

Wildlife camera analysis

Population Modeling
20 March 2023

My background



You have thousands [millions] of photos- now what?



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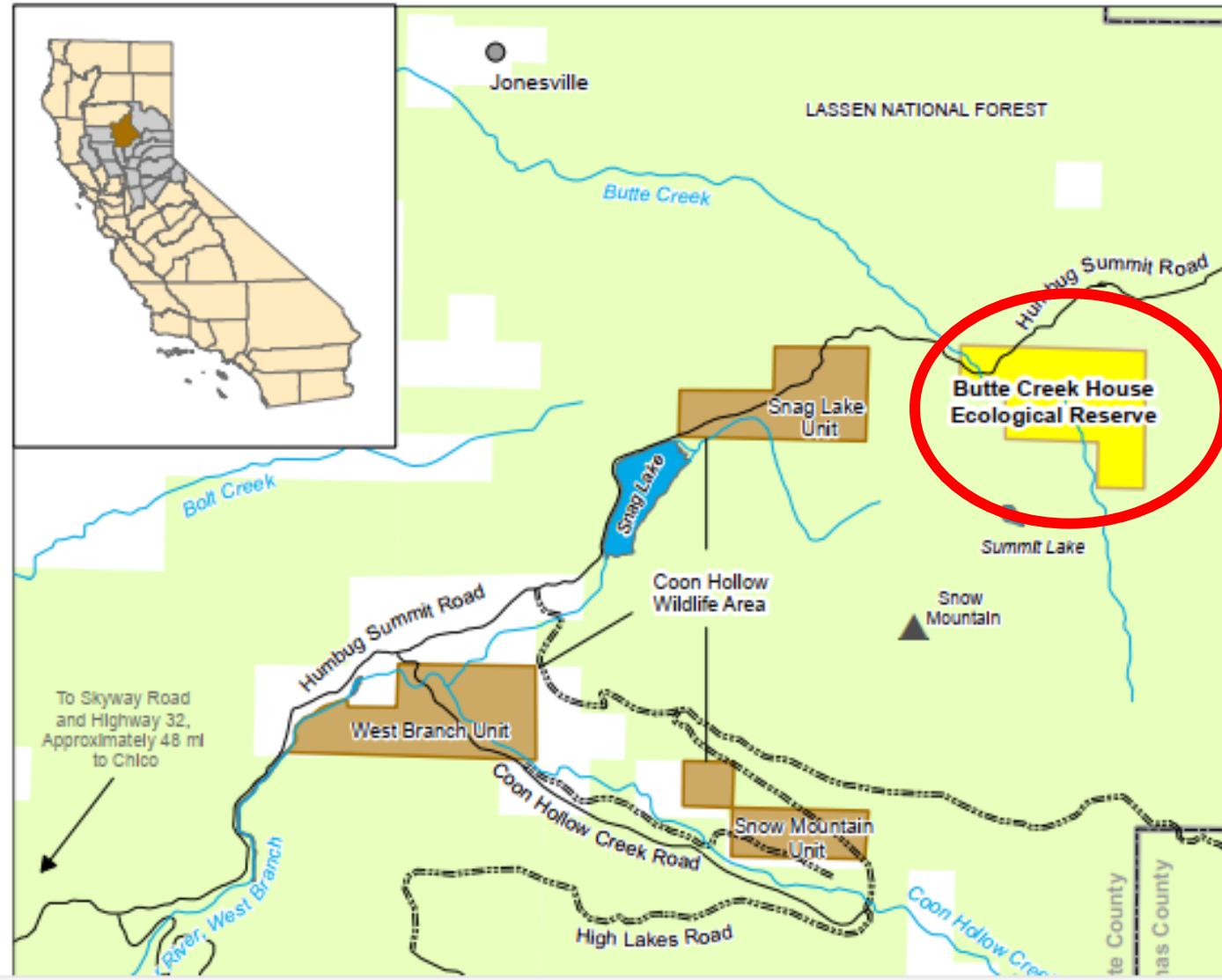
- 
1. Identifying your question
 2. Tagging/classifying photos
 3. Cleaning tagged data
 4. Analyses

1. Identifying your question

- How were the cameras set up?
 - Array structure: random, grid, targeted
 - Habitat/surroundings
 - Field of view
 - Camera settings
 - Baited?
- What is the survey period?
- Do you have enough detections?

