

Missing data or ignored information? Biological processes as a basis for an arrival model for Atlantic salmon smolts

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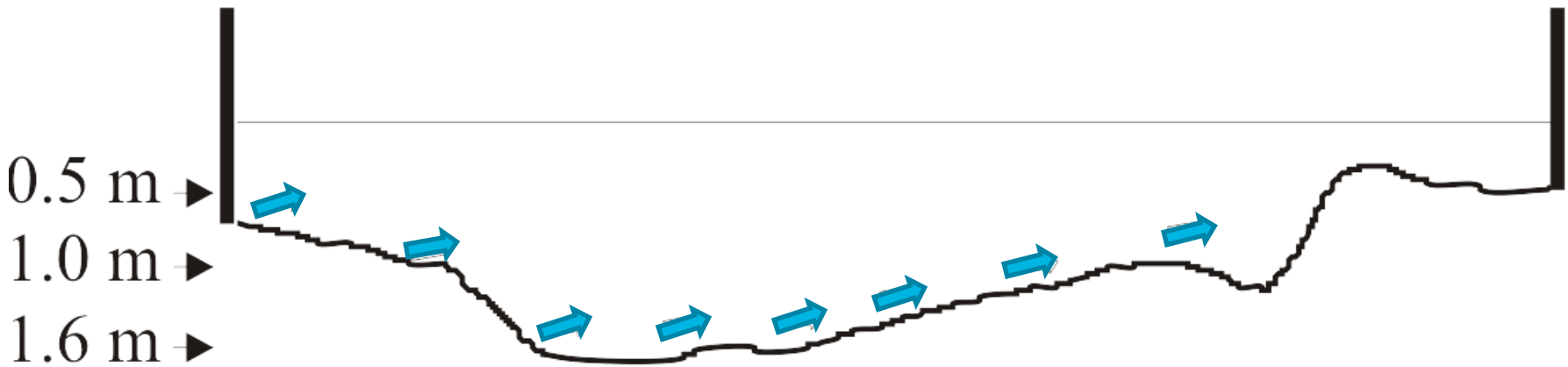
² University of Helsinki

Video monitoring system in river Utsjoki

8 cameras are set in river bed to monitor

- Ascending adults (spawners)
- **Descending migratory juveniles (smolts)**

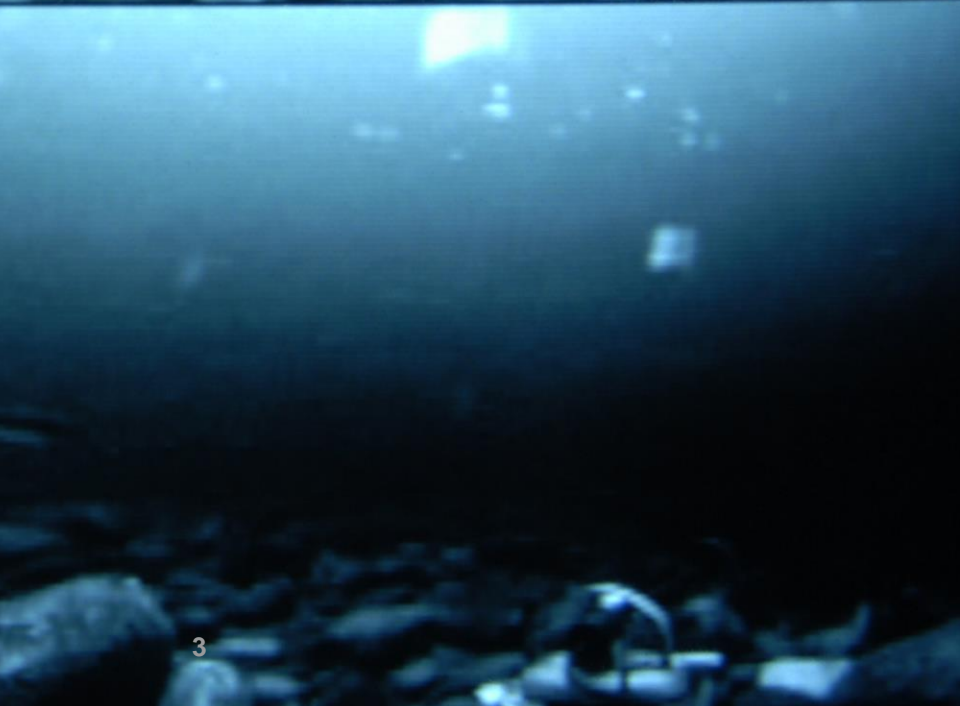
We focus on these!





