FACULTY OF BIOSCIENCE ENGINEERING

DEPARTMENT OF ANIMAL SCIENCES
AQUATIC ECOLOGY

ANALYSING THE BEHAVIOUR OF MIGRATING FISH TO PREDICT MOVEMENT NEAR BARRIERS

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RESEARCH INSTITUTE NATURE AND FOREST

RIBES

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BACKGROUND

Article

More than one million barriers fragment Europe's rivers

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A global boom in hydropower dam construction

Christiane Zarfl · Alexander E. Lumsdon · Jürgen Berlekamp · Laura Tydecks · Klement Tockner

Research article

River fragmentation and barrier impacts on fishes have been greatly underestimated in the upper Mekong River

Jingrui Sun [a,b], Weilong Du [a,b], Martyn C. Lucas [c], Chengzhi Ding [a,b,*], Jinnan Chen [a,b], Juan Tao [a,b], Daming He [a,b,**]

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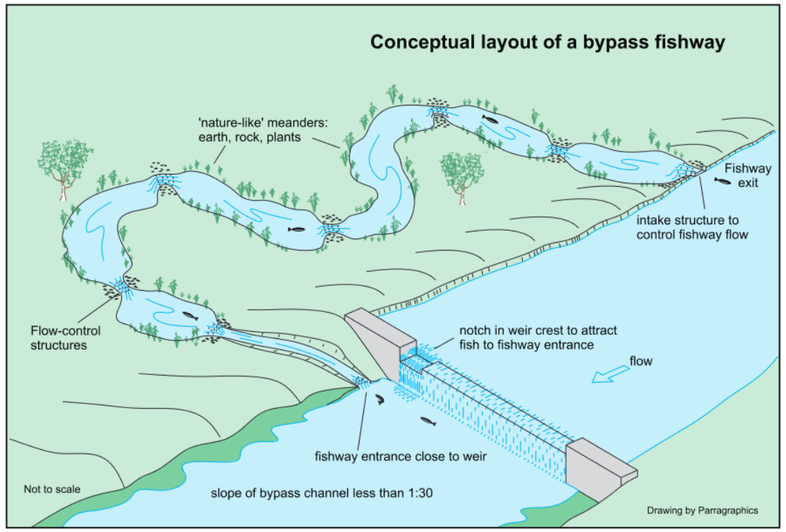
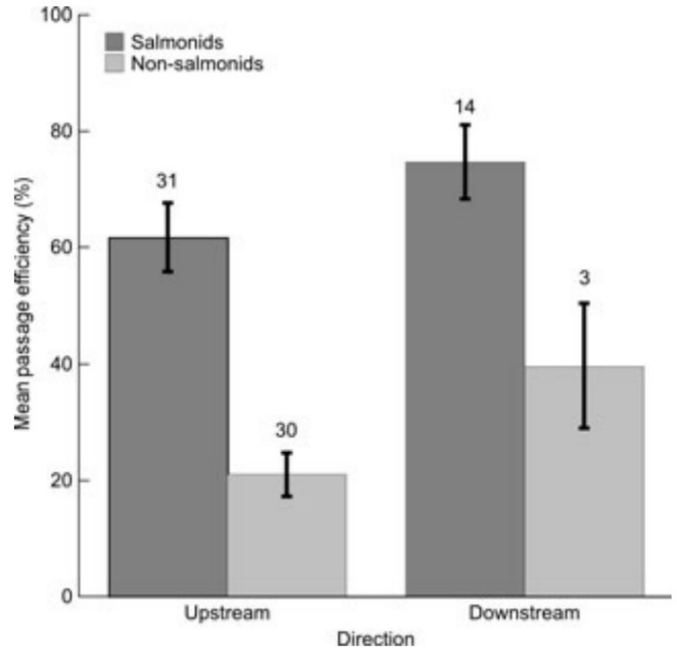
BACKGROUND

- Fish passes as solution?
- Passes not necessarily effective
- Can we predict?
  - Individual based models?
  - Requires data!
  - One aspect -> habitat selection



source: Thorncraft and Harris (2000)



source: Noonan et al. (2012)