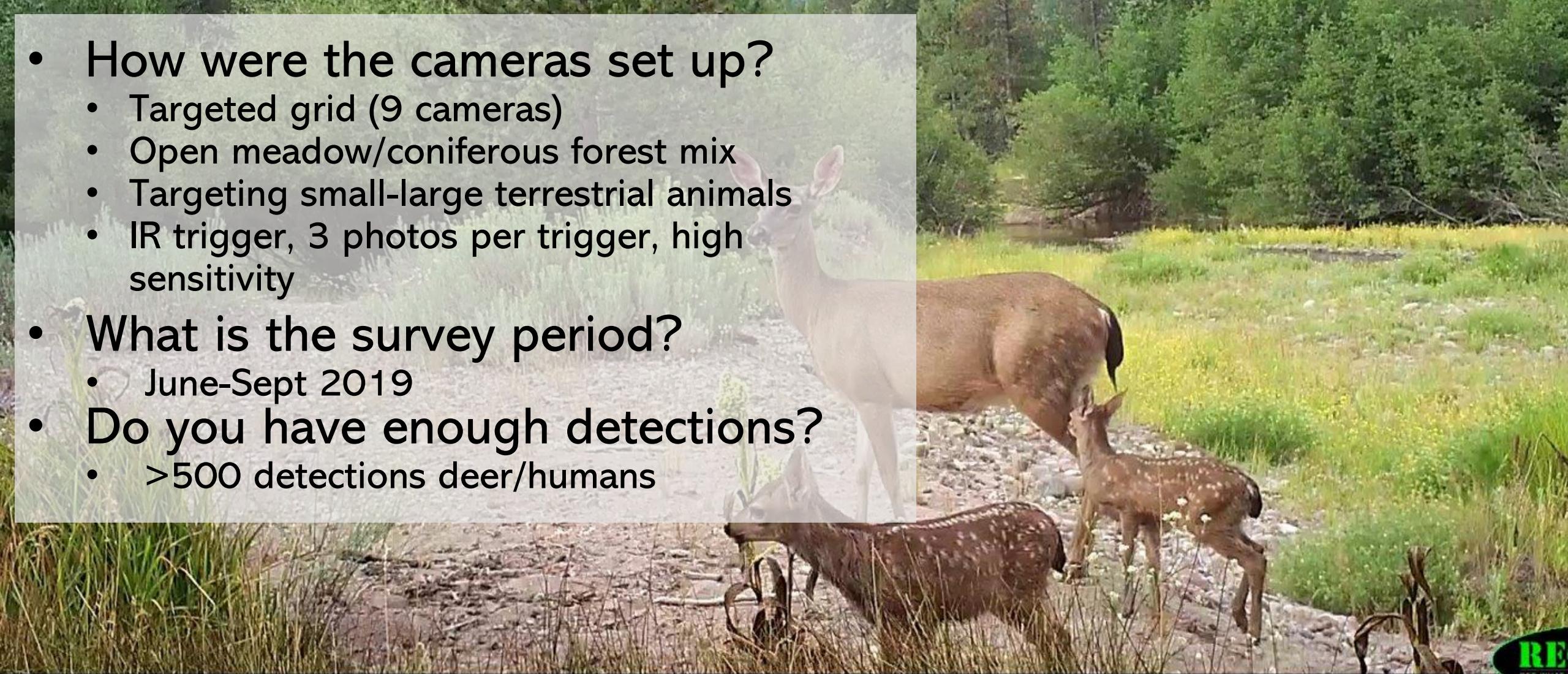


California Department of Fish and Wildlife
North Central Region
BUTTE CREEK HOUSE ECOLOGICAL RESERVE
Butte County



1. How is deer activity impacted by human presence?

- How were the cameras set up?
 - Targeted grid (9 cameras)
 - Open meadow/coniferous forest mix
 - Targeting small-large terrestrial animals
 - IR trigger, 3 photos per trigger, high sensitivity
- What is the survey period?
 - June-Sept 2019
- Do you have enough detections?
 - >500 detections deer/humans



2. Tagging/classifying photos

- Step 1- identify what info you want (species, individual, group size, behaviors, etc.)
- Step 2- choose a tagging program that fits your needs
 - Manual tagging programs: Timelapse
 - R packages: camtrapR
 - AI identification: MegaDetector, Wildlife Insights