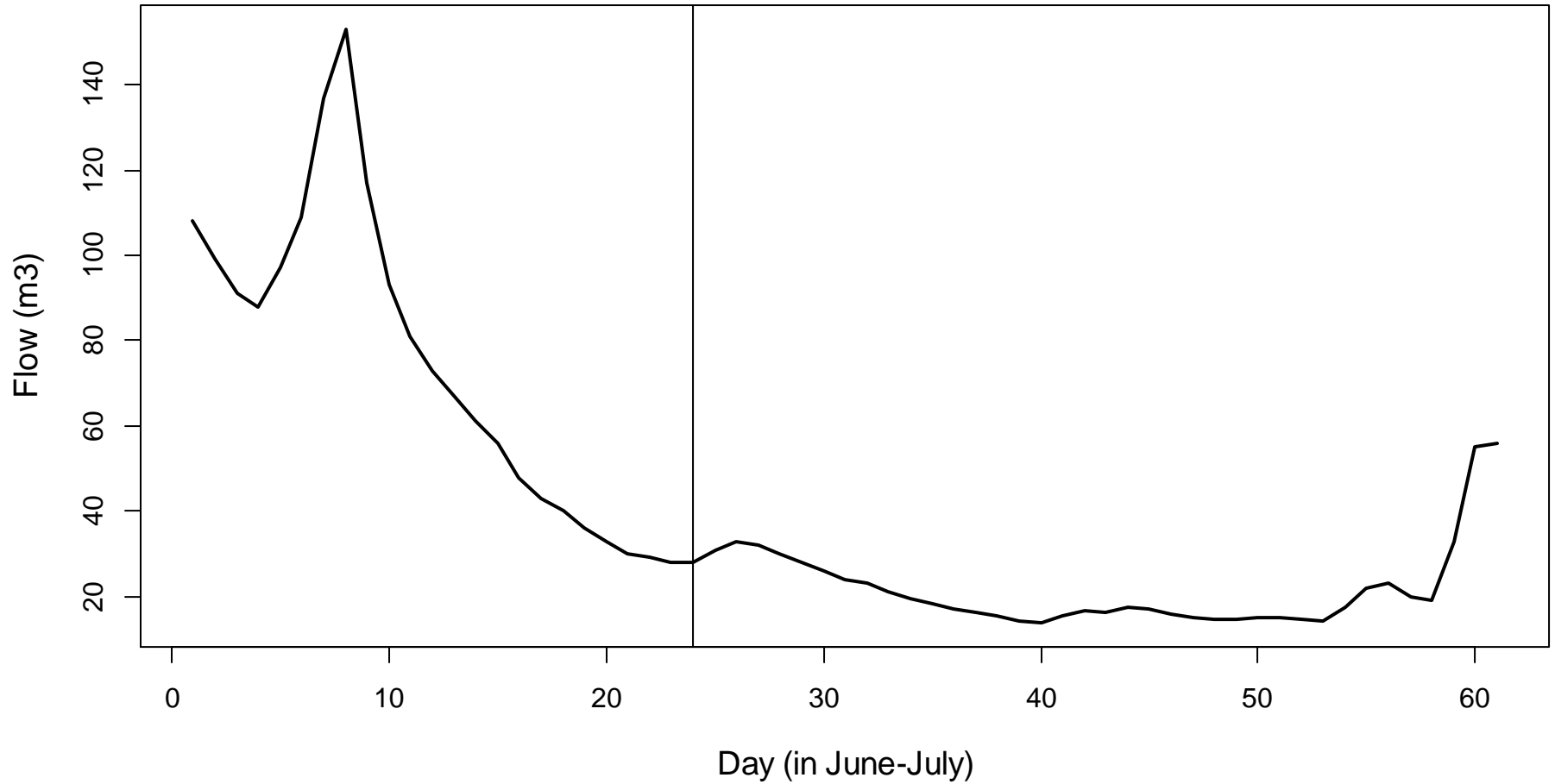
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