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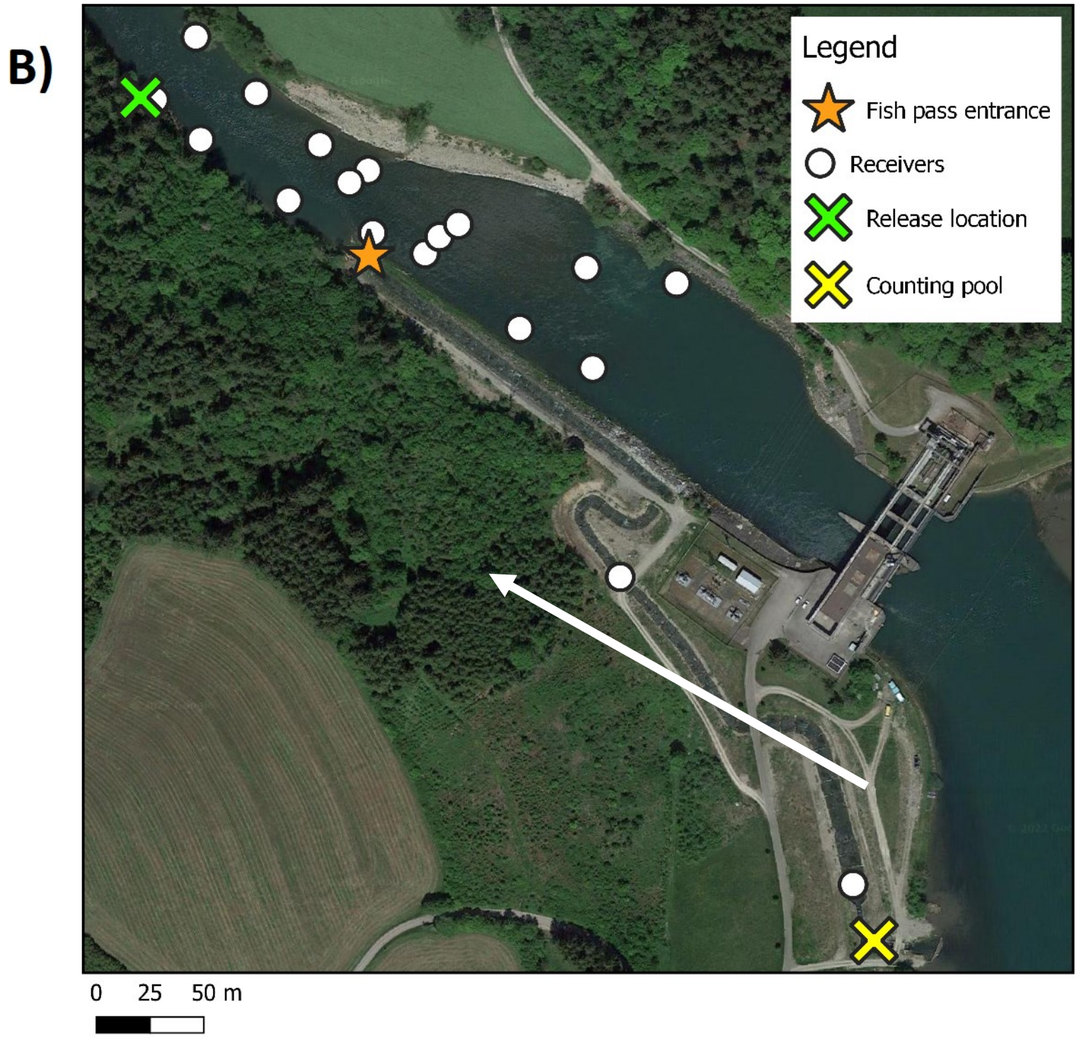
BACKGROUND

- Habitat preference and selection?
  - Habitat -> anything describing a point in space
  - Habitat preference -> disproportionate usage of habitat relative to availability
  - Habitat selection -> behaviour through which fish selects habitat

STUDY SITE



- Tracked barbel + grayling during spawning migration
- 2D acoustic telemetry

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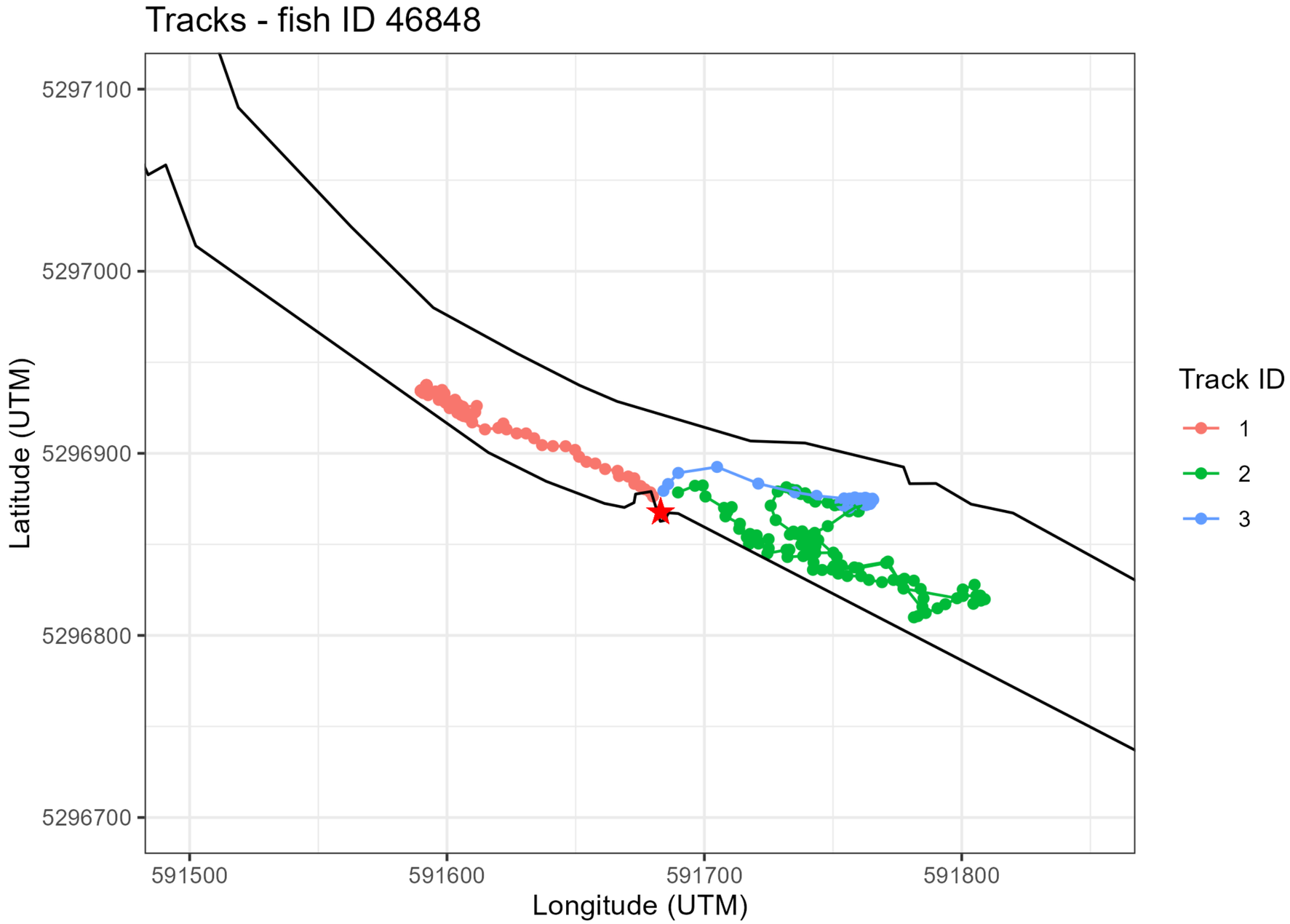

