Detecting Potential and Actual Turbine-Marine Life Interactions: A Call for the Development of Best Practices

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OERA Offshore Energy Research Association of Nova Scotia

Acadia Estuarine Centre for Research

FORCE Fundy Ocean Research Center for Energy

Acadia University

Open Seas Instrumentation Inc.

Ocean Tracking Network Headquartered at Dalhousie University

smru Limited

Ocean Sonics

Mitacs

Nova Scotia Power An Emera Company

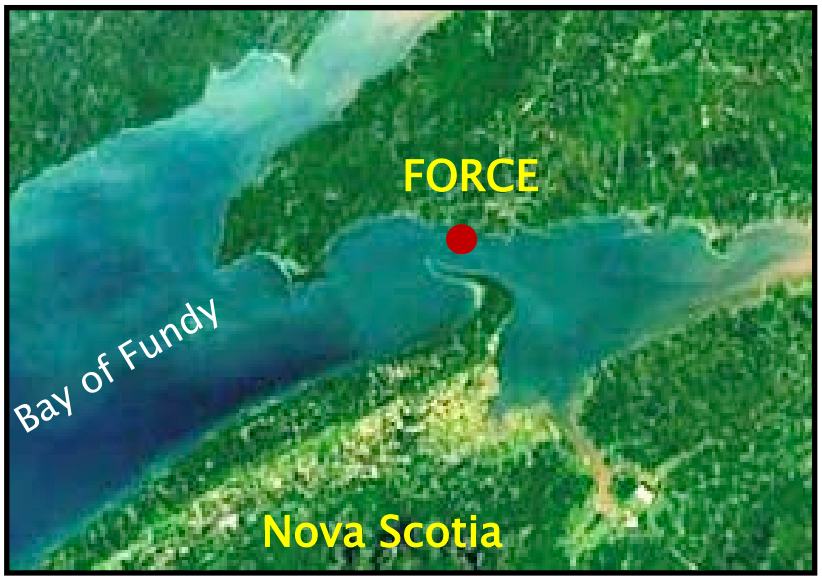
vemco

Natural Resources Canada

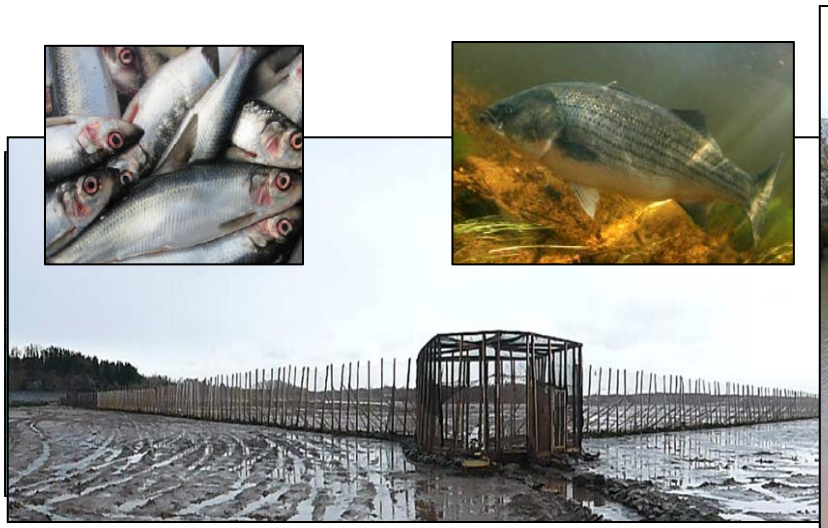
NSERC CRSNG

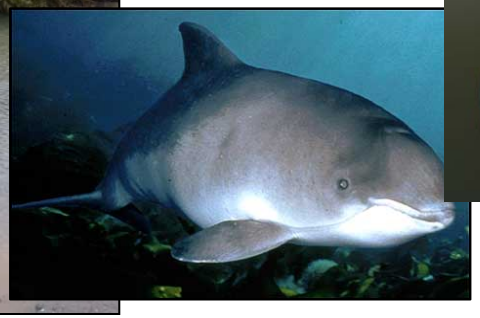
Fisheries and Oceans Canada

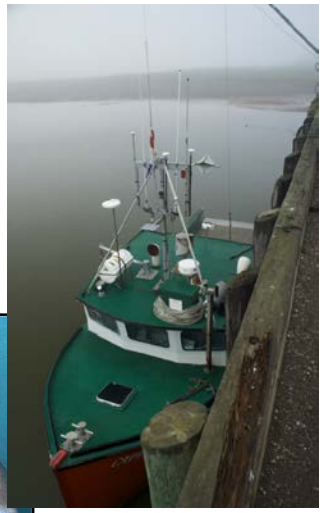
Tidal Energy Dev't: Environmental Implications



- Independent oversight at FORCE
  - Environmental Monitoring Advisory Committee (EMAC)
- Near to mid-field effects?
- Impacts on marine mammals?
- Impacts on fish and lobsters?
  - Migration corridor
  - Transboundary fishes
  - Threatened / endangered







Acoustic Detection of Fish & Lobsters

- Temporal and spatial patterns in site use
- Acoustic tags (Vemco)
  - Fish (286 tags implanted)
  - Lobster (85 tags, carapace)

Species	Status	#Tags
Atlantic sturgeon	Threatened	114
American eel	Threatened	45
Striped bass	**Endangered (BoF)**	**165**
Atlantic salmon	Endangered (iBoF)	62

