ENVIRONMENT DAY 2026

ada

EELS

Dr Jon Bolland

Senior Research Fellow
Hull International Fisheries Institute
University of Hull

SPONSORED BY BREHENY CIVIL ENGINEERING

PARK FARM

UNIVERSITY OF HULL

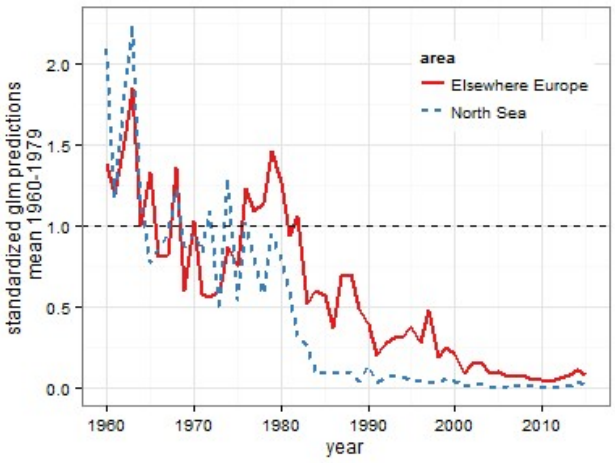
Environment Agency

REDEEM project re-cap

Jonathan Bolland and
Ros Wright

UNIVERSITY OF HULL

European eel…



Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

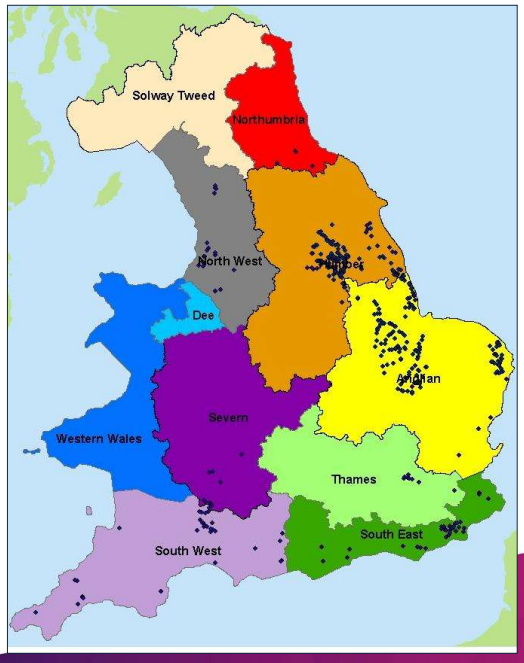
European eel and pumping stations

COUNCIL REGULATION (EC) No 1100/2007
of 18 September 2007
establishing measures for the recovery of the stock of European eel

2009 No. 3344
FISHERIES, ENGLAND AND WALES
RIVER, ENGLAND AND WALES
The Eels (England and Wales) Regulations 2009

ICES International Council for the Exploration of the Sea
CIEM Conseil International pour l'Exploration de la Mer

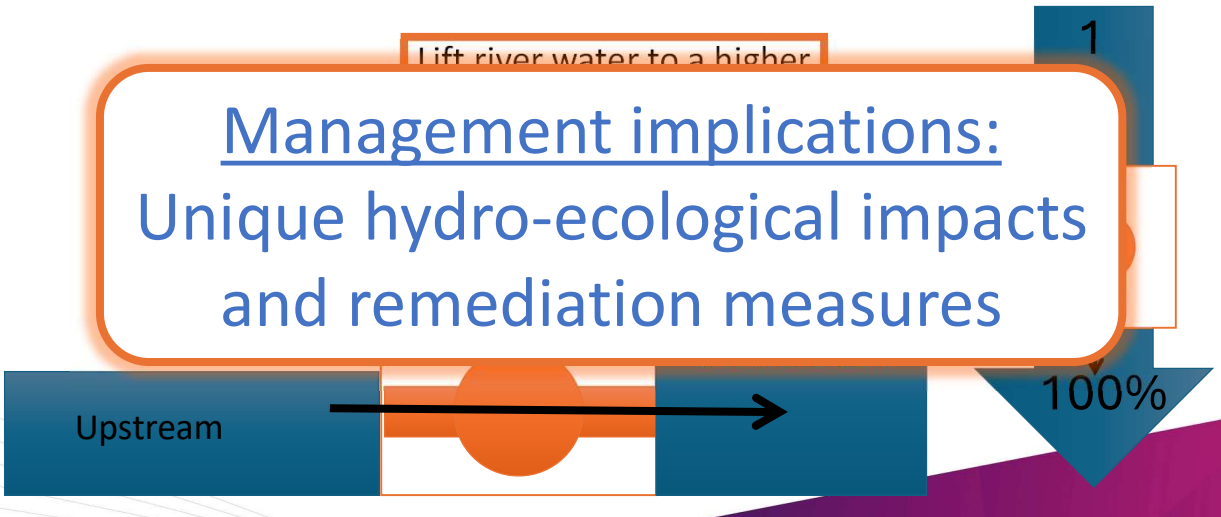
- all non-fisheries related anthropogenic mortalities should be reduced to zero.
- the quantity and quality of eel habitats should be restored



Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

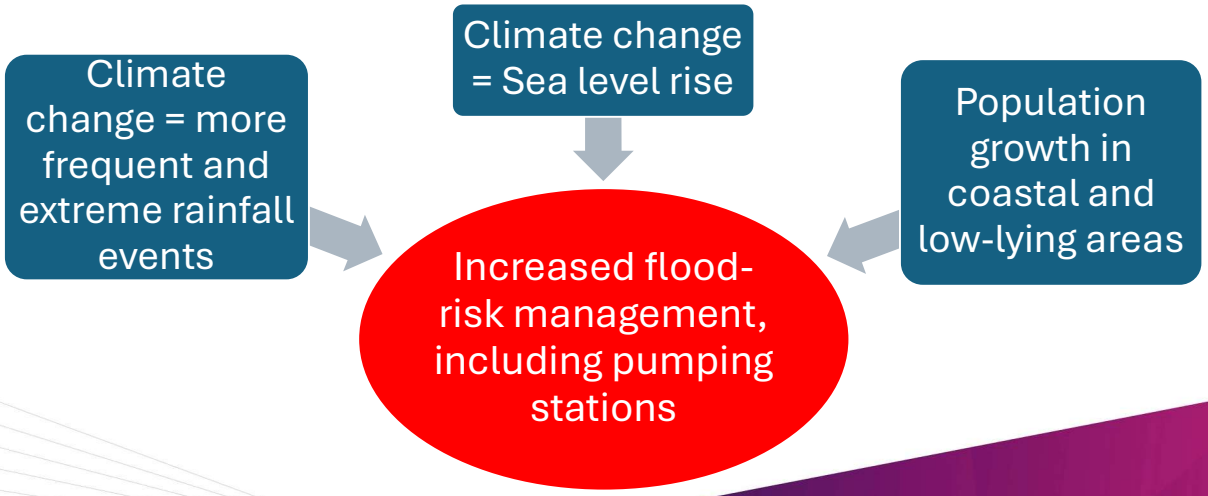
Moving water up hill



Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

Future requirement for pumping stations



Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

REDEEM project: **Re**search and **D**evelopment of fish and **E**el **E**ntrainment **M**itigation at pumping stations

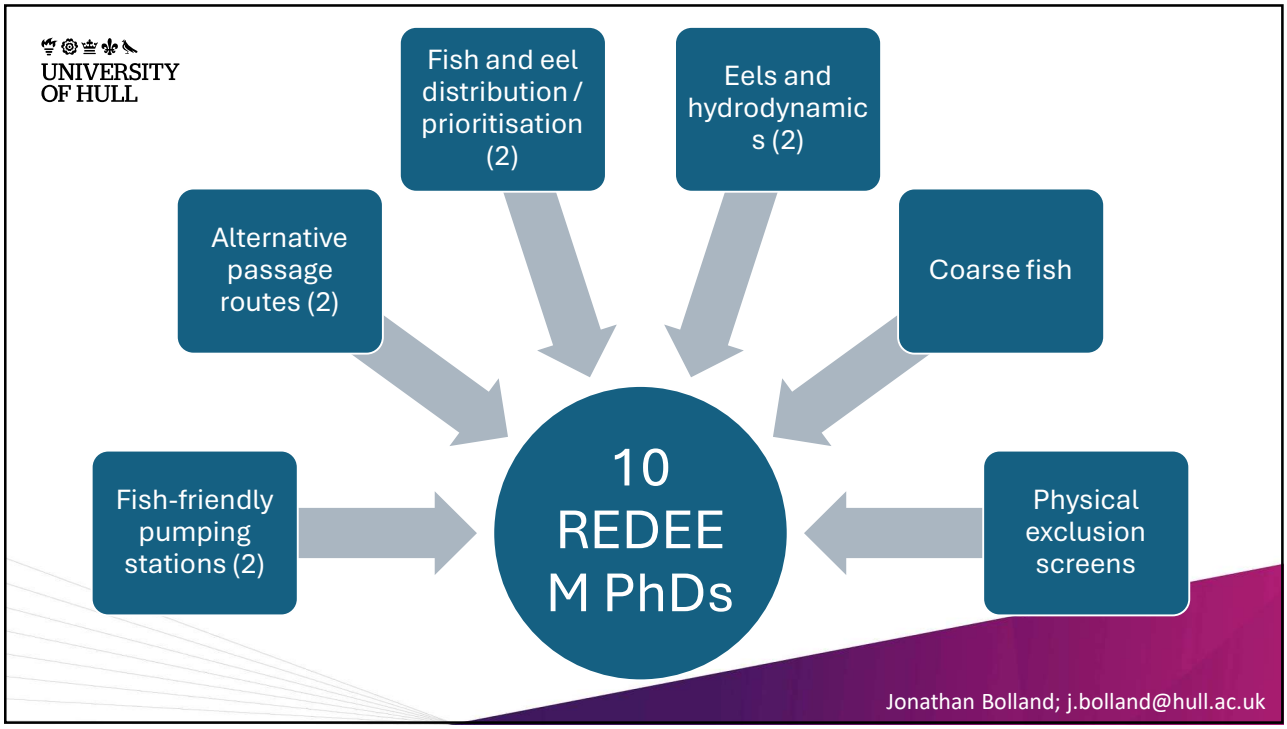
Provide evidence-based cost-effective solutions for reducing the environmental impact of pumping stations and hydropower turbines, and achieving compliance with Eel Regulations and other legislation