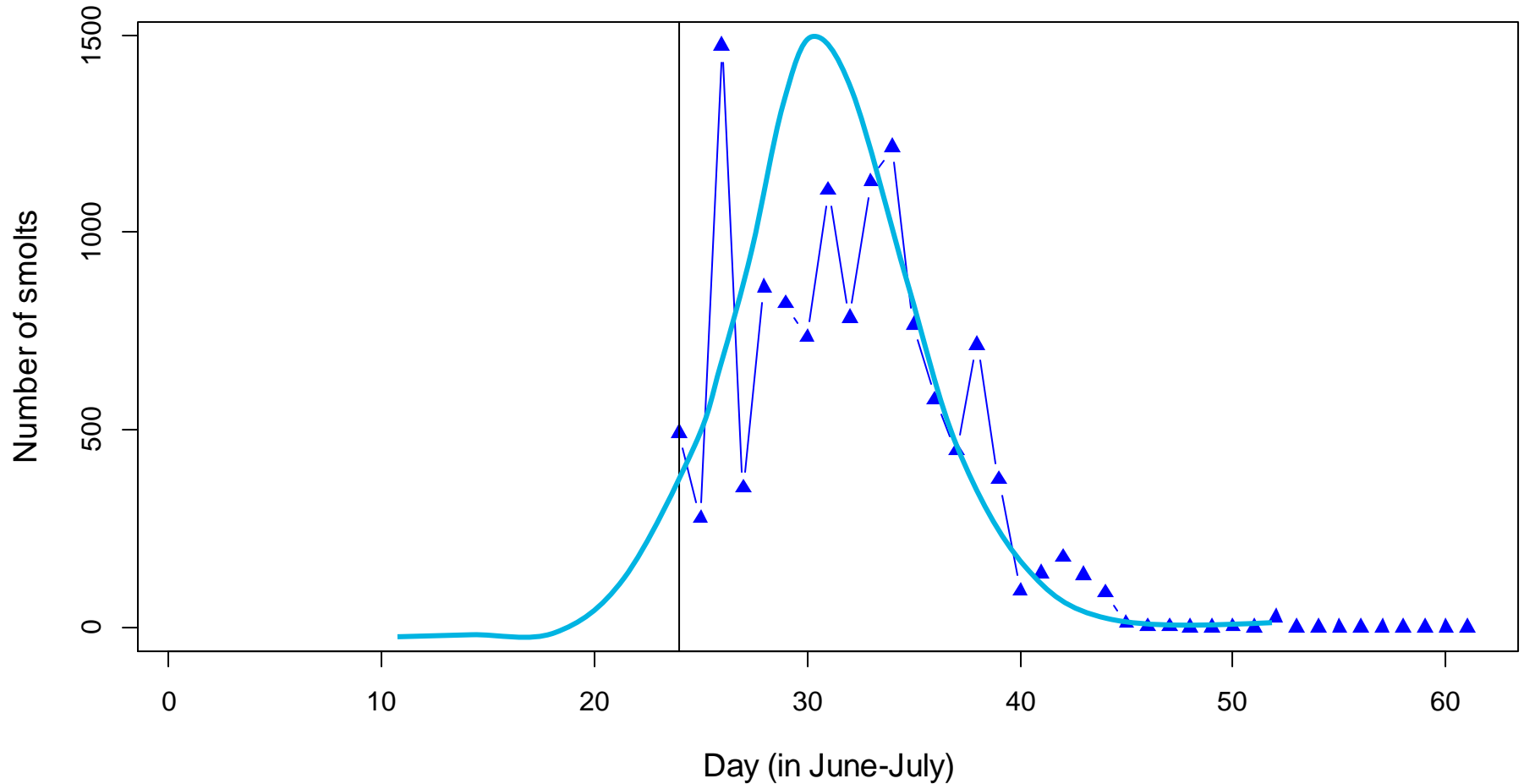
Difficult environmental conditions can cause missing data

