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Supplementary material

Multi-species occupancy models: review, roadmap, and recommendations
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Appendix 1



Figure A1. Word cloud of the broad context in publications about studies focusing on community occupancy.

Table A1. List of variables included in the studies.

Variables			
Climatic	Habitat	Species Traits	Anthropogenic
Precipitation	Farmland	Forage	Hunting
Hydroperiod	Forest	Nest Type	Logging
Inundation	Rainforest	Diet	Agriculture
Solar Radiation	Grassland	Body Mass	Fragmentation
Fire	Wetland	Home Range Size	Road
Temperature	Savanna	Gestation	Housing Density
Cloudiness	Pasture	Resident	Development
Elevation	Plantation	Migrant	Fire
Flooding	Duneland	Activity Pattern	Plantation
Drought	Shrubland	Dispersal	Recreation
	Marsh	Clutch Size	Deforestation
	Ditch		
	Stream		

Table A2. Concept key and definition of variables used in the review

Variables of interest
<p>Publication details:</p> <ul style="list-style-type: none"> - Paper Title (String): Publication title - Authors (String): Publication author listing - Journal (String): The journal in which the study was published - Year Published (Integer): The year in which the study was published in the journal - Author Affiliation Countries (Integer): The countries in which author affiliations as listed are in - Number of Authors (Integer): The number of authors in the manuscript - Study question and context: What was the study trying to understand?
<p>Study organisms:</p> <ul style="list-style-type: none"> - No. of Species Seen (Integer): The total number of species observed during the study - No. of Species Not Seen (Integer): The species that occur in the area but were not observed during the study - Focal Species (String): The species the study was designed for

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Table A2 – *Continued from previous page***Variables of interest**

- Bycatch Species (String): The species on which data were obtained despite not being explicitly designed for it/them
- Bycatch Species Seen but Not Listed (Boolean): Whether there is a mention of organisms other than focal species seen during the study even if all the bycatch species are not listed
- Study Group (String): Classification of study species based on their known diet
- Taxa (String): Broad taxonomic unit of the study organisms in this publication
- Species (String): Basic unit (lowest taxonomic rank) of biological classification in this study
- Genus (String): Genera corresponding to each of the study species
- Family (String): Taxonomic family corresponding to each species in the study
- Order (String): The taxonomic order to which the species studied belong
- Class (String): The taxonomic class to which the study species belong
- Kingdom (String): The taxonomic kingdom to which the study species belong
- Vertebrates (Boolean): Whether the focal species are vertebrates or not

Study area-related:

- Continent (String): The continent to which the country where the study was conducted belongs
- Country (String): The country in which the study location occurs
- Region (String): The region in which the study location occurs
- Study Area (String): The actual study location
- Sea or Ocean Name (String): The name of the sea or ocean in case the study location is a marine area
- Elevation (String): Elevation range of study location
- Depth (String): Depth range of study location
- Spatial Scale (String): The total area covered in the study
- Spatial Scale Justification (Boolean): Whether any justification of spatial scale chosen was provided
- Spatial Scale Justification Reason (String): What was the justification for choosing this spatial scale?
- Latitude (String): What was the latitude of the study location?
- Longitude (String): What was the longitude of the study location?
- System Type (String): Whether the study was on a terrestrial, marine, aquatic system

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Table A2 – *Continued from previous page***Variables of interest**

- Protected Area (Boolean): Whether the study system is a protected area
- Urban Area (Boolean): Whether the study system is considered an urban area
- Habitat (String): Broad habitat type of the study system

Study Period:

- Study Year (Integer): The year in which the study was conducted
- Temporal Scale (String): The duration of the study
- Temporal Scale Justification (Boolean): Whether any justification for the temporal scale chosen was provided?
- Temporal Scale Justification Reason (String): What was the justification provided for choosing this temporal scale?
- Study Season (String): The season/s during which the study was conducted
- Time of Day (String): Whether the sampling was during the day, at night, or both

Study methods:

- Detectability (String): Whether the detectability of the species of concern is high or not
- Detection Covariates (String): Detection covariates in the global model
- Detector Make (String): The make and model of the detectors used in the study
- Detector Spacing (String): The distance between detectors used in the study
- Detector Type (String): The type of detector used in the study
- Detector Spacing Justification (String): Whether any justification for the spacing between detectors that was chosen for the study was provided
- Detector Spacing Justification Reason (String): What justification for detector spacing chosen was provided?
- Implementation (String): Sampling methodology and field method
- Method Used (String): The type of modeling for which the study is designed
- No. of Detectors (Integer): The total number of detectors used for the study
- Trap Days (Integer): No. of trap days for the study

