



Resolving recruitment bottlenecks for the critically endangered European eel



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European Eel status

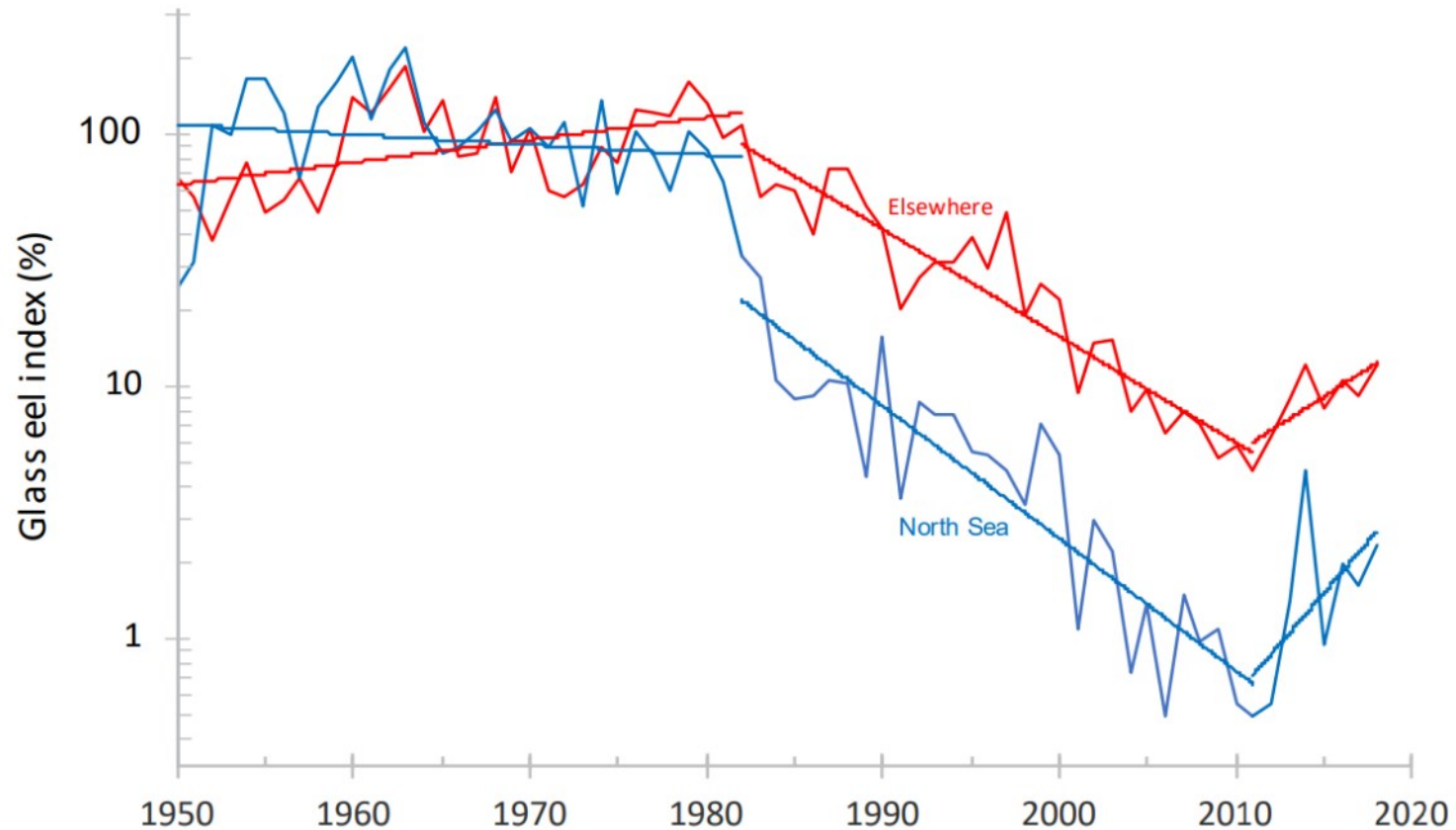
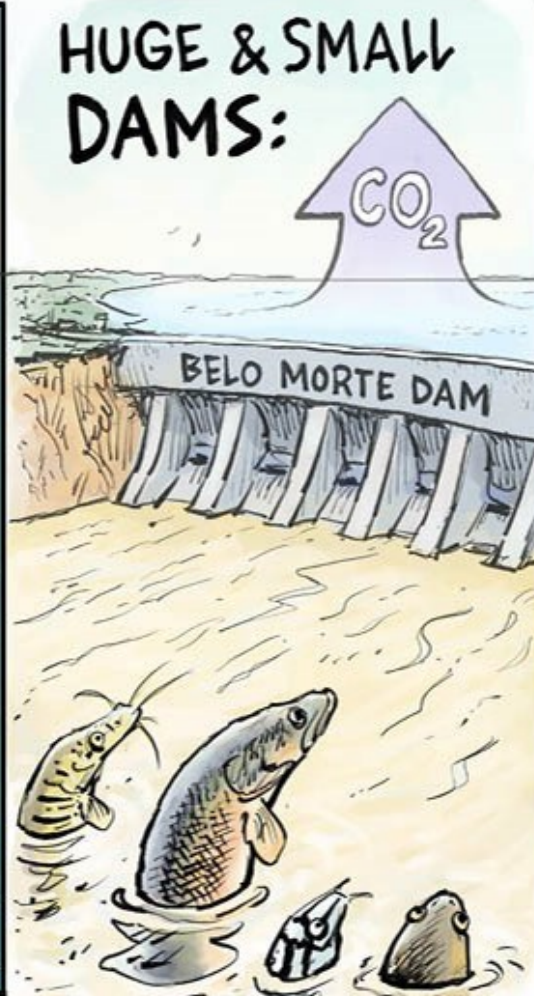


Figure 1. Trends in the abundance of glass eel arriving at the European continent
Data: ICES, 2018a. Tentative linear trend lines have been added for 1950–1982,
1982–2011 and 2011–2018. Note the logarithmic scale of the vertical axis.

