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Optimizing animal movement studies

Developing an application to evaluate study design

Inês Maria Simões Silva
i.simoes-silva@hzdr.de

HZDR HELMHOLTZ ZENTRUM DRESDEN ROSSENDORF
TECHNISCHE UNIVERSITÄT DRESDEN
CBG Max Planck Institute of Molecular Cell Biology and Genetics
UFZ HELMHOLTZ Centre for Environmental Research
Uniwersytet Wrocławski

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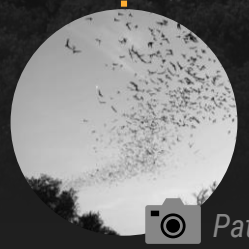
Scientists have been systematically tracking individual animal movements since the 1800s, employing ever-evolving technologies.


Fred Zwicky

1800s
Bird banding


Patricia Lim

1940s
Radar

1960s
Radio telemetry

1990s
GPS technology

2000s
Nanotechnology, drones

Leon Berard

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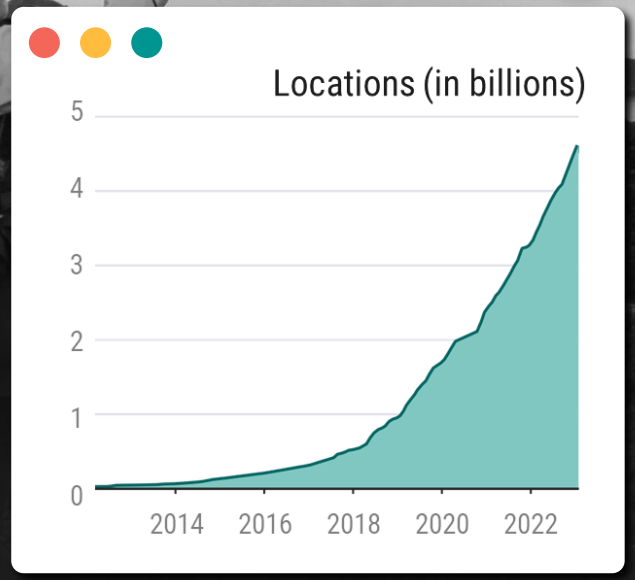

Movebank.org

Large-scale data collection is revolutionizing our understanding of animal movement, **opening new frontiers for research and conservation.**

