Development and application of an agent based model for glass eel selective tidal stream transport

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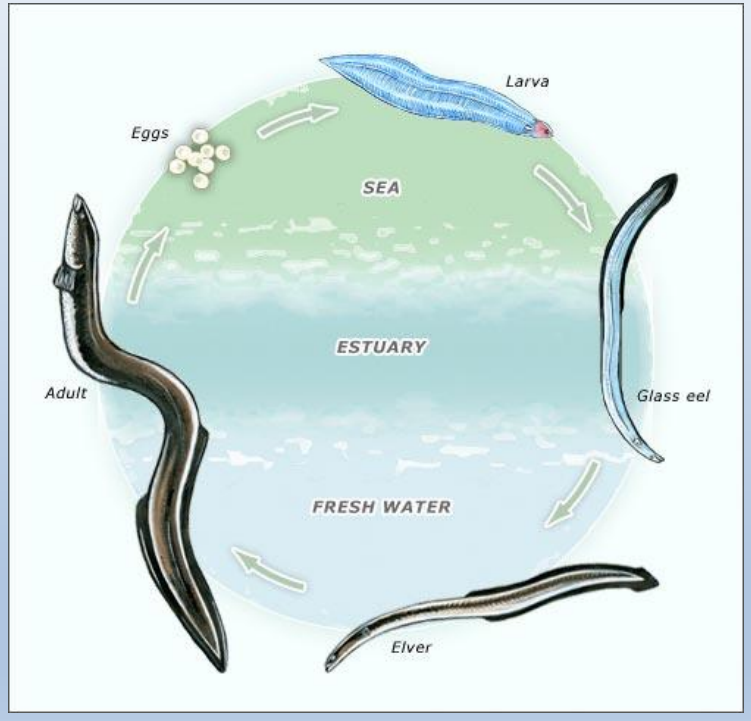
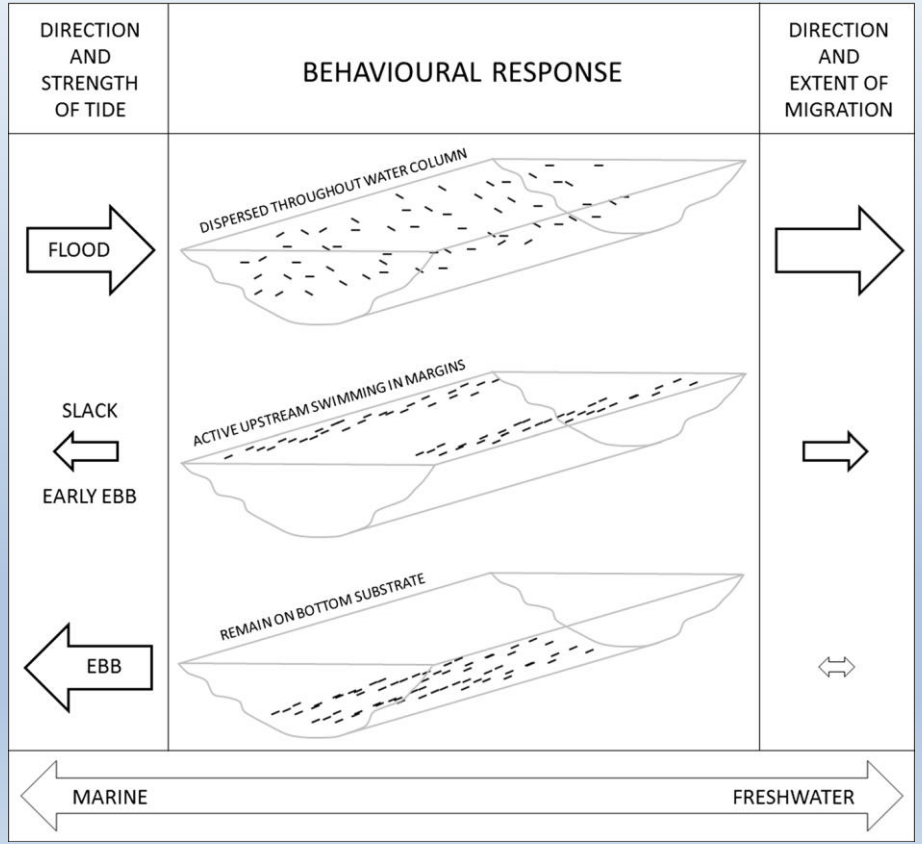
Introduction