Data entry for All files

File RCNX0060.JPG

RelativePath P1\P1B\P1B 5.19

DateTime 19-May-2022 15:20:00 ▲ ▼

Species1 ▾

Num_indiv1 0 ▲ ▼

Behav1

Area1

Species2 ▾

Num_indiv2 0 ▲ ▼

Behav2

Area2

Species3 ▾

Num_indiv3 0 ▲ ▼

Behav3

Area3

Species4 ▾

Num_indiv4 0 ▲ ▼

Behav4

Area4

Notes

Tagger

Site ▾

Camera ▾

ImageIssue Copy
previous
values
← C →

Instructions Image set Data table

2022-05-19 15:20:00



P1 B

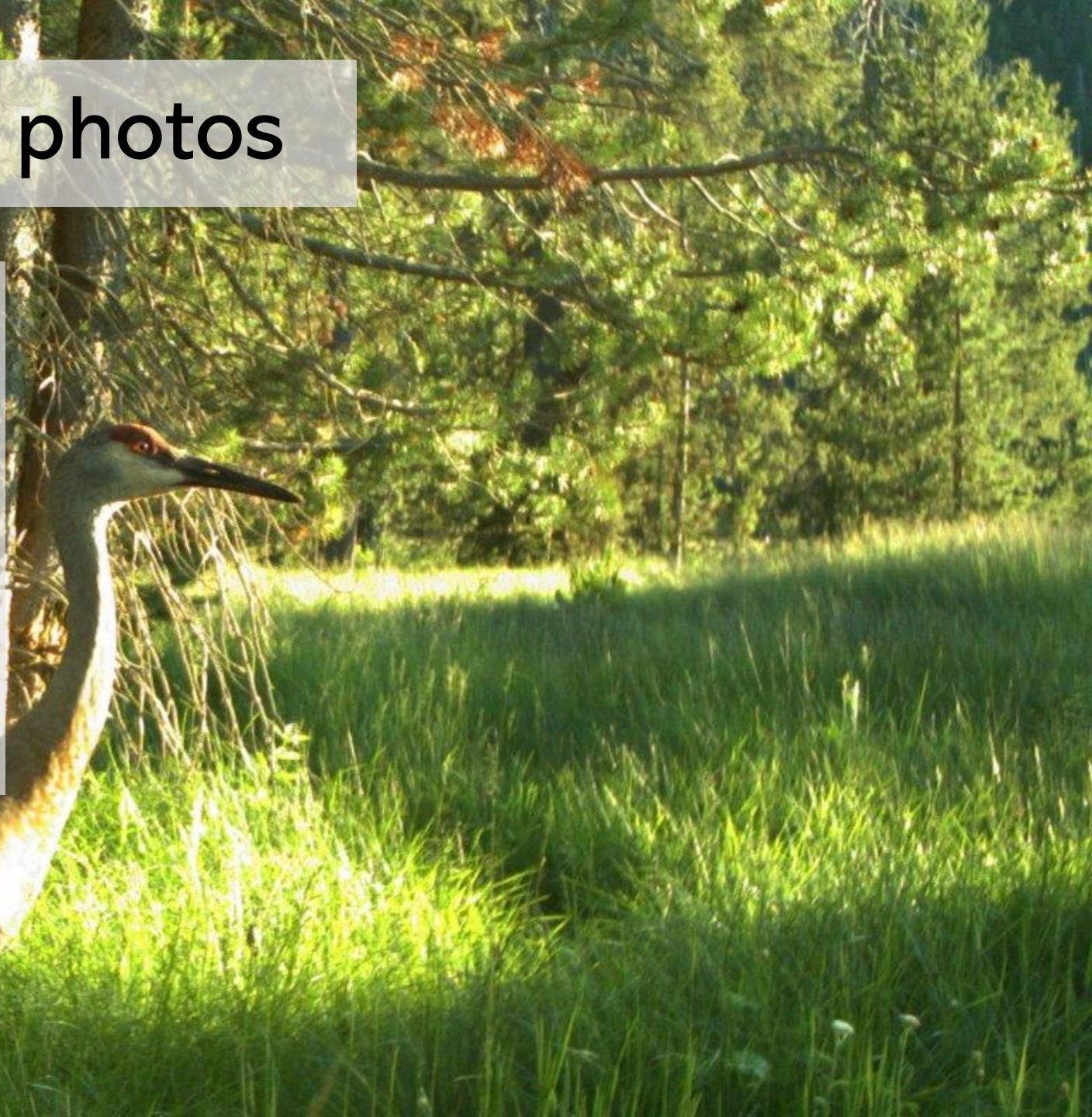
File: 15260 of 279243

Select: All files

Sorted by: RelativePath↑ then by Date/Timet

2. Tagging/classifying photos

- Step 1- deer and human detections (time and location)
- Step 2- manually tagged using Timelapse
 - (~1000 photos per person per hour tagging rate)



3. Cleaning tagged data

- Formatting date/time
- Manual tagging- fix typos, unknowns/ambiguous IDs
- AI tagging- check photos with low confidence, check random samples



4. Analyses

- Population density/abundance
 - Mark-resight
 - Random encounter model
 - N-mixture model
- **Occupancy models**
- **Temporal activity models**
- Relative abundance (detection rate) or time to detection vs. covariates (mixed effects models, hierarchical models)

4. Occupancy models

Answer question of how human detections influence **SPATIAL** deer activity (detection at camera sites with different human activity)

