Estimating Burmese Python Abundance

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Project motivation

A need for demography estimates to study and evaluate control efforts

Traditional mark recapture programs not feasible or desirable

Detection probability extremely low

How can population size be estimated given current data streams?

Currently available data

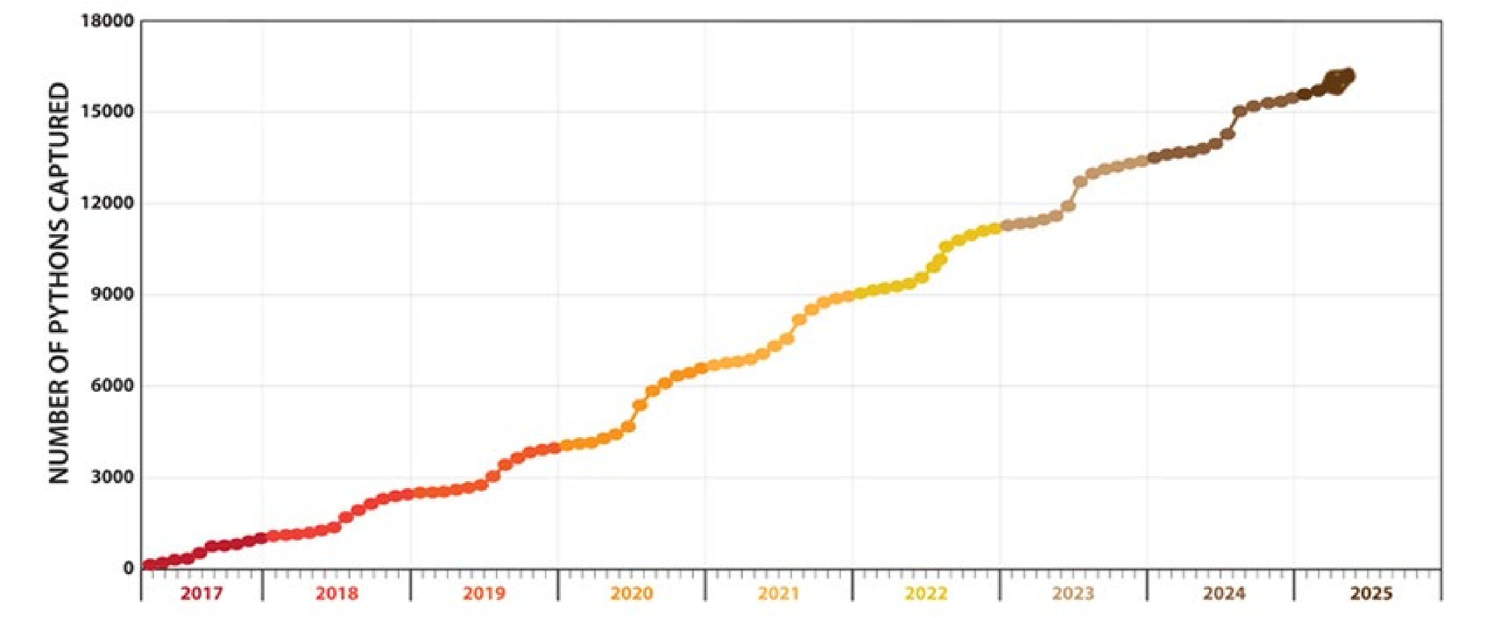
What data do we have?

Number of snakes removed from SFWMD and FWC removal program

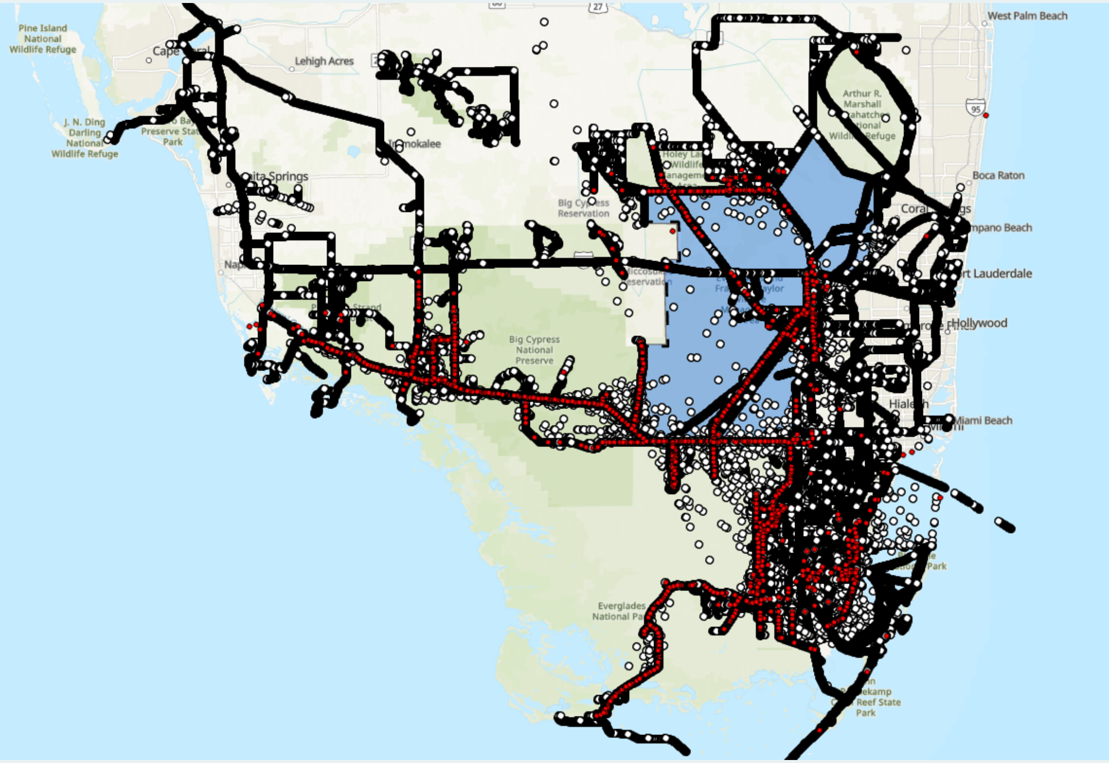
What data do we need for a model?

Survey effort

Survey locations



Currently available data



Contractor locations and effort

As of February 2021, ESRI’s Survey123 app and ‘MyTracks’ feature used for contractor invoicing