2005

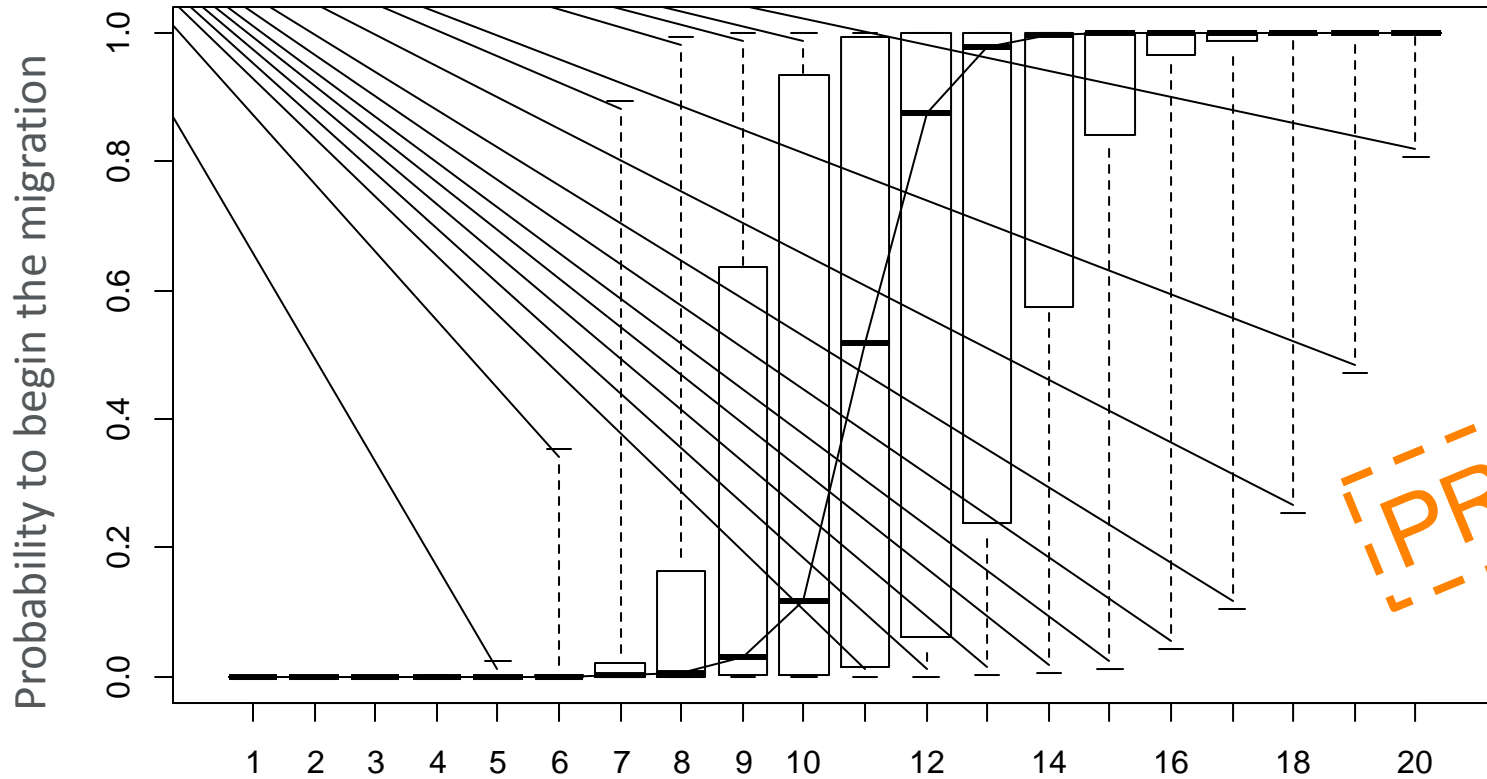


Difficult environmental conditions can cause missing data

2005



Step1: Probability to begin migration at given temperature



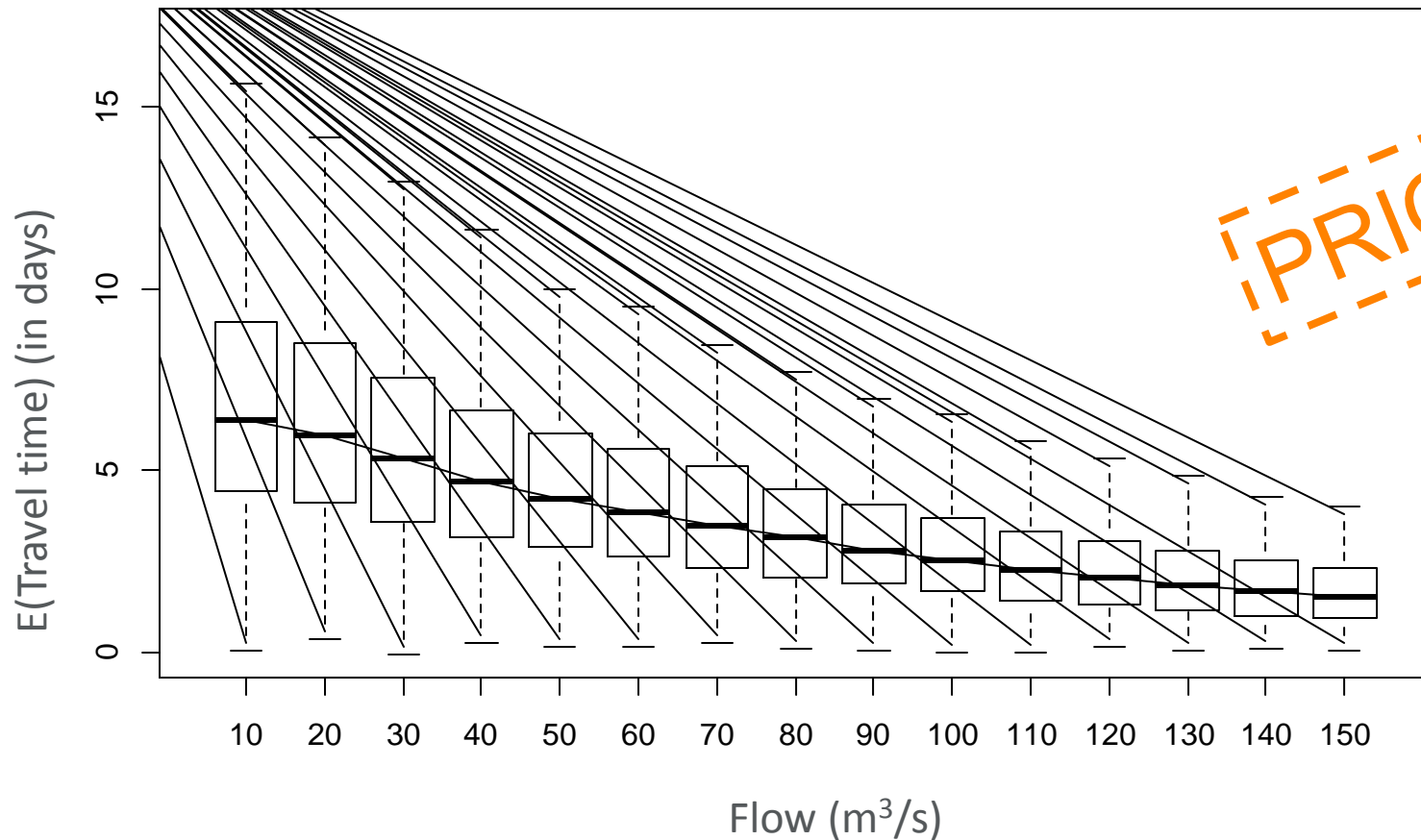
$$\mu P_{i,y} = aP + bP \cdot Temp_{i,y}$$