Leon Berard

move design

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Define research questions

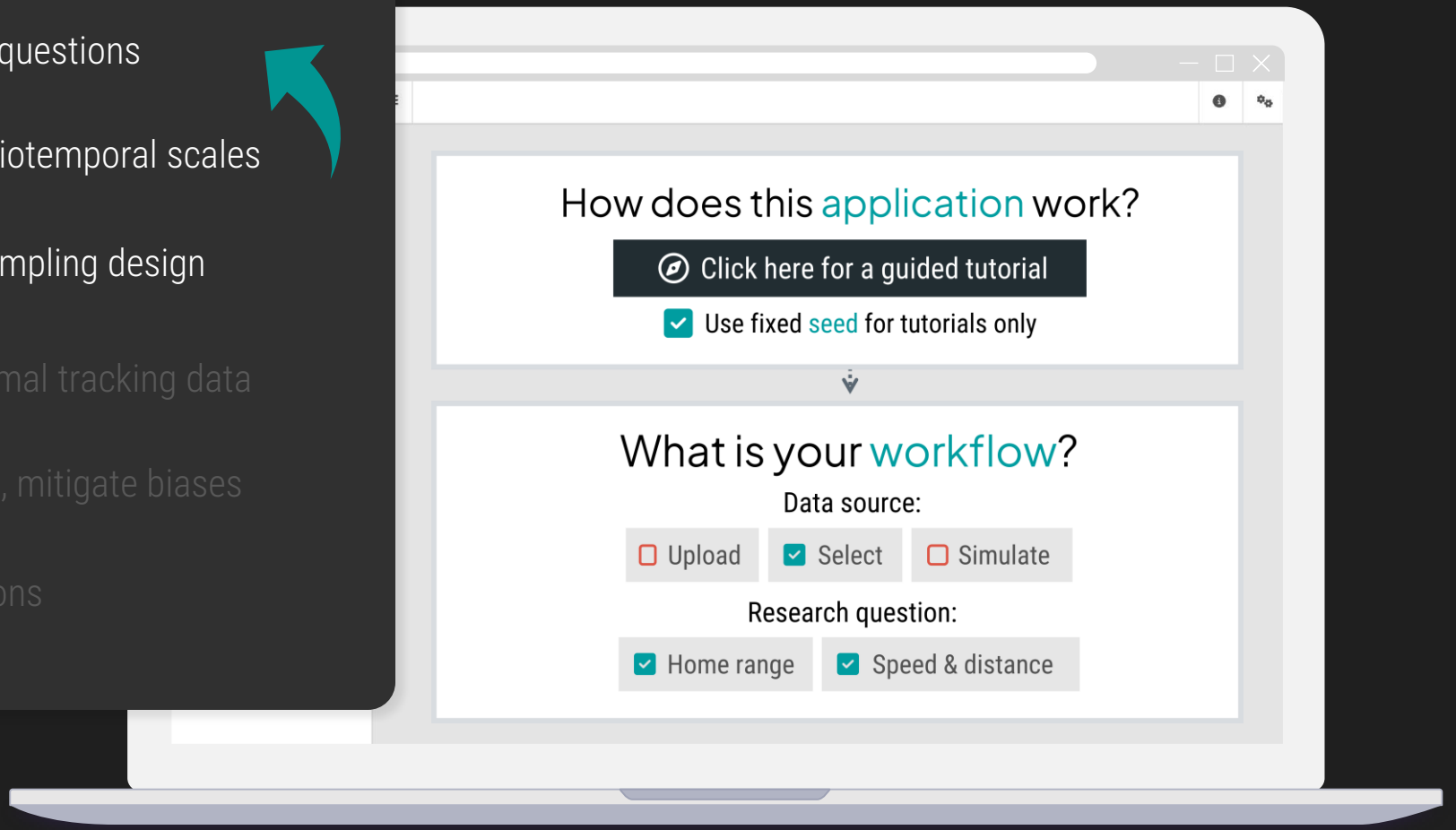
Identify spatiotemporal scales

Choose sampling design

Collect animal tracking data

Analyze data, mitigate biases

Assess conclusions



move design

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- Define research questions
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- Choose sampling design
- Collect animal tracking data
- Analyze data, mitigate biases
- Assess conclusions

Compromise between

Battery life — *Fix rate*

SAMPLING DURATION
How long is an animal tracked for?

SAMPLING INTERVAL
How much time between new locations?

Users can also currently test:

Data loss,
Location error,
Device storage limitations,
Resolution/battery trade-off,

All can constrain study design.

Researchers design their projects without knowing
how much data is sufficient for potential research targets…..

“what do I do with the data I’ve already collected?”

Collecting data first and setting goals later introduces a risk of aimless exploration during data analyses.

move design

- Define research questions
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ctmm R package
Calabrese et al. (2016)

1.

Animal movement paths are realizations of **continuous stochastic processes**,

2.

Summarize behavior using **characteristic timescales**,

τ_p *Position autocorrelation timescale*

τ_v *Velocity autocorrelation timescale*

move design

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ctmm R package
Calabrese et al. (2016)

1.

Animal movement paths are realizations of continuous stochastic processes,

2.

Summarize behavior using characteristic timescales,

τ_p *Position autocorrelation timescale*

τ_v *Velocity autocorrelation timescale*

3.

These timescales impose constraints on sampling design that *must* be met for sufficiently large (*effective*) sample sizes.