Surveys must be linked to capture success and failure

An initial model

Starting simple

Starting with a specific site (EFST)*

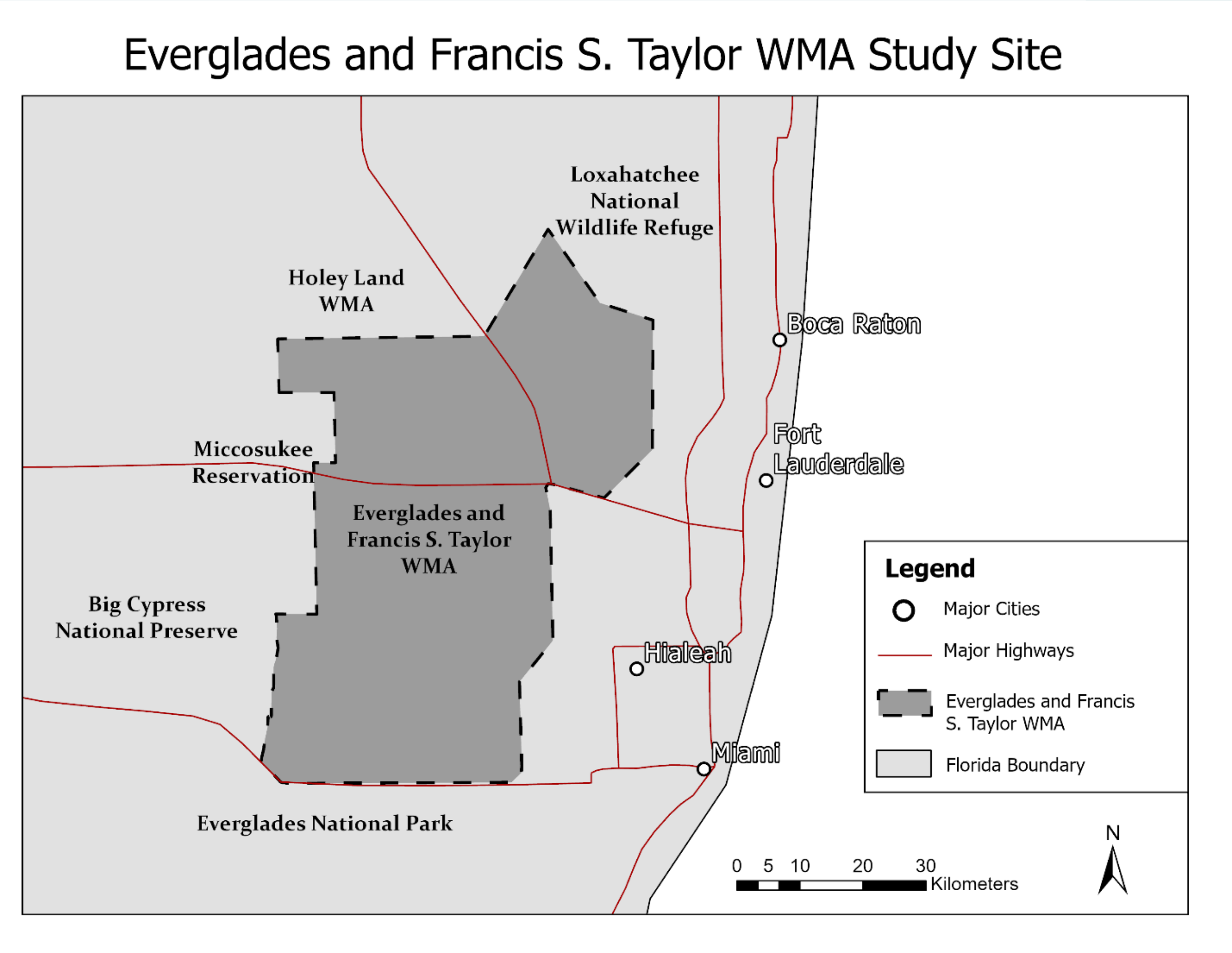
Assuming population closure

- No birth, death, or migration
- Short sampling period

Beginning with February 2021

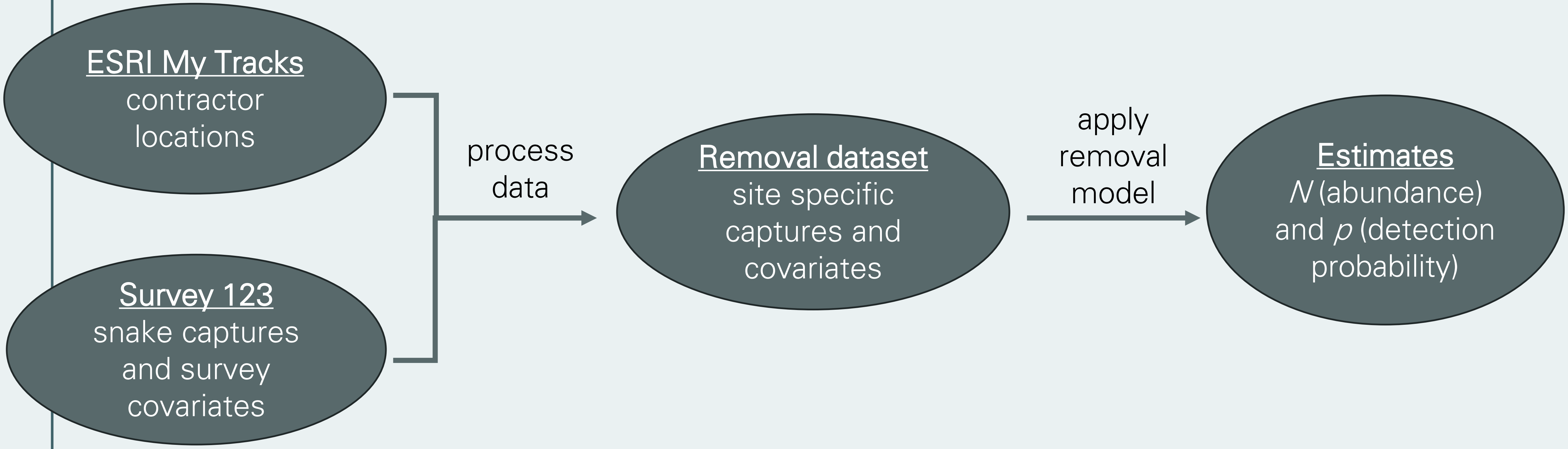
Modeling framework

Removal model using N-mixture framework



*Brandon Welty
Linking Burmese Python Ecology with Removal Efforts in the Everglades
Session 42, 1:50pm

Analysis workflow



Processing data

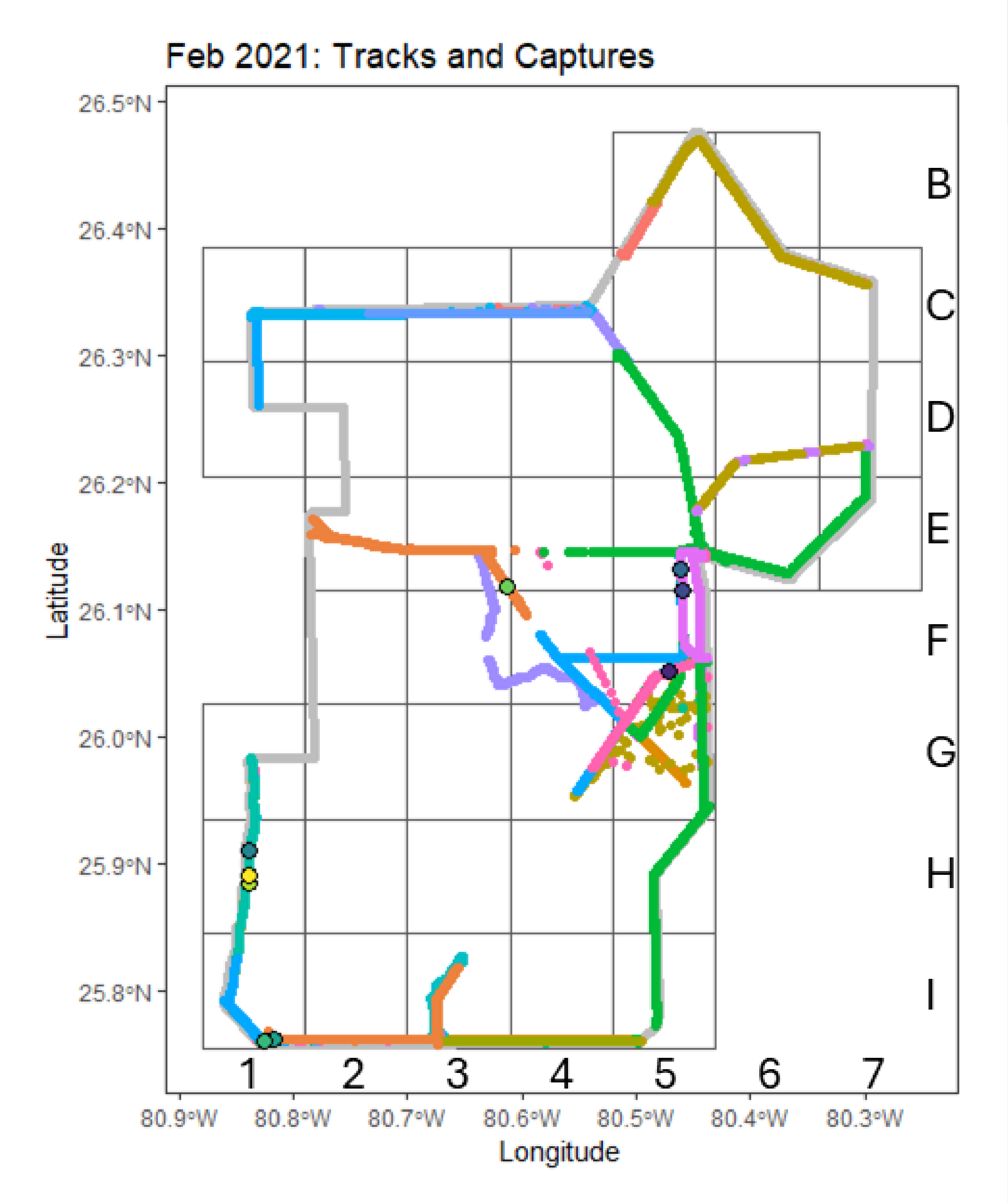
	site	date	effort_hours	captures	day
1	C2	2021-02-05	0.9958333	0	1
2	C3	2021-02-05	0.9041667	0	1
3	C4	2021-02-05	0.9602778	0	1
4	E5	2021-02-05	2.2980556	2	1
5	E6	2021-02-05	0.1844444	0	1