Environment Agency

ada Representing Drainage Water Level & Flood Risk Management Authorities

Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

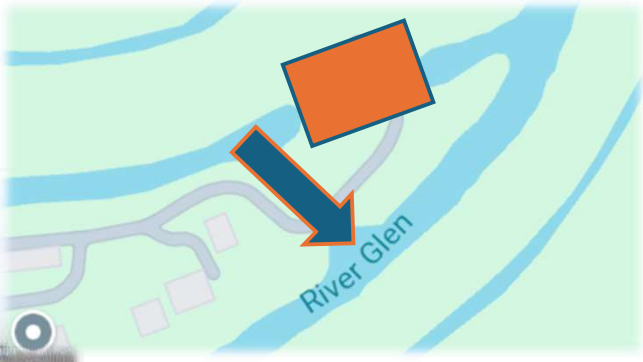


Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

How it all started…

UNIVERSITY OF HULL

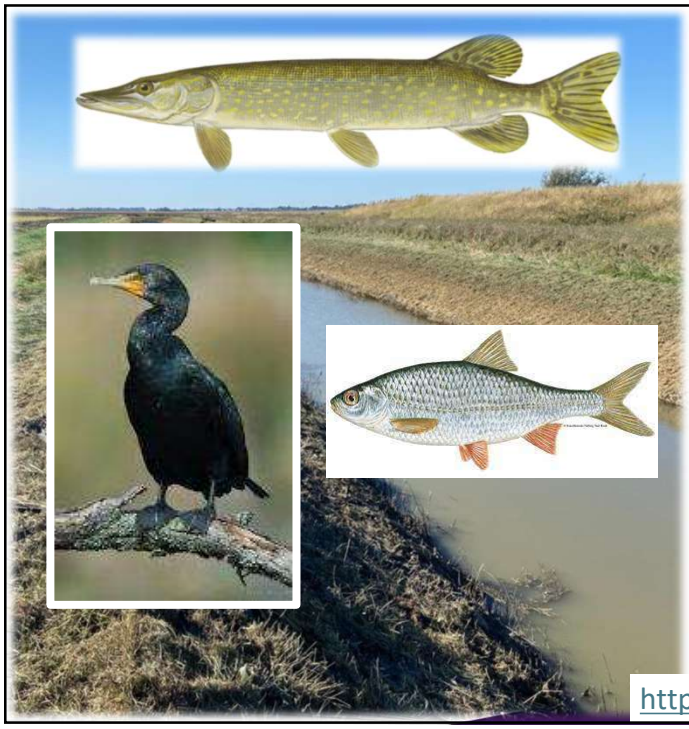


Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

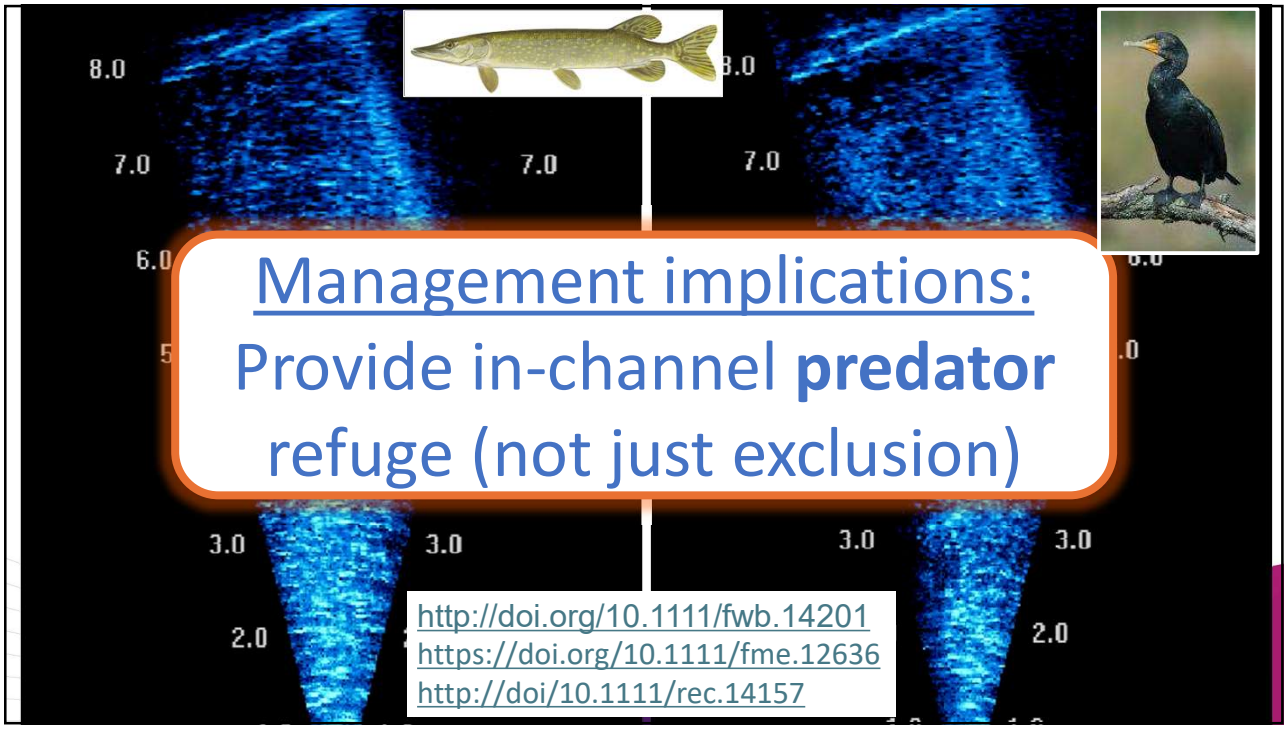
Knowledge of how fish and eels interacted with pumping stations

Jonathan Bolland; j.bolland@hull.ac.uk



Predator refuge

https://doi.org/10.1016/j.jenvman.2023.117716



Management implications:

Provide in-channel **predator** refuge (not just exclusion)

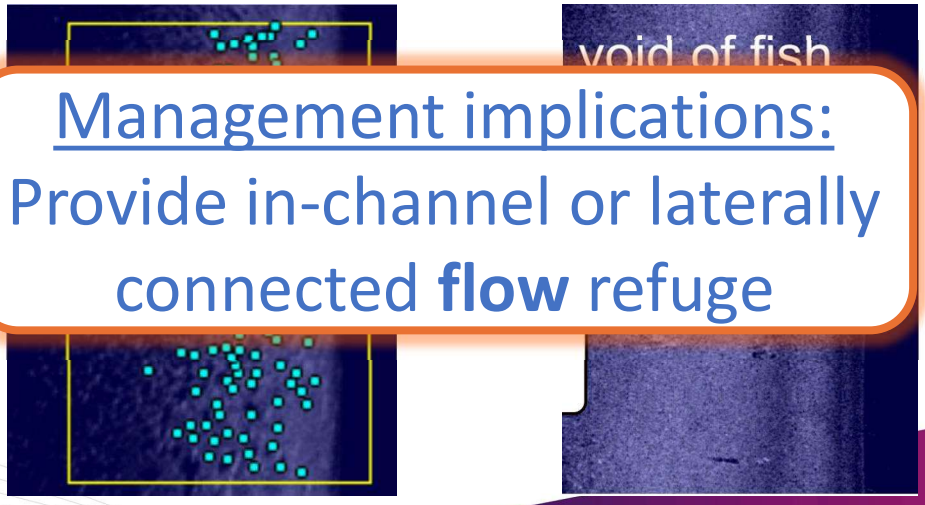
http://doi.org/10.1111/fwb.14201
https://doi.org/10.1111/fme.12636
http://doi/10.1111/rec.14157