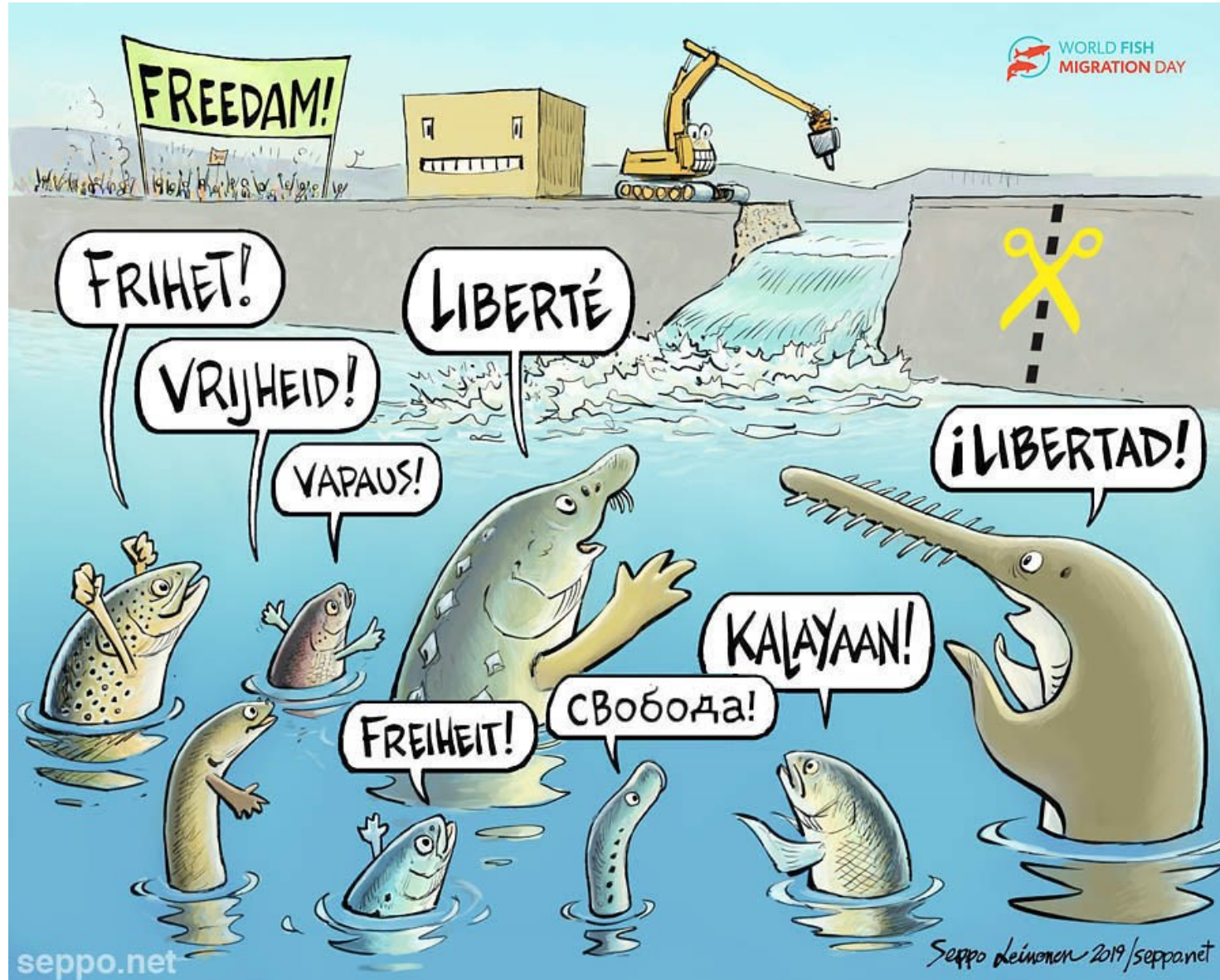
GLOBAL THREATS FOR MIGRATING FISH



seppo.net



Seppo Nieminen 2018/seppo.net





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I'D REALLY RATHER REMOVE THESE DAMS, BUT THIS NATURE-LIKE BYPASS IS GOOD FIRST AID.