February 2021 data

30 sites with associated search effort, searched for 1-17 days

Sites searched 0.5 – 2.5 hrs per site per day

10 python captures

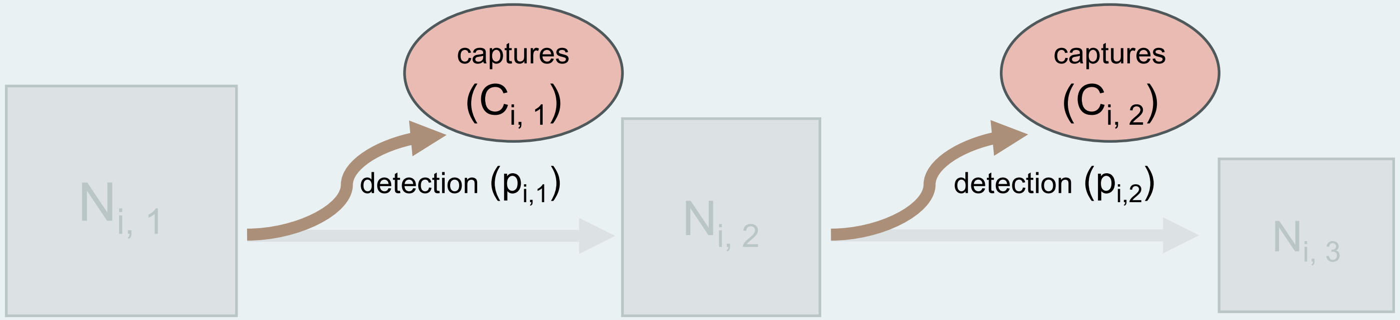


N-mixture removal model

Observation process:

$C_{i,t} \sim Binomial(N_{i,t}, p_{i,t})$

$logit(p_{i,t}) = \beta_0 + \beta_1 effort_{i,t}$



Underlying state process:

$N_{i,t} \sim Poisson(\lambda)$ for $t = 1$

$N_{i,t} = N_{i,t-1} - C_{i,t}$ for $t \geq 2$

Estimating λ, β_0, and β_1

site *i* time *t*

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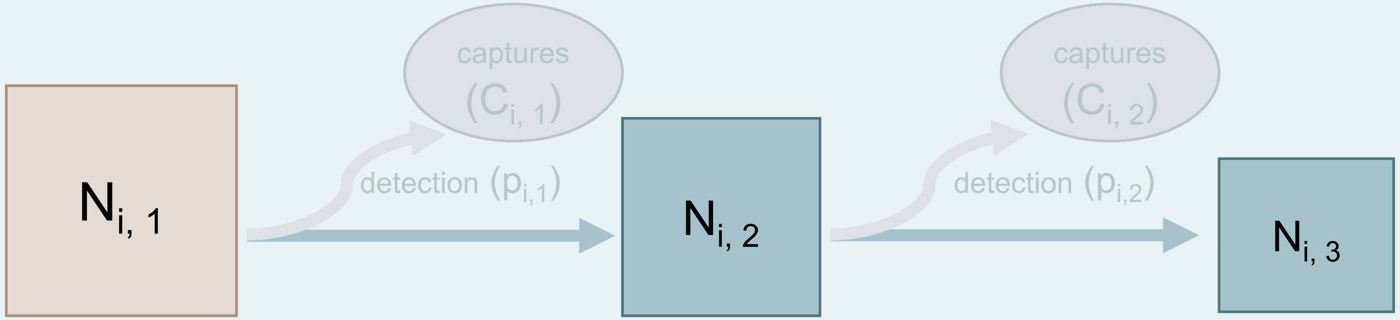

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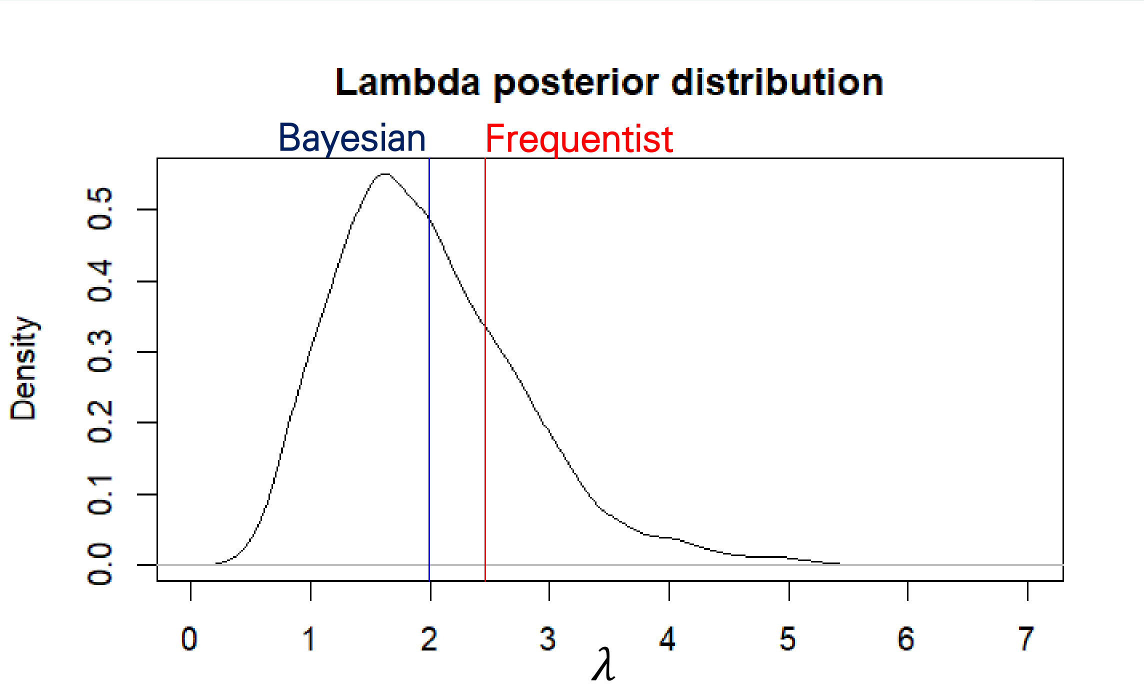
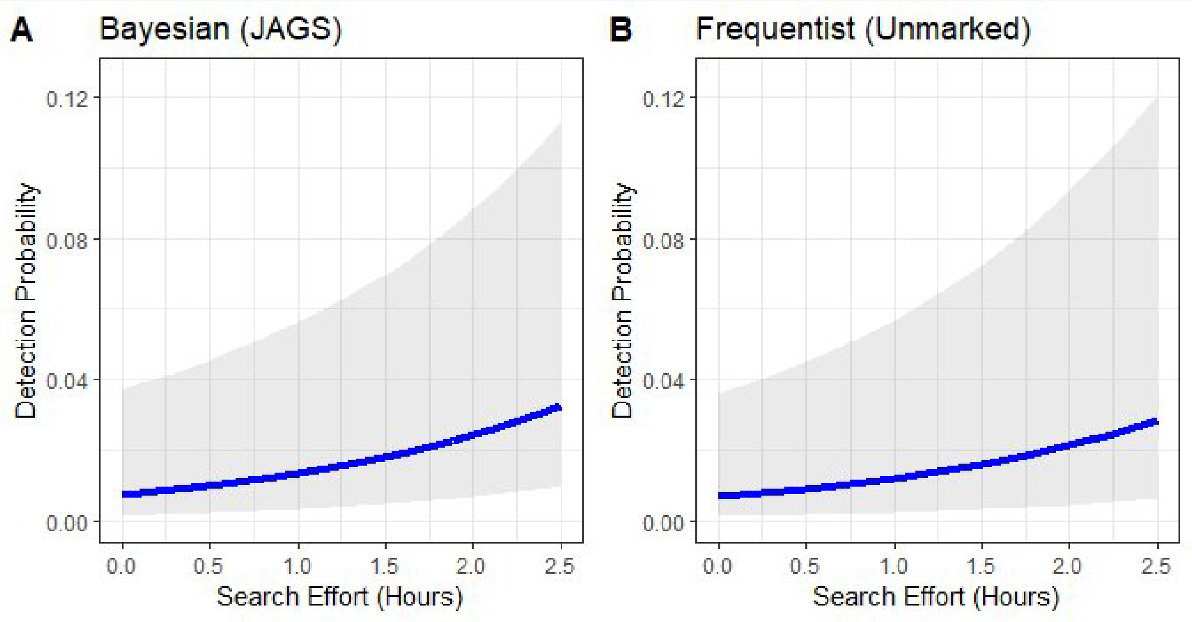
N-mixture model results

