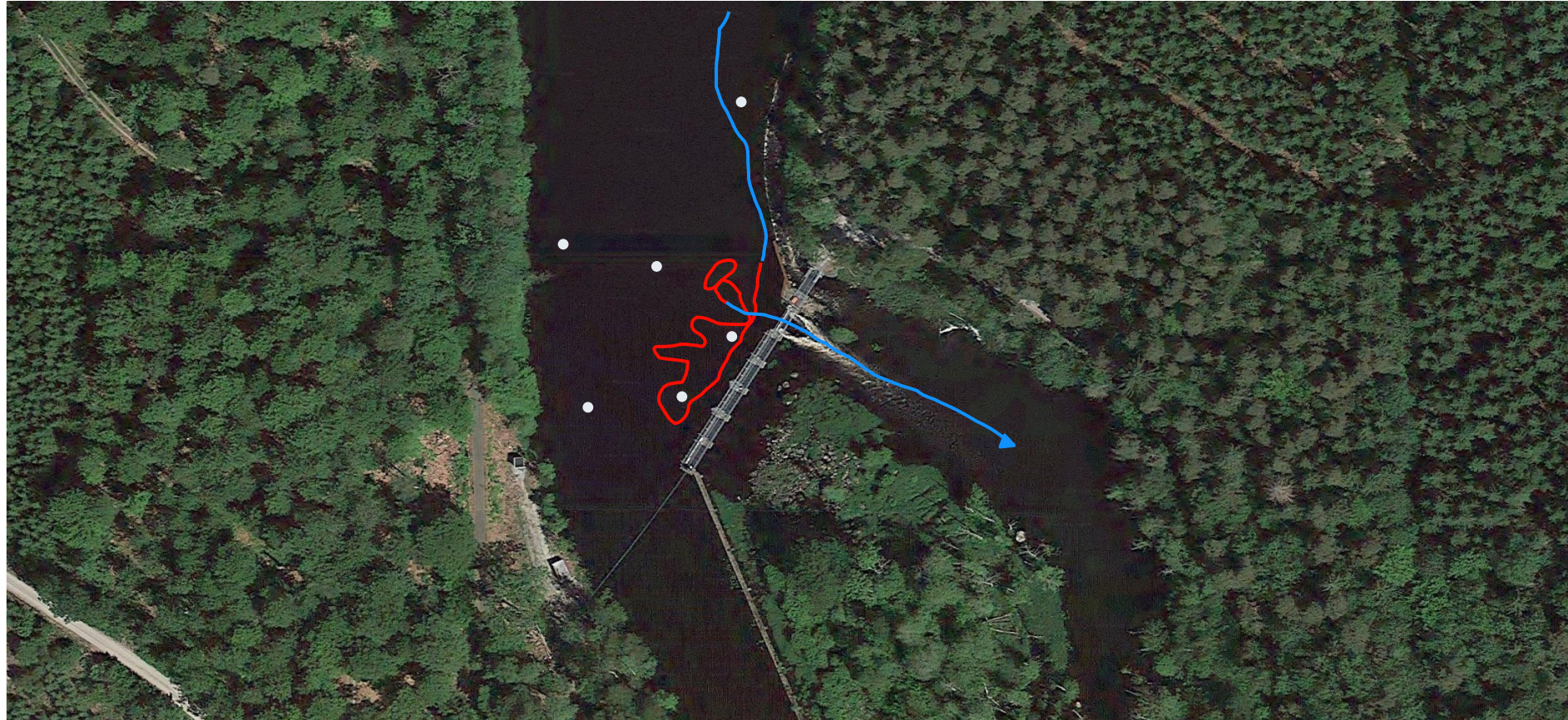# Application of Animal Movement Models to Acoustic Telemetry Positioning