Eel migration and river fragmentation

Så påverkar
människan ålen
Illustration: © Zara Olsson



Win-win solutions for hydropower and nature



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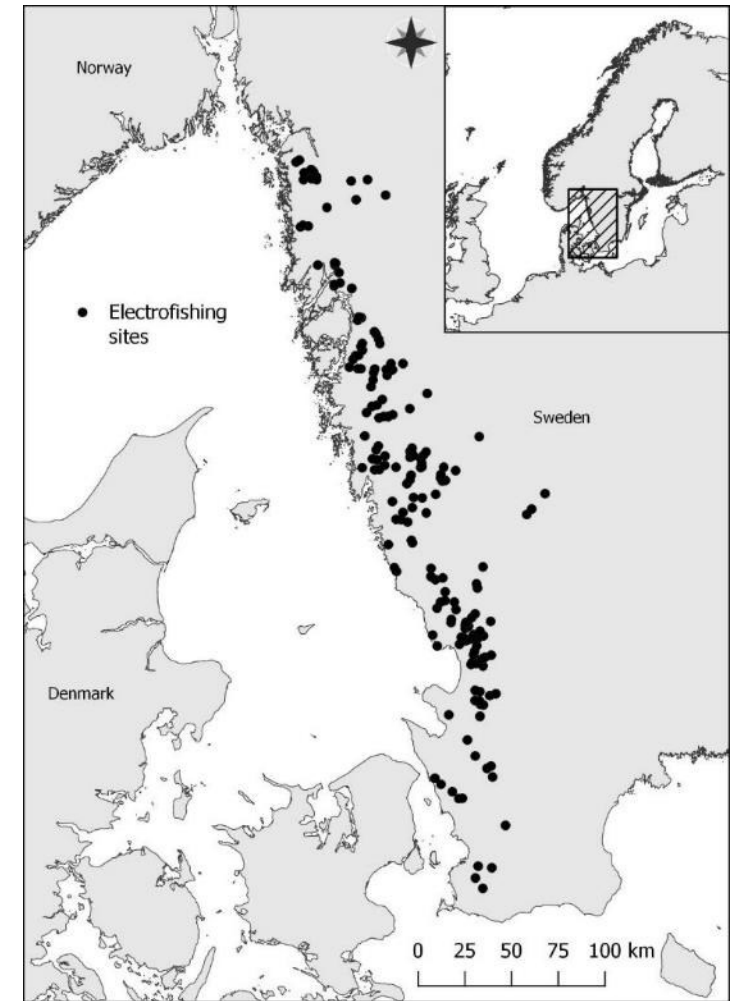


SLU



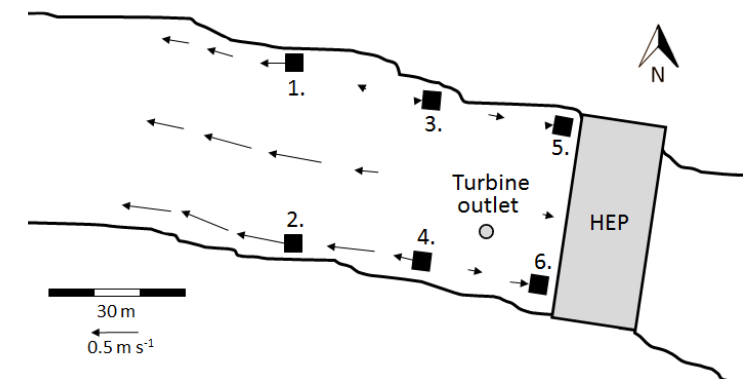
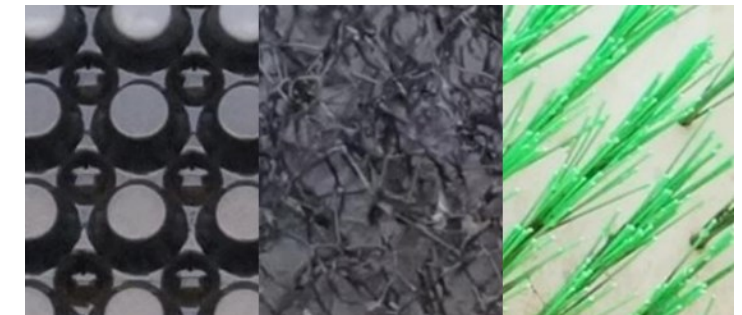
Win-win main findings

- Higher probability of eel occurrence upstream **nature-like fishways**, than dams fitted with eel ramps, technical fishways and dams without FPSs (Tamario *et al.*, 2019)
- In the experiment on eel substratum selection, 40% of the eels passed in lanes with **studded substratum**, whereas only 21 and 5% passed using open weave and bristle substrata respectively (Watz *et al.*, 2019) (*Validated in the field*)
- Ramps positioned by the bank with **low water velocities** caught the most eels, but proximity to the dam had no effect on performance (Watz *et al.*, 2019).



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- How important are ramp design, hydrodynamics and phenotypic variation for ramp performance?





Optimized eel passage solutions

*Olle Calles, Johan Watz, Dennis Leandersson, Johan Höjesjö,
Magnus Lovén Wallerius, Pernilla Hanson, David Aldvén
& Anders Nilsson*