4. Occupancy models

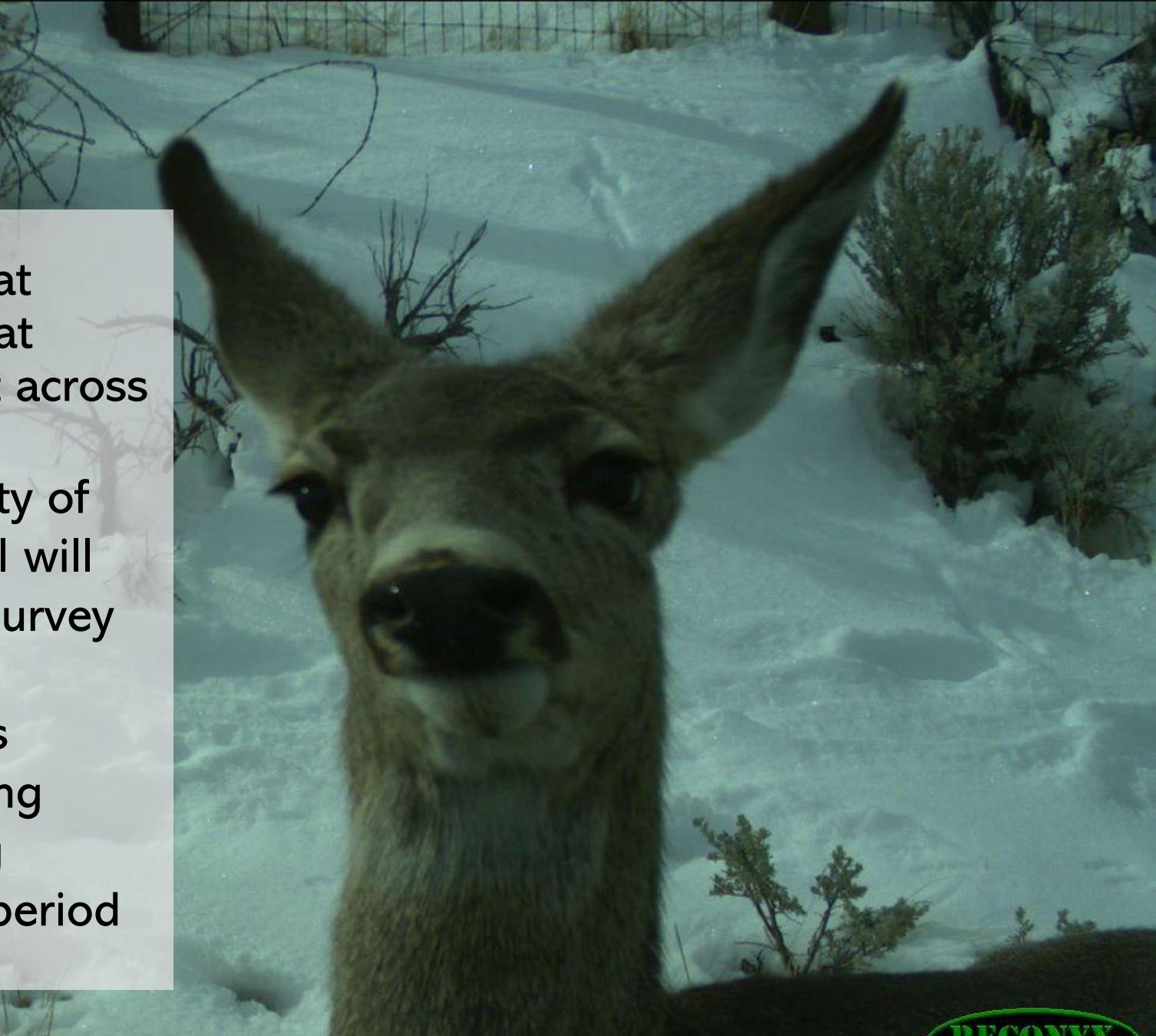
- Assumptions:
 - Fine vs. large-scale movements (continuous habitats)
 - Site closure (sites either occupied or unoccupied during survey)

This means assumptions of occupancy models are often violated with cameras set close together (e.g., within a species' home range size)



4. Occupancy models

- So, for cameras, assumption is that animals move in and out of sites at random and site use is consistent across sampling season
 - **Occupancy** becomes probability of use (probability that an animal will use site at least once during survey season)
 - **Detection** probability becomes probability of an animal passing camera (and camera capturing animal) during replicate time period



4. Occupancy models

- Detection history
 - 1s and 0s during specified replicate time periods (e.g., 1 day or 1 week) for species detected or not per camera
 - NAs for camera days where data was not collected

	o1	o2	o3	o4	o5	o6	o7	o8	o9	o10	o11	o12	o13	o14	o15	o16	o17	o18	o19	o20	o21	o22	o23	o24	o25	o26	o27	o28	o29
10	NA	NA	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	1	
11	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
12	NA	1	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0									
13	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	
14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA										
15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA										
4	0	1	0	1	0	1	0	0	0	1	1	1	0	0	1	0	0	0	1	1	0	1	1	0	1	1	0	0	
7	0	0	1	0	0	0	1	0	0	0	0	1	1	0	0	1	1	1	1	0	1	1	0	1	1	0	0	1	
9	NA	NA	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	

4. Occupancy models

- Effort
 - 1s and NAs during for every replicate time period per camera, denoting whether camera was collecting data or not (fraction for start/end when not full days)

	o1	o2	o3	o4	o5	o6	o7	o8	o9	o10	o11	o12	o13	o14	o15	o16	o17	o18	o19	o20	o21	o22	o23	o24	o25	o26	o27	o28
10	NA	NA	0.5	1	1.0	1	1	1	1	1.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	NA	NA	NA	NA	0.5	1	1	1	1	1.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
13	NA	0.5	1.0	1	1.0	1	1	1	1	1.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4	0.5	1.0	1.0	1	1.0	1	1	1	1	1.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	0.5	1.0	1.0	1	1.0	1	1	1	1	1.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	NA	NA	0.5	1	1.0	1	1	1	1	1.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