Management implications:

Do NOT turn pumps on during the day

UNIVERSITY OF HULL

Extreme pump operation = No flood but very fast flows!



Management implications:

Provide in-channel or laterally connected **flow** refuge

https://doi.org/10.1111/fme.12636

Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

Mortality

Management implications:
The vast majority of traditional pumping stations killed eels

"The majority of eels were alive but exhibited extreme lethargy, loss of balance and laboured gill movements. External damage was generally localised and did not appear significant. There was some significant gill damage, with heavy levels of aneurisms (burst blood vessels) being observed"

https://doi.org/10.1111/fme.12312

Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

Assess the effectiveness of fish-friendly pumps… and the entire station

UNIVERSITY OF HULL

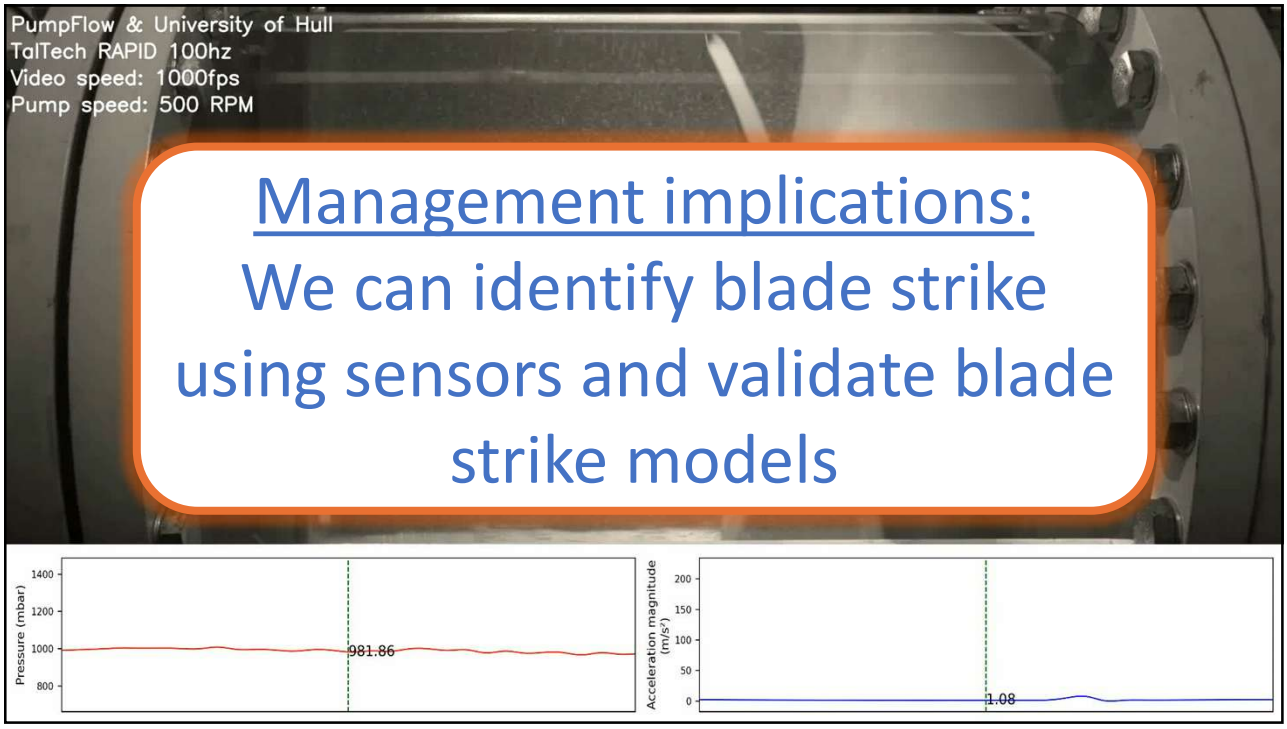
A view inside the black box!

Management implications:
We can provide real-world validation fish-friendliness

https://doi.org/10.1016/j.ecoleng.2025.107526

Jonathan Bolland; j.bolland@hull.ac.uk


Pumpflow


PumpFlow & University of Hull
TalTech RAPID 100hz
Video speed: 1000fps
Pump speed: 500 RPM
Management implications:
We can identify blade strike using sensors and validate blade strike models
Pressure (mbar)
1400
1200
1000
800
981.86
Acceleration magnitude (m/s²)
200
150
100
50
0
1.08

UNIVERSITY OF HULL

Not just the pump

Management implications:
The entire pumping station must be fish-friendly

https://doi.org/10.1038/s41598-024-67870-5

Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

Let me help you…

Please **contact me** if you have any site with FFP we can test with sensors!