VATTENFALL 

Havs
och Vatten
myndigheten



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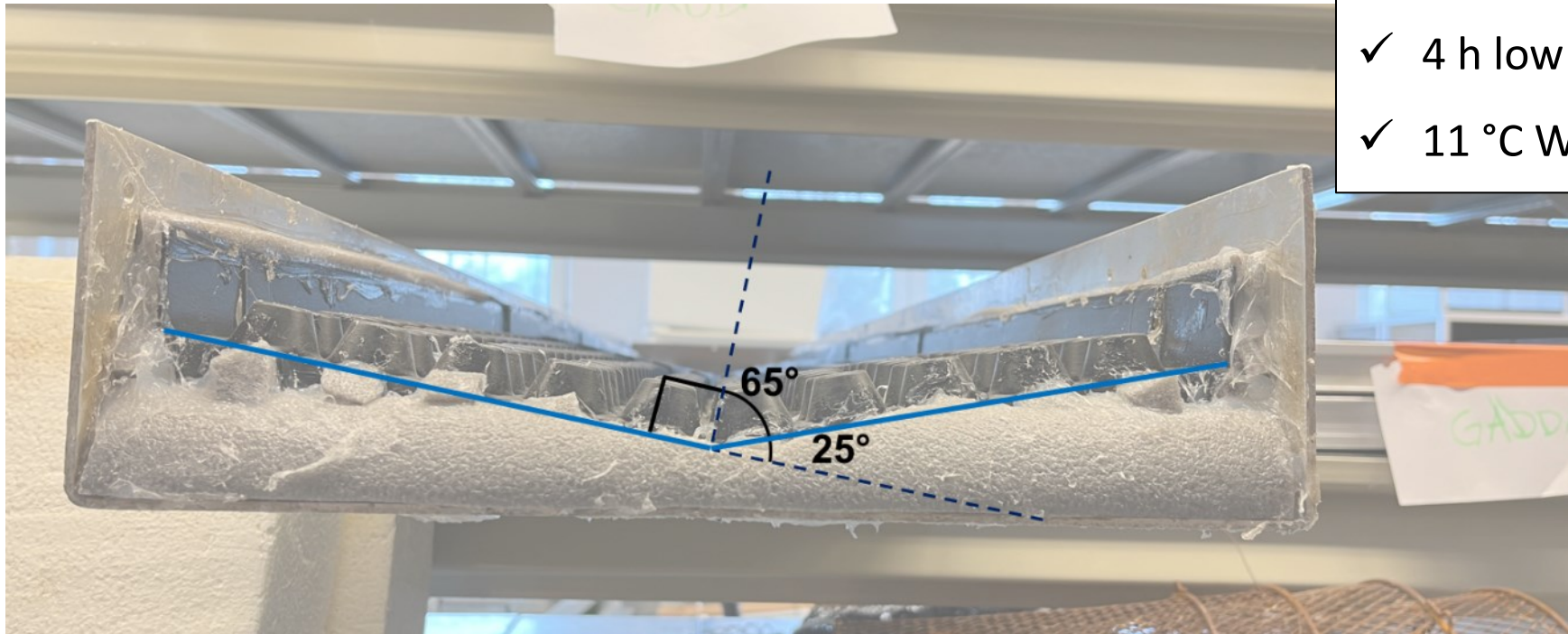
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Eel ramp designs