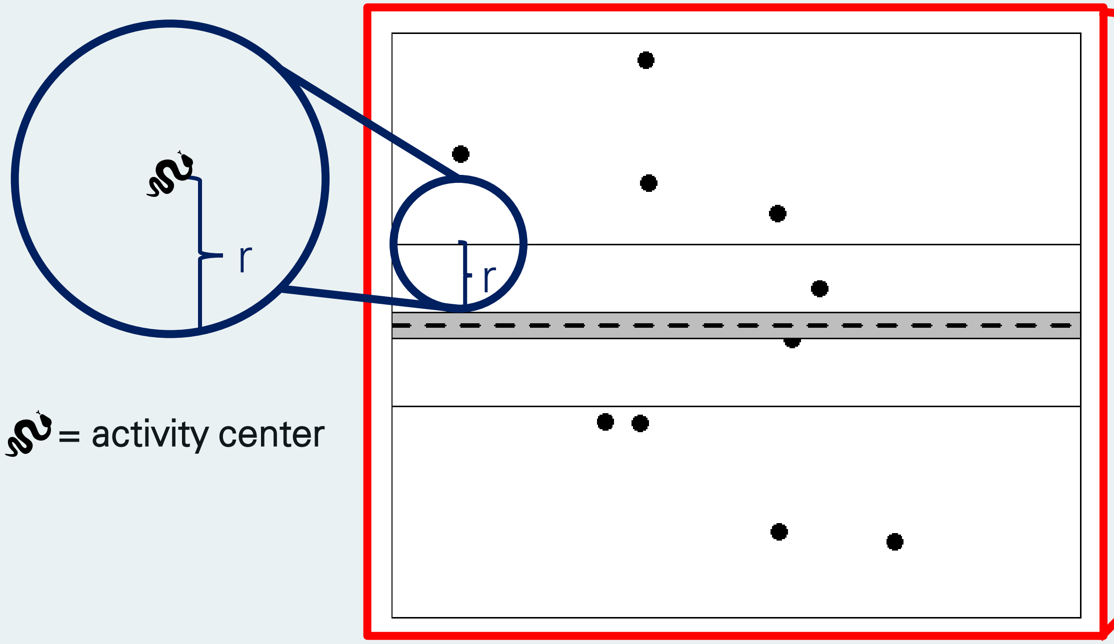
Method	Parameter	Mean	LCI	UCI
Bayesian	λ	1.977	0.723	2.411
Frequentist	λ	2.46	0.806	7.528
Bayesian	β_0	-4.761	-6.259	-4.195
	β_1	0.594	0.319	0.690
	p(1hr)	0.015	0.004	0.064
Frequentist	β_0	-5.005	-6.719	-3.291
	β_1	0.589	0.292	0.887
	p(1hr)	0.012	0.002	0.057