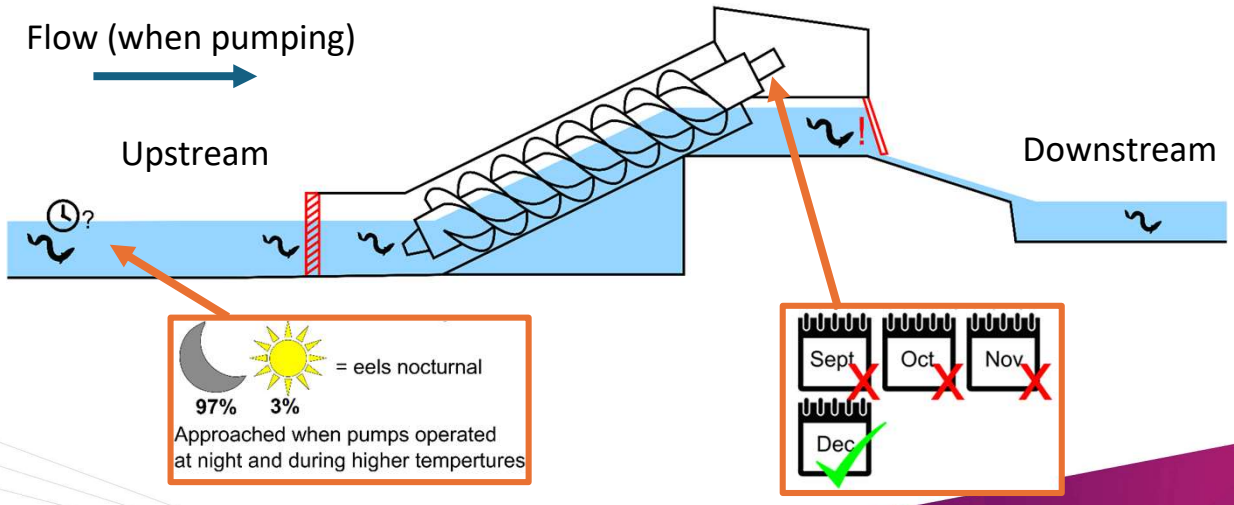
Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

Safe AND timely passage

UNIVERSITY OF HULL

Non-operation = barrier to migration



https://doi.org/10.1038/s41598-024-67870-5
https://doi.org/10.1016/j.ecoleng.2024.107389

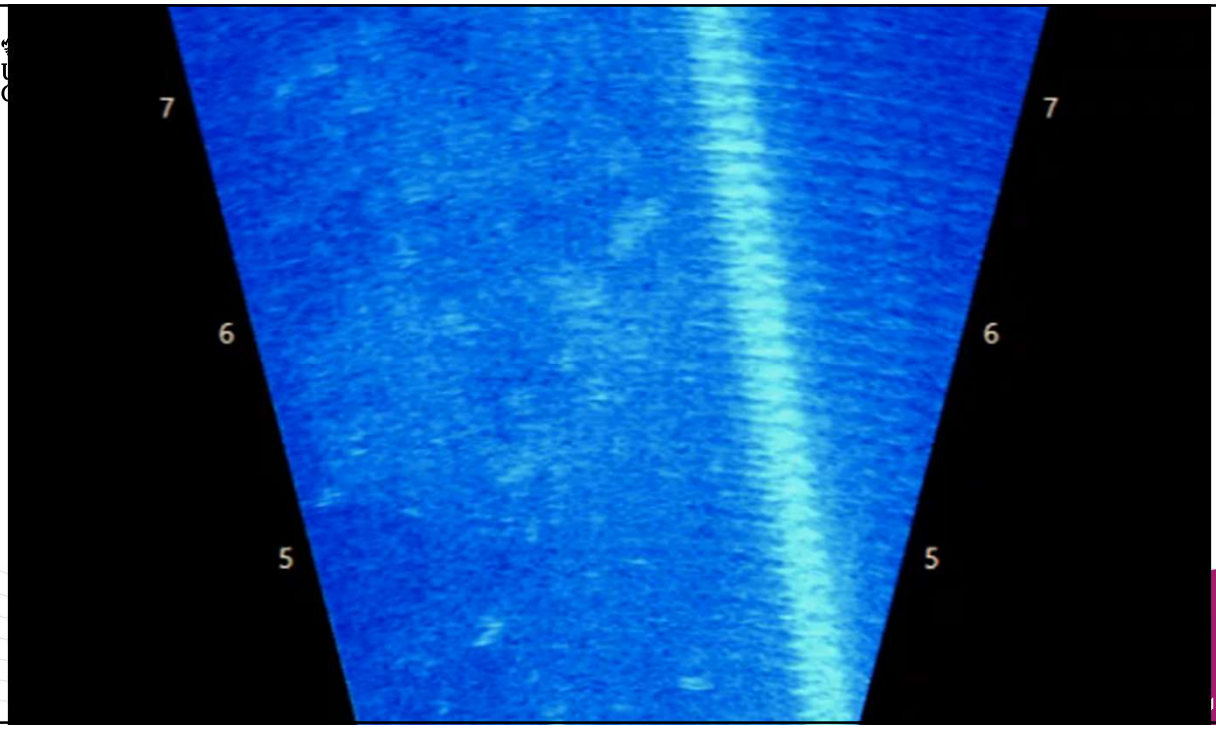
Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

Management implications:

Fish-friendly pump operation must align with eel migration (especially during drought years)

Jonathan Bolland; j.bolland@hull.ac.uk



UNIVERSITY OF HULL

Rethinking pumping stations as fish passage solutions

100 mm aperture

190 mm aperture

Management implications:
Eels must readily pass weedscreens and enter fish-friendly pumps