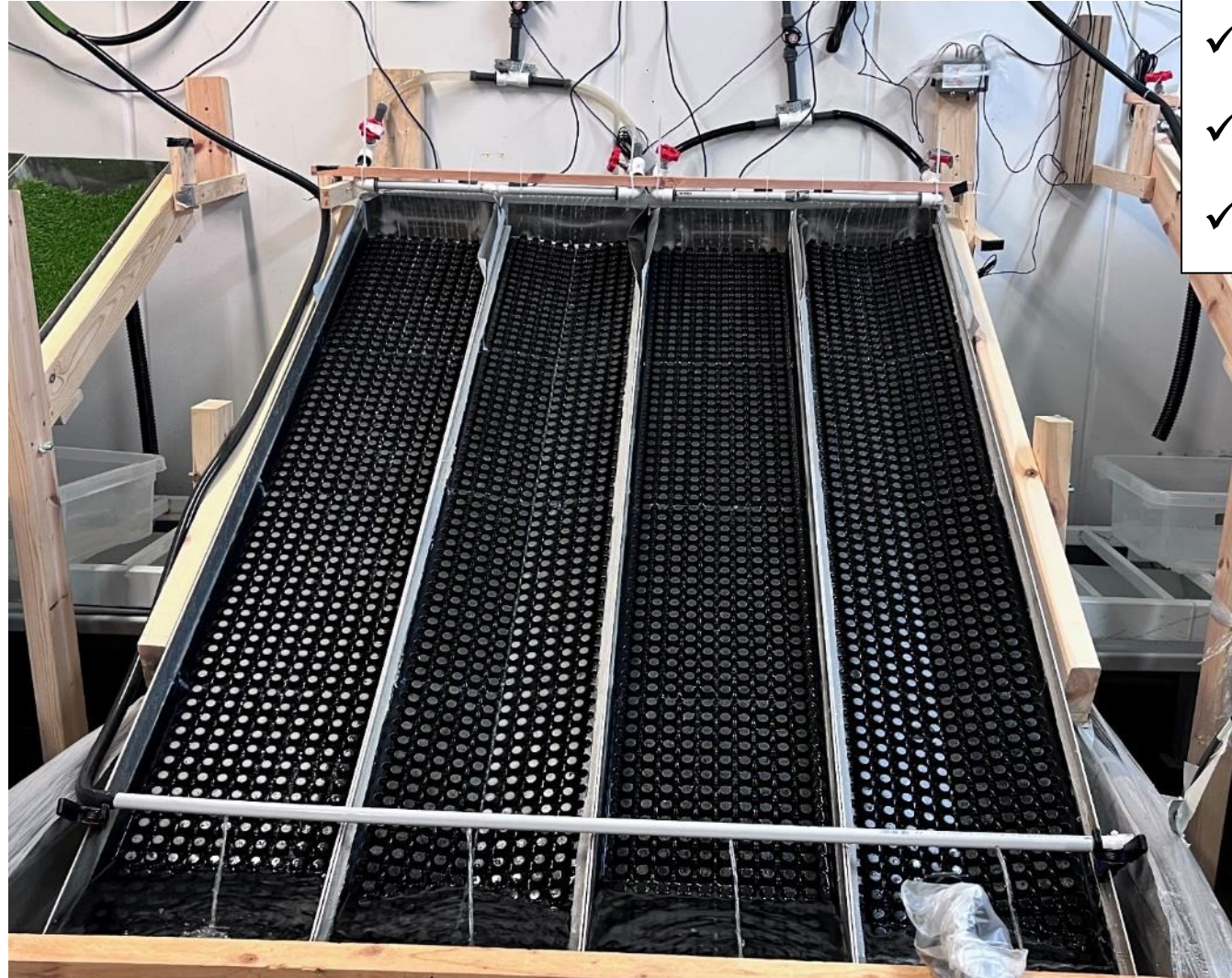


Design and flows - Setup

- ✓ 30° ramp inclination
- ✓ 12.5° lateral tilt
- ✓ 4 h low light period
- ✓ 11 °C WT



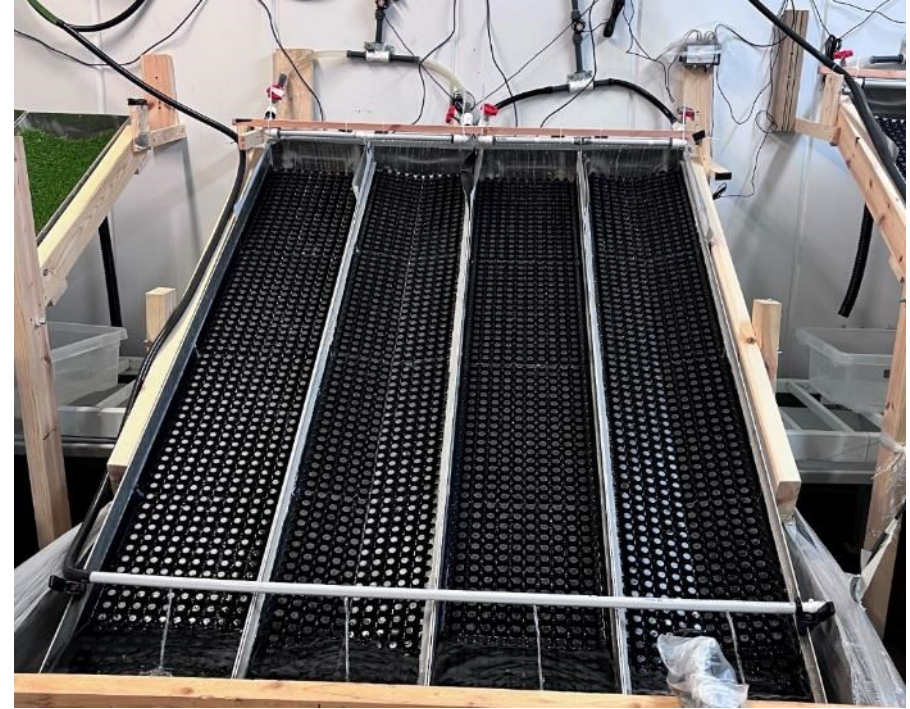
Design and flows - Setup



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Optimized passage project

- Passage performance for designs and flows (2x2):
 - Plunging attraction flow (1.0 L/min)
 - Laterally flat vs. v-shaped
 - Low vs. high flow (3.0 vs. 9.0 L/min)
 - 15 eels 12 h overnight ($N = 2 \times 15 \times 25 = 750$)
- Passage performance and phenotype:
 - Individual exploratory behavior (OFT)
 - Size



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Exploratory behavior - Setup

Open field test
(OFT)