$$P_{i,y} \sim N(\mu P_{i,y}, sdP)$$

$$\text{logit}(p_{i,y}) = P_{i,y}$$

Temperature (degrees celsius)

Step 2: Travel time to video site at given flow



$$E(\mu D_{i,y}) = \exp(aD - bD \cdot Flow_{i,y})$$

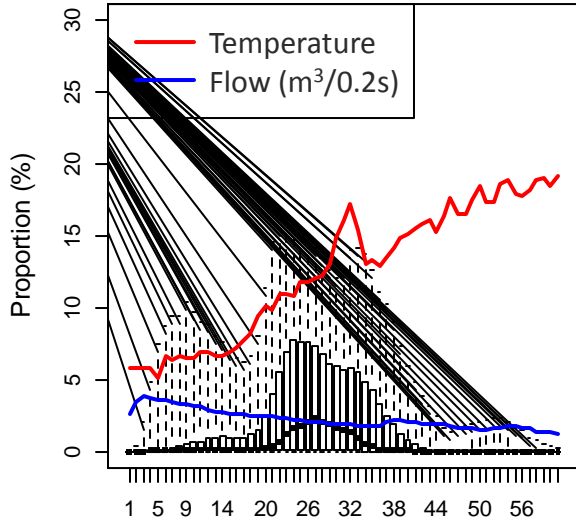
$$E(D_{i,y}) \sim \text{logN}(\mu D_{i,y}, sd D_{i,y})$$

Step 3: the rest – mainly logical or minimally informative

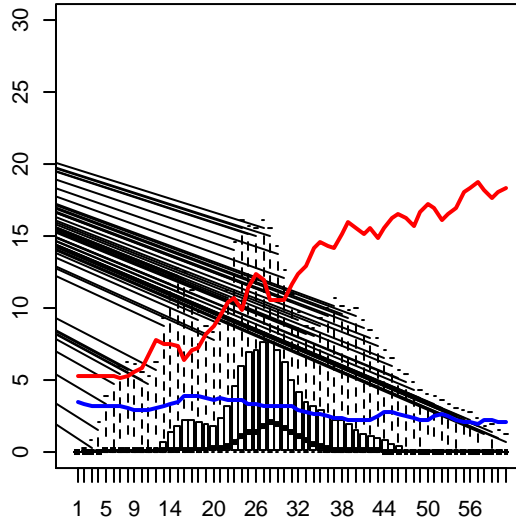
- Effectively flat prior for annual total number of smolts
- Dirichlet-multinomially distributed numbers of smolts arriving to video site among 61 days in June-July
- Arrival distribution at video site (among next 14 days), given any start date for migration: cdf of logN
- Beta-binomial observation process – currently assuming 10% unobserved on average
- Etc.