37% passage

57% passage

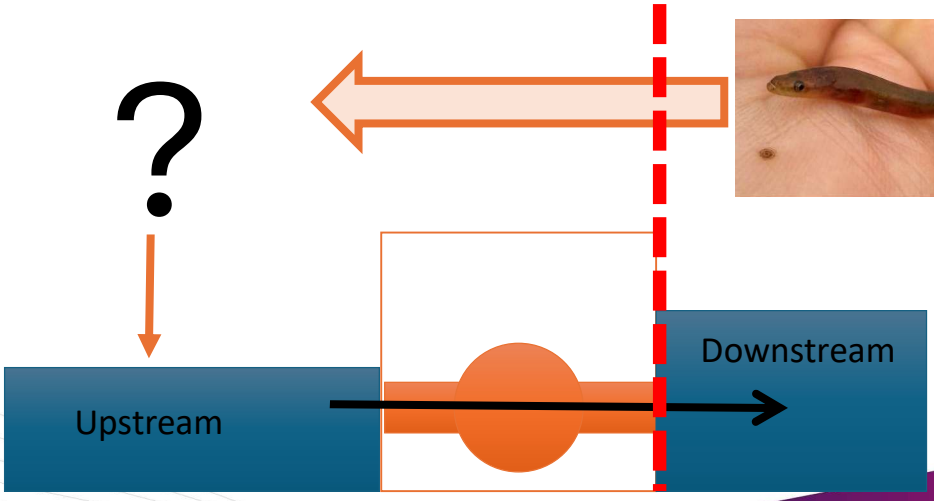
Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

Eels are rare!

UNIVERSITY OF HULL

Barrier to upstream migration



Jonathan Bolland; j.bolland@hull.ac.uk

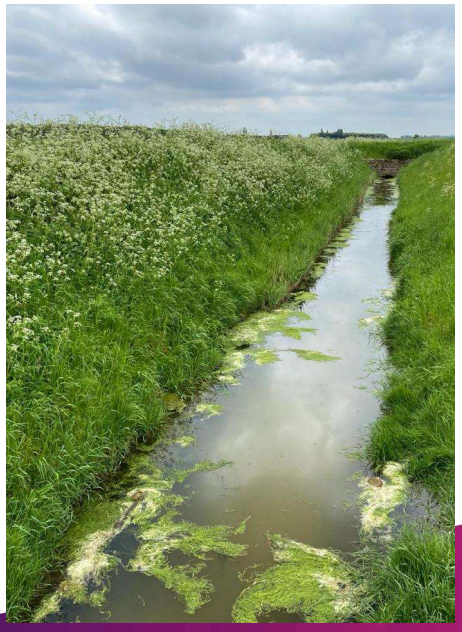
UNIVERSITY OF HULL

Connectivity

Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

Habitat quantity and quality



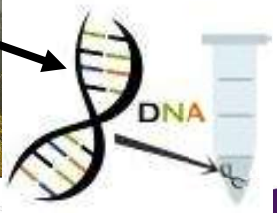
Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

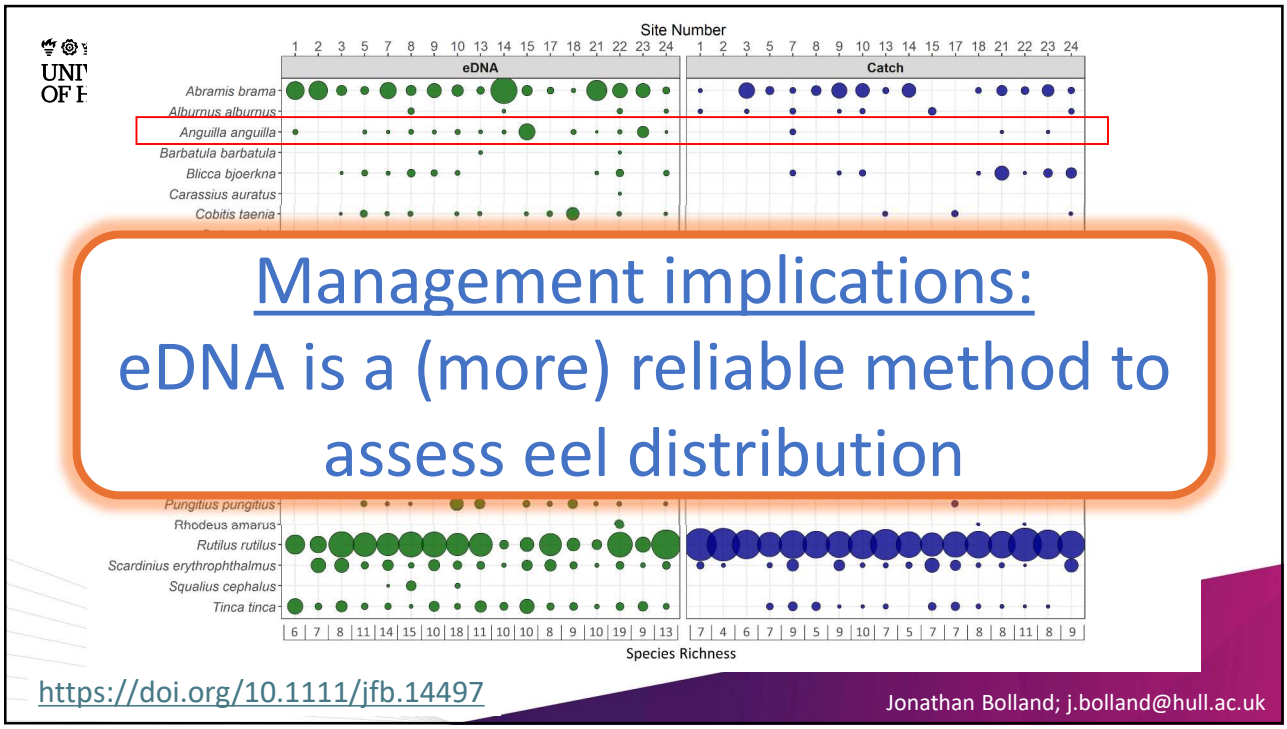
eDNA versus traditional sampling

V

- As species interact with the environment, DNA is shed
- This DNA is referred to as Environmental DNA (eDNA)
- eDNA can be sampled, to identify species present in the watercourse.
- eDNA is increasingly recognised as highly sensitive and cost-effective