Exploratory behavior - Setup

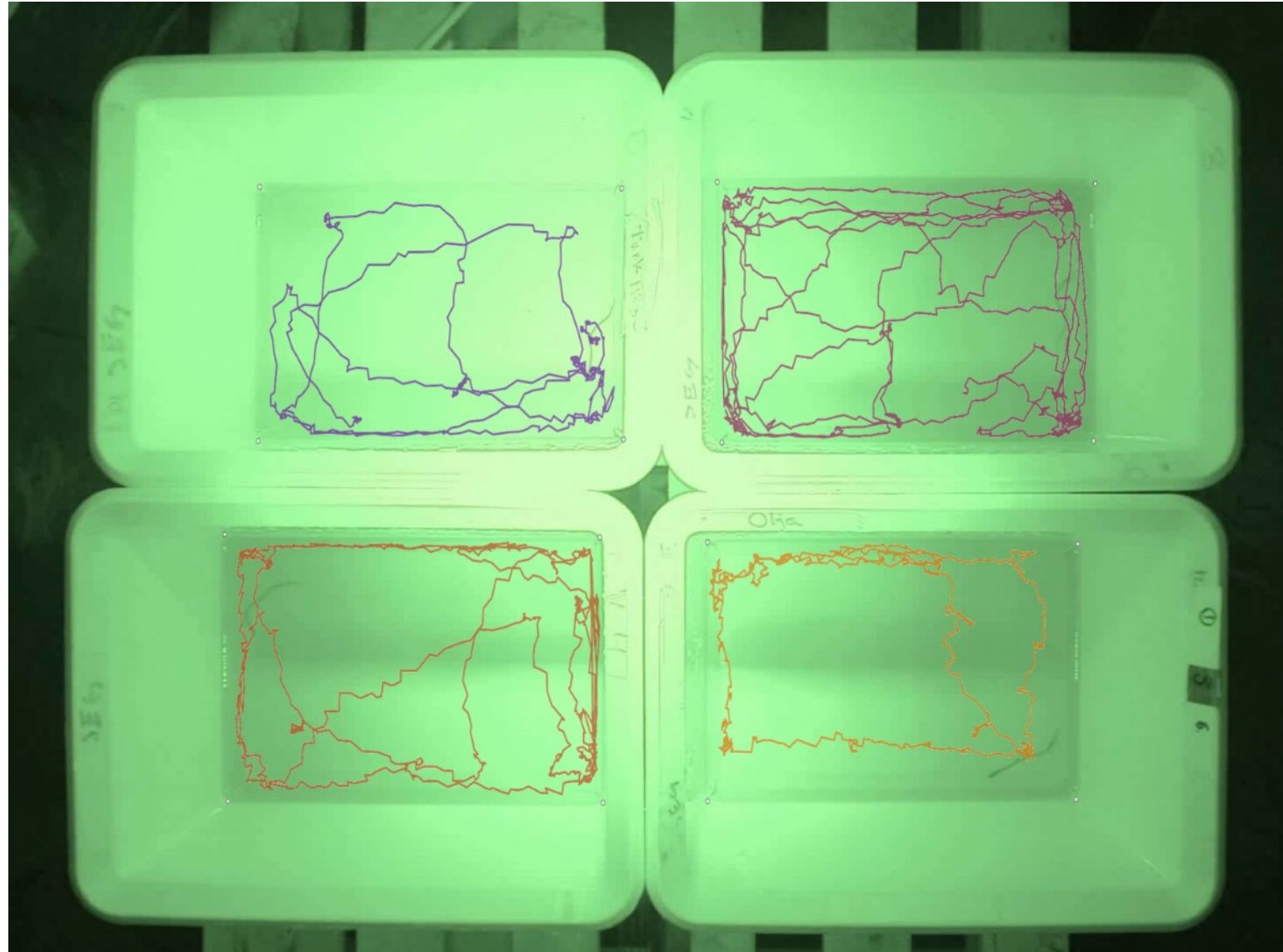
Open field test
(OFT)



*Python & YOLOv3 object
detection algorithm*

Exploratory behavior - Results

Open field test
(OFT)



*Average OFT score
405.1 ± 224.4 cm
(mean score ± SD)*

Ramp experiment - Results



- Climbing probability (*Binomial GLMM*):
 - 29.5% climbed - higher at low flow
 - Decreased with distance moved in OFT (*cf. Mensinger et al., 2021*)

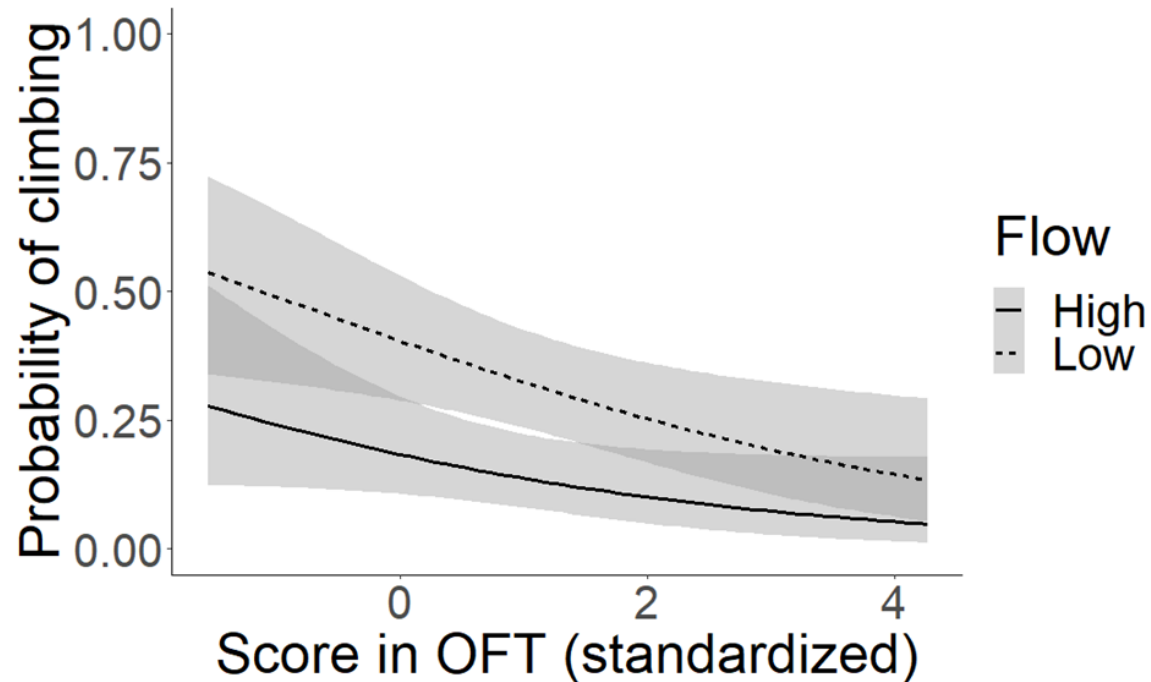


Figure 2. Predicted probabilities estimating how score in OFT affected climbing for eels in high flow (solid line) and low flow (dashed line).