James A. Campbell
Samuel Shry
Olle Calles
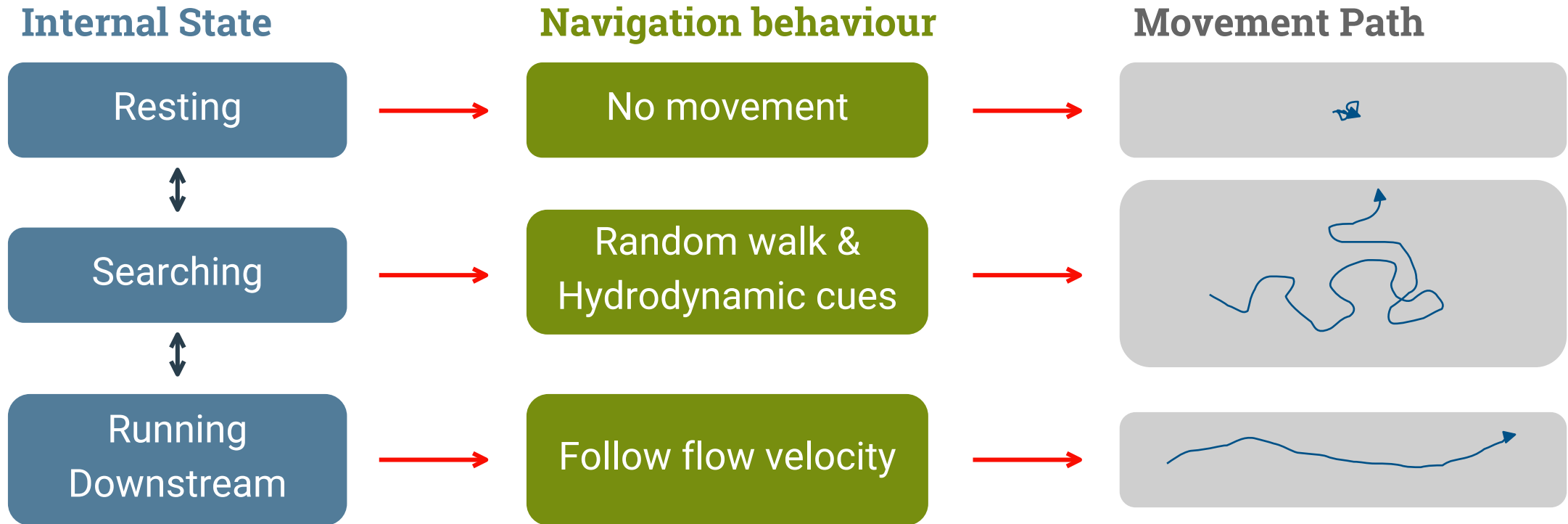**Franz Hölker**

