Assessment of Zooplankton Injury and Mortality Resulting from the Deployment of Underwater Turbines for Tidal Energy Production

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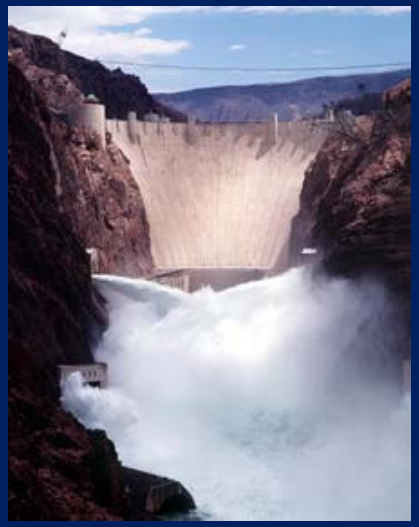
Turbine Effects on Megafauna



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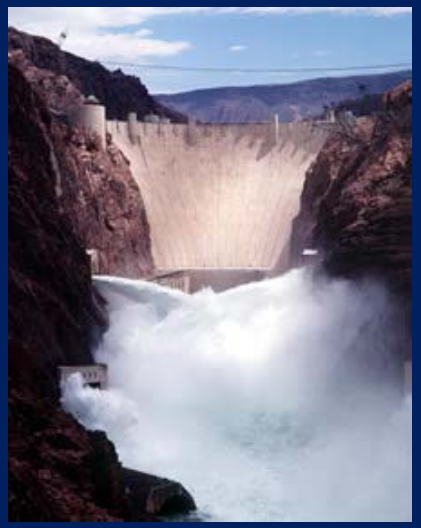
Turbine Effects on Zooplankton

Traditional Hydroelectric Plants have existed for decades, and turbines rotate at similar speeds (e.g. Hoover Dam turbines 90 rpm).



•Very difficult to make quantitative measurements

•Not always possible to separate trauma factors:

Blade strikes
Shear Stress
Cavitations
Barotraumas

•Environmental changes caused by dams alter zooplankton communities both up and down stream of the dam.

Best Hydroelectric Plant data suggests mortality range of 5-15%.

No data exists for Tidal Turbines

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Study Area: Muskeget Channel
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Cape Cod
Nantucket Sound, Massachusetts
Martha's Vineyard
Muskeget Channel
Nantucket
Channel Depth: ~50 m
Channel Width: 0.5-2.0 km
Max current velocity: 2.5 m/s
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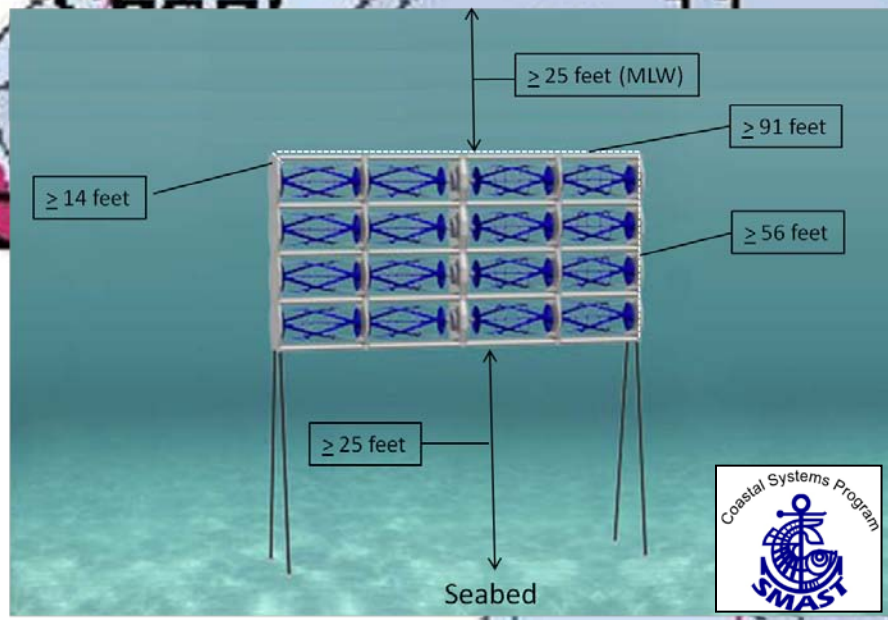
Commercial Scale Turbine Arrays Require Interception of Significant Volumes of Water



