Potential Risks to Larvae and Plankton from Tidal Turbines: Background

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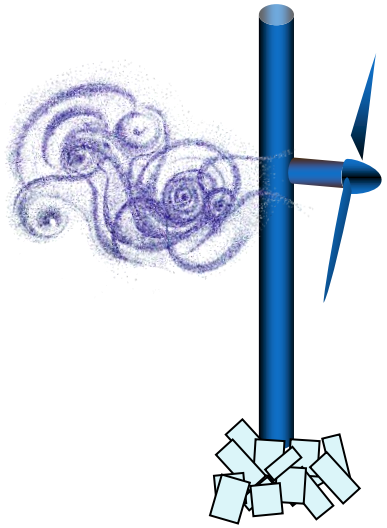
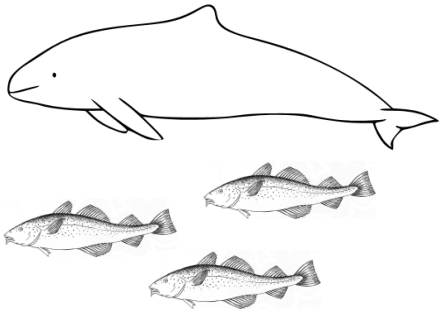
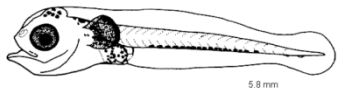
SAMS

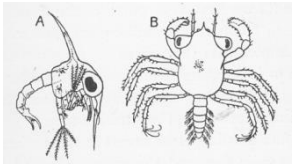
The challenge: scale





Feet & metres
Higher Reynold's numbers
Highly mobile

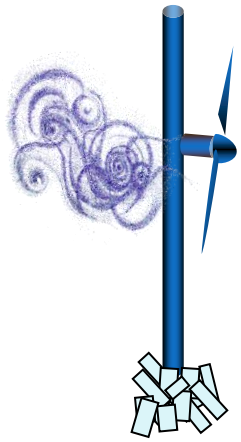




Millimetres
Low Reynold's numbers
Mobility is limited

- Damage from turbine itself – unlikely
- Forces acting on zooplankton are completely different, because of scale

Potential effects - turbulence



- Damage from increases in viscous shear stress resulting from turbines
- Settlement success in some species is related to turbulence levels – potential for alteration?