4. Occupancy models

Site covariate:

1 value per camera site per covariate

Stays the same during entire survey period

```
> sitecov  
  landcov      humDR  
1 FOREST 0.08163265  
2 MEADOW 0.02127660  
3 FOREST 0.02380952  
4 MEADOW 0.44000000  
5 MEADOW 1.12500000  
6 MEADOW 0.86666667  
7 MEADOW 0.09803922  
8 MEADOW 0.66666667  
9 FOREST 0.08163265
```

To answer how human detections at cameras influence deer detections, we will include human detection rate (number detections/number active survey days at site)

This targets spatial component of deer activity-
(probability of detection at sites)

4. Occupancy models

Observation covariate:

1 value per camera site per covariate

Stays the same during entire survey period

> obscov	month
1	6
2	6
3	6
4	6
5	6
6	6
7	6
8	6
9	6
10	6
11	6
12	6
13	6
14	6
15	7
16	7
17	7
18	7
19	7
20	7
21	7
22	7
23	7
24	7
25	7
26	7
27	7
28	7

4. Occupancy models

- Covariates:
 - **Occupancy** – site covariates
 - **Detection** – observation and site covariates

With the sample data, cameras are very close together (within the same 3-5km² area), so we will only measure the effect of site covariates on detection probability (not occupancy)

4. Temporal activity estimates

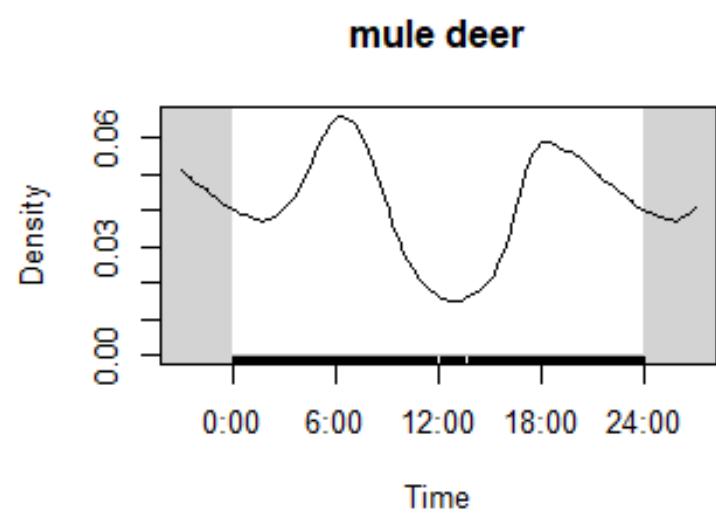
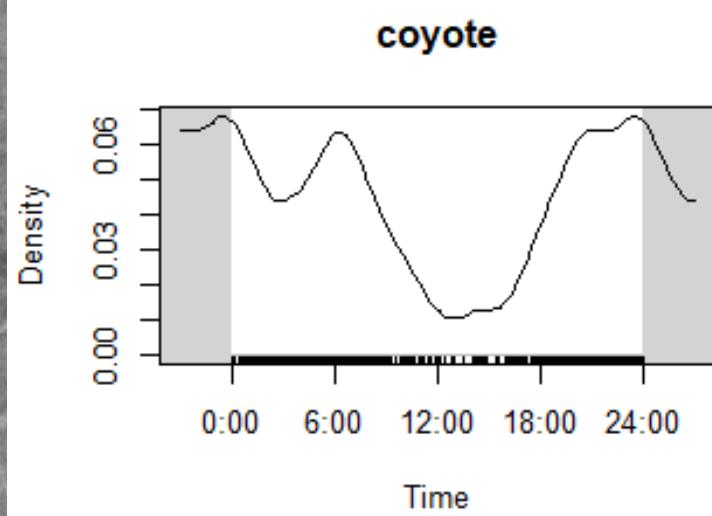


Answer question of how human detections influence **TEMPORAL** deer activity

(Do deer have lower activity during times humans have higher activity at cameras?)