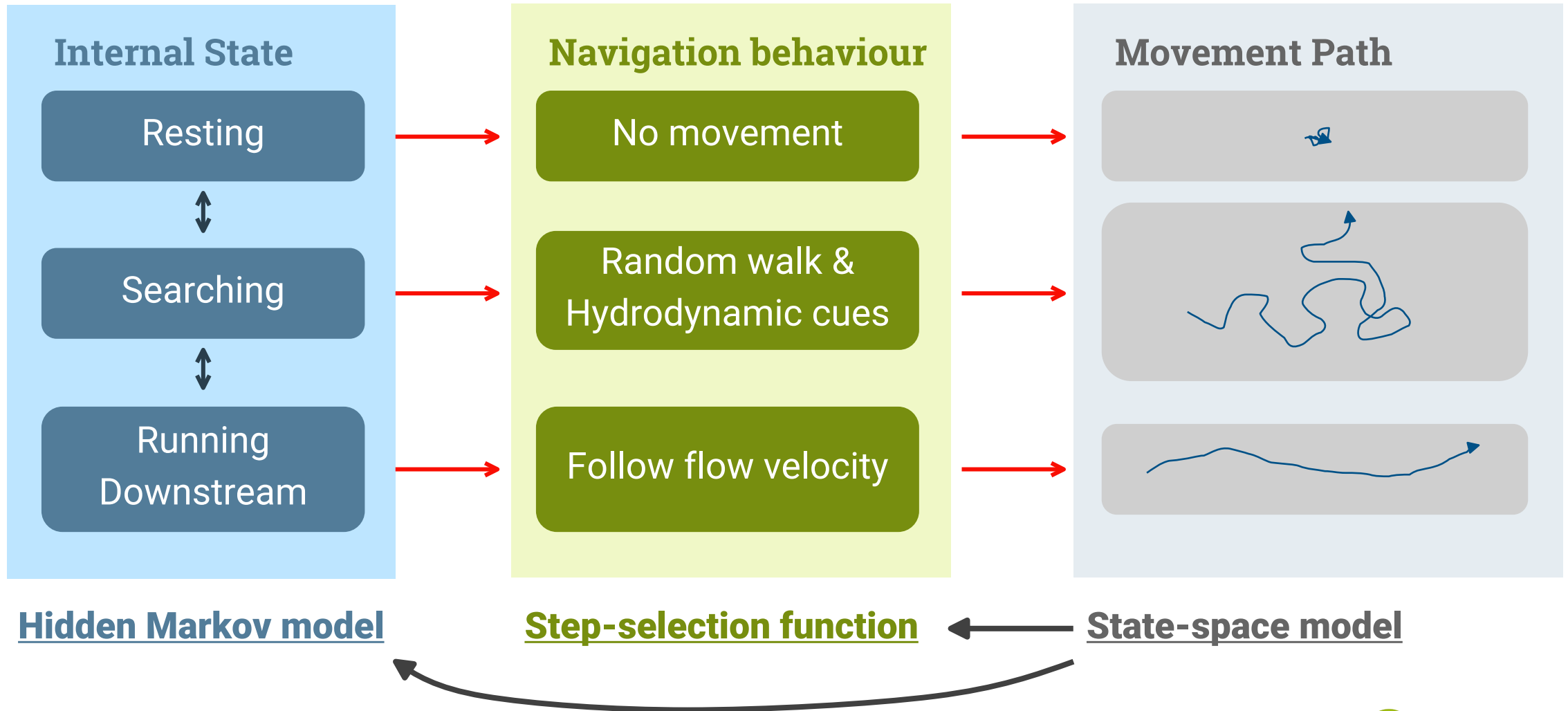# Modelling fish passage behaviour
A typical conceptual model…

IGB

Modelling fish passage behaviour
A typical conceptual model...

Internal State

Navigation behaviour

Movement Path

Resting	→	No movement	→	
Searching	→	Random walk & Hydrodynamic cues	→	
Running Downstream	→	Follow flow velocity	→	

IGB

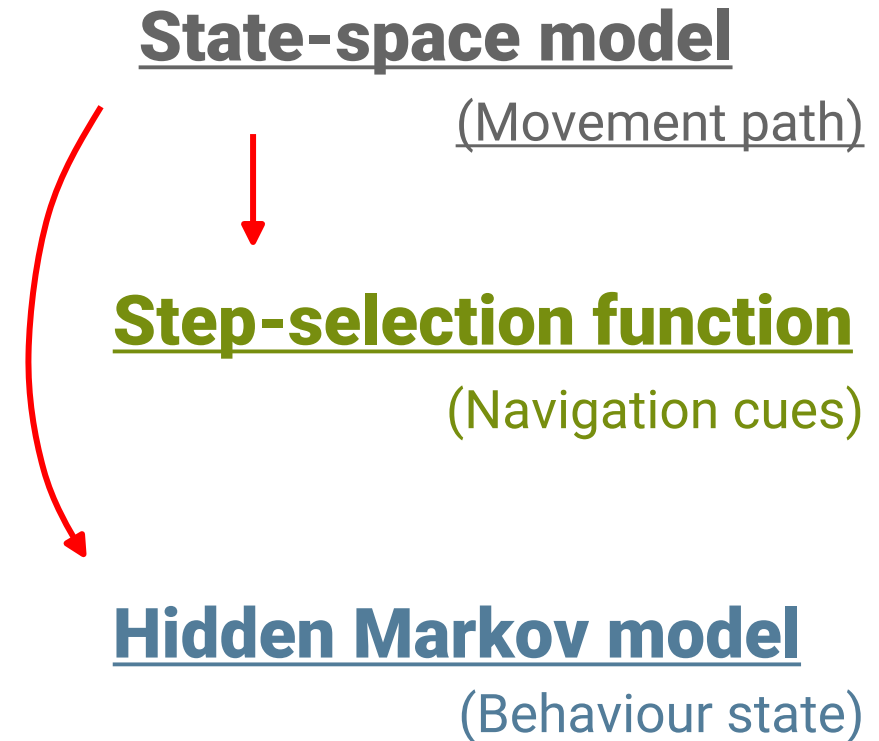# Modelling fish passage behaviour
with animal movement models