Predicted timing of migration at video site

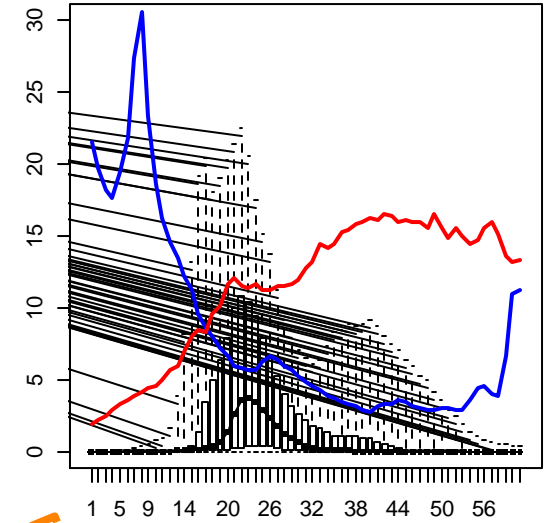
2003



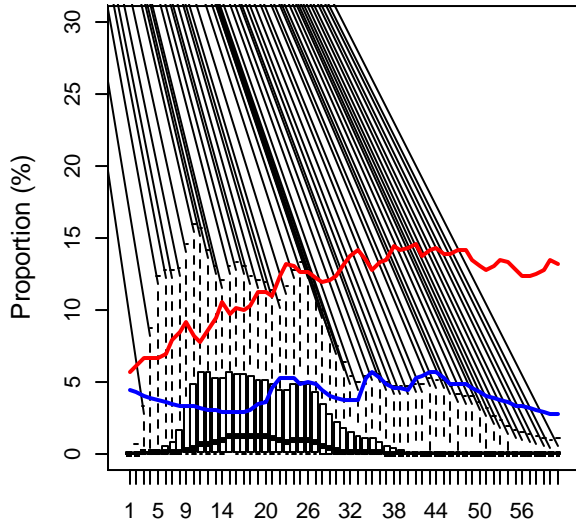
2004



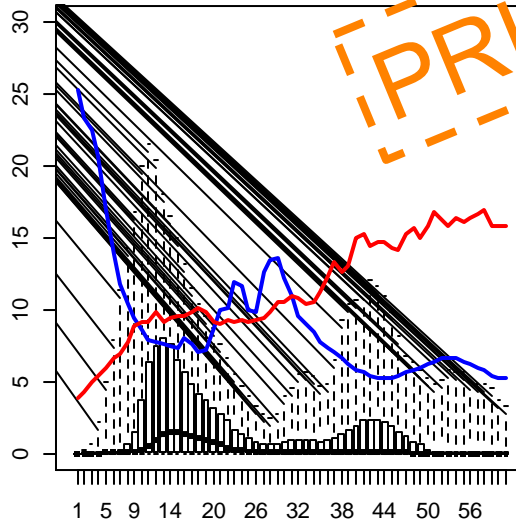
2005



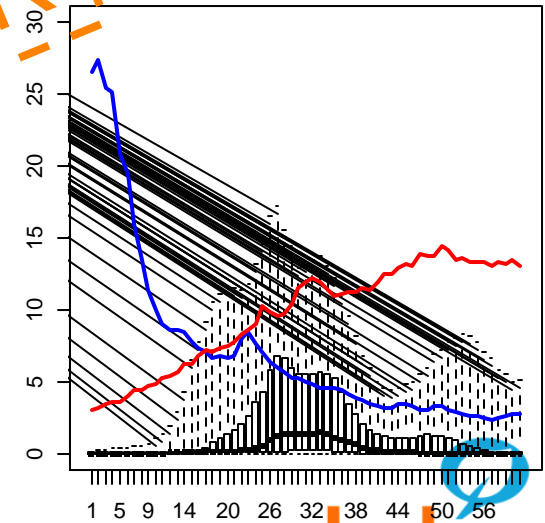
