Prioritising pumping stations for mitigation measures under the Eel Regulations: considerations related to pumping station characteristics and eel population status.

R.A. Noble¹, J.D. Bolland¹, R. Wright², J. Reeds², C. Bell², L.A. Murphy¹ & I.G. Cowx¹

¹ University of Hull International Fisheries Institute, Hull, HU6 7RX
Content

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  – Eel Regulation
  – Anglian region eels & pumps
  – Pumping station prioritisation

• What’s the hazard?
  – Characterising pumping stations

• What’s the risk?
  – Assessing eel stocks affected

• Thoughts on a work in progress
Background
The EC Eel Regulation & Pumping Stations

• European eel recruitment has declined by over 95% since the early 1980s

• EC Council Regulation (1100/2007) (the EC Eel Regulation)
  – Ensuring escapement of silver eels at a minimum of 40% of historical escapement levels in all river basin districts (RBDs) – 40% of potential production

• Eel Management Plans (EMPs) implemented within the 14 UK River Basin Districts (RBDs)

• Pumping stations both:
  – Barriers to upstream immigration
  – Downstream barrier and potential source of injury and mortality
Status of Eels in the Anglian River Basin District

- **UK EMP Progress Report 2015**
- **Anglian RBD Estimates**
  - $B_0$ = 6.27 kg.ha$^{-1}$
  - $B_0$ total = 341084 kg
  - $B_{current\ 2013}$ = 94596 kg
  - $B_{best\ 2013}$ = 171573 kg

- 3yr Average % = 26%
Pumping Stations in Anglian Region

- 447 pumping stations in Anglian RBD
  - 391 Inland Drainage Board
  - 51 Environment Agency
  - 5 Other

- Highly complicated drainage systems

- Some catchments entirely managed by pumping stations
Pumping Stations prioritisation – Solomon & Wright (2012)

- Identification of high priority structures
  - Screening and / or Bypass

- “importance index” - product of scores for
  - extent of available area upstream
  - distance from tidal limit

- Priority score adjusted by
  - Habitat quality (urban habitats)
  - Pump types (fish friendly?)
  - Presence of bypass channel
High priority sites – Cost-beneficial solutions
The “CapitaAecom Project”

• Environment Agency developed guidance for the technical, environmental and economic elements of proposed eel protection improvements

• CapitaAecom - assessments for the 124 high priority structures in the Anglian RDB to:
  – identify potential options
  – undertake CBA for individual sites
  – summarise sites and catchments

• Data from these high-level assessments used to characterise pumping stations for the EA/HIFI research project
Further assessment – characterising the risk

- Prioritisation considered catchment size & distance from sea as surrogates related to the eel stocks at risk (with some overrides)

- CBA identified mitigation measures may be very expensive

- Need to:
  - Identify actual risk from pumping stations
  - Determine the key eel populations and habitats at risk

- Further analysis to:
  - Assess eel stocks from existing data for pumped catchments
  - Characterise pumping stations based on threat to eels
  - Ensure research is representative and transferable
What’s the hazard?

Characterisation of Pumps
Pumping Station Characteristics

• Capacity
• Location
• Habitats drained
• Provision for bypass
• Activity/Operation
Reported Pumping Station Characteristics

- Max pumps = 10
- 6 pumping stations > 10m³.s⁻¹
- 2 stations at 60m³.s⁻¹
Reported Pump Characteristics

• What do we know about the pumps used?
  – Not a case of one size fits all

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>No of pumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allen Gwynnes</td>
<td>118</td>
</tr>
<tr>
<td>Bedford</td>
<td>51</td>
</tr>
<tr>
<td>Flygt</td>
<td>60</td>
</tr>
<tr>
<td>Sulzer</td>
<td>29</td>
</tr>
<tr>
<td>Other</td>
<td>68</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Controls</th>
<th>No of pumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic</td>
<td>347</td>
</tr>
<tr>
<td>Manual</td>
<td>18</td>
</tr>
<tr>
<td>Both</td>
<td>13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Powered</th>
<th>No of pumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric</td>
<td>326</td>
</tr>
<tr>
<td>Diesel</td>
<td>53</td>
</tr>
</tbody>
</table>

• Pump descriptions – very diverse in detail
  – Mixed, Axial
  – Submersible, Suspended
  – Horizontal, Vertical
  – Volute
Pump Characteristics?

