic diversity index (ADI), the acoustic evenness index (AEI), the normalised difference soundscape index (NDSI), the bioacoustic Index (BI), events per second (EVN), spectral entropy (SH), low-frequency cover (LFC), mid-frequency cover (MFC), and high frequency cover (HFC). The settings used for each acoustic index are in SuppInfo.

Table . List of the 13 acoustic indices used in…

|  |  |
| --- | --- |
| Acoustic Index | Description |
| ADI | Acoustic diversity index (ref) |
| AEI | Acoustic evenness index |
| BI | Bioacoustic index |
| NDSI | Normalized difference soundscape index |
| SH | Spectral entropy |
| ACT | Activity |
| EVN | Events per second |
| LFC | Low-frequency cover |
| MFC | Mid-frequency cover |
| HFC | High-frequency cover |
| ACI | Acoustic complexity index |
| CLS | Cluster count |
| SPT | Spectral peak density |

For comparison with the on-ground biodiversity data, each acoustic index was aggregated into a weekly value by taking the average of all 1-minute values for certain taxa-specific time periods. For birds, indices were averaged for the morning (6am-9am), afternoon (3pm-6pm), and daytime (6am-6pm). For frogs, indices were averaged for the evening (6pm-9pm) and night (6pm-6am). For total vertebrate biodiversity and non-avian biodiversity, indices were averaged for the entire 7-day dataset. Any time period that had less than 70% of the audio available was removed from the dataset.

*Statistical analyses*

Bootstrap pearson correlation values (and 95% CI) were calculated for each acoustic index and biodiversity measure (richness, Shannon’s diversity, count).

To determine how well multiple acoustic indices predict vertebrate biodiversity random forest models were fit to each biodiversity measure using all acoustic indices as predictors. Random forest models were fit using 1000 trees and 10 x 3 cross validation to estimate predictive performance (R version 3.6.1; randomForest version 4.6.14; caret version 6.0.86).