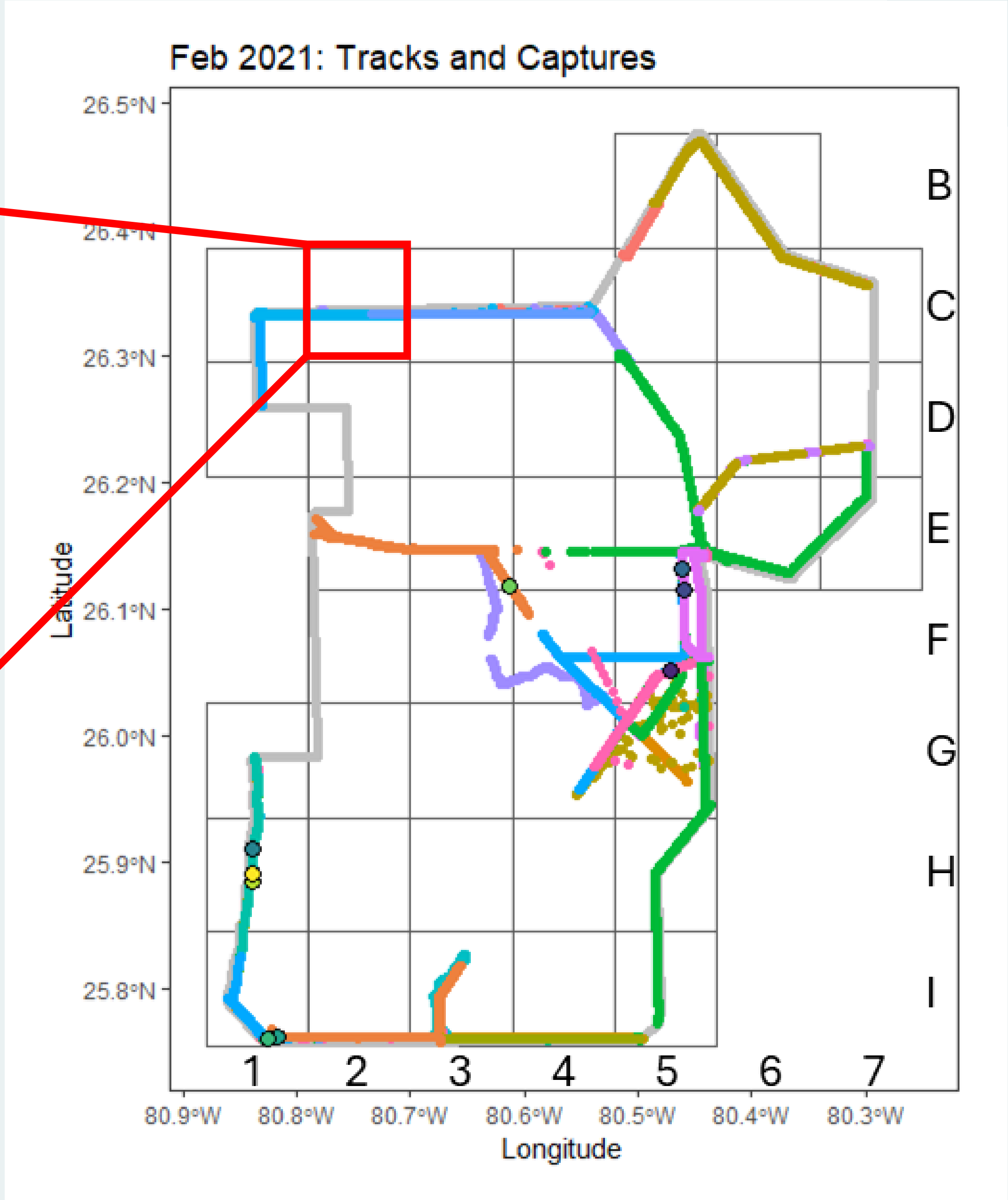




Preliminary Information-Subject to Revision. Not for Citation or Distribution

Interpreting results



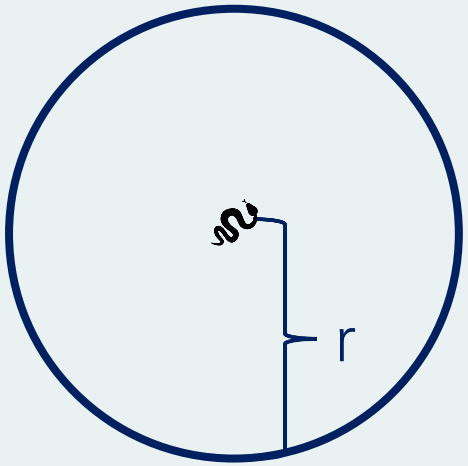


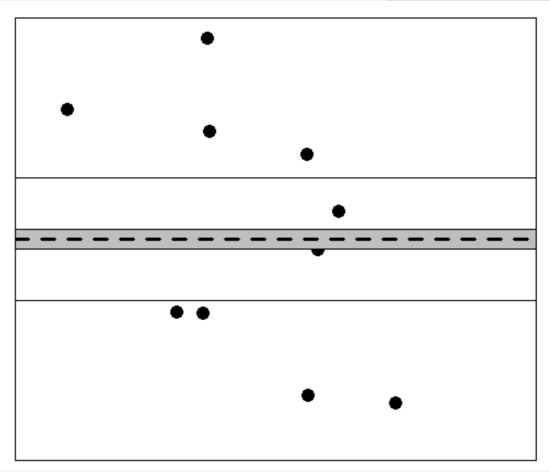
Interpreting lambda

Approximately 2 pythons per 90 km^2

$$\lambda = Density * Effective\ Sampling\ Area_i$$

Incorporating movement

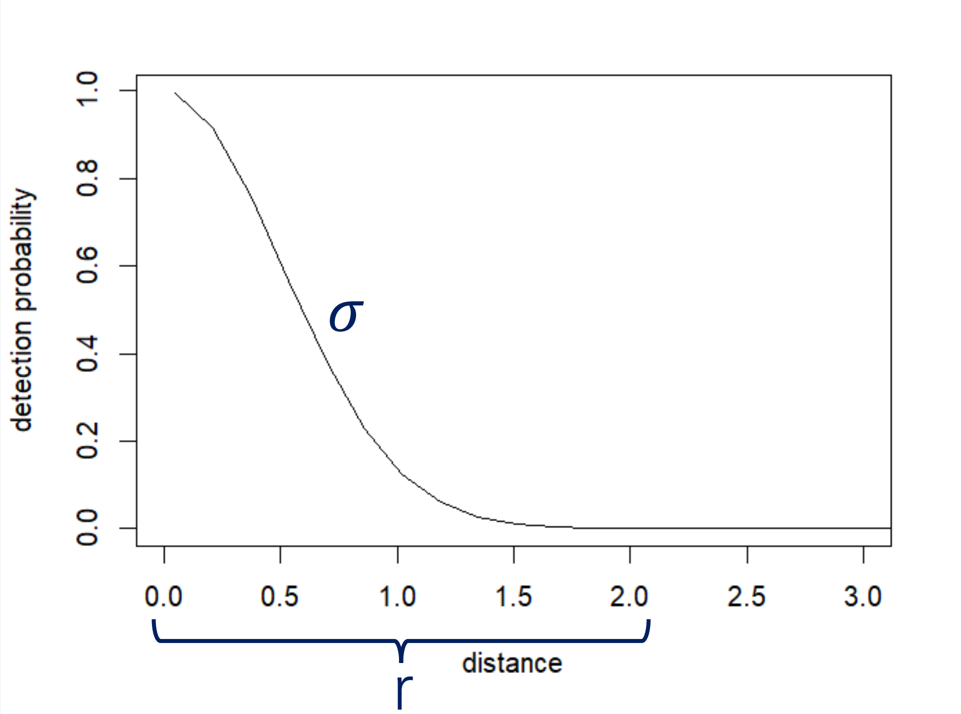




Distance sampling framework

$$p_i = p_0 \exp\left(-\frac{dist_i^2}{2\sigma^2}\right)$$

Typically, σ is estimated and distance is known



Potential solution