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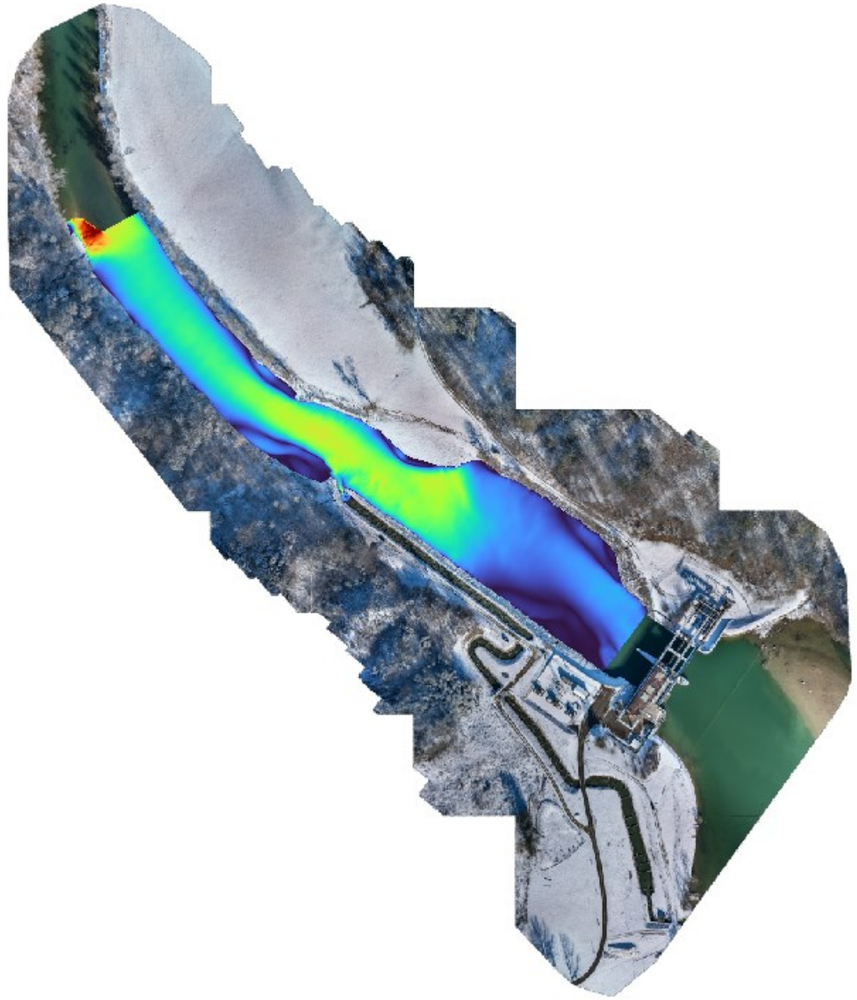
- Environmental data
  - Flow velocity
  - Water depth
  - Spatial velocity gradient (SVG)
  - Direction of flow
  - Direction of SVG



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EXPLORATORY

What parameters explain fish movement in this context?

PREDICTIVE

Can we predict fish movement?

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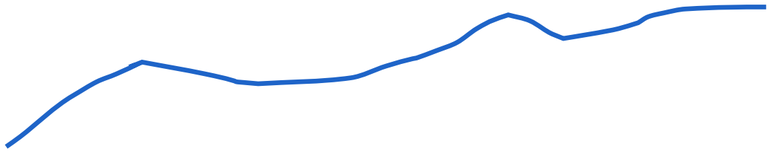
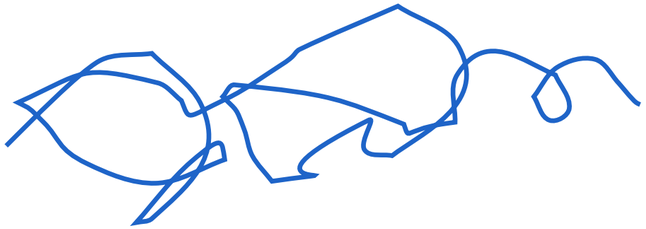
ANALYSIS