**Results**

*Acoustic index correlations*

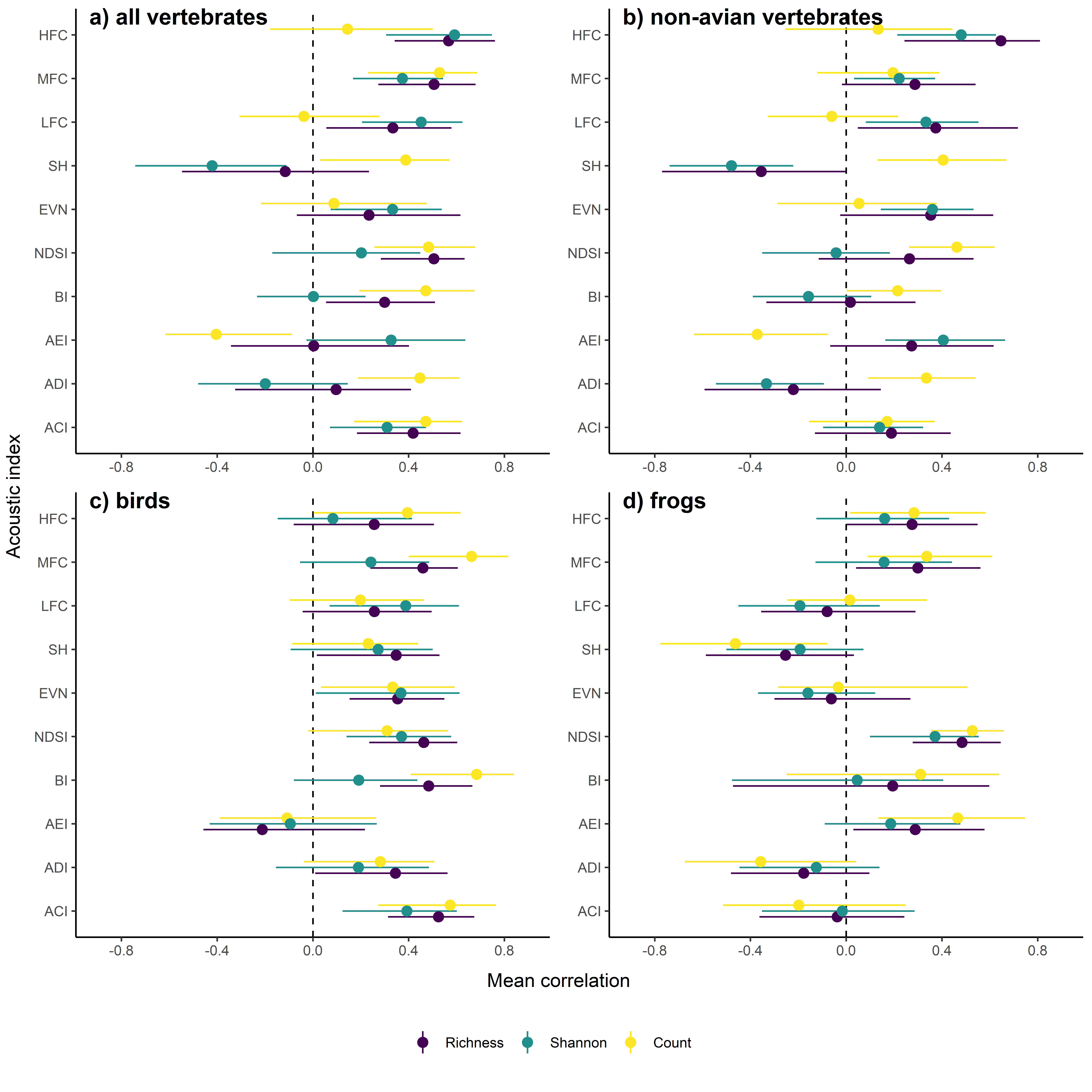


Figure . Bootstrap pearson correlation of ten acoustic indices and three biodiversity measures (species richness, Shannon’s diversity and count) for a) all vertebrate taxa, b) all non-avian vertebrate taxa, c) birds, and d) frogs.

XX index correlated …

Apart from NDSI, all other acoustic indices correlated poorly with frog biodiversity (Fig. x).