Using Data Augmentation to estimate number of activity centers

Testing through simulation

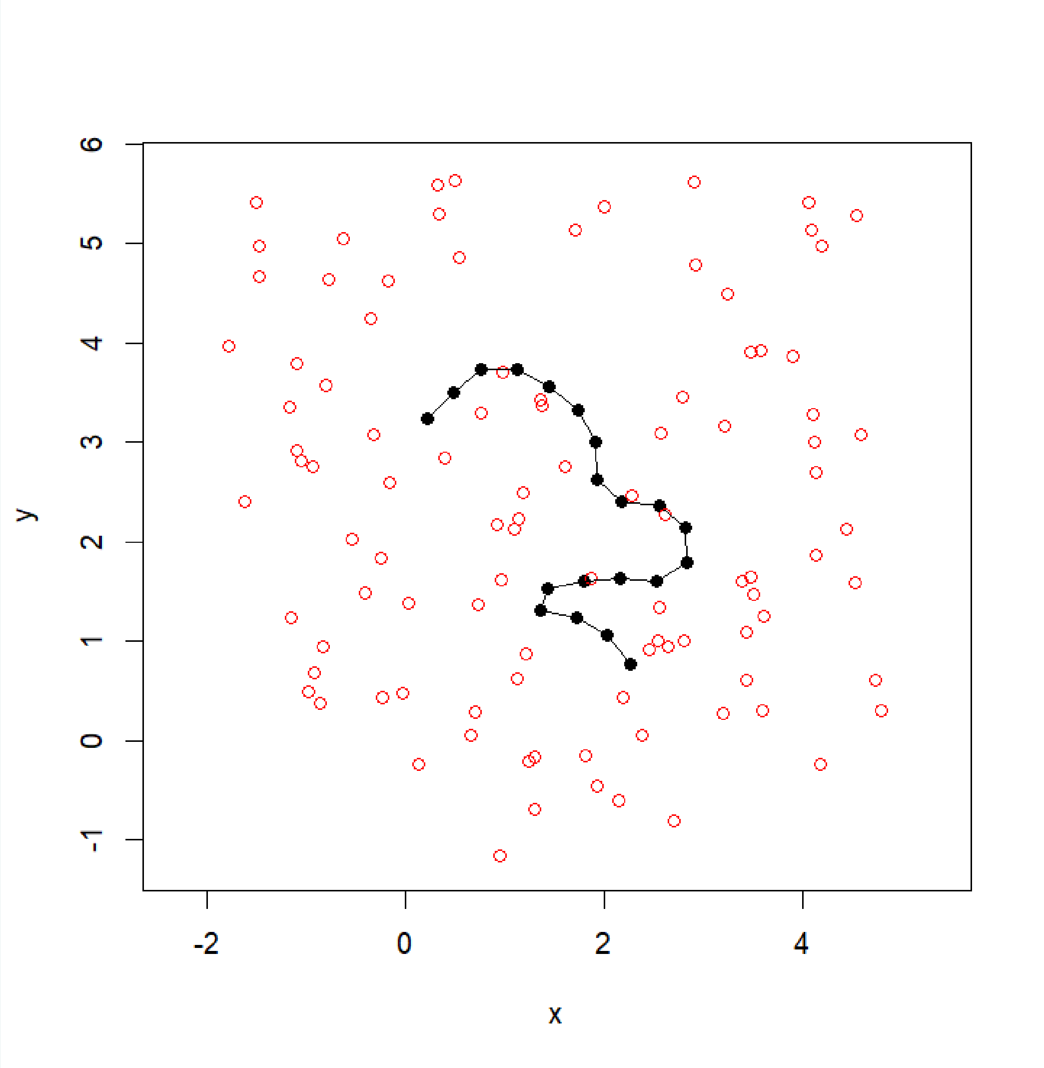
Simulated data

100 individuals

5 sampling occasions with removal

Transect divided into 20 potential capture locations

Estimate abundance with and without an informative σ prior



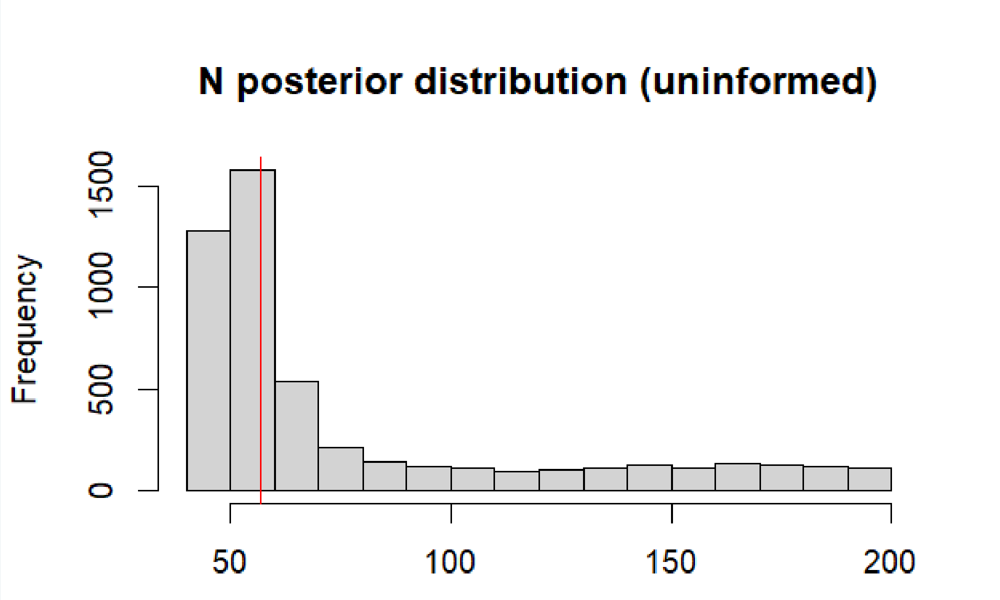
Testing through simulation

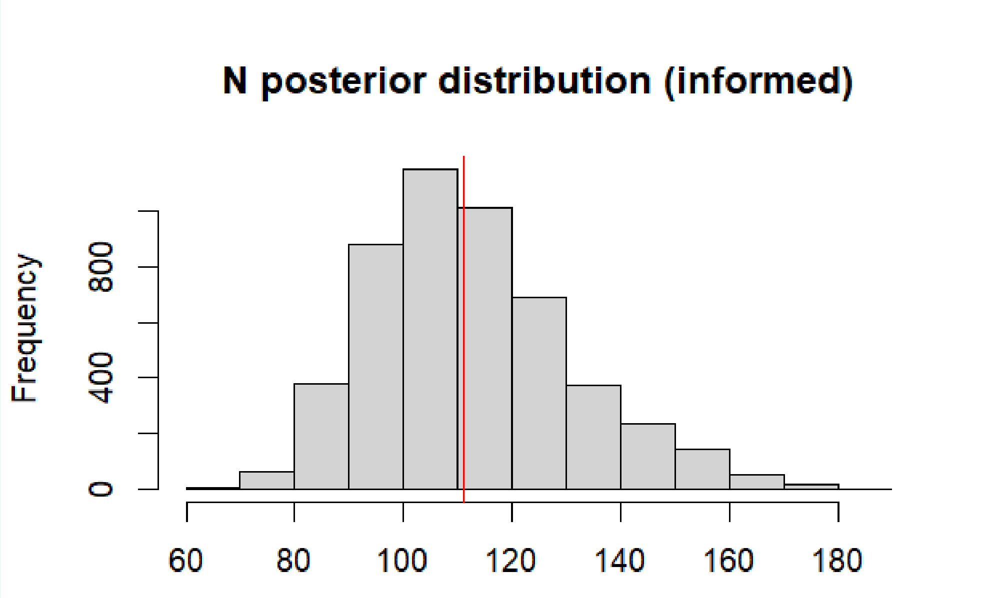
Results

Estimated abundance approaches truth when informative σ prior is used

Next steps

Incorporate true space-use ecology of pythons in EFST