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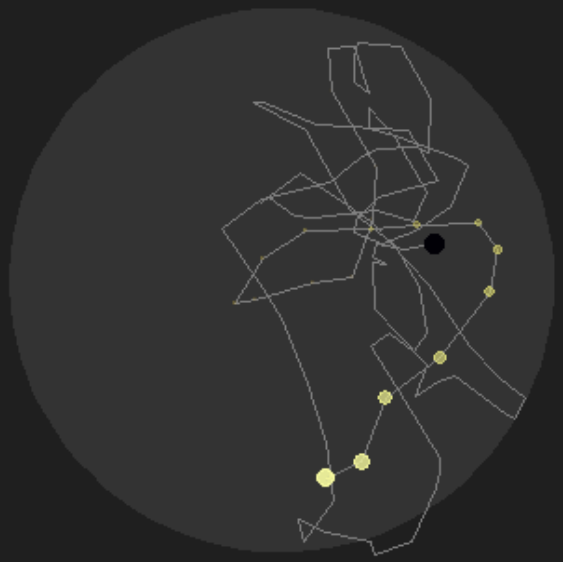
τ_p

Position autocorrelation timescale

τ_p = 1 hour



τ_p = 1 day

τ_p = 5 days

τ_p = 10 days

T

SPACE-USE ◄····· SAMPLING DURATION

☑ HOME RANGE

How long is an animal tracked for?

MOVEMENT BEHAVIOR

☐ SPEED & DISTANCE

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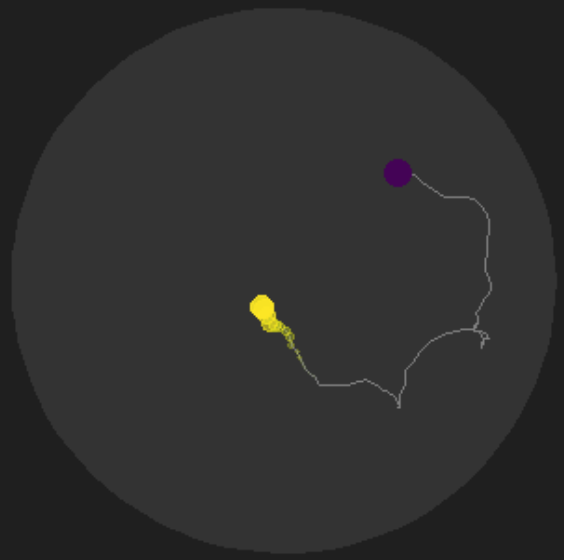
τ_v

Velocity autocorrelation timescale

τ_v = 1 minute

τ_v = 1 hour

τ_v = 12 hours

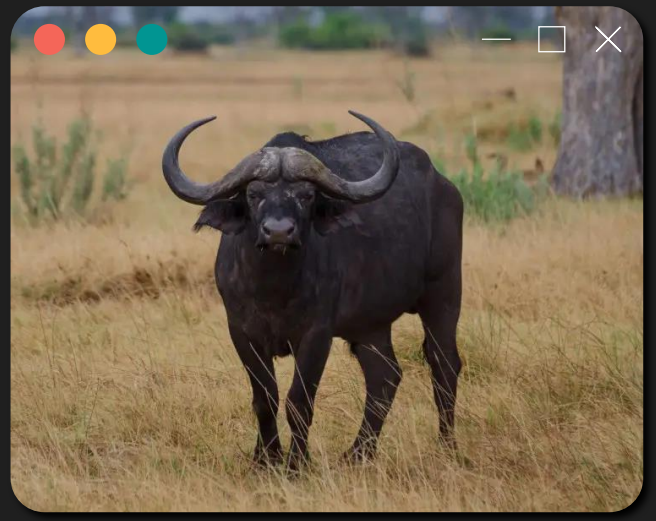


τ_v = 1 day

Δt

SPACE-USE
☐ HOME RANGE

SAMPLING INTERVAL ⋯⋯▸ MOVEMENT BEHAVIOR
How much time between new locations?
☑ SPEED & DISTANCE



African buffalo
(Syncerus caffer)