Minas Passage / FORCE Receiver Lines

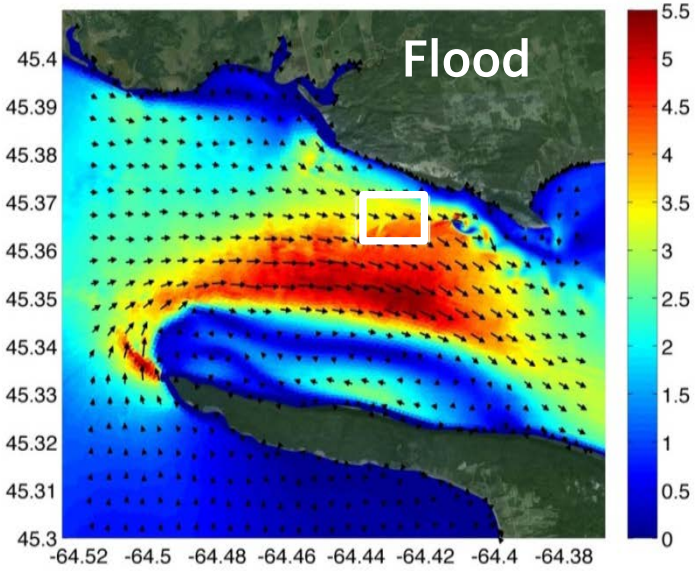
2011

2012 / 2013

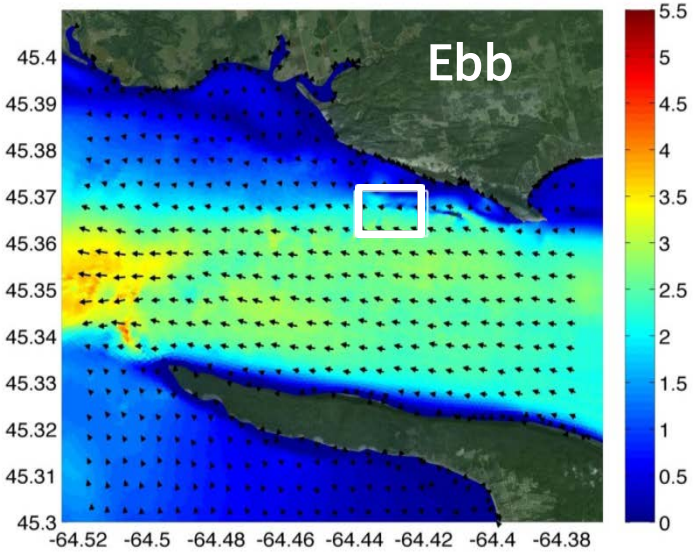
Listening gates

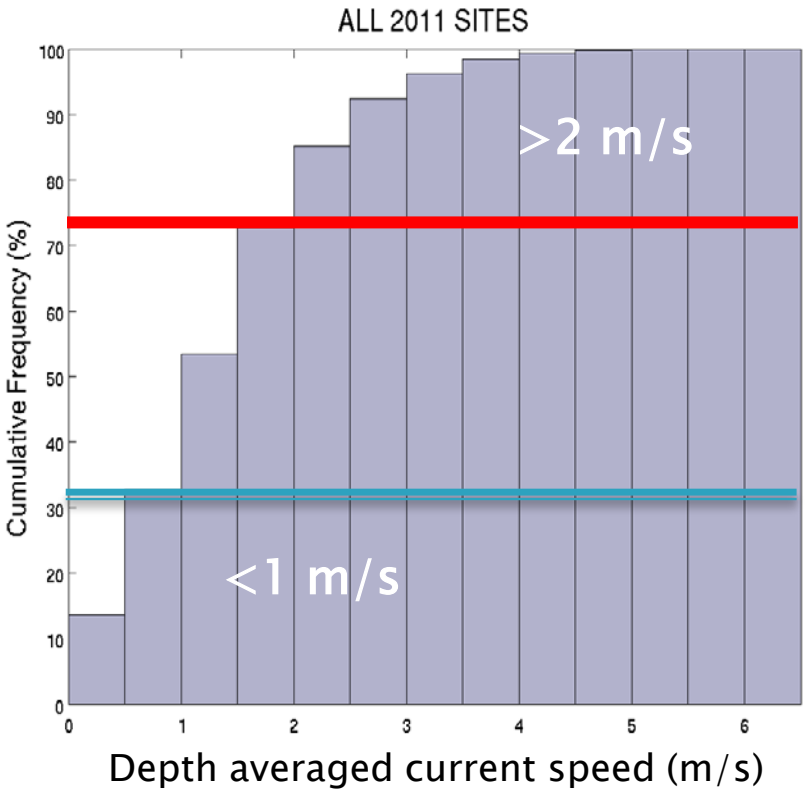