Ramp experiment - Results



- Ramp type and flow:
 - Low flow: higher overall climbing success (not size-dep.)
 - High flow: preference for V-shaped ramps

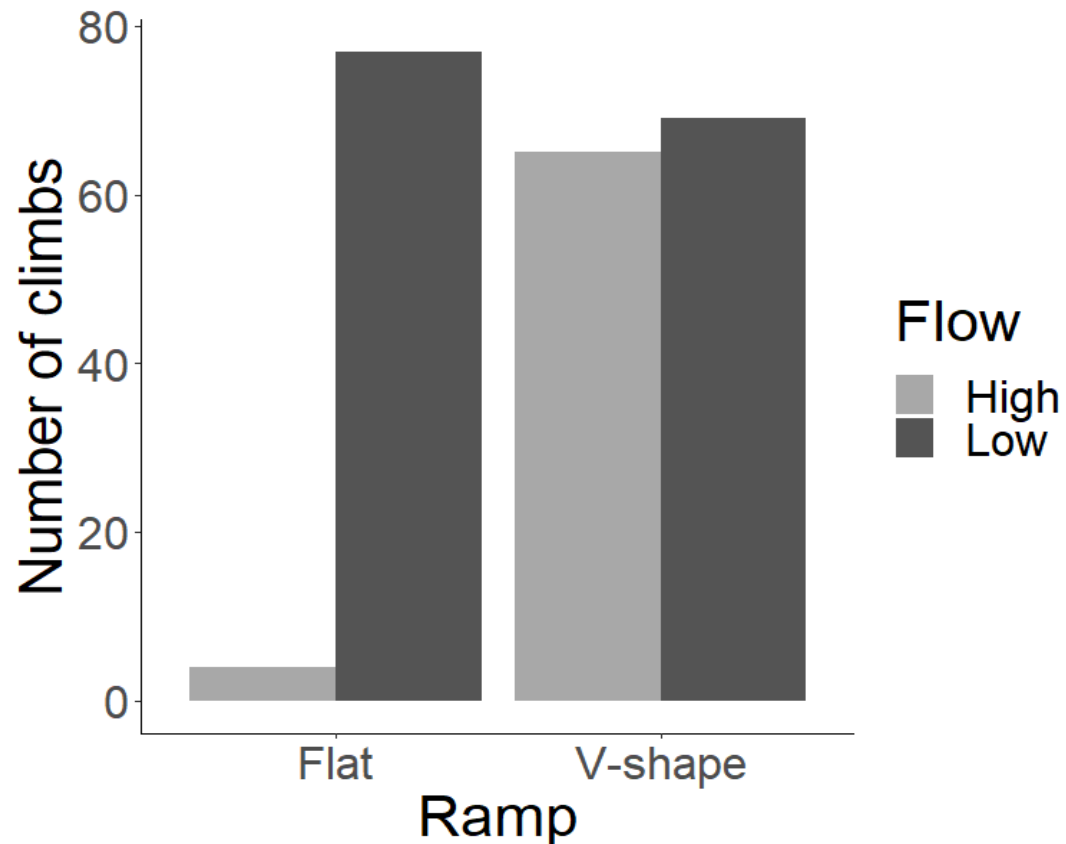
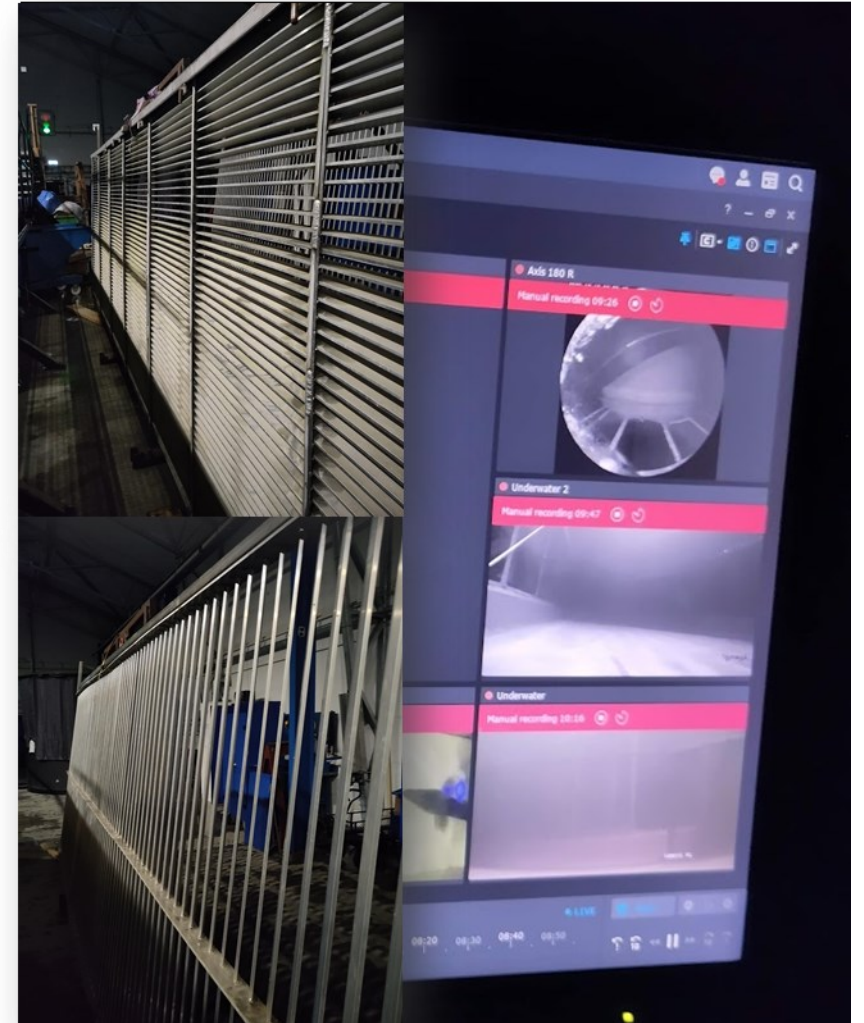