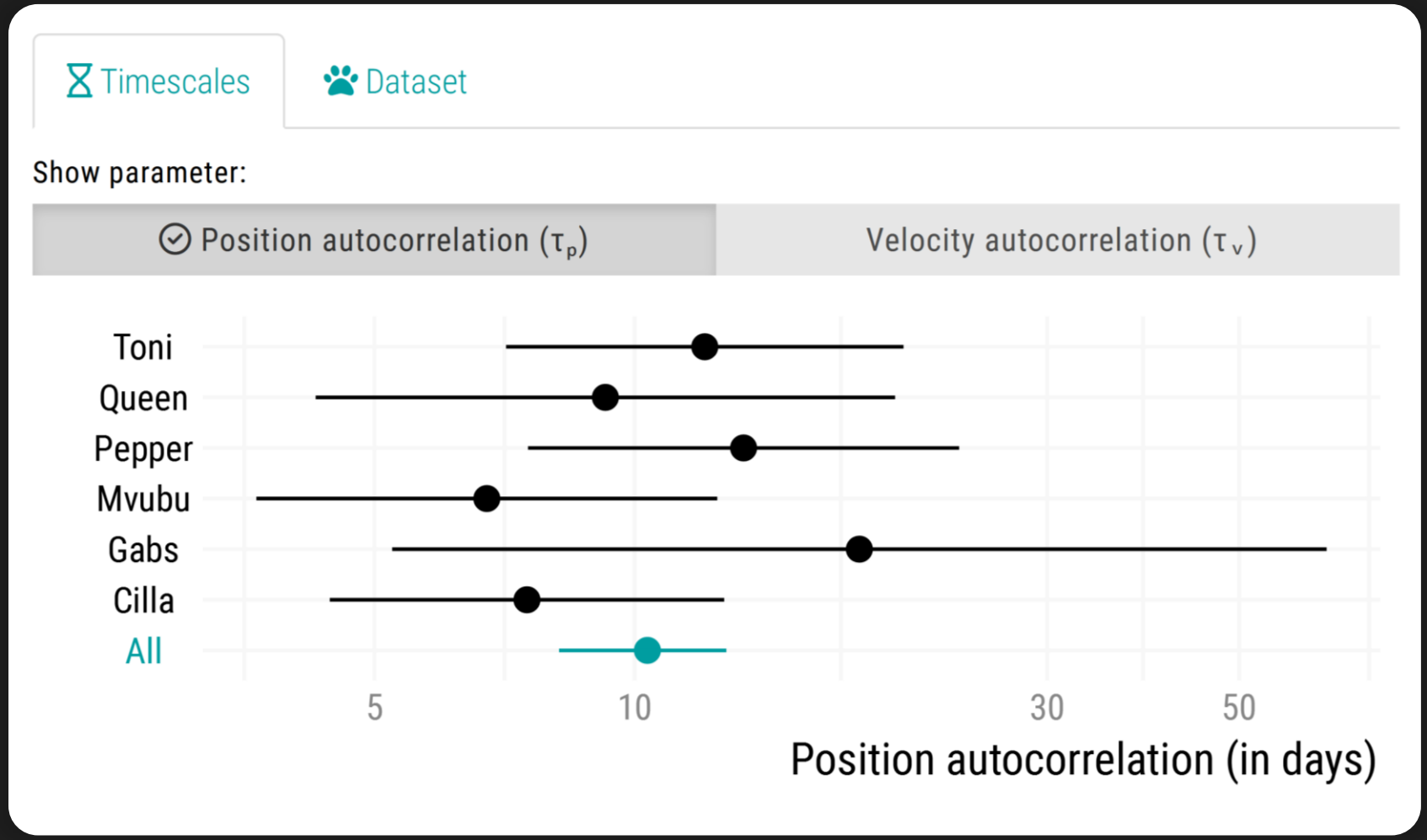
Position autocorrelation

10.3 days

8.2 – 12.8

(τ_p)

These parameters are fairly conservative at the species- and population-level.