Next steps

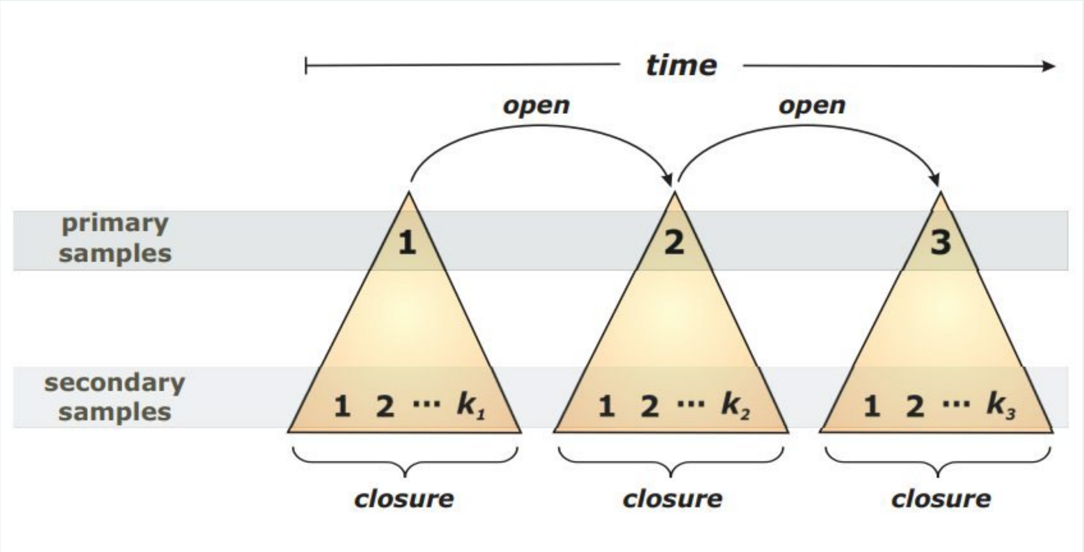
Additional covariates

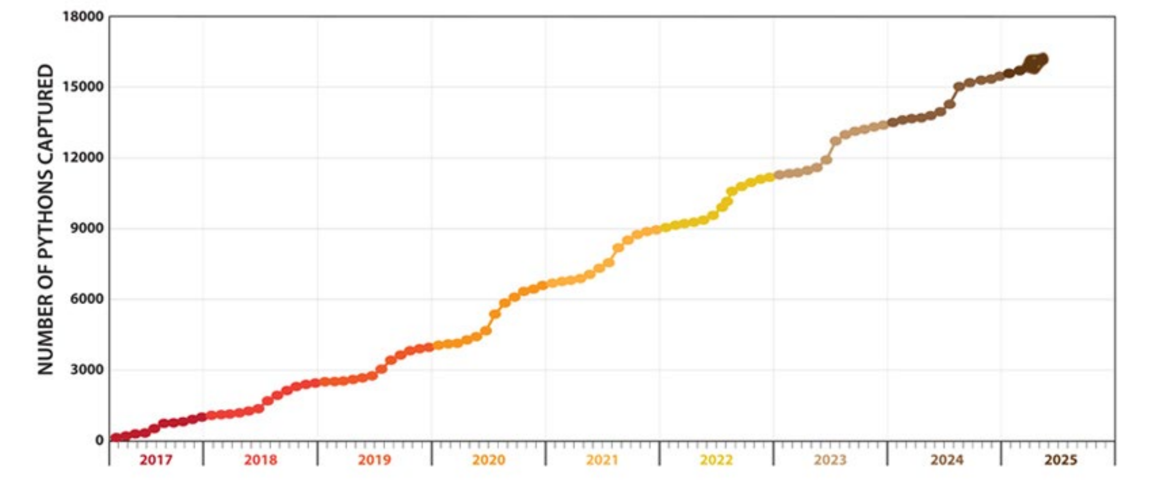
Habitat covariates of density λ

Sex and breeding season covariates of movement σ

Multiple closed periods

Expand model using 'Robust-Design' framework





Thank you!

Questions?

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Data augmentation and distance

Data augmentation

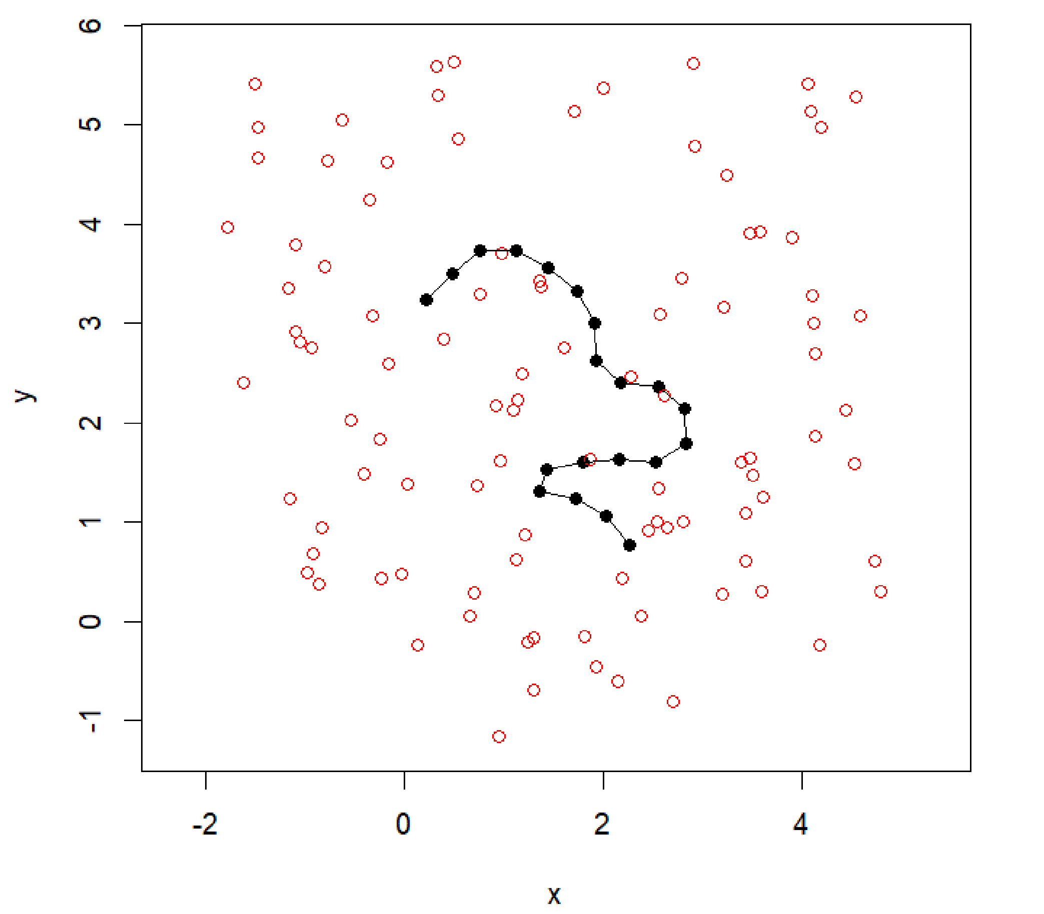
M = number of potential individuals

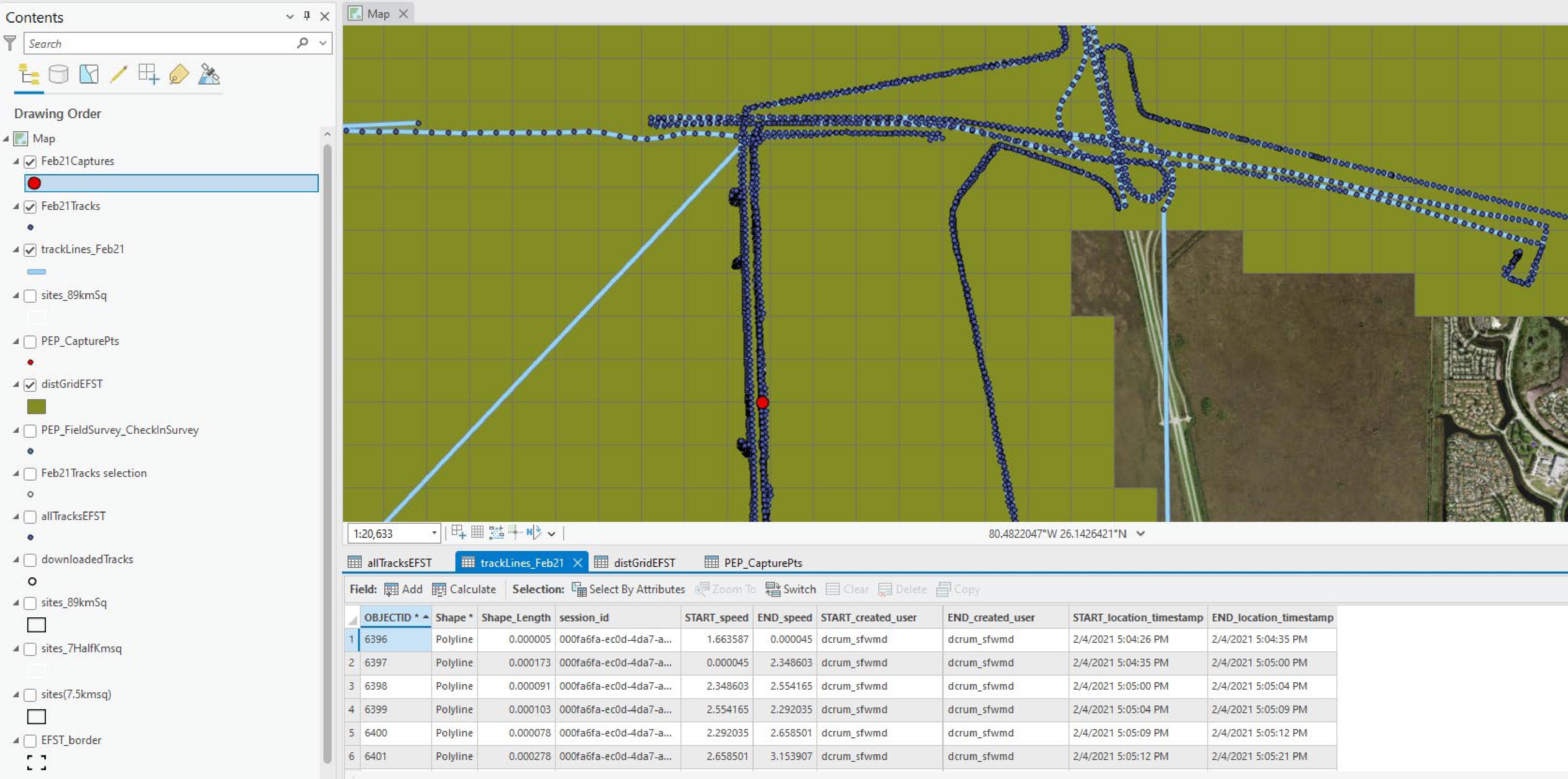
$z_i \sim Bernoulli(\psi)$, $\quad N = \sum_{i=1}^{M} z_i$