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Table A2 – *Continued from previous page***Variables of interest**

- Occupancy (Boolean): Whether occupancy modeling was done
- Occupancy Model Parameters (String): The occupancy attributes considered in the global model
- Occupancy Estimates (String): Values of the occupancy estimates
- Occupancy Method (String): What method was used?
- Occupancy Model Used (String): Which occupancy model was used?
- Number of Candidate Models (String): The total number of candidate models run under a model selection paradigm
- Model Season (String): What seasonality is used for the models
- Species Specific Modeling? (Boolean): Were the same detection/occupancy models assumed for all species? If only some are influenced by say temperature, structure is forced on all them
- Number of Chains (Integer): Number of chains used in MCMC (if used)
- Number of Iterations (Integer): Number of iterations used in MCMC (if used)
- Burn-in Period (Integer): Burn-in period in MCMC (if used)
- Thinning (Integer): Amount of thinning in MCMC (if used)
- Adaptive Phase (Integer): Adaptive phase in MCMC (if used)
- Priors (String): Information on priors
- Spatial Replicates (String): Number of spatial replicates used
- Temporal Replicates (String): Number of temporal replicates used
- Biotic Interactions (Boolean): Whether biotic interactions were considered as a covariate for occupancy or detection
- Habitat Covariates (String): The habitat covariates that were considered for occupancy or detection
- Habitat Included (Boolean): Whether habitat features were considered in the analysis;
 - Species Traits Included (Boolean): Whether species traits were considered in the analysis
- Species Traits (String): Which species traits were considered for the analysis
- Climate Included (Boolean): Whether climate variables were considered in the analysis
- Climate Covariates (String): Which climate covariates were considered for the analysis

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Table A2 – *Continued from previous page***Variables of interest**

- Anthropogenic Factors Included (Boolean): Whether anthropogenic influences were considered in the analysis
- Anthropogenic Covariates (String): Which anthropogenic factors were considered in the analysis
- Simulation Done (Boolean): Whether a simulation was done

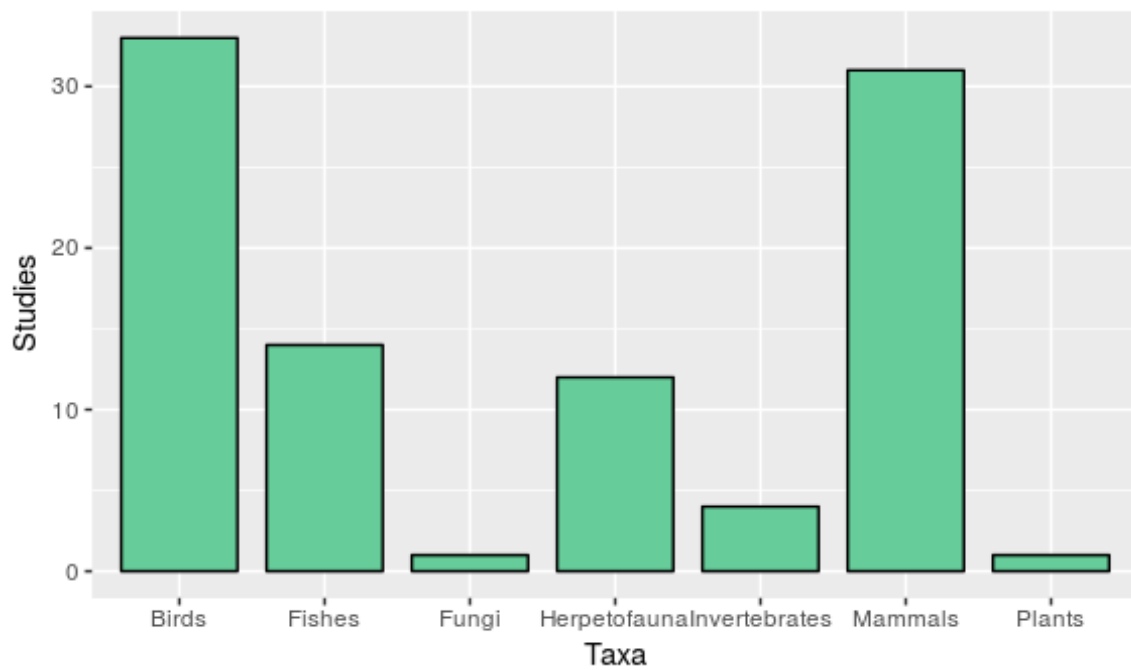


Figure A2. Bar chart representing the number of studies that focused on each kind of organism.