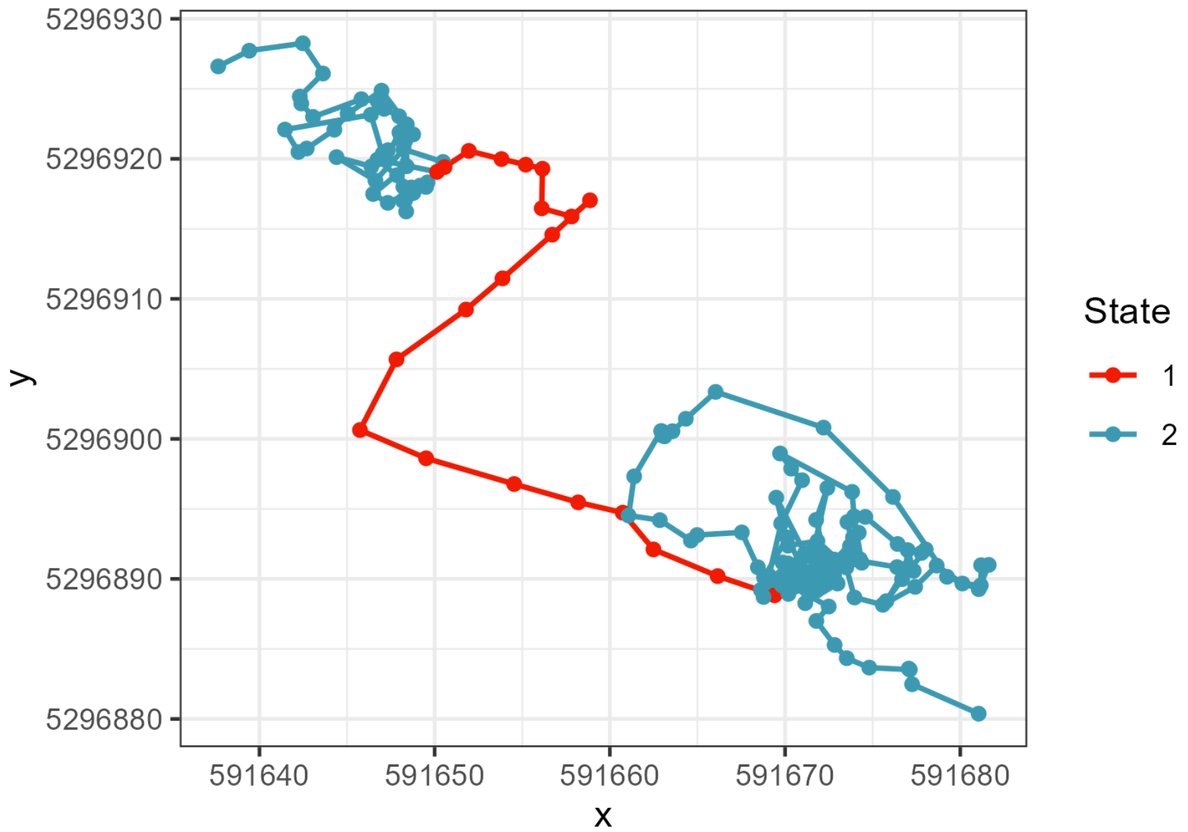
- Behavioural state
  - E.g. transiting vs resting vs searching





  - Hidden Markov models

ANALYSIS



- State 1 = transiting
- State 2 = resting/searching

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ANALYSIS

Data

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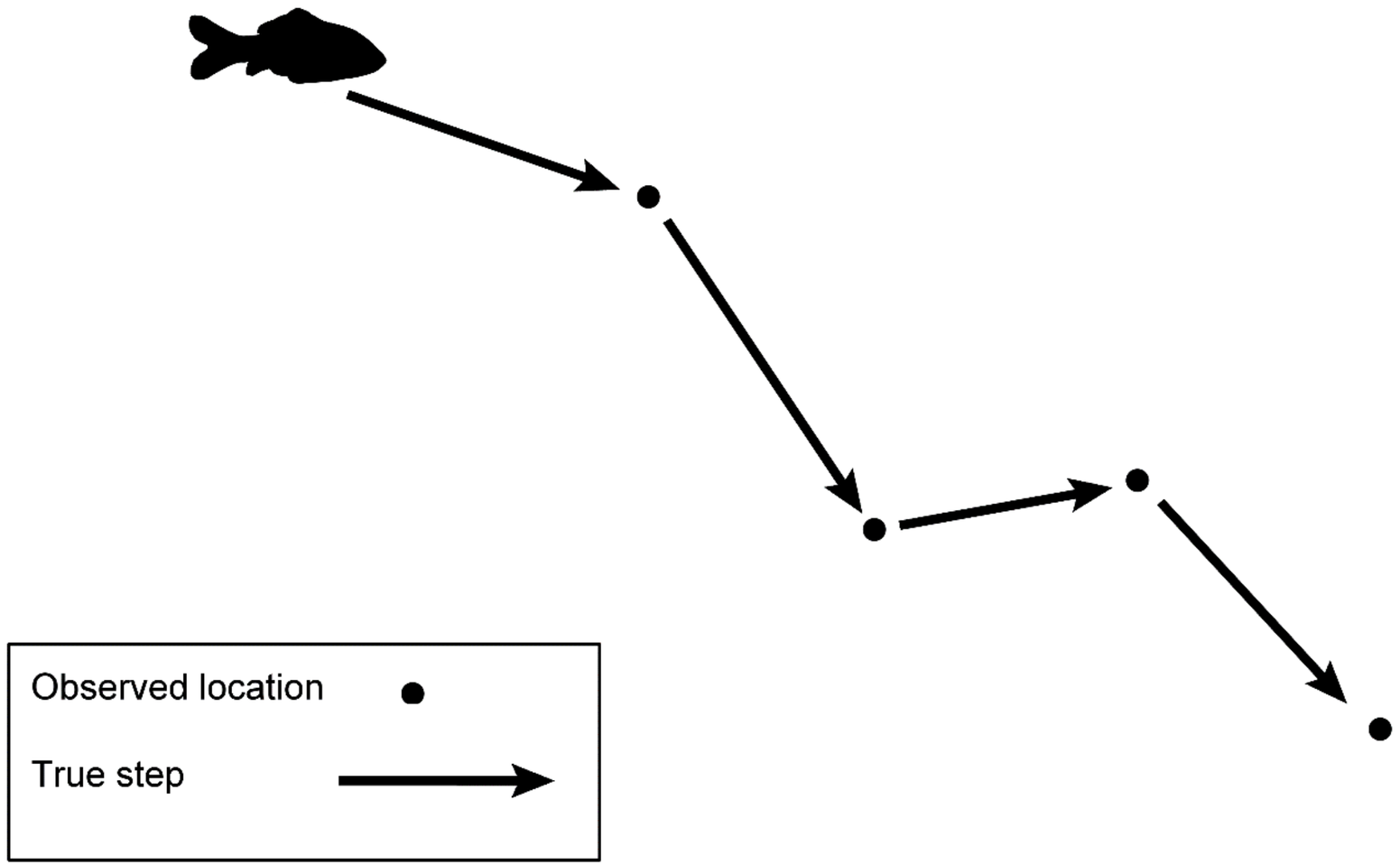
– Step selection function (SSF)