- Three temperate species: *A. anguilla, rostrata & japonica*
- Highly migratory (>10^3 km)
- (Crit.) Endangered (IUCN)
  - Habitat fragmentation
  - Fishing
  - Climate change
- Protection / mitigation begins with juvenile stages (i.e. recruitment)

Introduction

- Larvae drift from spawning grounds to coastal areas
- Limited swimming
  - Usage of tides
  - STST
- Local variable environmental influence



Harrison et al. 2014

Aim

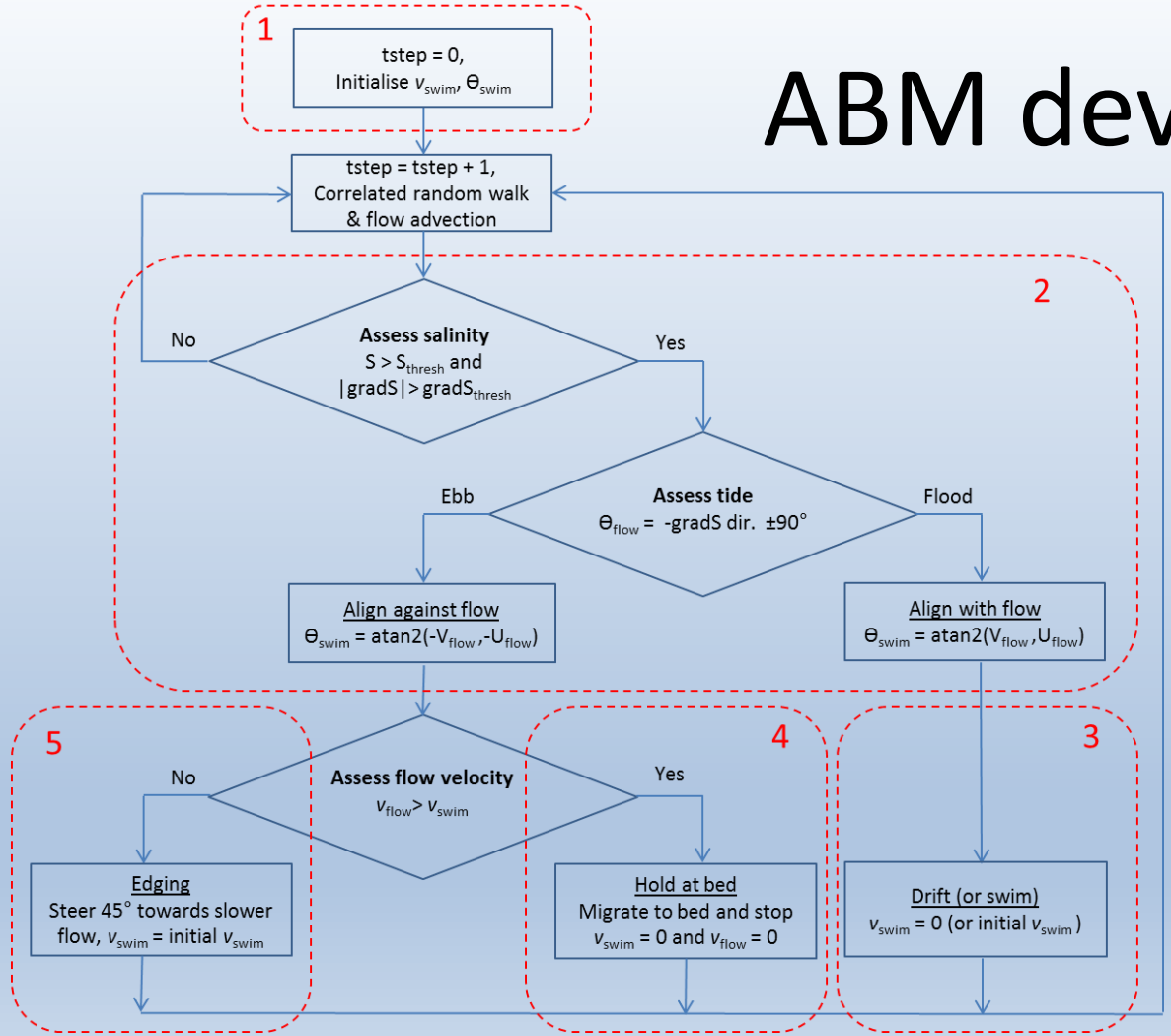
- Currently, annual recruitment estimates for *A. anguilla* are derived by catchment data by ICES.
    - Difficulties assembling and combining data to provide comprehensive overview
- ABMs have been successful in predicting/ estimating recruitment for other fish species
  - Help evaluate recruitment success and possible areas for mitigation opportunities