- Species robustness to hydrodynamic forces varies

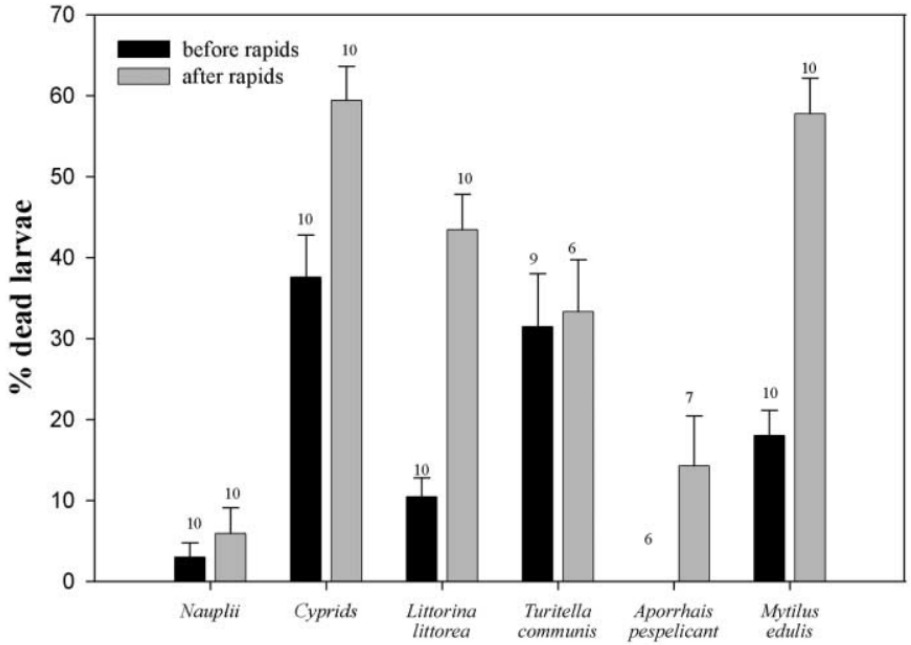
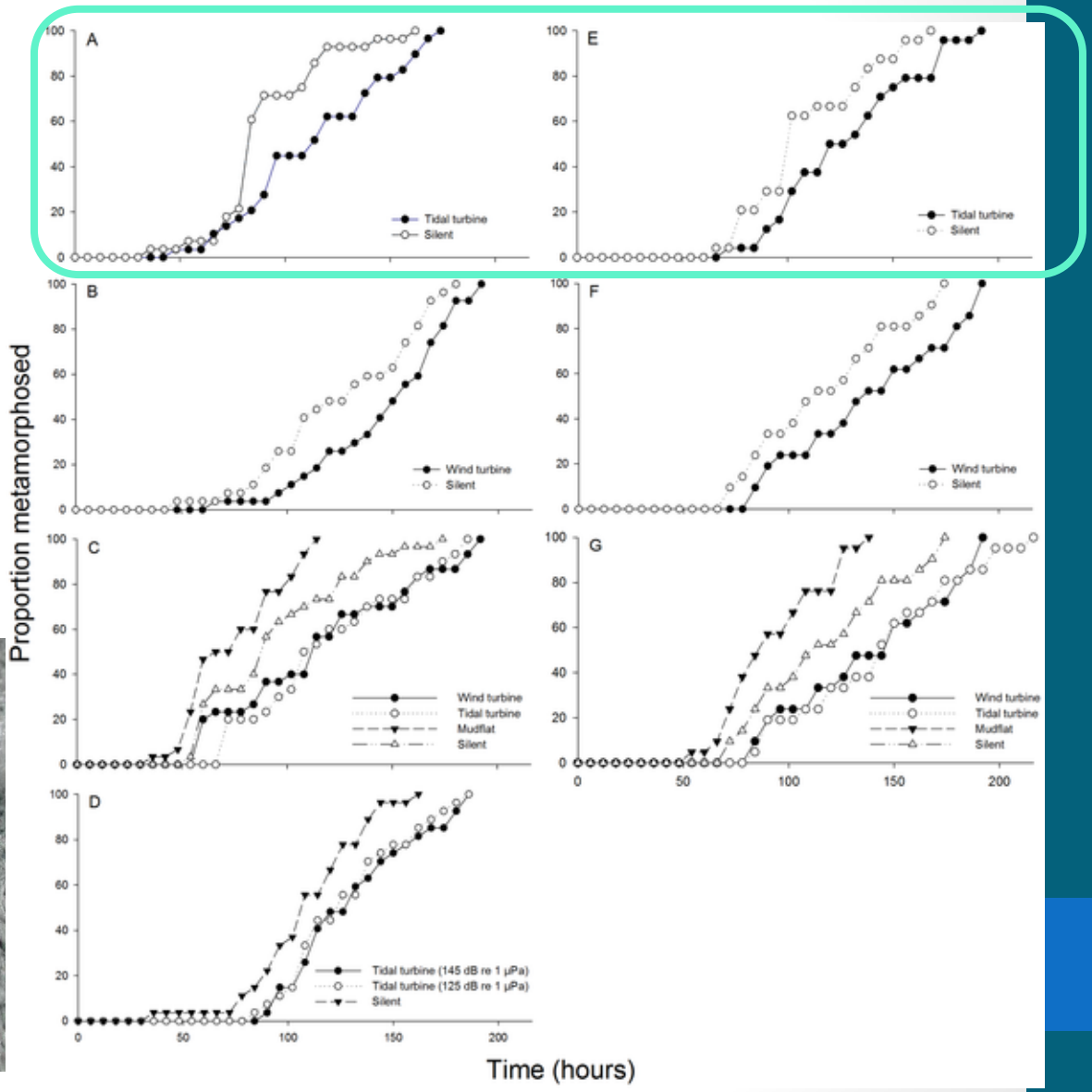


Figure 2. Proportion of dead larvae (±SE) in samples collected before and after turbulent transport across the rapids. Values above error bars indicate number of replicates in which species were present. *Mytilus membranipora*, *Electra pilosa*, polychaete trochophores and *Lamellaria perspicua* are not shown as all replicates had zero mortality.