- Size – pump diameter
- Impeller Type
- Rotational speed
- Capacity
- Pressures (changes)
- Number of vanes
- Angle of vanes
- ........
- Influence on potential injury or mortality
  - “Fish friendly”??
What’s the risk?

Eel stocks in priority pumped catchments
Environment Agency Eel population data

- Over 10,000 fish surveys in the Anglian region National Fish Population Database
- 1979 to 2015
- Mix of methods (nets, traps, electric fishing)
- Mix of purposes
- Eels recorded in 59% of surveys
Eel population data – temporal changes

Legend
Eel_CPUE 1986-1995
CPUE_R1
- Absent
- 0.01 - 0.10
- 0.11 - 1.01
- 1.01 - 5.00
- >5.00

Legend
Eel_CPUE 1996-2005
CPUE_R1
- Absent
- 0.01 - 0.10
- 0.11 - 1.01
- 1.01 - 5.00
- >5.00

Legend
Eel_CPUE 2006-2015
CPUE_R1
- Absent
- 0.01 - 0.10
- 0.11 - 1.01
- 1.01 - 5.00
- >5.00

1986 - 1995
1996 - 2005
2006 - 2015
Eel population data – temporal changes

• Can we identify catchments at risk?

• What are the priority catchments for mitigation?
Eel population data – Assessment of Pumped catchments

- Many WFD waterbodies have no NFPD survey data
- Low prevalence in inland water bodies
- Fewer areas where eels occur in >75% of all surveys
Eel population data – Assessment of Pumped catchments

- Issues with WFD Waterbodies
  - Don’t align with some pumped catchments
  - Sites in areas with no data
  - Drainage (pumped) network often not well-mapped in available GIS networks
  - Not clear if eel data within a WB linked to specific pumped areas at this high level
  - Manual interrogation required
Assessment of eel stocks for pumping stations

• Are there any NFPD locations within the area pumped (upstream (US) catchment)?
  – Yes or No

• Are there records of eels US of the pumping station?
  – Present, Absent or Unknown

• If surveys are present US what was the prevalence of eels?
  – % of surveys containing eels in US WB
Assessment of eel stocks for pumping stations

• Are there any NFPD locations within the waterbody downstream (DS) of the pumping station?
  – Yes, No or Direct to Tidal Water

• Are there records of eels in the waterbody DS of the pumping station?
  – Present, Absent, Unknown or Direct to Tidal Water

• If surveys are present in the DS waterbody what was the prevalence of eels?
  – % of surveys containing eels in DS WB or Direct to Tidal water
Eel populations – Upstream catchment

- Some sites and catchments well covered
  - Eel data
  - Drainage network

- Easy to determine what is being drained and what is affected

- Typically sites on larger systems or draining “semi-natural” systems
Eel populations – Upstream catchment

However:

- Often limited eel data from “side drains” or tributaries
- Occasionally unclear what is actually drained
- Most pumping stations in this figure pump from side channel into a fairly unrestricted main channel
Eel populations – Upstream catchment

Example high priority sites

Reasonable eel data at a high level (main catchment/channel)

Limited or no eel data for many tributaries / pumped waters
Occurrence of NFPD survey data upstream of sites prioritised as high priority for screening (A or B class) assessed in the Capita project

<table>
<thead>
<tr>
<th>Priority</th>
<th>NFPD Surveys</th>
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<tbody>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>A</td>
<td>35.7%</td>
</tr>
<tr>
<td>B</td>
<td>69.5%</td>
</tr>
</tbody>
</table>
# Eel populations – Upstream catchment

<table>
<thead>
<tr>
<th>Priority</th>
<th>Occurrence of eels</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Absent</td>
<td>Present</td>
<td>Unknown</td>
</tr>
<tr>
<td>A</td>
<td>64.3%</td>
<td>35.7%</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>1.7%</td>
<td>28.8%</td>
<td>69.5%</td>
</tr>
</tbody>
</table>

Occurrence of eels upstream of sites prioritised as high priority for screening (A or B class) assessed in the Capita project.
Eel populations – Downstream catchment

- Vast majority have NFPD surveys in the downstream waterbody (66%) or discharge direct to tidal water (33%)
- Only one PS had no data downstream
- Where surveys are done eels are known to be present in the downstream waterbody of all PS
Conclusions

• A large proportion of high priority sites have no data for eel populations in the area upstream

• Need for further assessment of eel stocks for some sites

• Assessment of habitat required (with consideration of level management)

• Work required to assess the hazard posed by different types of pumps and pumping stations

• Work in progress!