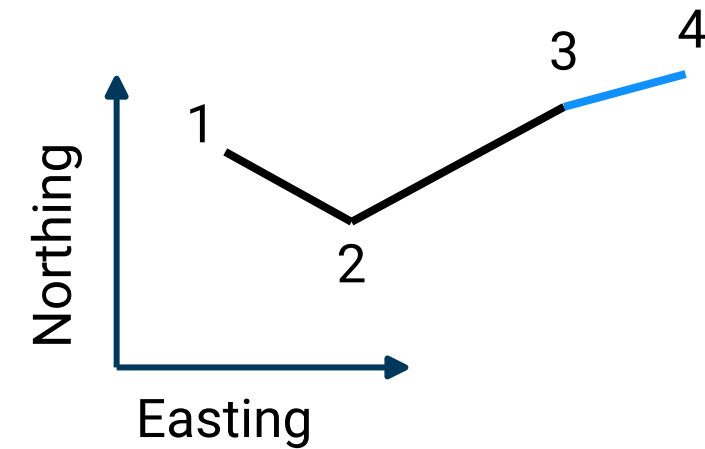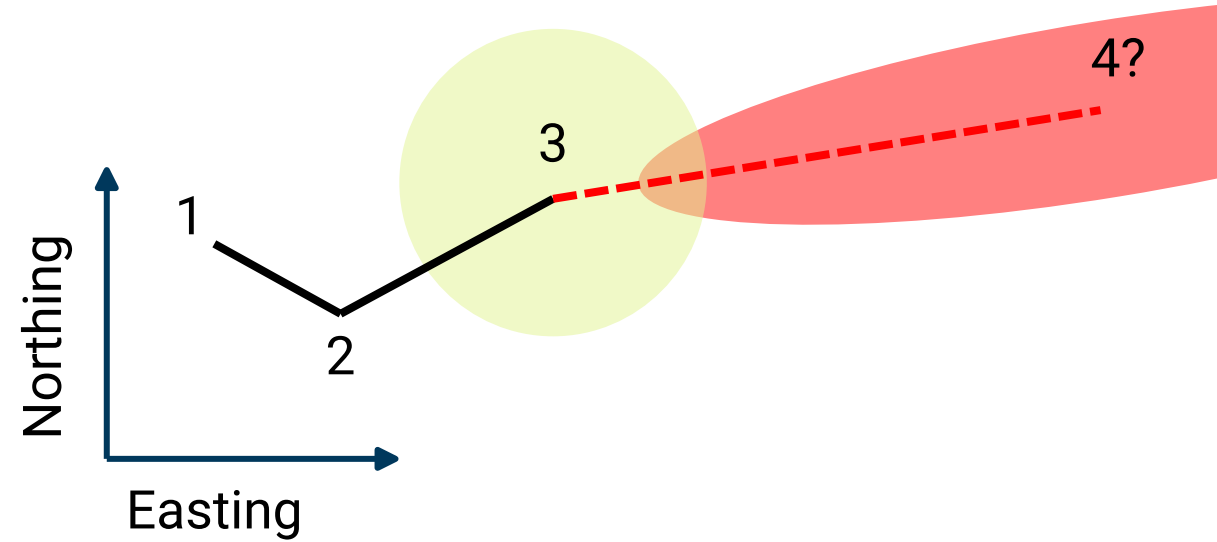