Habitat preference -> disproportionate usage of habitat **relative to availability**



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Fit SSFs individually

Calculate average habitat preferences

Describe average trend

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RESULTS

- Wide variation in habitat preference
- Little difference in habitat preference between behavioural state overall
- Some general trends emerged

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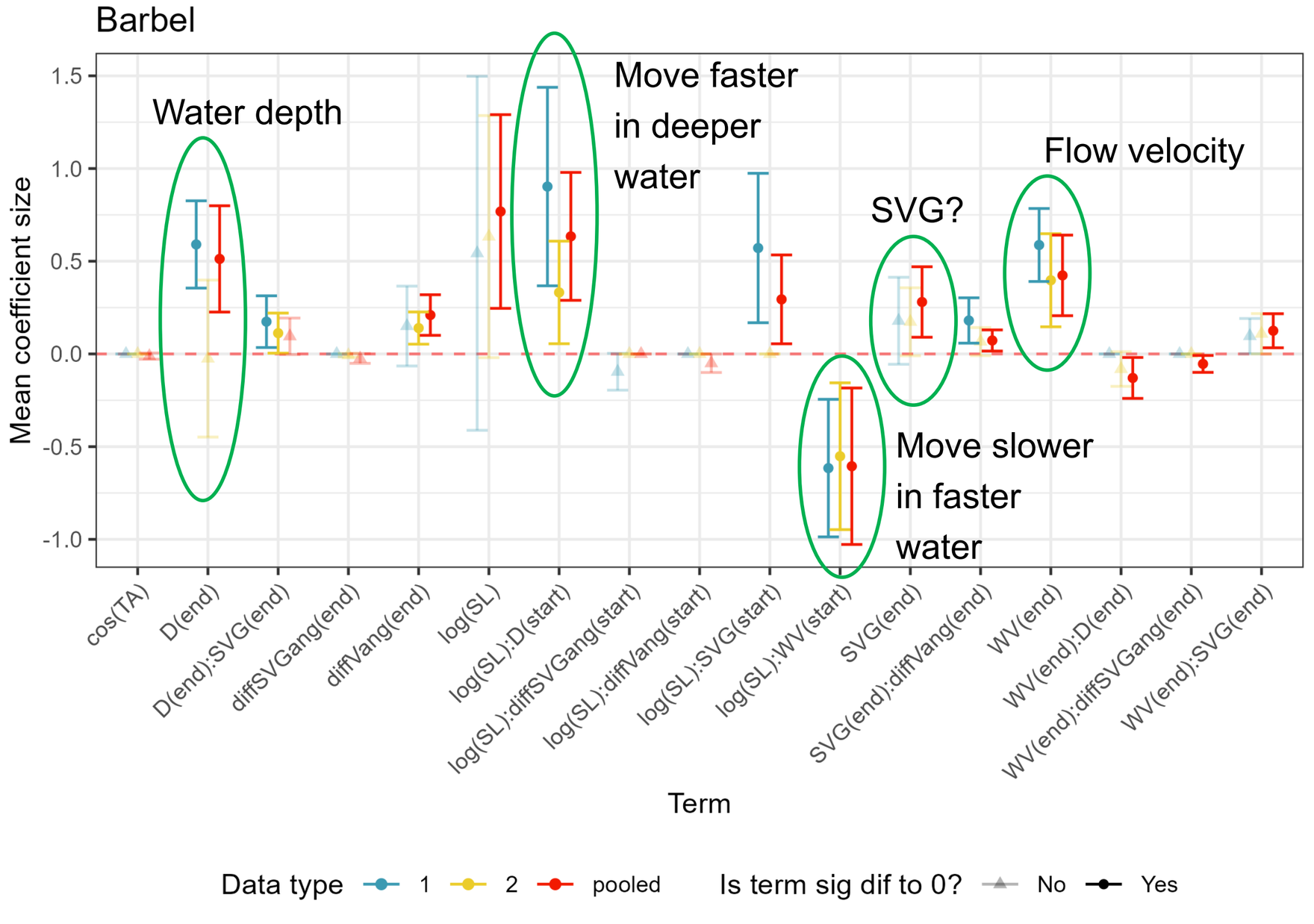
Positive = select for