New England Marine Renewable Energy Center
MREC
www.mrec.umassd.edu

Massachusetts Maritime Academy

Launch of Barge for 2011 Technology Demonstration

Small scale pilot projects often provide the only source for information required to permit commercial projects.

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Turbine Operating in Muskeget Channel

Traditional Plankton Collection Methods

Deploy plankton net at turbine hub depth
(30 cm diameter, 50μm)

Record current velocities for volume estimates

Perform serial dilutions to ensure proper zooplankton densities

Analyze within 2 hours

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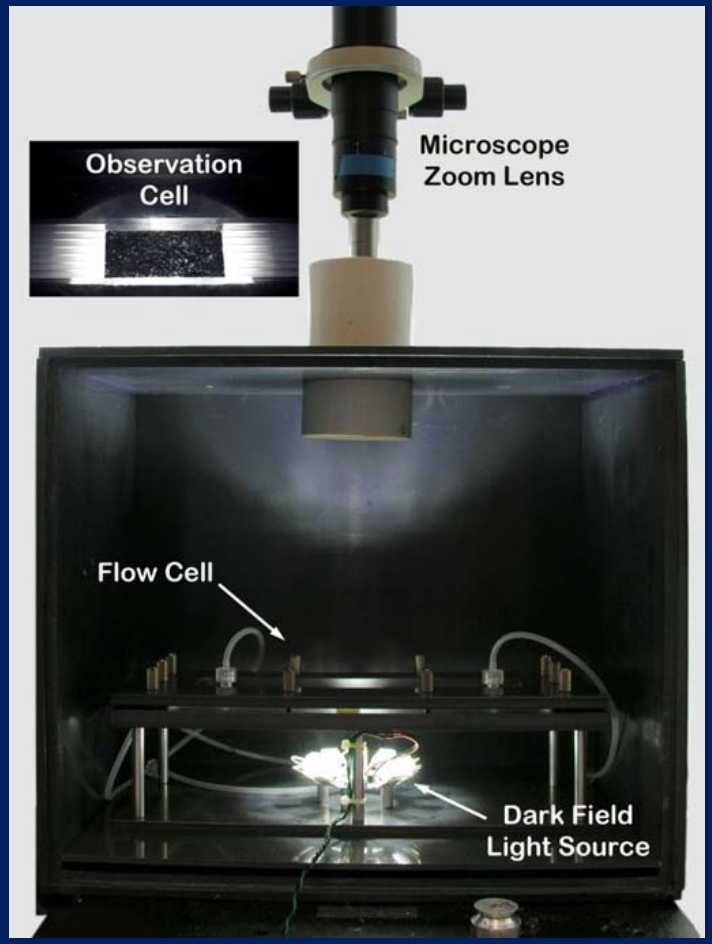
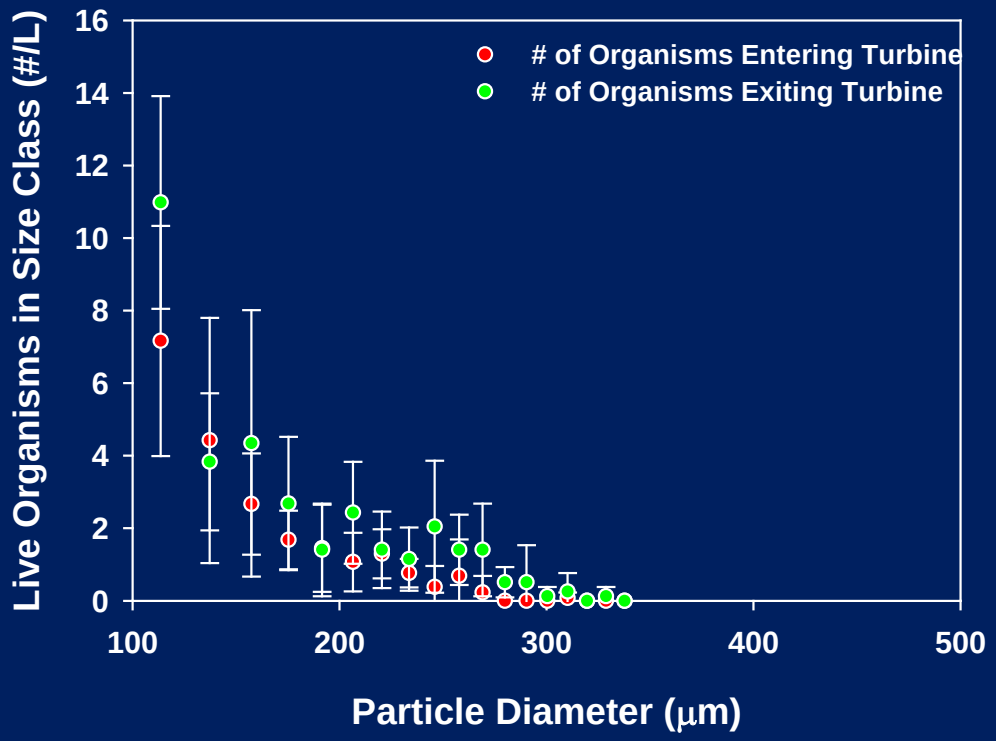
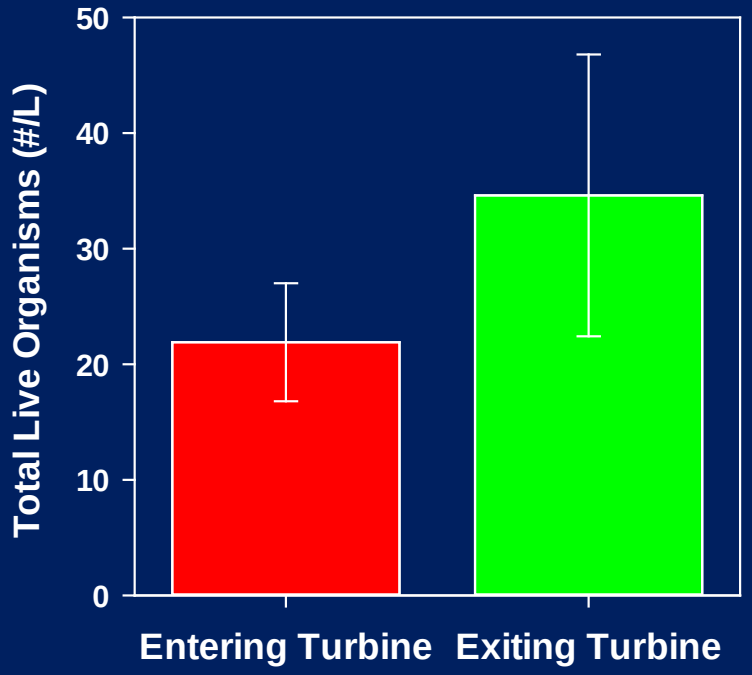
Determining Viability of Zooplankton

- Developed for USCG to assess ballast water treatment standards
- Techniques adapted from NIH protocols including Image J opensource software

