

## **Metadata S1. Information for R code and Data S1**

### **Metadata and code for:**

Fidino, M., and S. B. Magle. Using Fourier series to estimate periodic patterns in dynamic occupancy models. *Ecosphere*.

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**Note:** All of the files in Data S1 must be within your working directory for the analysis to work. Furthermore, the analyses have been set up to be done in parallel and uses all but two of the cores in a computer. Therefore, if you have two or less cores on your computer you will need to adjust any function

in `Fidino_2017_utility_functions.R` that uses the `detectCores` function. This includes `zest_posterior`, `make_pred_PTM_pulse`, `make_pred_PTM_boom` and `fit_models`. Furthermore the `n.chains` arguments in `Fidino_2017_total_variability.R` associated to the `run.jags` functions would need to be changed.

**Data S1 consists of 4 scripts used for analysis and model summary. These scripts include:**

**Fidino\_2017\_utility\_functions.R:** This script contains utility functions to fit homogeneous time, stochastic time, and periodic time dynamics occupancy models. This script needs to be sourced before using any of the other scripts. Functions in this file are explained within the script itself.

**Fidino\_2017\_analysis\_script.R:** This script uses the functions in `Fidino_2017_periodic_utility_functions.R` to fit periodic time, stochastic time, and homogeneous time dynamic occupancy models to the 9 seasons of Chicago camera trap data for coyote, red fox, striped skunk, raccoon, and Virginia opossum data.

**Fidino\_2017\_model\_summary\_and\_plotting.R:** Uses the saved model outputs from the analysis script and the functions in `Fidino_2017_utility_functions.R` to calculate summary statistics for plotting (i.e., this script summarizes the MCMC outputs to generate Figure 1 in the manuscript).

**Fidino\_2017\_total\_temporal\_variability.R:** This script uses the functions in `Fidino_2017_periodic_utility_functions.R` to fit a periodic time model to each species that also includes a random temporal component. The primary variable of interest from these models is the standard deviation associated to the random temporal component, as it can be compared to the standard deviation from a model that only contains a random temporal component (i.e., no periodic element).

**Data S1 also has the 6 JAGS dynamic occupancy models used throughout this analysis, this includes:**

**Fidino\_2017\_periodic\_time\_model\_pulse.R:** The periodic time model used for coyote, striped skunk, and red fox. Used in `Fidino_2017_analysis_script.R`

**Fidino\_2017\_periodic\_time\_model\_boom\_bust.R:** The periodic time model used for raccoon and Virginia opossum. Used in `Fidino_2017_analysis_script.R`

**Fidino\_2017\_stochastic\_time\_model.R:** Used on all species and includes a random temporal effect on colonization rates. Used in `Fidino_2017_analysis_script.R`

**Fidino\_2017\_homogeneous\_time\_model.R:** Used on all species and does not have any temporally varying parameters on colonization rates. Used in `Fidino_2017_analysis_script.R`

**Fidino\_2017\_periodic\_time\_full\_model\_pulse.R:** The periodic time model used for coyote, striped skunk, and red fox that also includes a random temporal component. This requires  $\delta$  to be supplied as data. Used in `Fidino_2017_total_temporal_variability.R`

**Fidino\_2017\_periodic\_time\_full\_model\_boom\_bust.R:** The periodic time model used for raccoon and Virginia opossum that also includes a random temporal component. This requires  $\delta$  to be supplied as data. Used in `Fidino_2017_total_temporal_variability.R`

**Finally, Data S1 has the data used in the analysis. This includes:**

**Fidino\_2017\_community\_incidence\_matrix\_sp10\_sp13.txt:** This includes data on whether or not coyote, red fox, striped skunk, raccoon, and Virginia opossum were observed at the 95 camera trapping sites each season between spring 2010 to spring 2013. If they were detected the cell takes a value of 1, if they were not detected it takes a 0, and if the site was not sampled it takes an NA. It can be converted to a 3-dimensional array using the `df_2_array` function in `Fidino_2017_periodic_utility_functions.R` and then used to calculate beta priors and supplied as initial values to model. This is a species by site by season array after being converted. The species order is coyote, red fox, striped skunk, raccoon, and Virginia opossum.

**Fidino\_2017\_chicago\_detection\_data\_sp10\_sp13.txt:** This includes data on the number of days each species was detected and is supplied as data to the JAGS model so that each species detection probability can be calculated. It can be converted to a species by site by season array using the `df_2_array` function in `Fidino_2017_periodic_utility_functions.R`. If a site was not sampled at a particular season an NA is reported.

**Fidino\_2017\_Chicago\_days\_camera\_active\_sp10\_sp13.txt:** This includes data on the number of days a camera trap was active each site and season. Used with the detection data to calculate detection probabilities, and is a site by season matrix. If a site was not sampled a zero is reported.

**Fidino\_2017\_URB\_covariate.txt:** The URB covariate for each site, in the same order as all of the other data.