Negative = don’t select for



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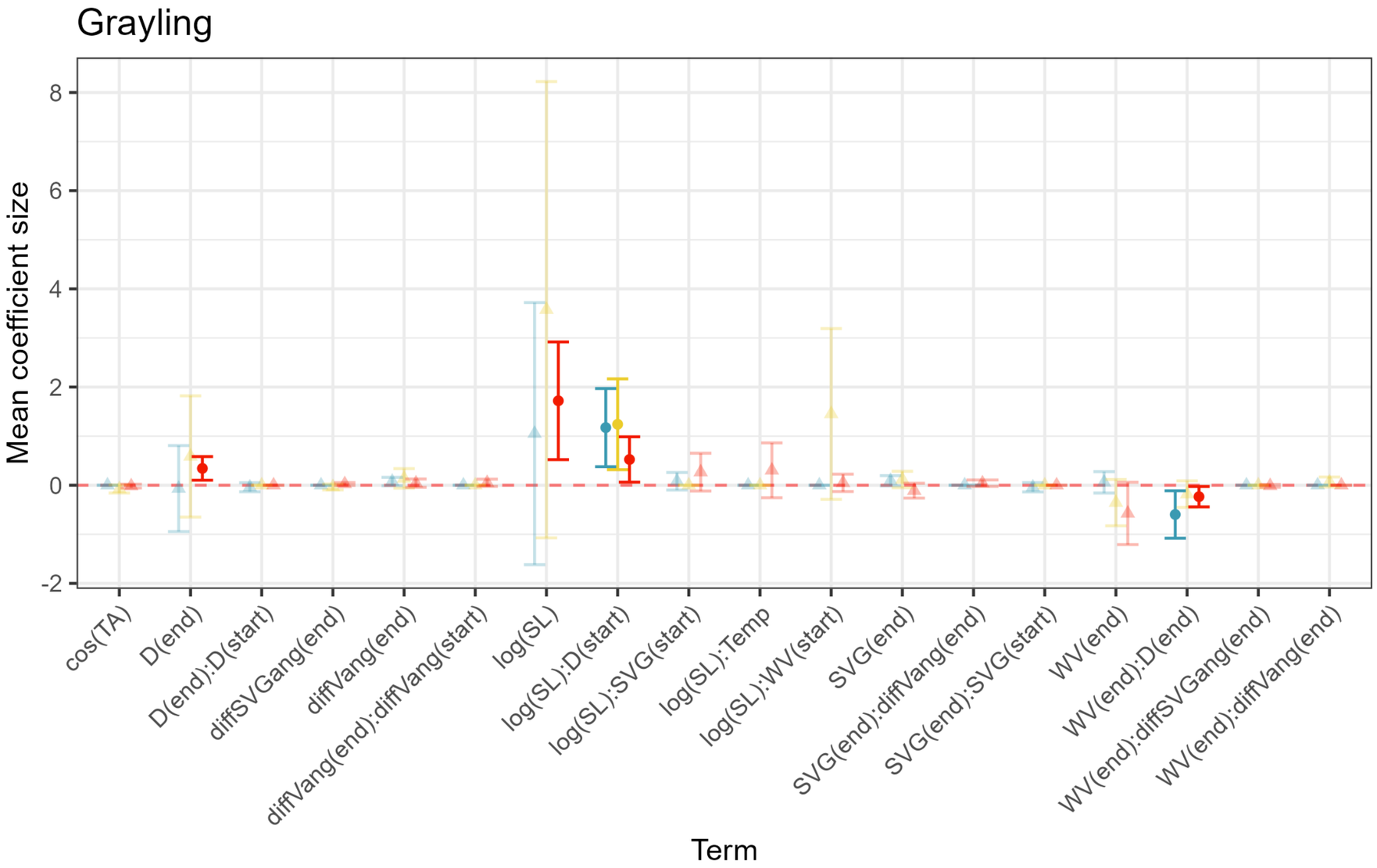

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PREDICTING

- Cross-validation suggested including behavioural states slightly improved prediction of spatial usage

MEAN VALUES AND COVARIANCE MATRIX ⇨ MULTIVARIATE NORMAL DISTRIBUTION ⇨  ⇨ SIMULATE!