- *Develop an ABM for upstream tidal migration of glass eels*

ABM development

- Literature review of role of environmental factors:
  - Water Temperature (metabolic processes)
    - Lab experiments → V_{swim} vs. T
  - Salinity
  - Light (e.g. day/night)
  - Turbidity & others…
  - Interactions and local differences

ABM development



1. Initialisation
2. Salinity and tide assessment
3. Flood : drifting (or active swimming)

- Flow assessment

4. Ebb: holding station
5. Edging (on/off)

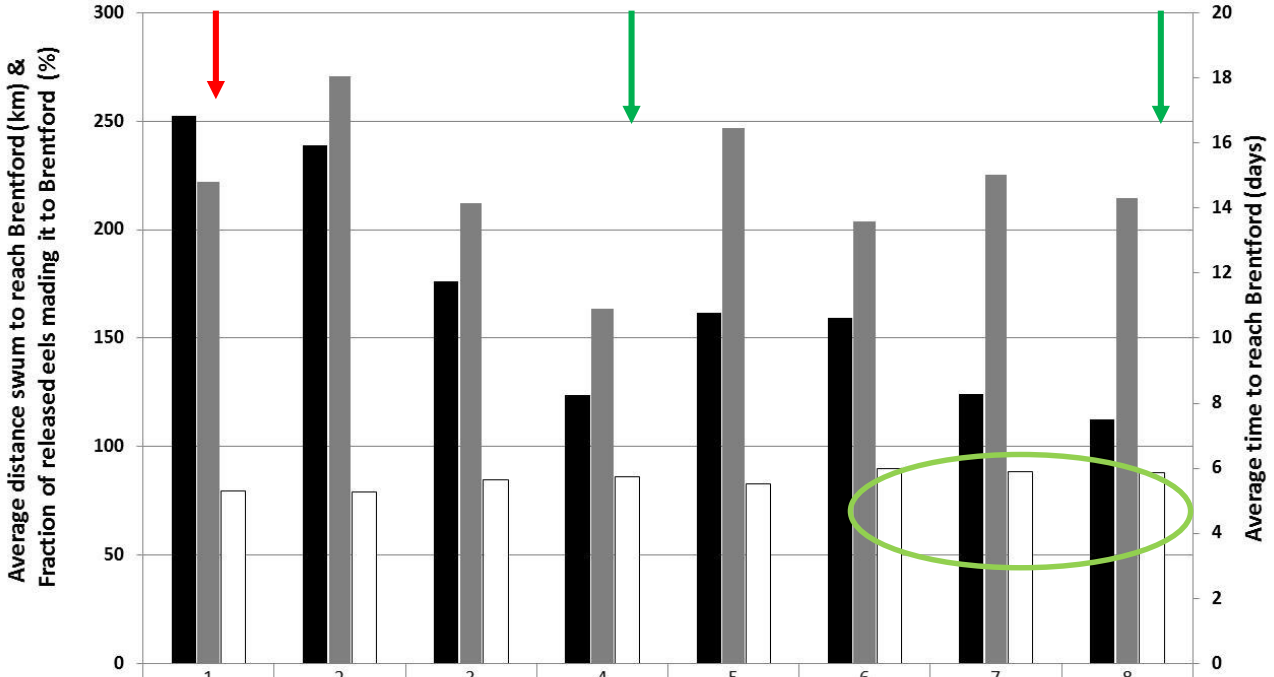
- Day/night

Validation / Application

- Coupled to 3D hydrodynamic models
- 8 different ‘STST’ scenarios
- Validation in Thames Estuary using 2014(6) ZSL/EA
- Application to Milford Haven Waterway