Jessop, M.J. (2007). J. Mar Biol Assoc UK 87:675-685

Potential effects - noise

- Turbine noise increased time to metamorphosis (+18 hours) in crabs in experimental settings



Pine MK, Jeffs AG, Radford CA (2012) Turbine Sound May Influence the Metamorphosis Behaviour of Estuarine Crab Megalopae. PLoS ONE 7(12): e51790.

Potential effects - dispersal

- Flow patterns determine where larvae go, and where they can settle
- Changes in system hydrodynamics will alter larval dispersal patterns
- Greater effect in channels/estuaries vs. open ocean?
- Need to understand larval behaviour:
  - Diel Vertical Migration?
  - Selected Tidal Stream Transport?
  - Swimming ability

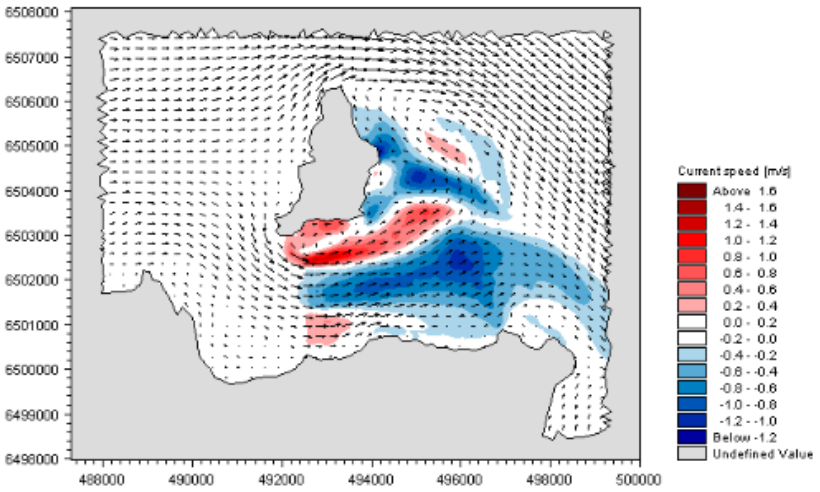


Figure 6: Changes in current speed between 900 MW extraction scenario and natural flow conditions

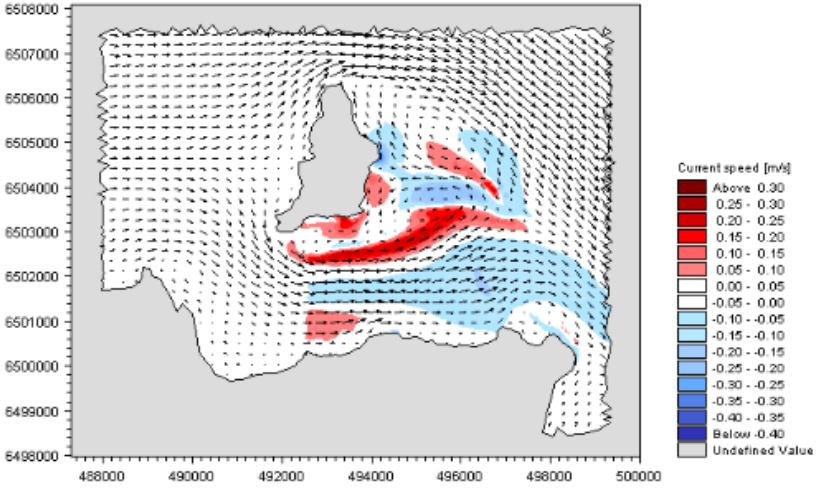


Figure 7: Changes in current speed between 160 MW extraction scenario and natural flow conditions

Easton et al. (2010). Proc. 3rd International Conference on Ocean Energy. 6th October, 2010. Bilbao, Spain

Uncertainties?

- Scale – scaling from larval scale (mm), through 'dispersal' scale (10-100's km!)
- How relevant is the issue?
  - Turbine loss vs. loss to other factors (e.g. predation)
- What limits these populations? Larval supply? Recruitment? Top-down? Fisheries?

Mortality – tidal turbines vs all other sources?