300-400 m between units

Current regime in Minas Passage



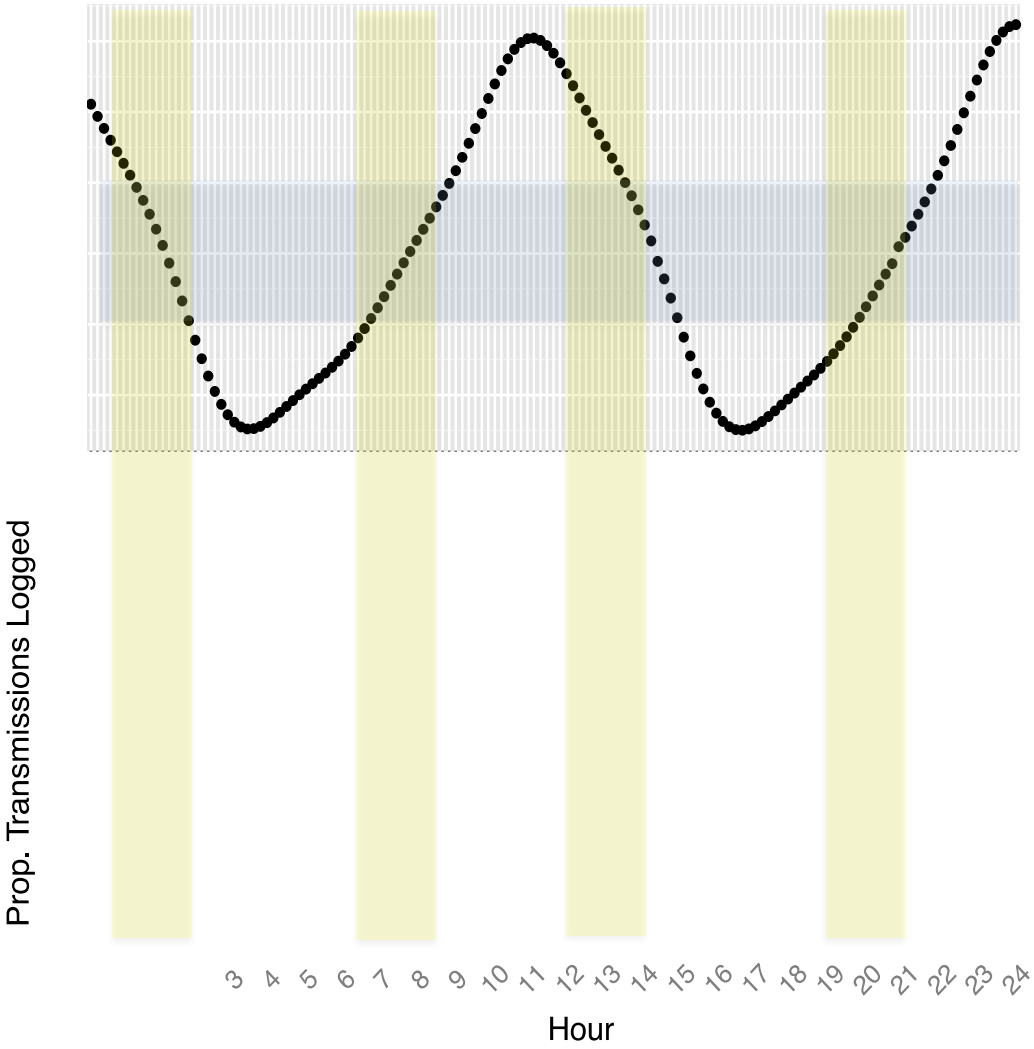
Minas Passage





Source: Karsten, Acadia

Depth-Averaged Current Speed & Range Tests
(Acoustic Tag Detection)