Results

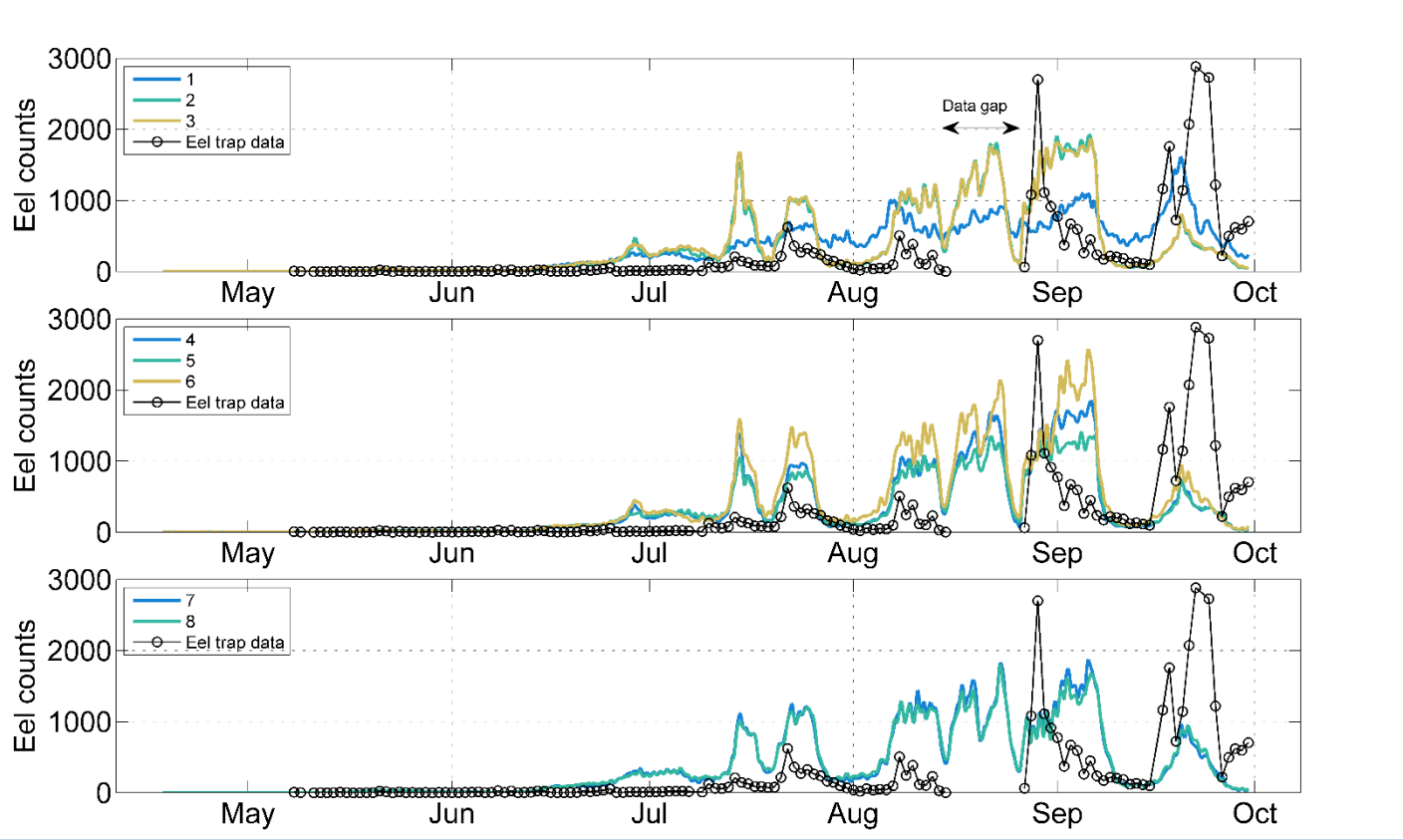
Thames



	1	2	3	4	5	6	7	8
■ Average distance swum to reach Brentford (km)	253	239	176	124	162	159	124	113
□ Fraction of released eels making it to Brentford (%)	79	79	85	86	83	90	88	88
■ Average time to reach Brentford (days)	14.8	18.0	14.2	10.9	16.5	13.6	15.0	14.3