*Random forest models*

Random forest models performed …

Scatter index for frogs …

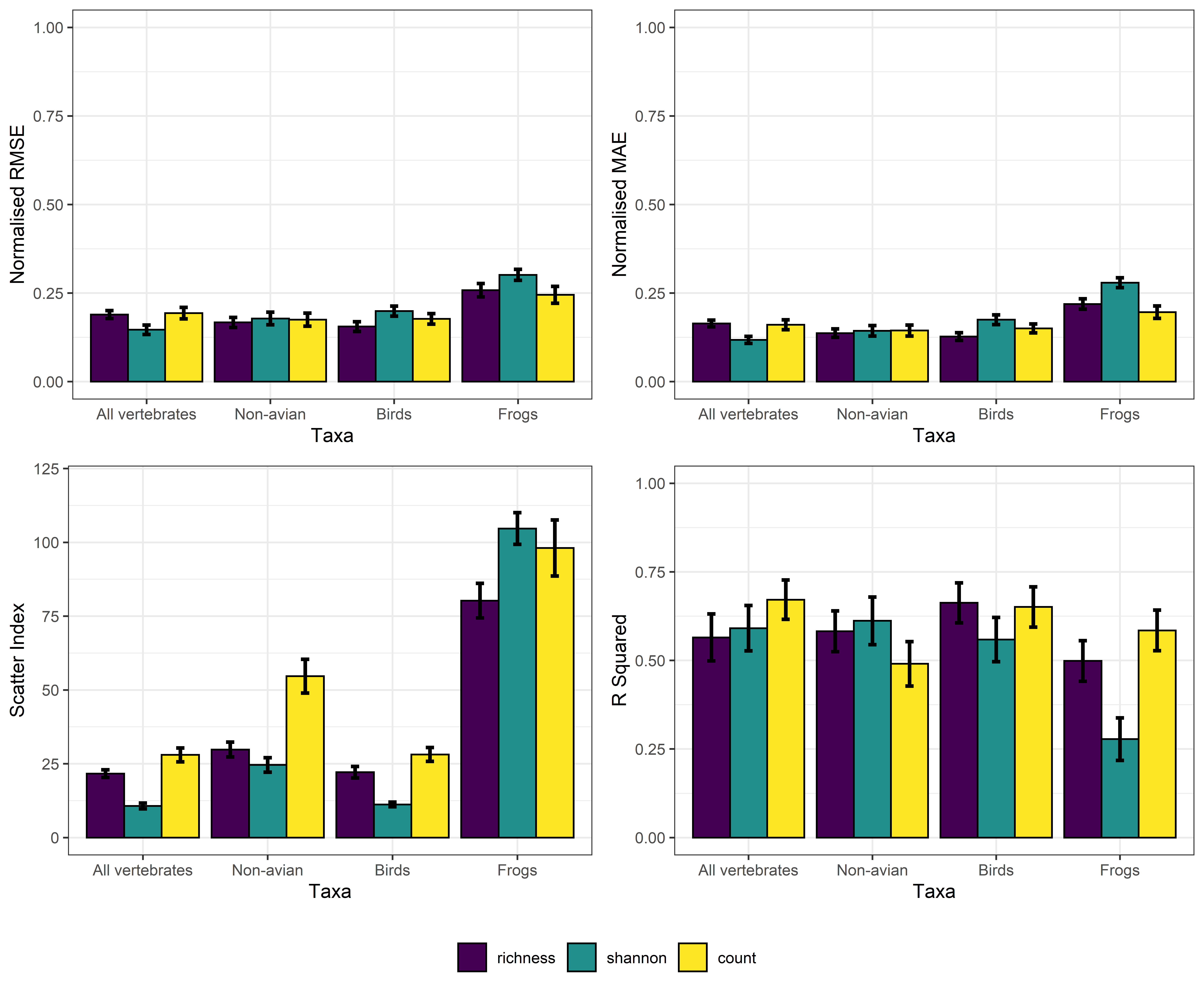


Figure . Mean (±SE) performance of random forest models predicting richness, Shannon’s diversity, and total count of all vertebrates, non-avian vertebrates, birds, and frogs. Performance measured with 10 x 3 cross-validation.

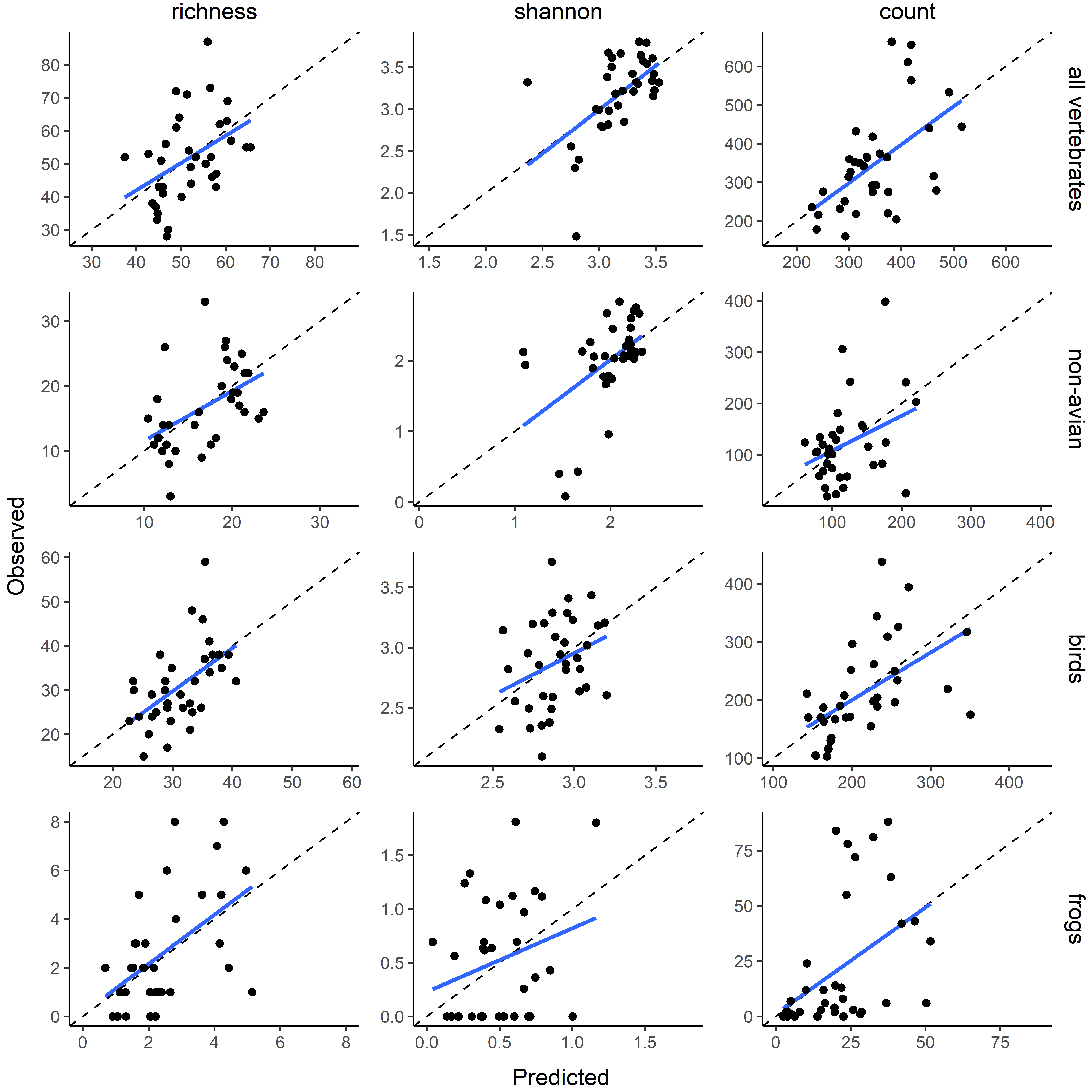


Figure . Comparison of observed and out-of-bag predicted values for random forest models

**Discussion**

**Supporting Information**