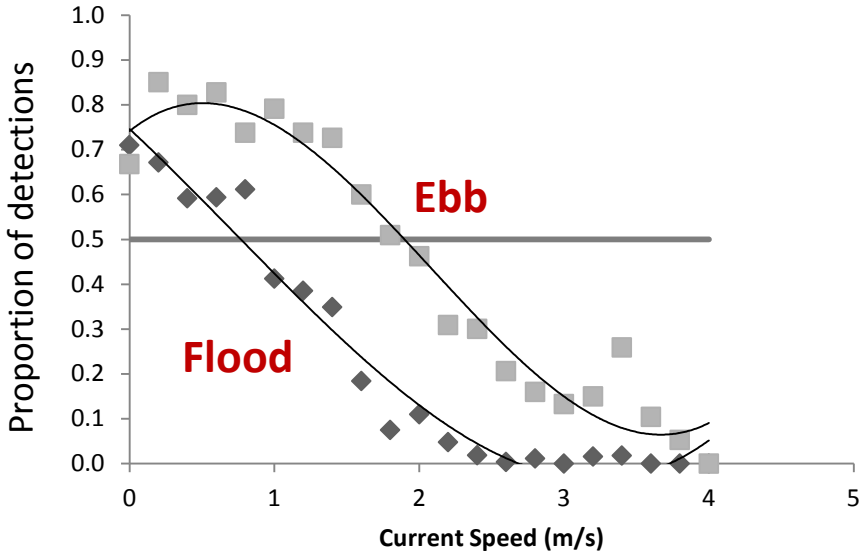
Flood

0-1 m/s

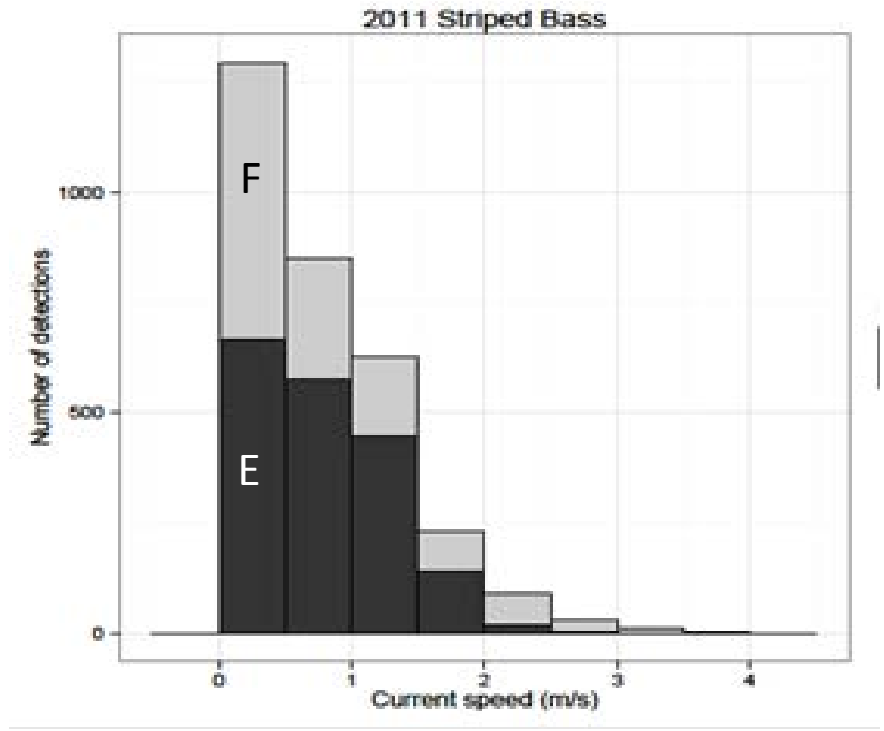
Ebb

Tags detected ~40% of the time and not during peaks flows

Acoustic Tag Range: 165 m