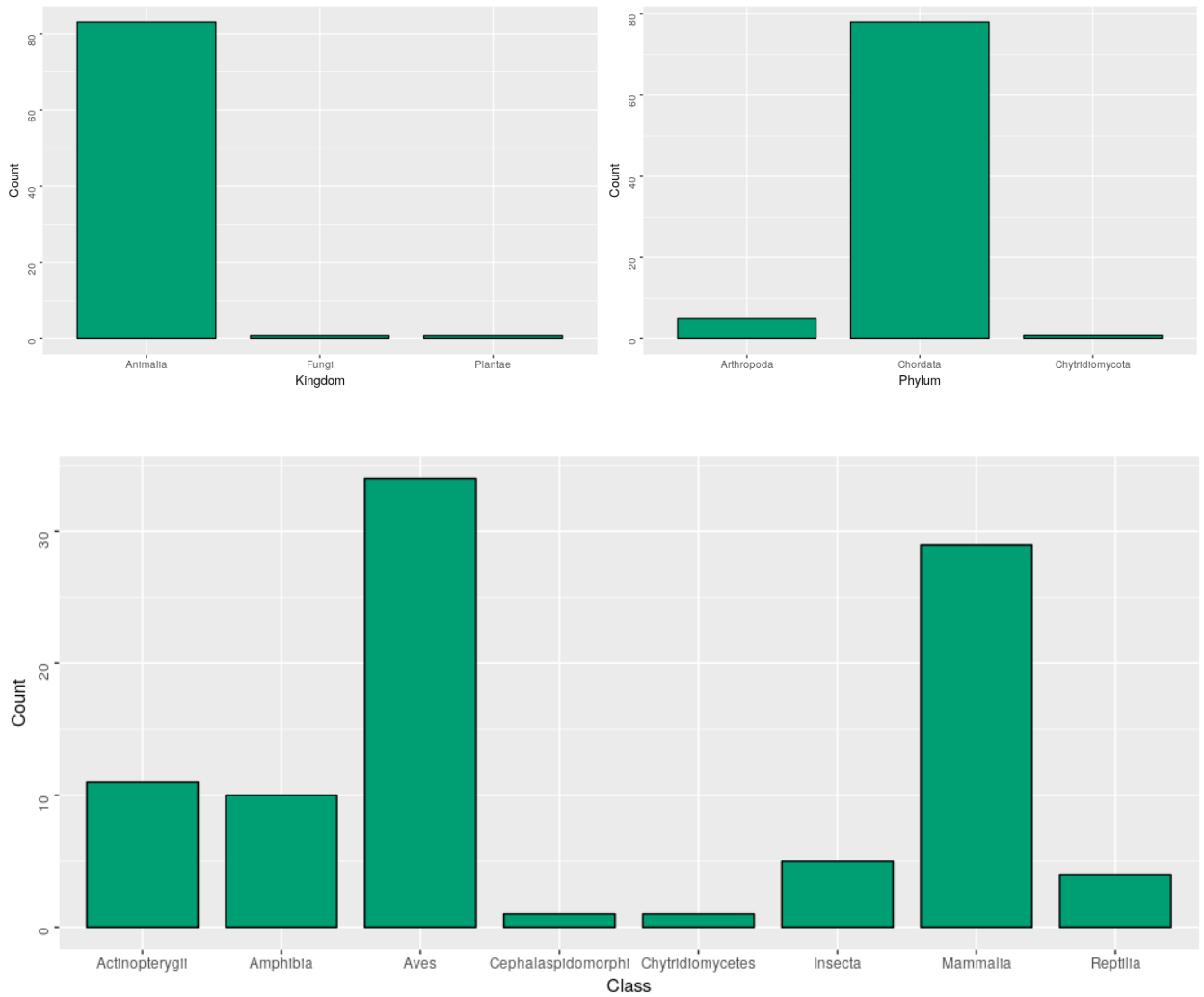


Figure A3. Bar charts of the taxonomic kingdom, phylum, and class to which organisms that formed a part of multi-species occupancy studies belonged.