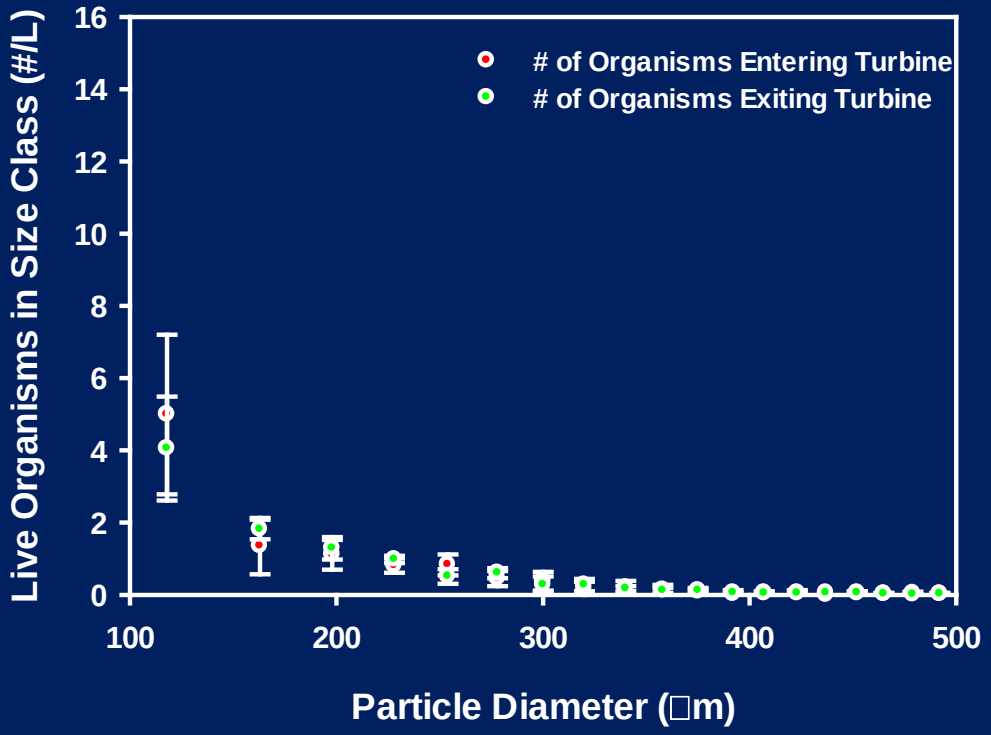


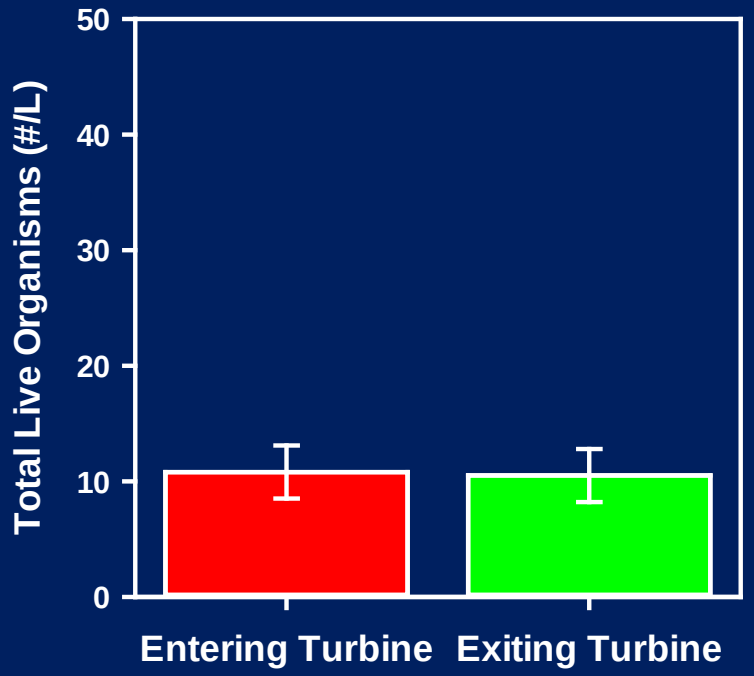
2011 Free Flow Demonstration





2012 Flo Design Demonstration





Future Work

- Enhance sample throughput and statistical significance through automation
- Obtain data from other turbine types
    - Gorlov Turbine
    - Ductless turbine
- Applications to Traditional Hydroelectric Powerplants
- Potential impacts on macroscopic zooplankton (Fish larvae, Jelly fish, siphonophores, etc)

Acknowledgments

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Massachusetts Clean Energy Center

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