- Simulated 100 unique individuals at 3 discharges

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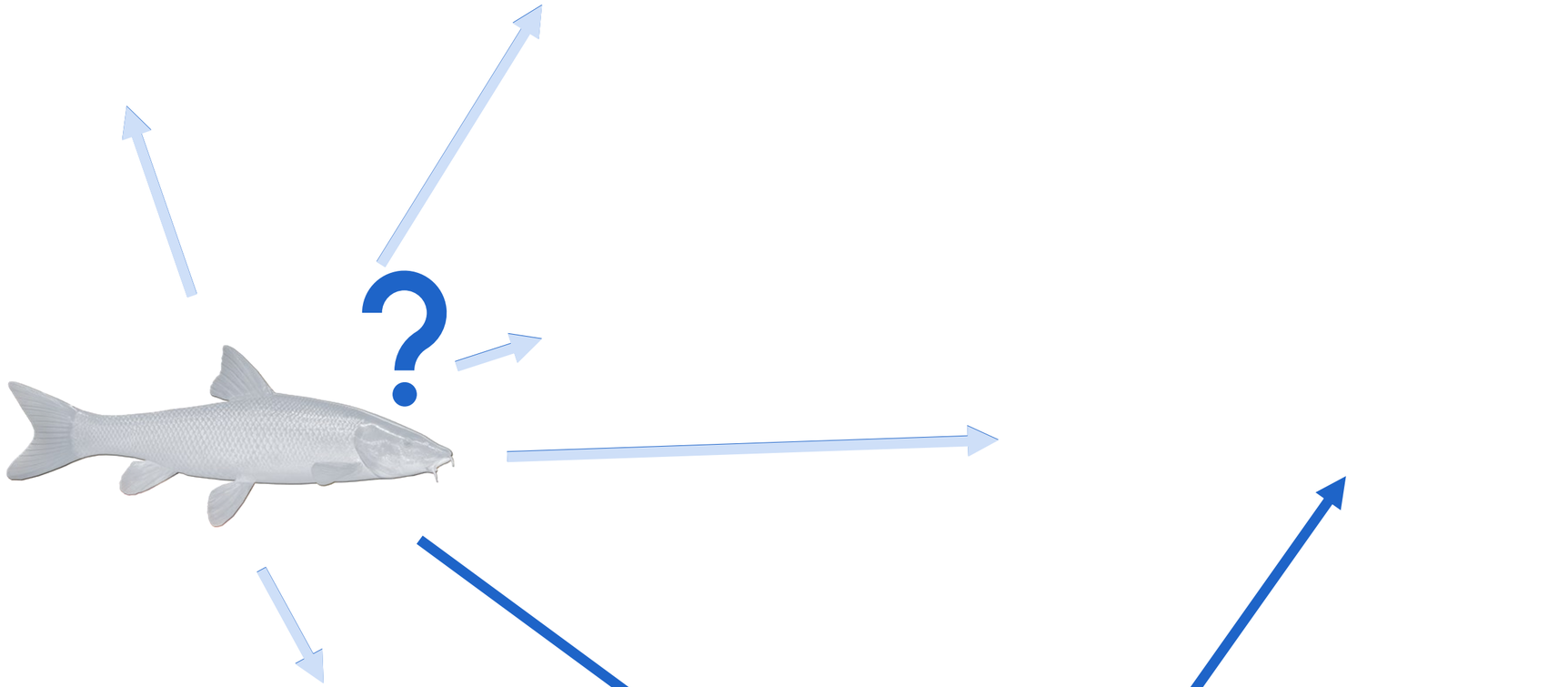

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Start location of simulations

Remove positions before analysing

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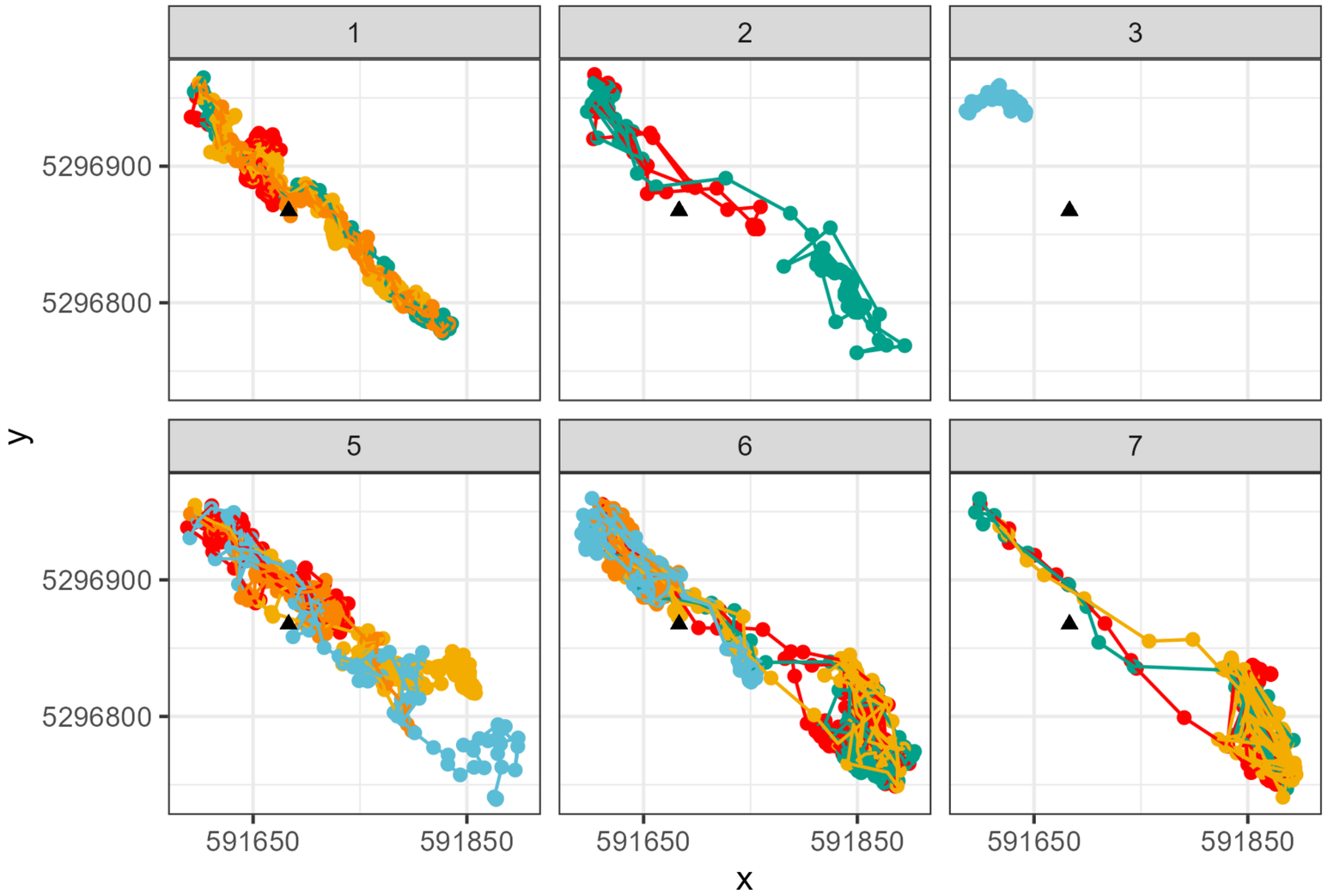