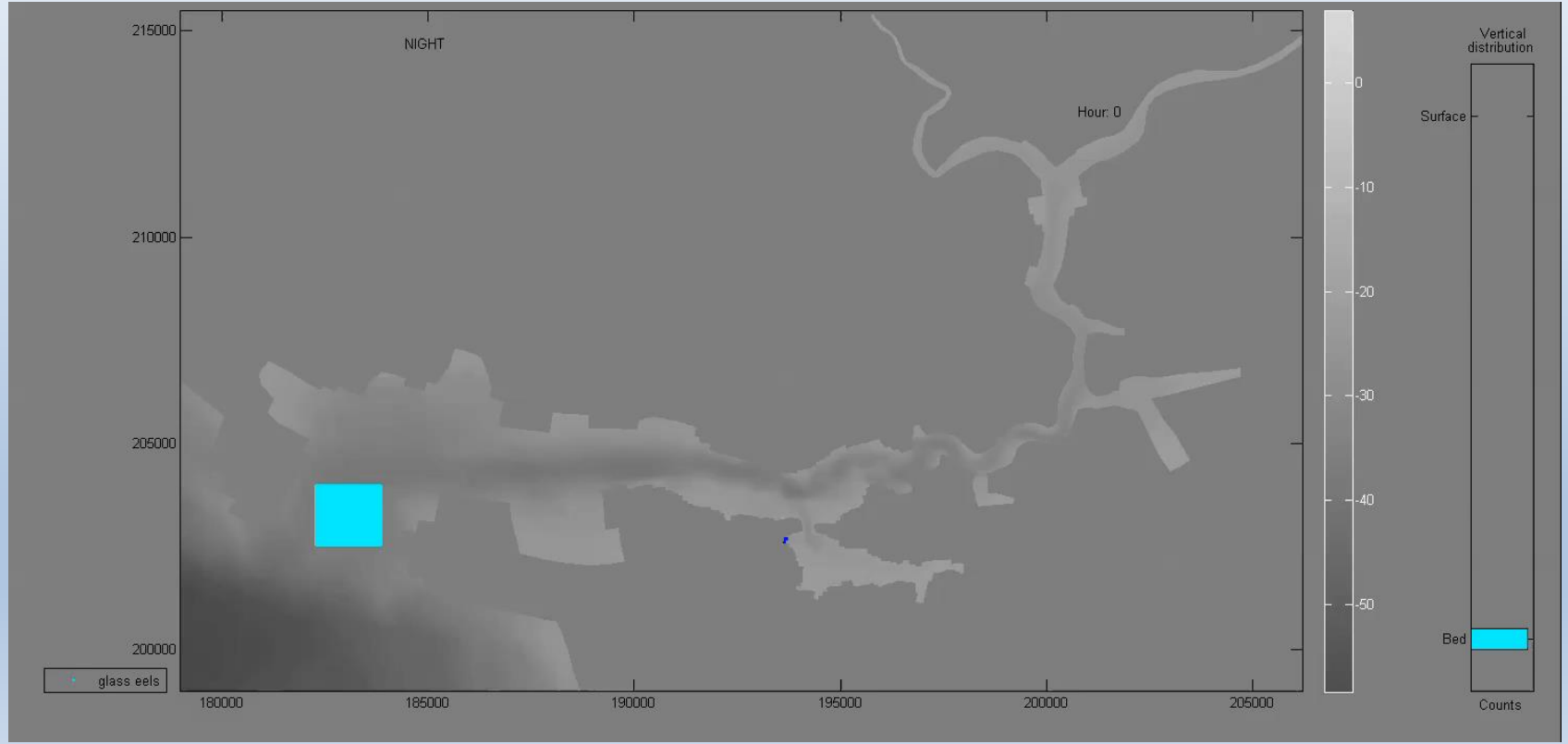
1. NO STST
2. STST + DAY/ NIGHT; swimming throughout water column on night flood
3. STST + DAY/ NIGHT; swimming at surface on night flood
4. STST + no DAY/NIGHT; swimming at surface on floods
5. STST + DAY/NIGHT; drifting throughout water column on night flood
6. STST + DAY/ NIGHT + EDGING; swimming at surface
7. STST + DAY/ NIGHT + EDGING; drifting at surface
8. STST + no DAY/ NIGHT + EDGING; drifting at surface