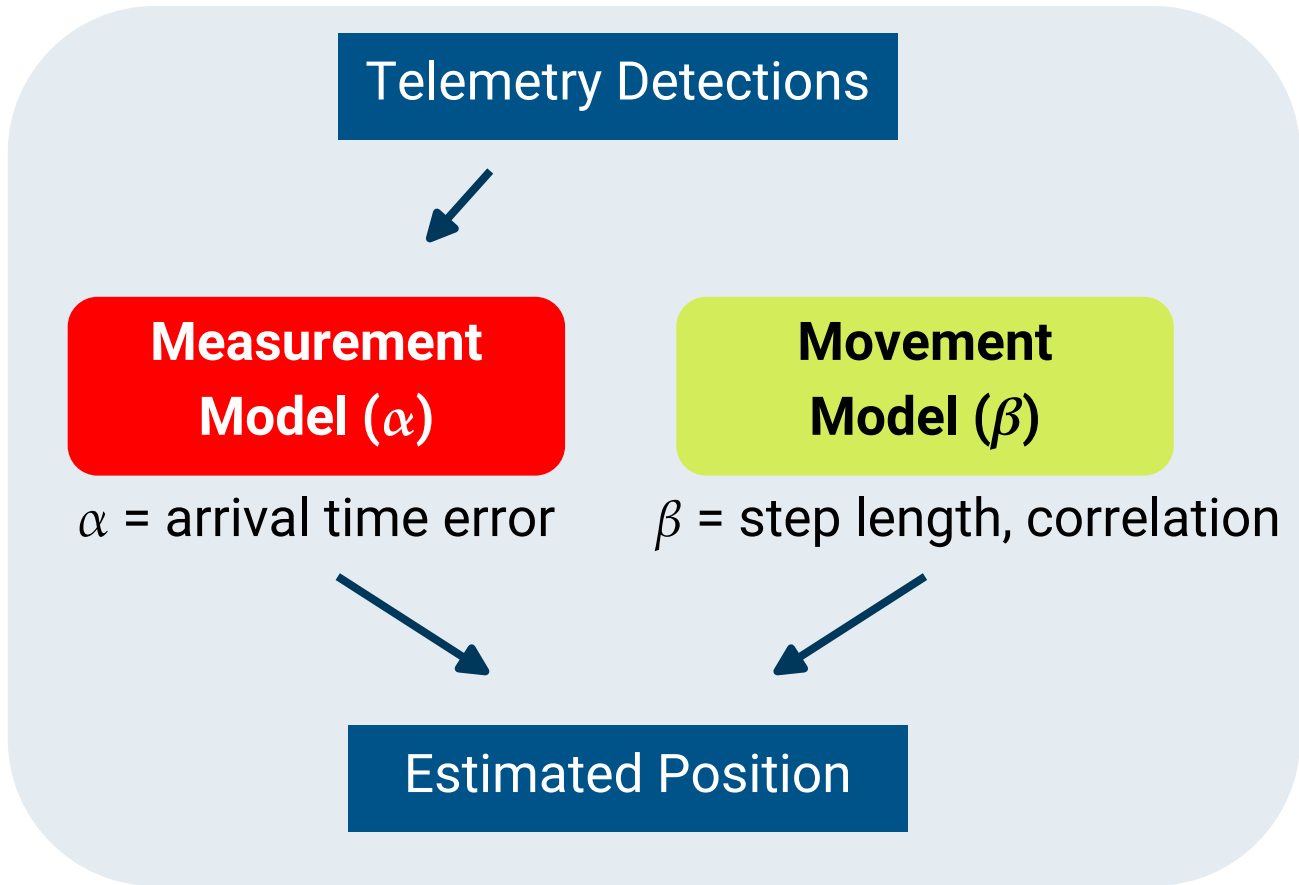05-18-2023   Animal Movement Models & Acoustic Telemetry Positioning