2006



2008

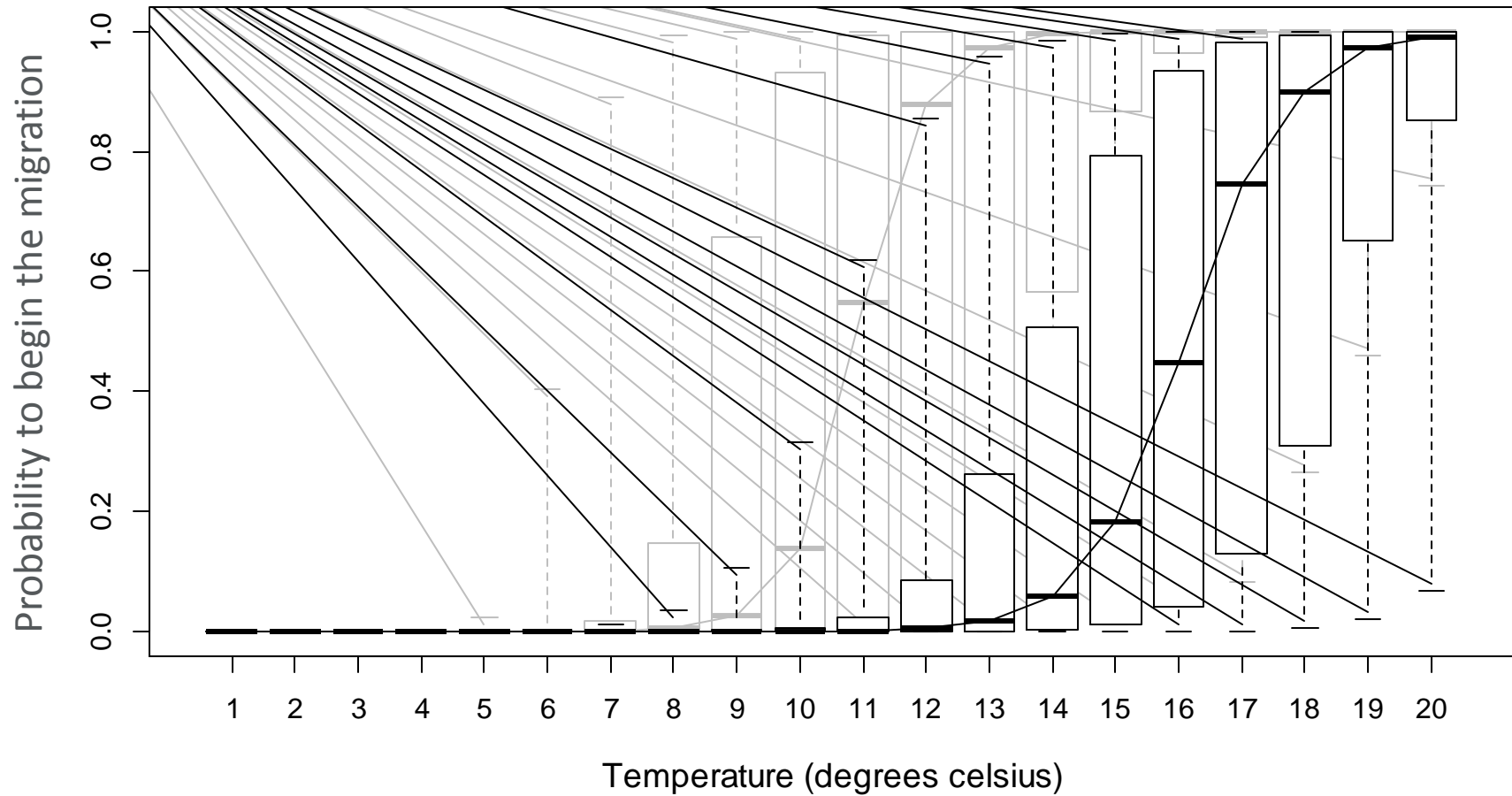


2014

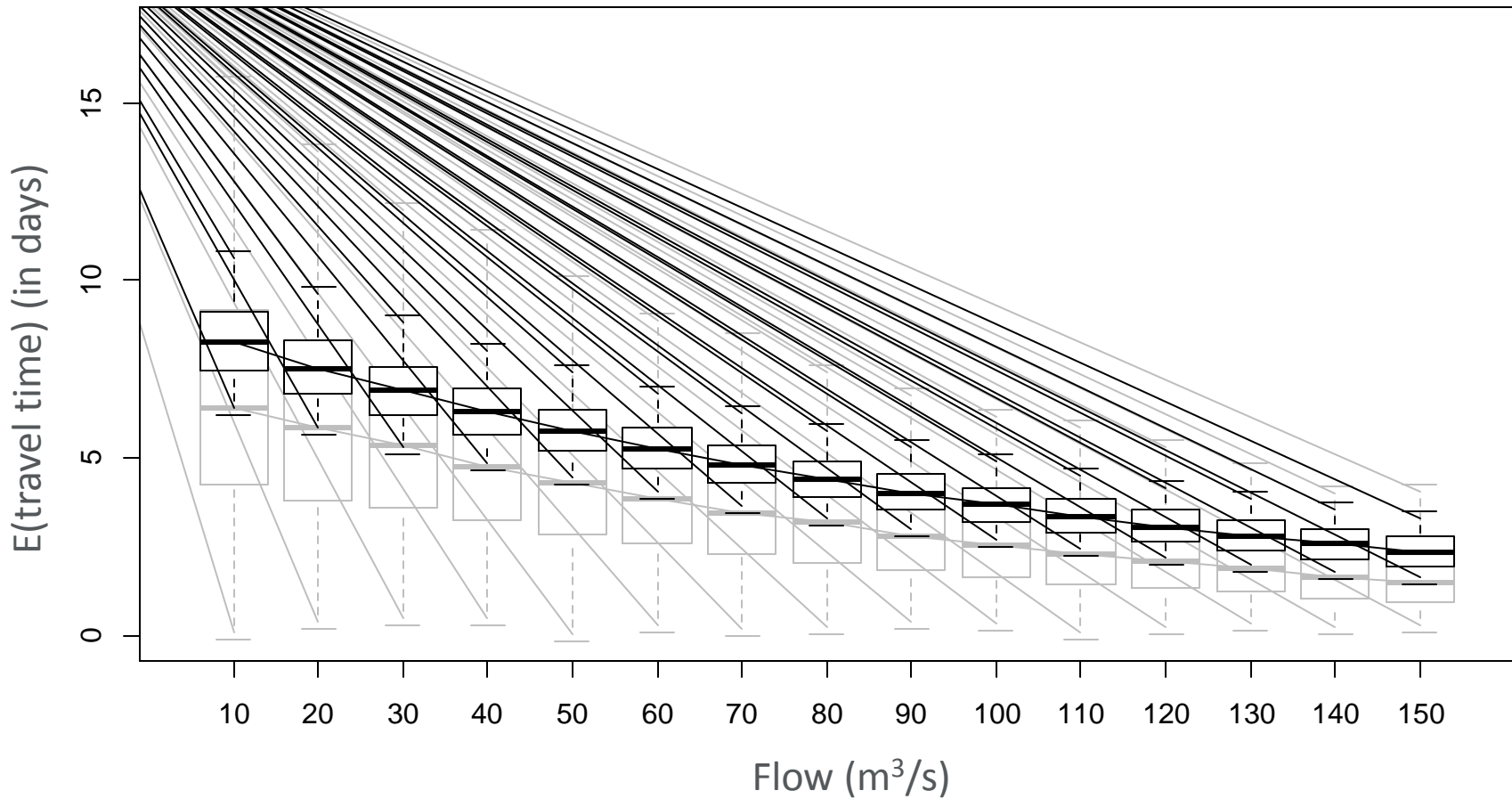


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Probability to begin migration at given temperature