Distance

$$p_{i,t} = p_0 \exp\left(-\frac{dist_{i,t}^2}{2\sigma_i^2}\right) * z_i$$

$$c_{i,t} \sim Categorical(p_{i,t})$$





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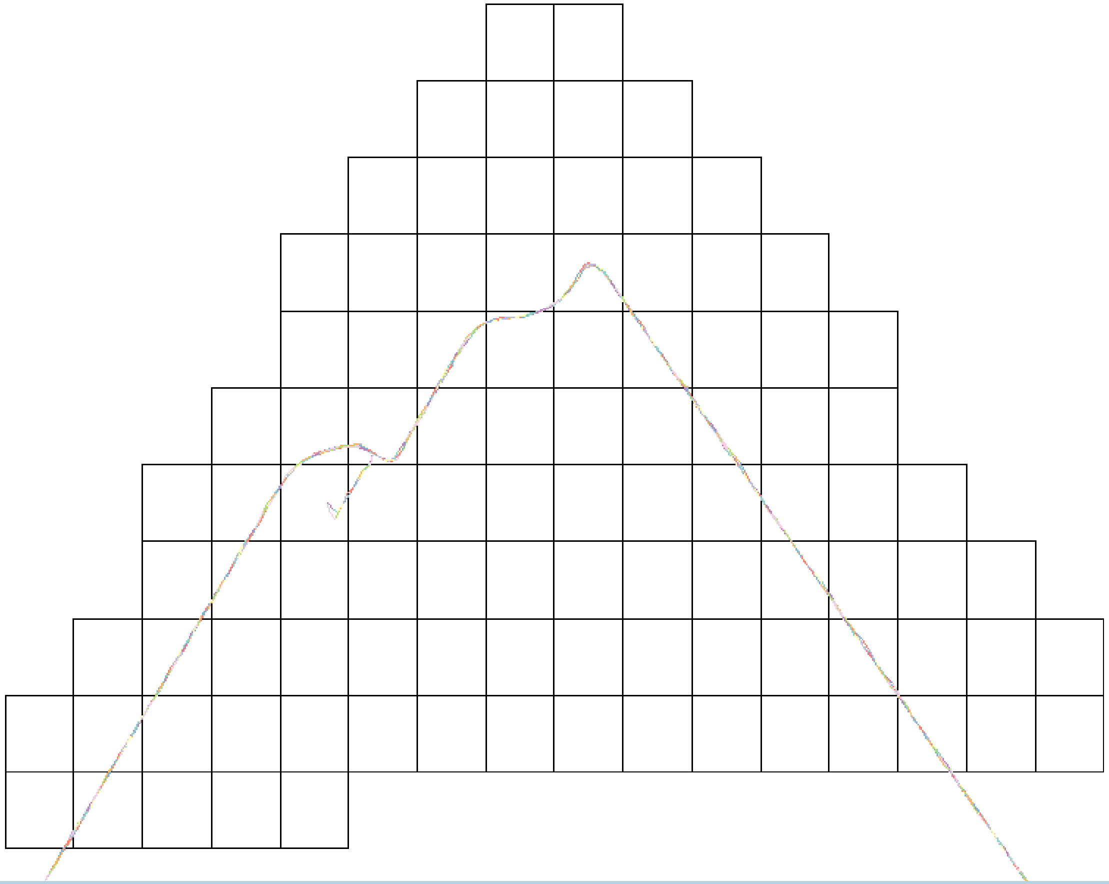
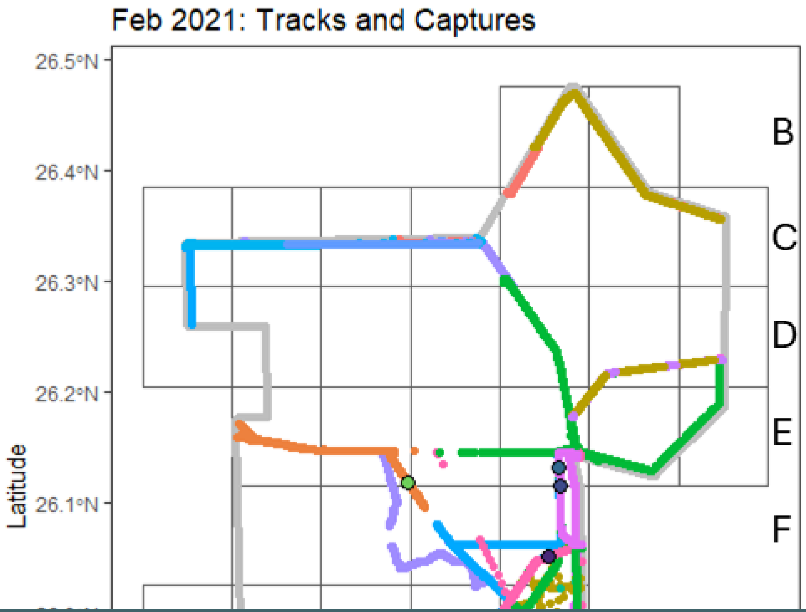
2	6397	Polyline	0.000173	000fa6fa-ec0d-4da7-a...	0.000045	2.348603	dcrum_sfwmd	dcrum_sfwmd	2/4/2021 5:04:35 PM	2/4/2021 5:05:00 PM
3	6398	Polyline	0.000091	000fa6fa-ec0d-4da7-a...	2.348603	2.554165	dcrum_sfwmd	dcrum_sfwmd	2/4/2021 5:05:00 PM	2/4/2021 5:05:04 PM
4	6399	Polyline	0.000103	000fa6fa-ec0d-4da7-a...	2.554165	2.292035	dcrum_sfwmd	dcrum_sfwmd	2/4/2021 5:05:04 PM	2/4/2021 5:05:09 PM
5	6400	Polyline	0.000078	000fa6fa-ec0d-4da7-a...	2.292035	2.658501	dcrum_sfwmd	dcrum_sfwmd	2/4/2021 5:05:09 PM	2/4/2021 5:05:12 PM
6	6401	Polyline	0.000278	000fa6fa-ec0d-4da7-a...	2.658501	3.153907	dcrum_sfwmd	dcrum_sfwmd	2/4/2021 5:05:12 PM	2/4/2021 5:05:21 PM





	V1	V2	V3	V4	V5
1	0.0000 [m]	223.7801 [m]	335.5276 [m]	250.0006 [m]	335.5276 [m]
2	223.7801 [m]	0.0000 [m]	512.6542 [m]	335.5276 [m]	250.0006 [m]
3	335.5276 [m]	512.6542 [m]	0.0000 [m]	223.7844 [m]	447.5689 [m]
4	250.0006 [m]	335.5276 [m]	223.7844 [m]	0.0000 [m]	223.7844 [m]
5	335.5276 [m]	250.0006 [m]	447.5689 [m]	223.7844 [m]	0.0000 [m]

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