4. Temporal activity estimates

Ridout and Linkie (2009): kernel density daily activity patterns

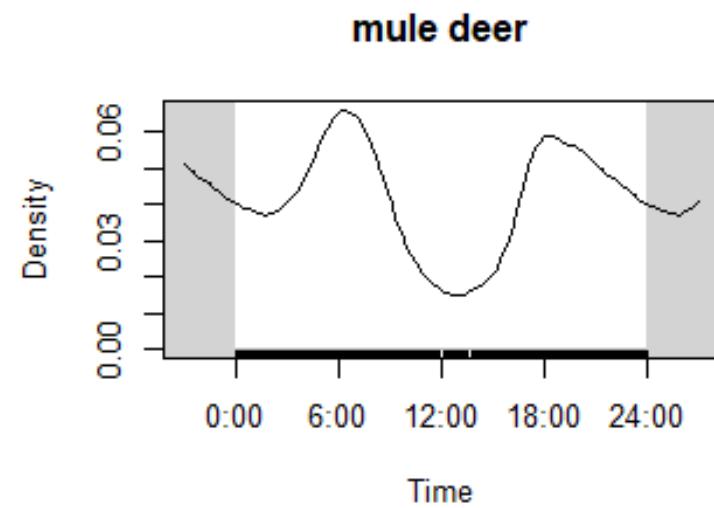
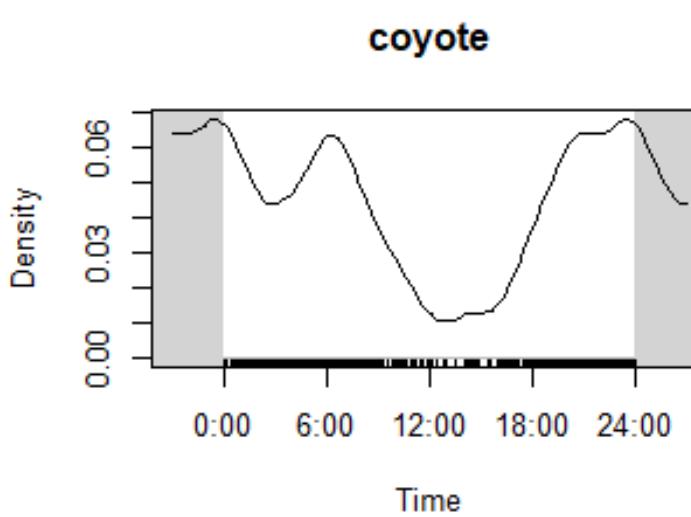


4. Temporal activity estimates

overlap package in R

Steps:

1. Convert time to radians
2. Per species of interest, calculate von Mises kernel density of time of detections (corresponds to circular distribution for time)



4. Temporal activity estimates

Calculating overlap between species or temporal activity at different sites

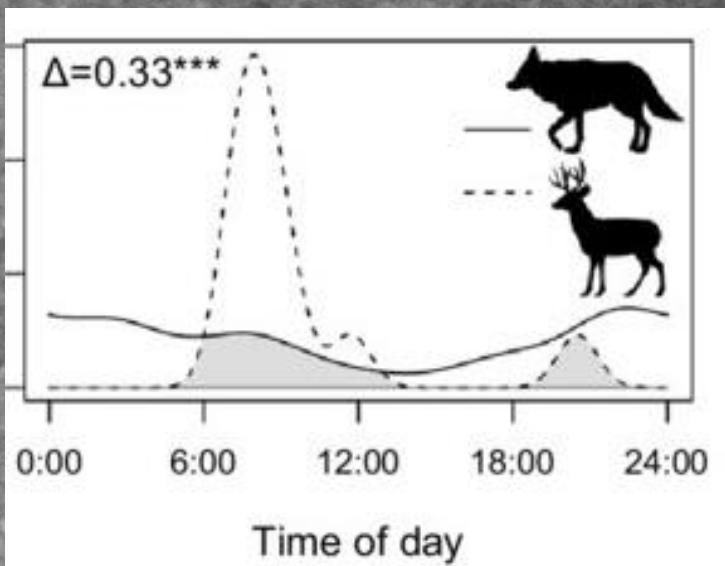
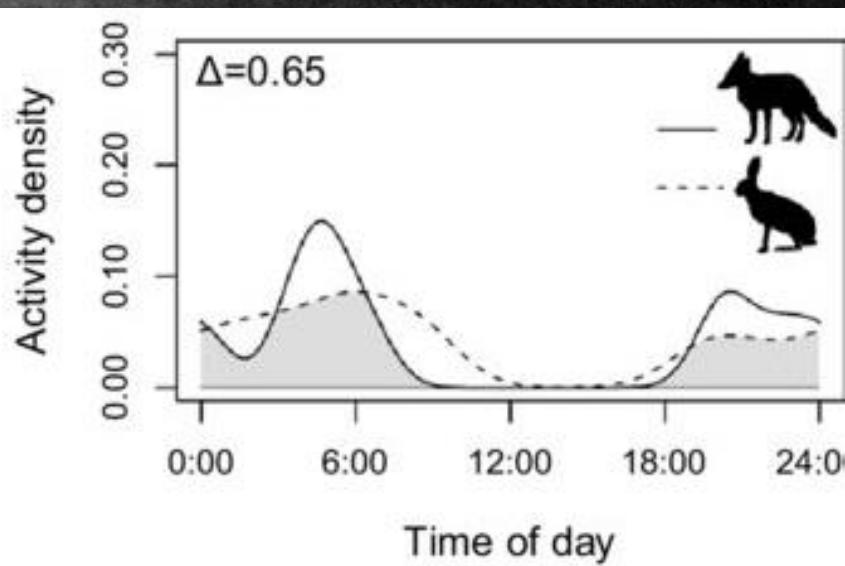


Fig. from Durán-Antonio et al. 2020



4. Temporal activity estimates

overlap package in R

Steps:

1. Calculate coefficient of overlapping (Δ , area under curves where they overlap)
2. Different methods of overlap calculation for different sample sizes

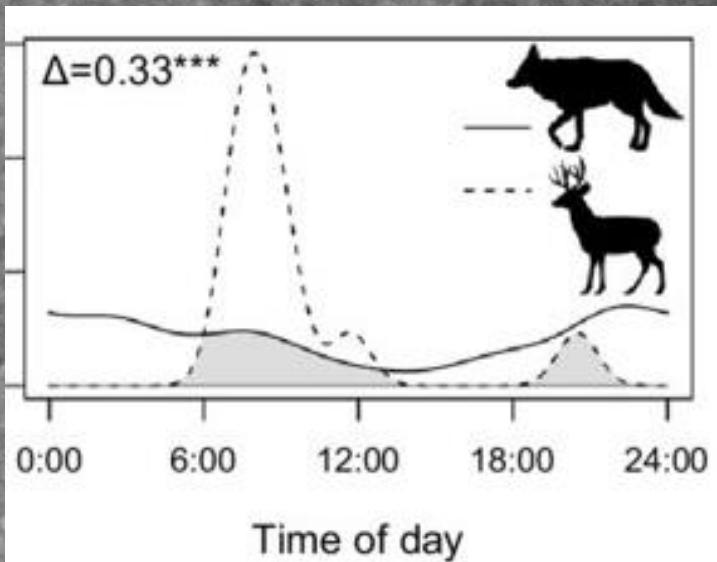
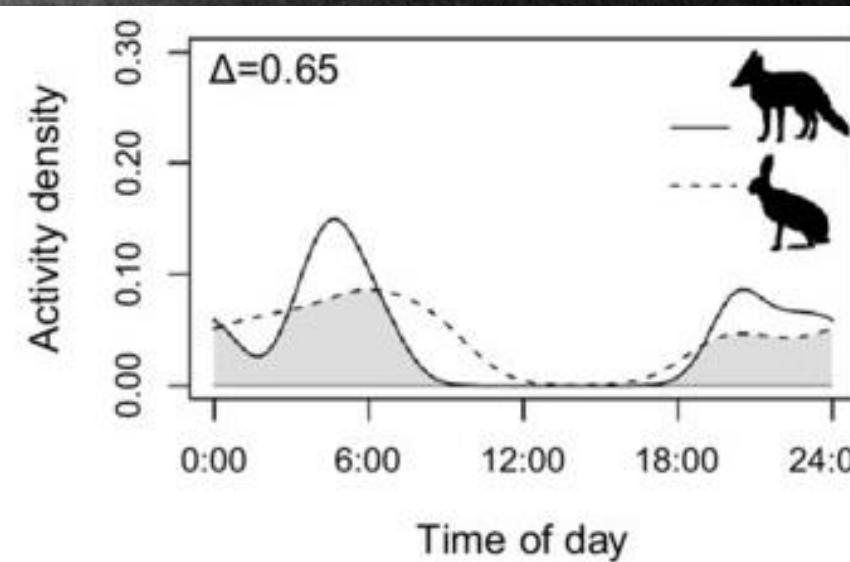


Fig. from Durán-Antonio et al. 2020



4. Temporal activity estimates

overlap package in R

Steps:

3. Bootstrap sample to calculate confidence intervals of Δ
4. Package function (bootCI) accounts for bootstrap biases when calculating confidence intervals

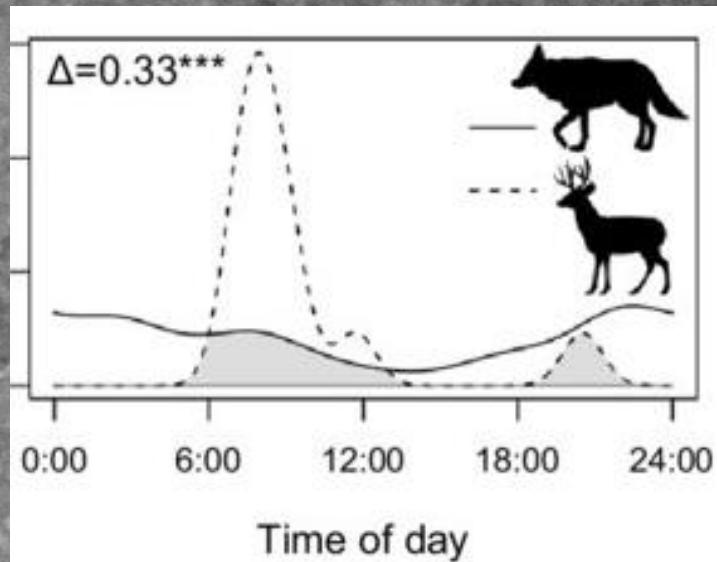
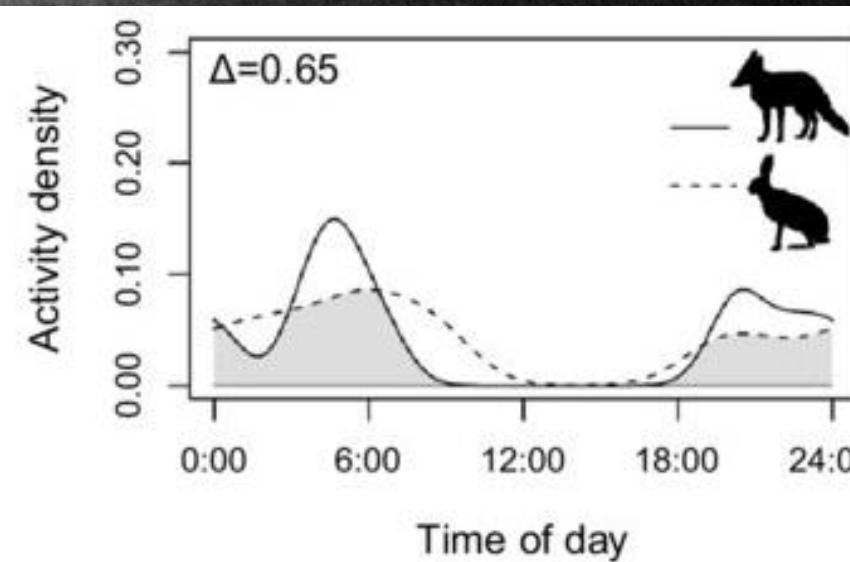