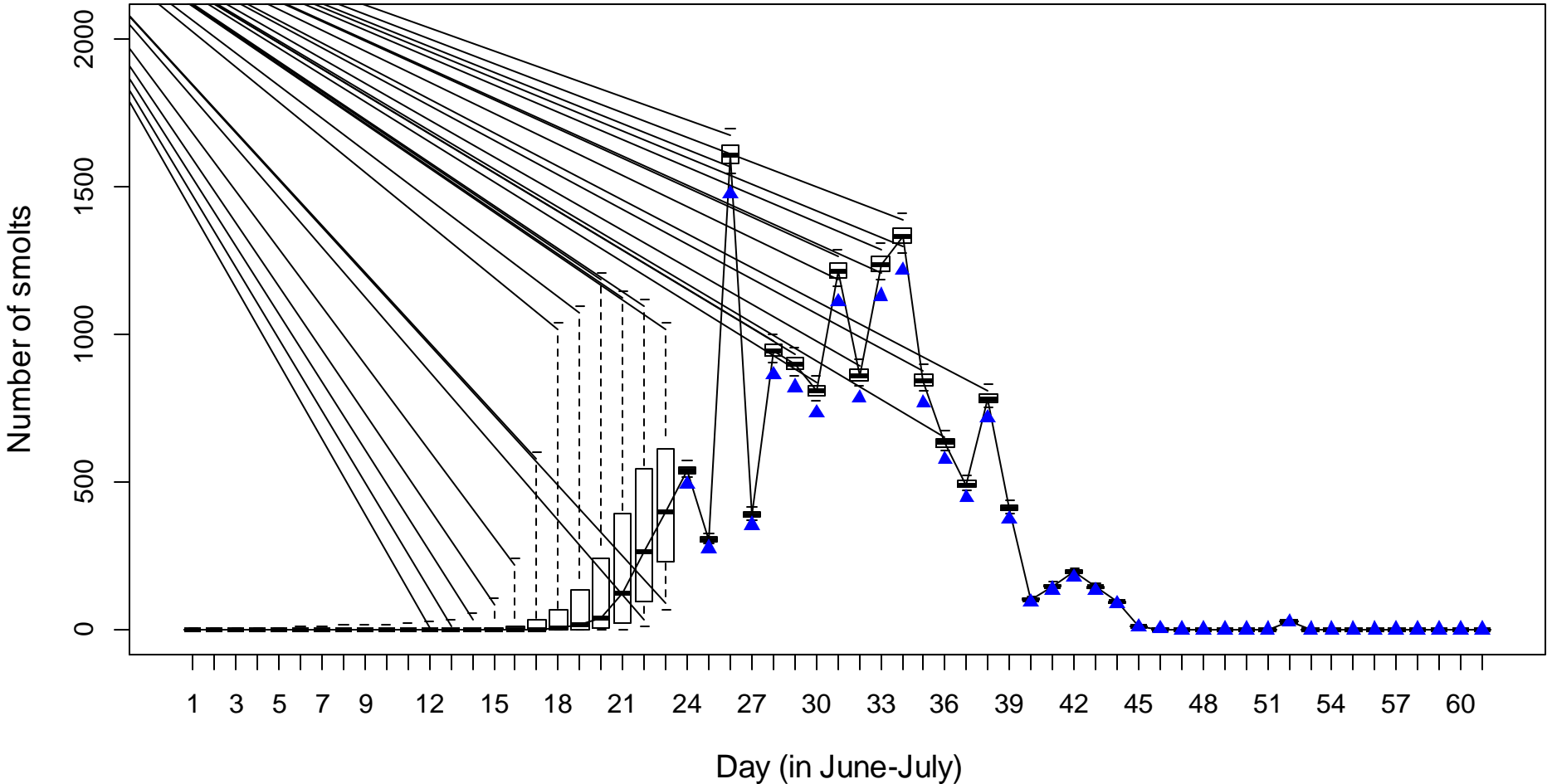


Travel time to video site at given flow



Arrival distribution

2005



Summary

- Biologically realistic models can be built to reflect the background knowledge of the process
 - No data is needed for this part!
 - Data are used when priors update to posteriors -> learning
- Environmental covariates can be useful
- Expert knowledge is valuable and should not be ignored
 - A learning process also on communication between the modellers and the substance experts
- Focus from missing data to available sources of information

Thanks!