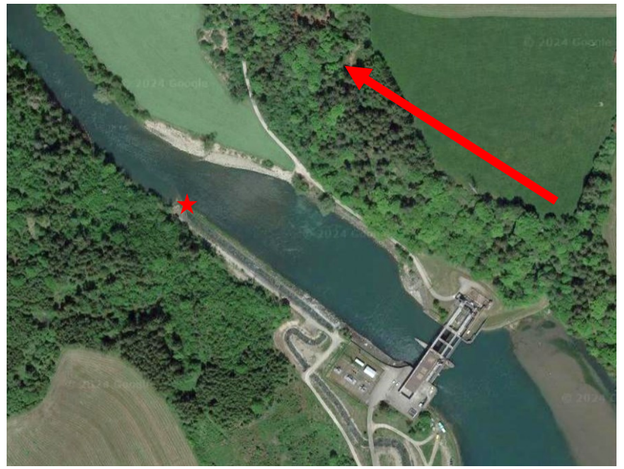

Approach ID

- 1
- 2
- 3
- 4
- 5

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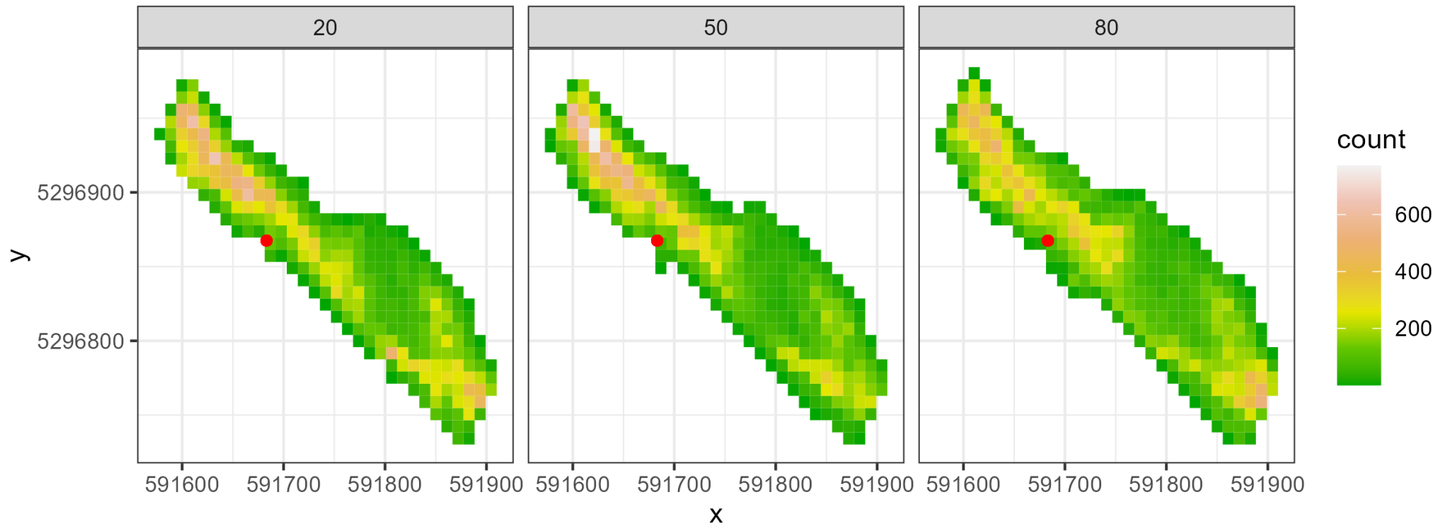
A) Barbel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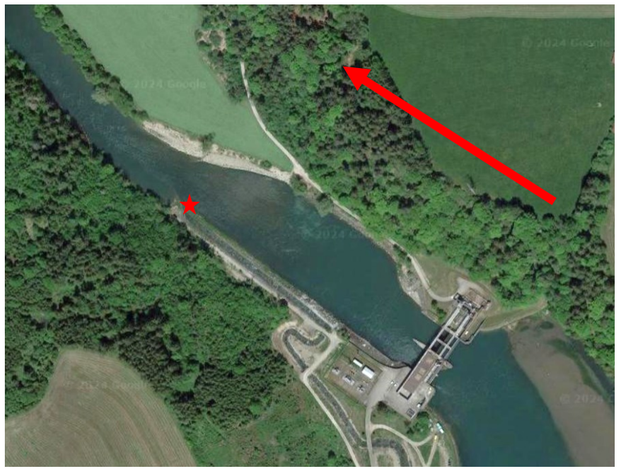

CONCLUSIONS

- Fish predicted to use area immediately downstream of barrier
- Grayling less distinct usage around fish pass
- Insight into habitat preference by two species
- Wide individual variability
- Data -> model -> predict

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