Jonathan Bolland; j.bolland@hull.ac.uk

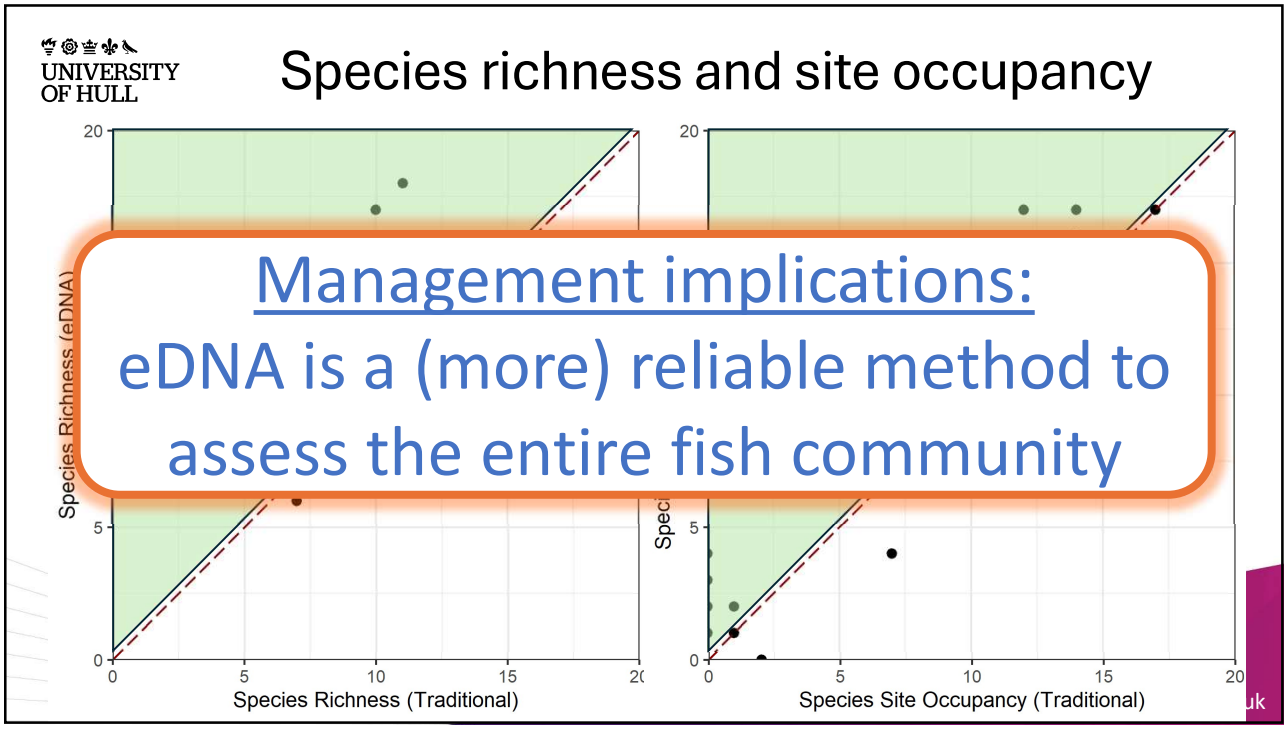


Management implications:

eDNA is a (more) reliable method to assess eel distribution

https://doi.org/10.1111/jfb.14497

Jonathan Bolland; j.bolland@hull.ac.uk



Management implications:

eDNA is a (more) reliable method to assess the entire fish community

UNIVERSITY OF HULL

Eels in the Fens (ongoing)

Wide-scale understanding of eel (and entire fish community) distribution

UNIVERSITY OF HULL

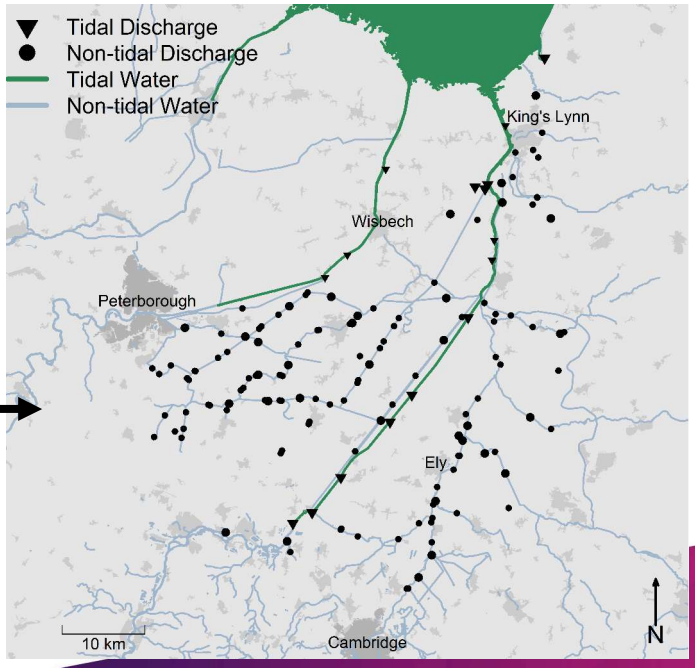
Objectives

- Determine eel presence/absence in each catchment
- Assess catchments for upstream and downstream eel passage remediation
- Optimise allocation of funds and resources

Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

The Fens

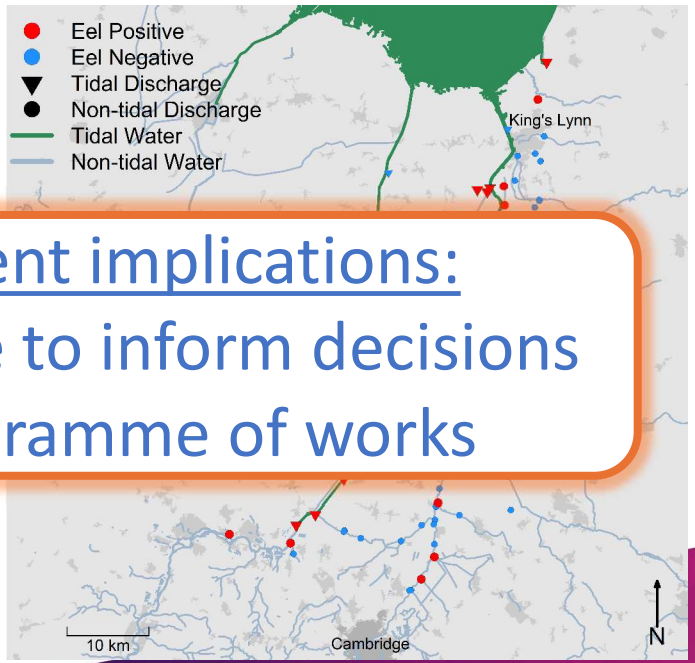


Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

Known eel distribution!

- 4 x 2-week sampling



Management implications:
Use knowledge to inform decisions during programme of works

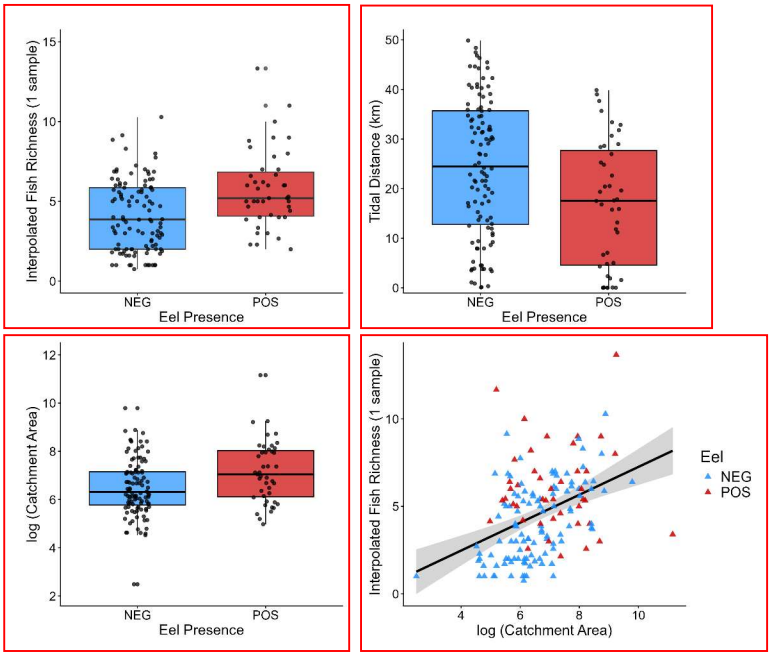
➢ 43/152 (**28.3%**) sites positive for eel

Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

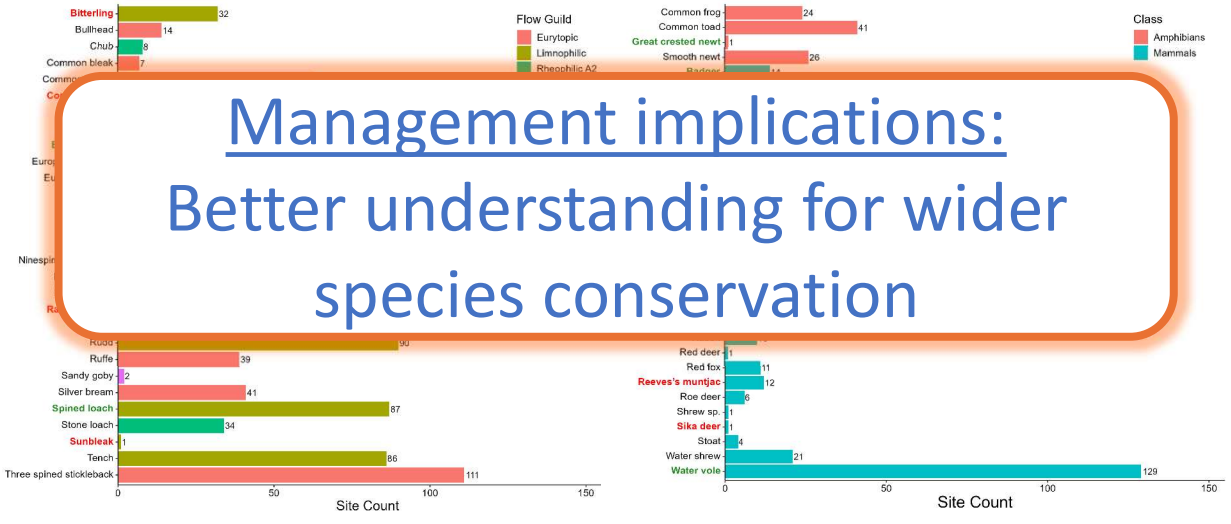
- Median fish richness (excluding eel) significantly higher ($p < 0.01$)
- Tidal distance significantly lower ($p < 0.01$)
- Catchment area significantly greater ($p < 0.05$)

- Significant (weak) correlation between catchment area and fish richness ($r^2 = 0.3996$, $p < 0.01$)



Jonathan Bolland; j.bolland@hull.ac.uk

Metabarcoding = entire vertebrate community



Management implications:

Better understanding for wider species conservation

UNIVERSITY OF HULL

REDEEM knowledge exchange event

2–3 June 2026 @ University of Hull

Sponsored by the Environment Agency, i.e. free to attend!

Presentations and discussions to deliver real-world benefits for practitioners, ranging from ecologists to asset managers and policymakers to engineers

Jonathan Bolland; j.bolland@hull.ac.uk

UNIVERSITY OF HULL

Thank you

For more information:
j.bolland@hull.ac.uk