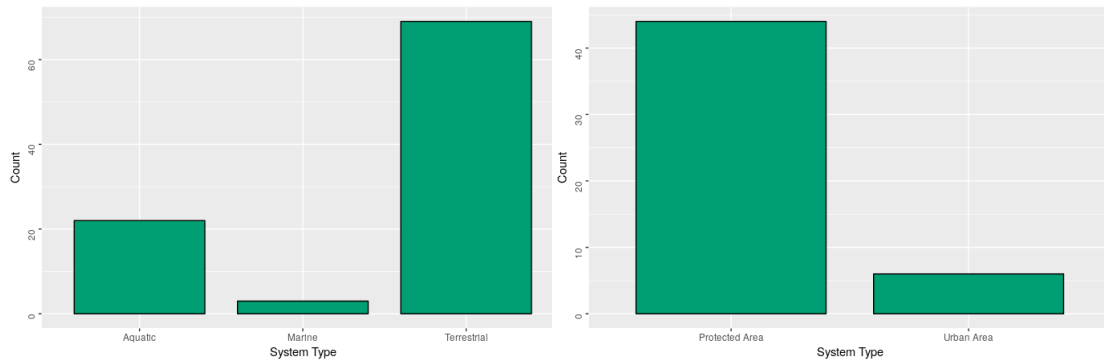


Figure A4. Study system types.

A majority of community occupancy studies were terrestrial and in a protected area.

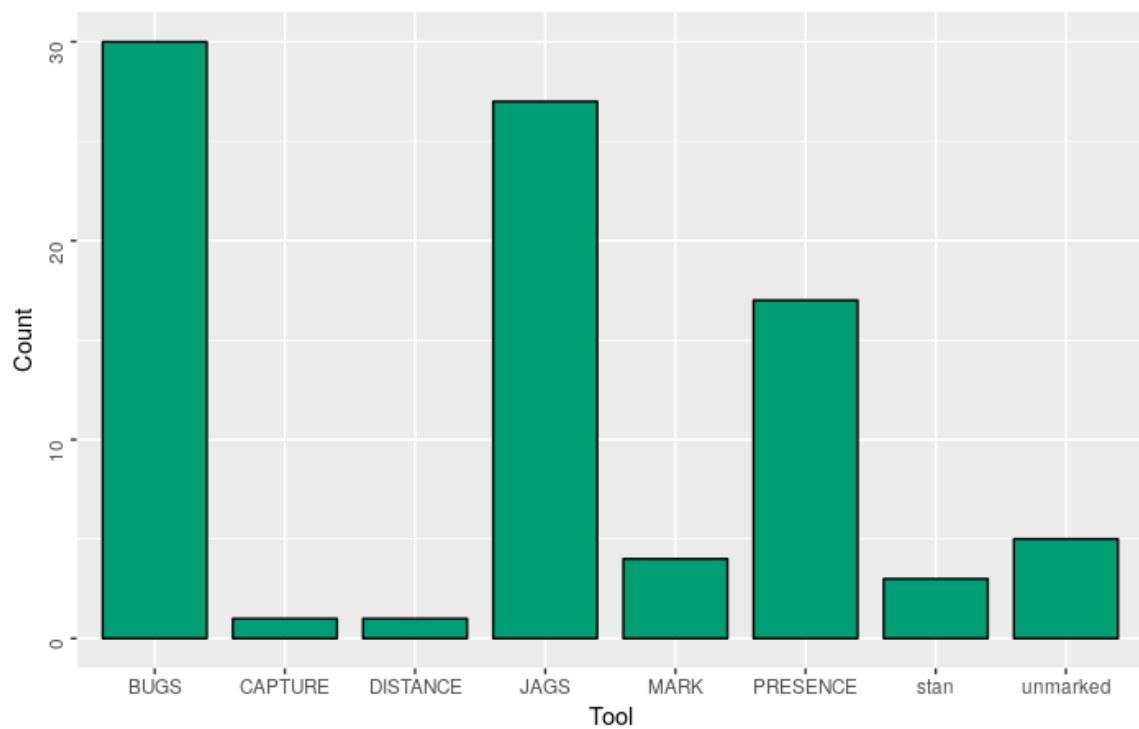


Figure A5. Use of statistical tools for community occupancy across field site and taxa.
The Bayesian framework seemed to be the most popular, with a majority of the studies using either BUGS or JAGS.