Results *Thames*



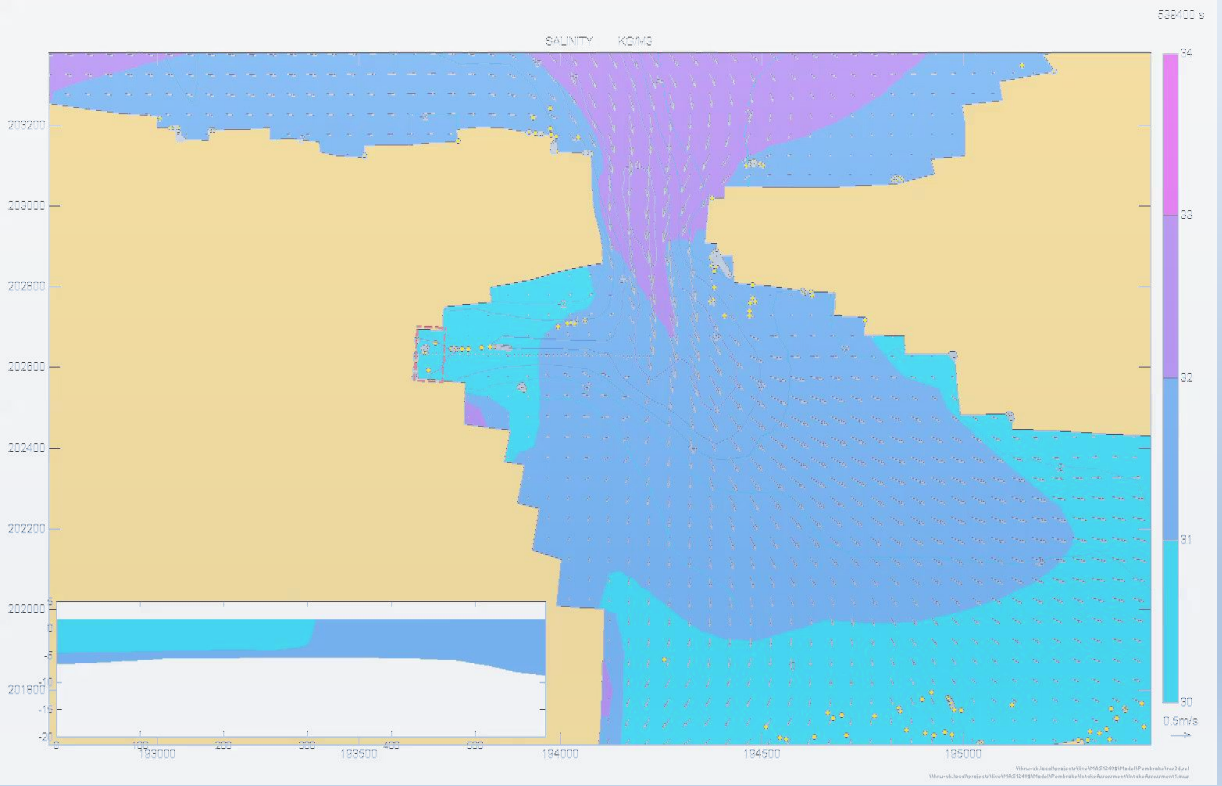
Results *Milford*

(8) STST + no DAY/ NIGHT + EDGING; drifting at surface



Results *Milford*

(8) STST + no DAY/ NIGHT + EDGING; drifting at surface



Conclusions

- ABM capable of representing upstream migration, matching catchment data
- Case study confirms glass eel impingement and provides estimate
- Possibilities to expand to other areas/ species

Thank you!

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