Fig. from Durán-Antonio et al. 2020



4. Temporal activity estimates

overlap package in R

We will be quantifying overlap between humans and deer

Steps:

3. Bootstrap sample to calculate confidence intervals of Δ
4. Package function (bootCI) accounts for bootstrap biases when calculating confidence intervals

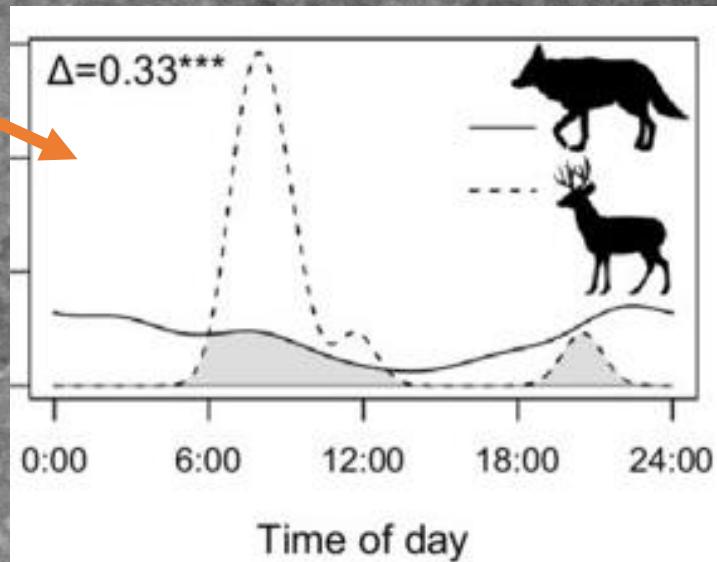
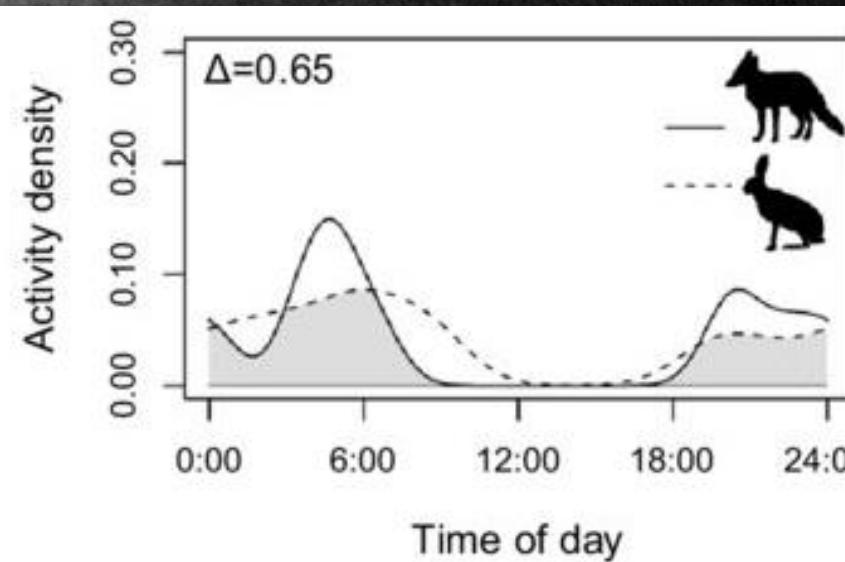


Fig. from Durán-Antonio et al. 2020





Google drive for this class:

- 2 datasets from CDFW- delete from computer when done
- Datasets will be removed from drive but other files will remain

Additional resources/literature
in wildlife camera resources
word document