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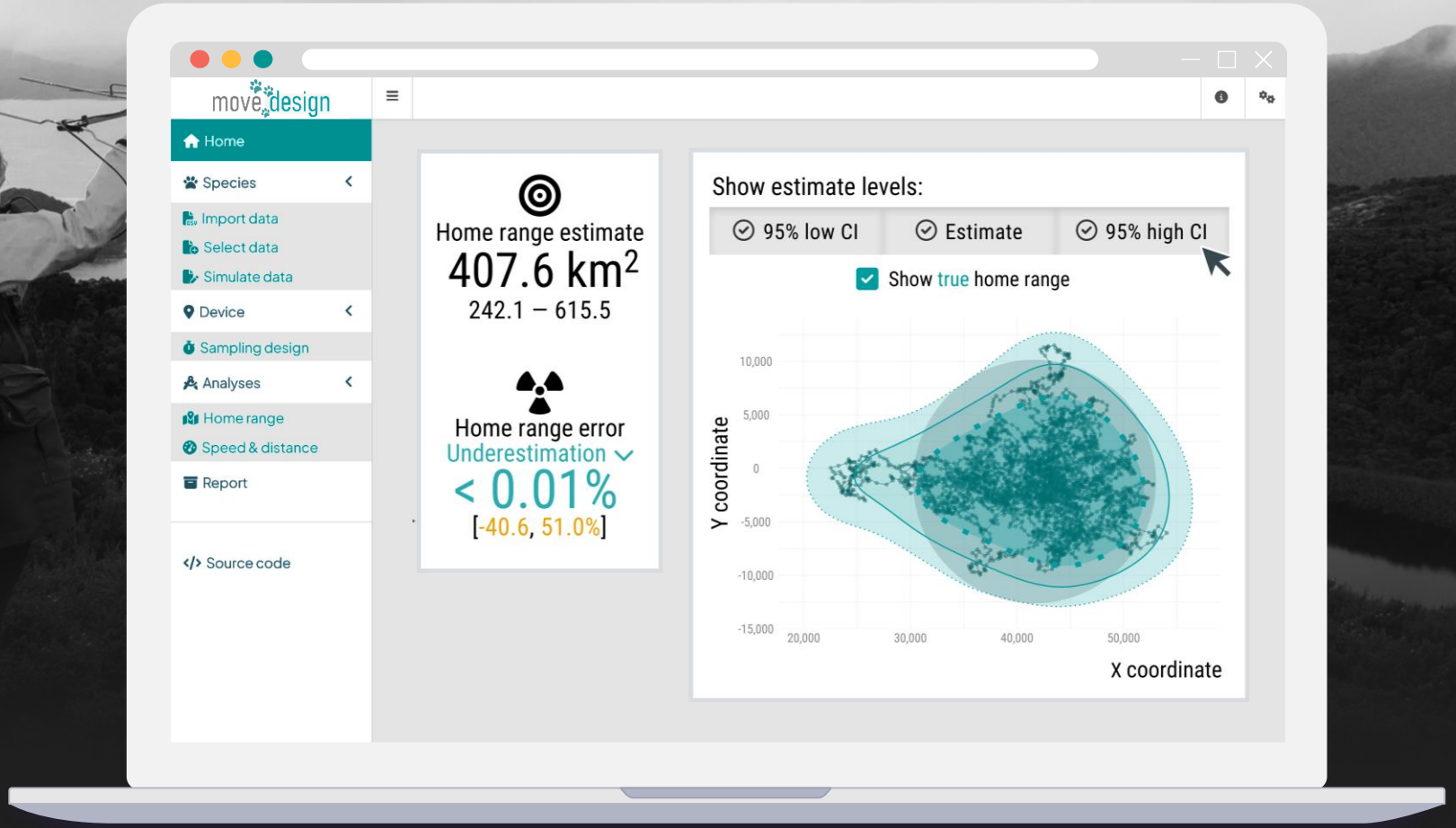
Future goals:

Explore new use cases and test other movement metrics,
Address more challenging sample design questions (*e.g.*, optimal number of tracked individuals).



Leon Berard

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Thank you for your attention!

Check the first paper here!

Special thanks to:

CASUS
Dr. Justin Calabrese
Dr. Jorge Menezes
Dr. Eduardo Colombo

External collaborators
Dr. Chris Fleming
Dr. Michael Noonan
Dr. William Fagan
Dr. Jesse Alston

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