Modelling fish passage behaviour
with animal movement models

- Passage behaviour can be predicted by *"chaining together"* animal movement models.

- **Unaccounted for error in movement path** estimation can **lead to bias** in later applied SSFs and HMMs.

- **How large is telemetry positioning error from state-space models?**

State-space model

(Movement path)

Step-selection function

(Navigation cues)

Hidden Markov model

(Behaviour state)

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State-space models
for acoustic telemetry positioning

Telemetry Detections

Measurement Model (α)

Movement Model (β)

α = arrival time error

β = step length, correlation

Estimated Position

IGB

State-space models
for acoustic telemetry positioning

Telemetry Detections

Measurement Model (α)

Movement Model (β)

α = arrival time error

β = step length, correlation
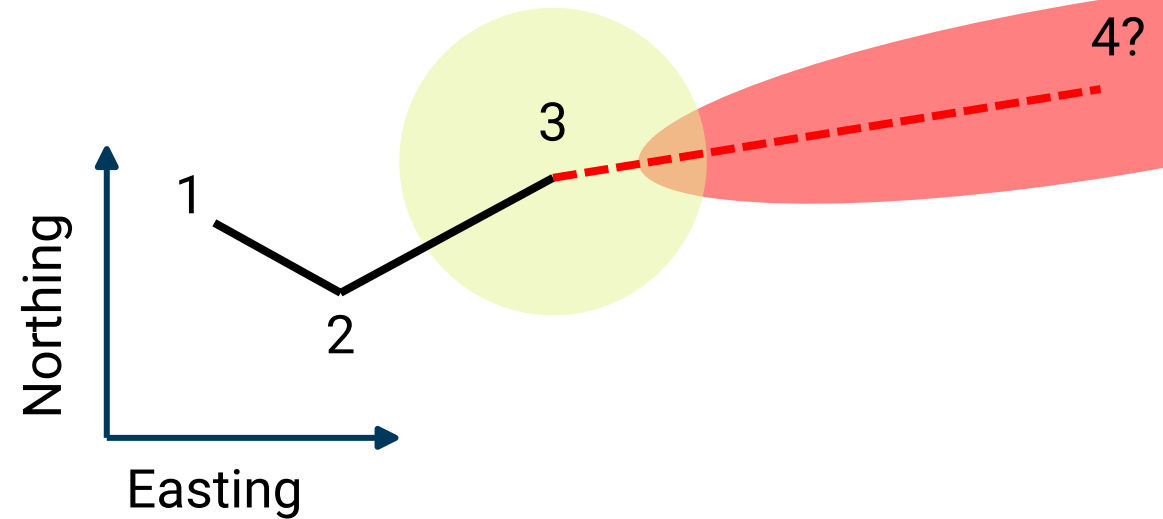
- α **can be measured from calibration data**
- β **cannot be determined from data...**
- **How does choice of β affect my positioning accuracy?**