Figure 3. The cumulative number of eel climbs for laterally flat and V-shaped ramps under the two different treatment flows (dark grey = low flow, and light grey = high flow).

Ramp experiment – Field-validation



Silver eel passage experiment



Thanks for listening



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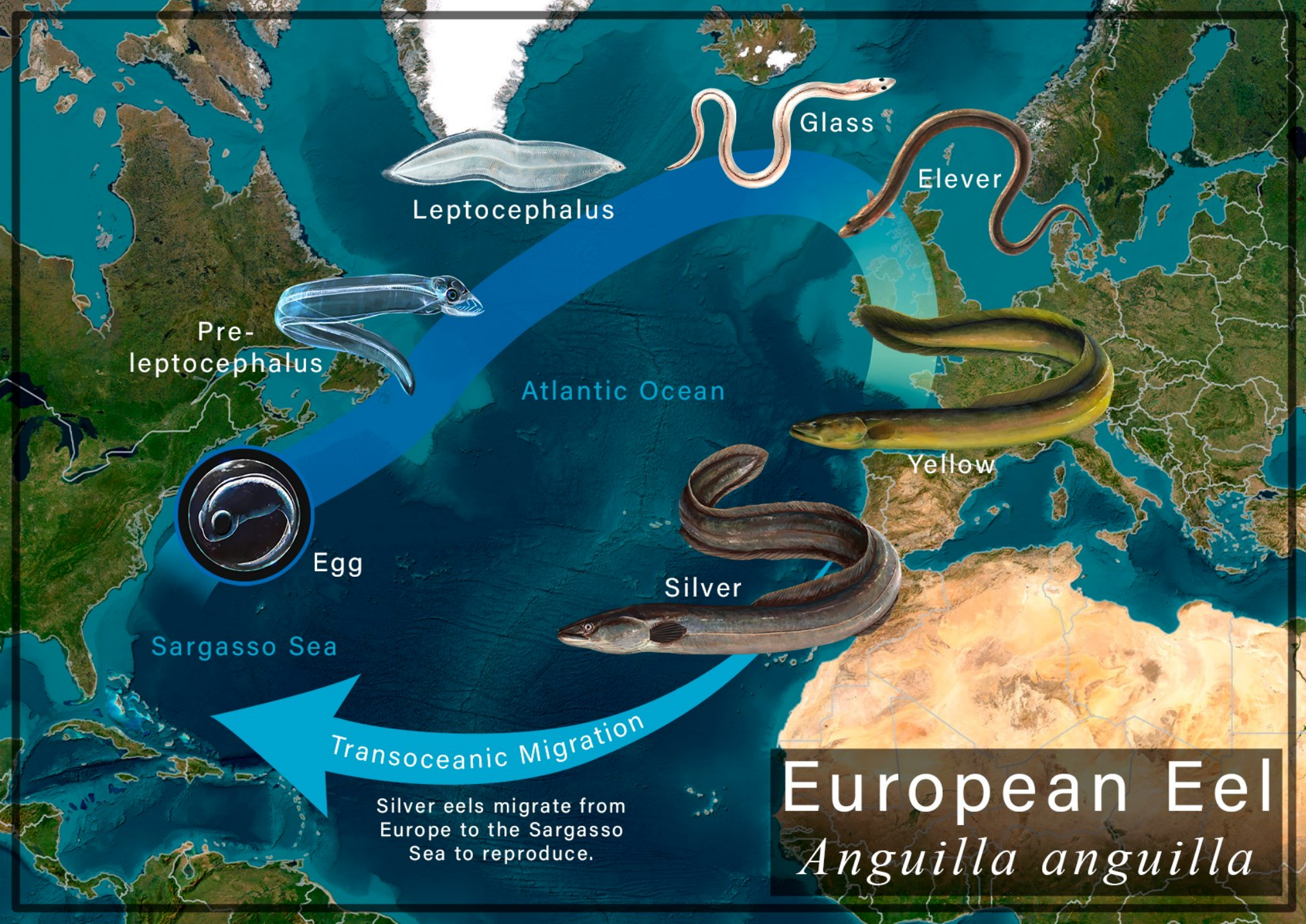


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Illustrations:
Jennifer Clausen



Questions?