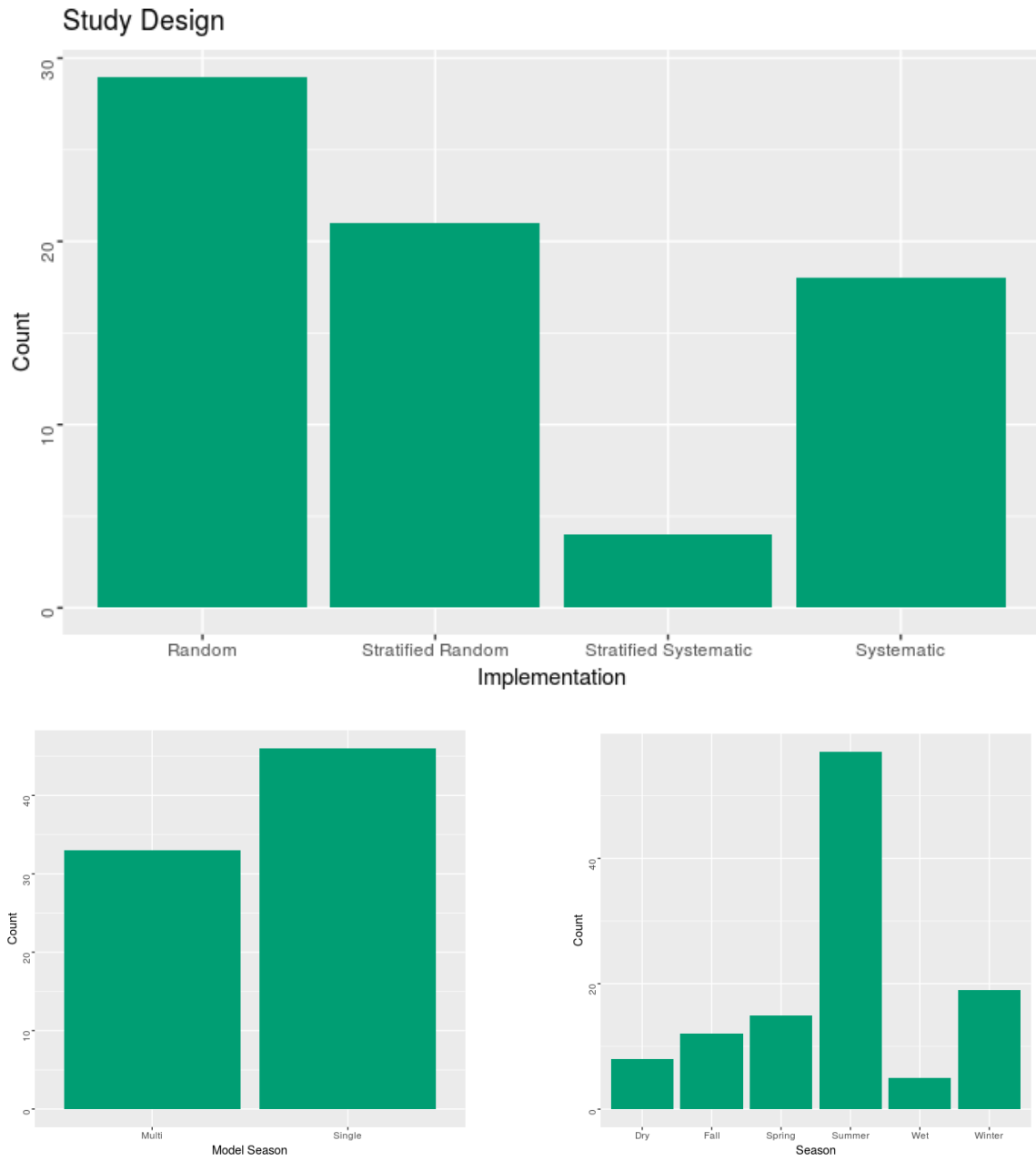


Figure A6. Study designs and seasons.