IGB
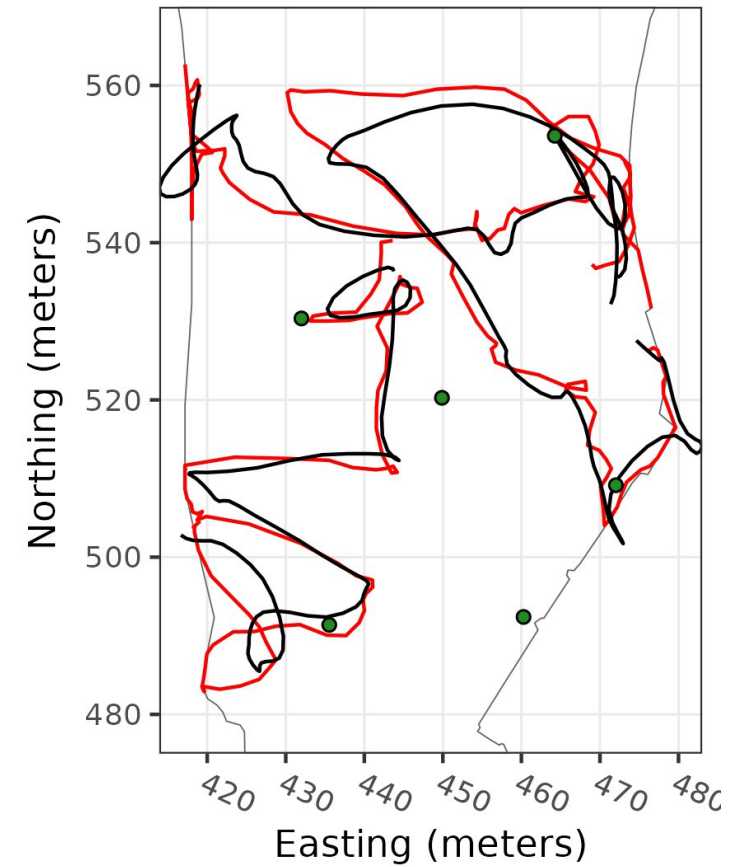
State-space models
Measuring error with simulations...
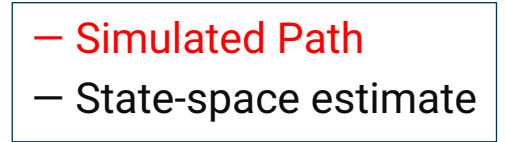
State-space models
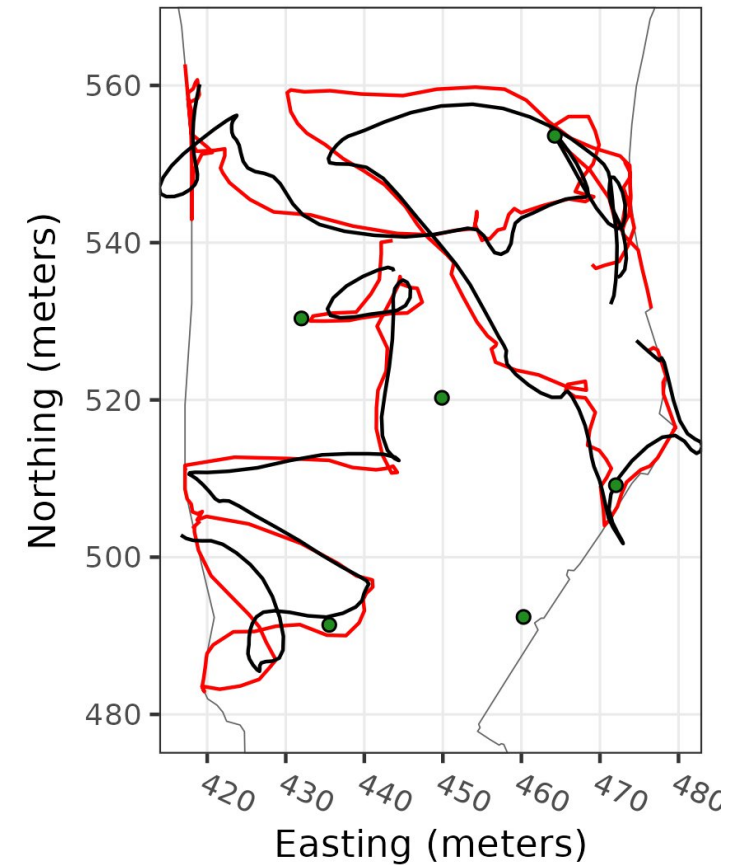## Measuring error with simulations...

Methods

- Measured **positioning error resulting from choice of movement parameters** β

- Using **simulated data sets**

Results

- **Positioning error is quite robust** to selection of β.

  - Error on the order of 5−10 metres.

- **Better to over-estimate the movement step length**.

Single-state sims. 1-3

State-space models
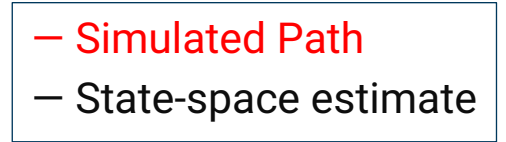### Measuring error with simulations...

See my conference proceeding...

Application of Animal Movement Models to Acoustic Telemetry Positioning

A deep dive on telemetry positioning error...

... and guidance on how to use animal movement models.

Questions?

Single-state sims. 1-3

Legend:
— Simulated Path
— State-space estimate

IGB