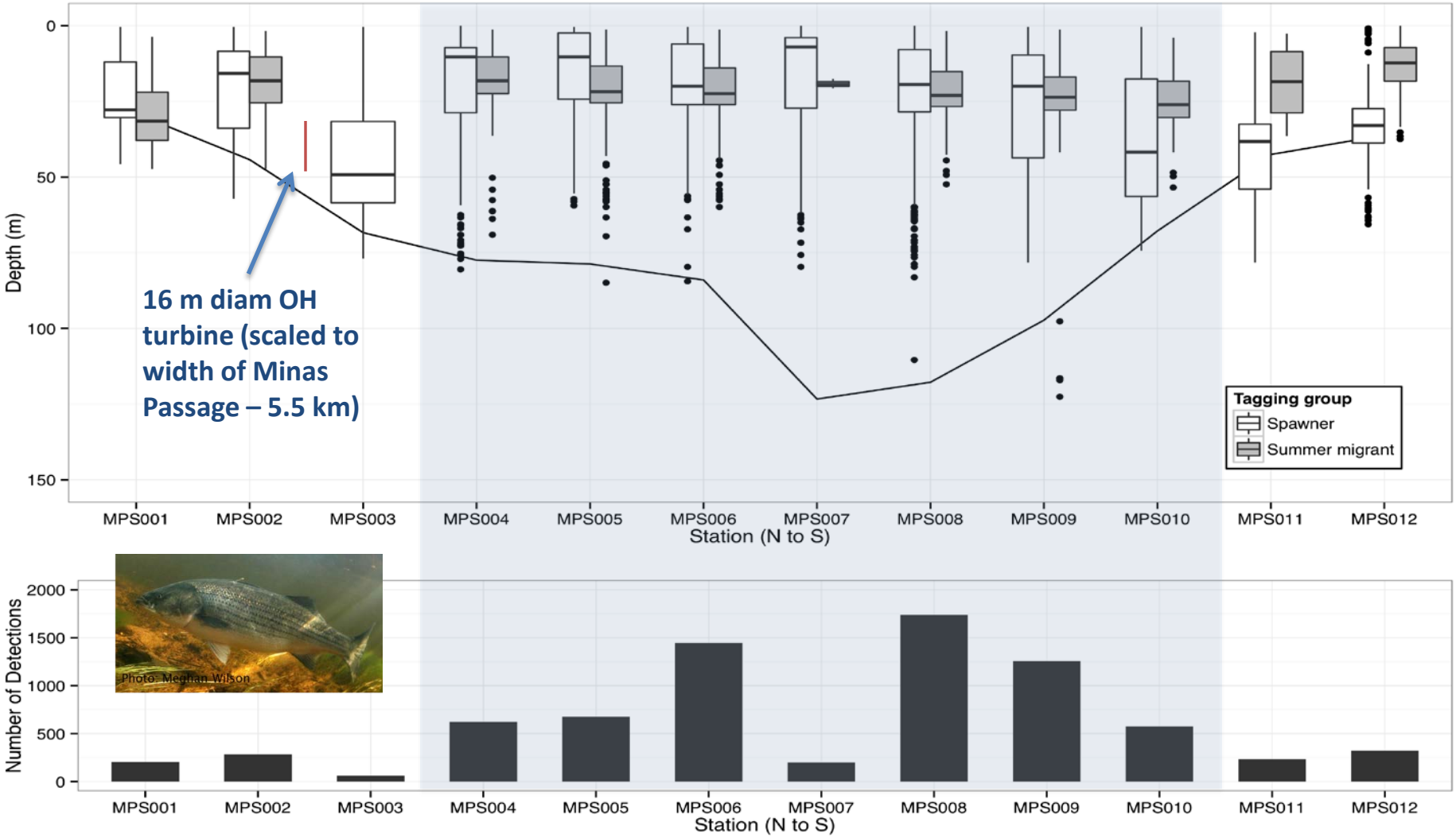
- Receiver detection efficiency
  - ↓ as current speed ↑
  - Lower on the Flood tide
    - Turbulence effect?



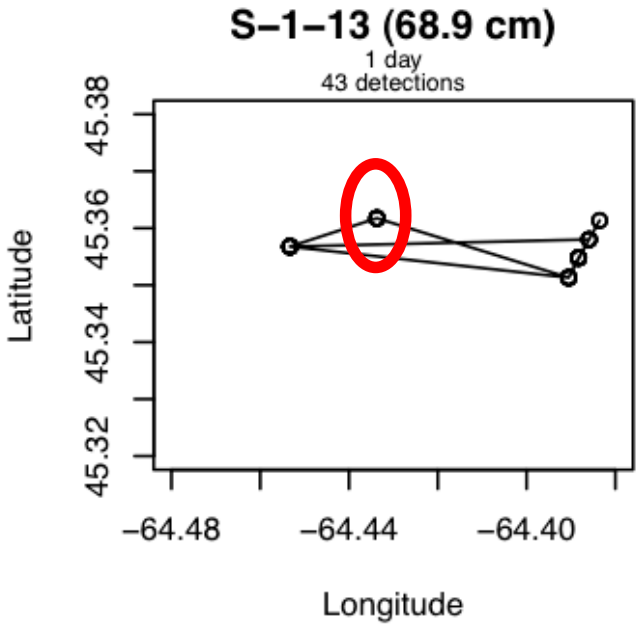
- Striped bass detections in MP
  - decline as current speed increases
  - mirrors detection efficiency patterns, may not be due to absence of fish

- Need technology advances than can filter out the noise / interference

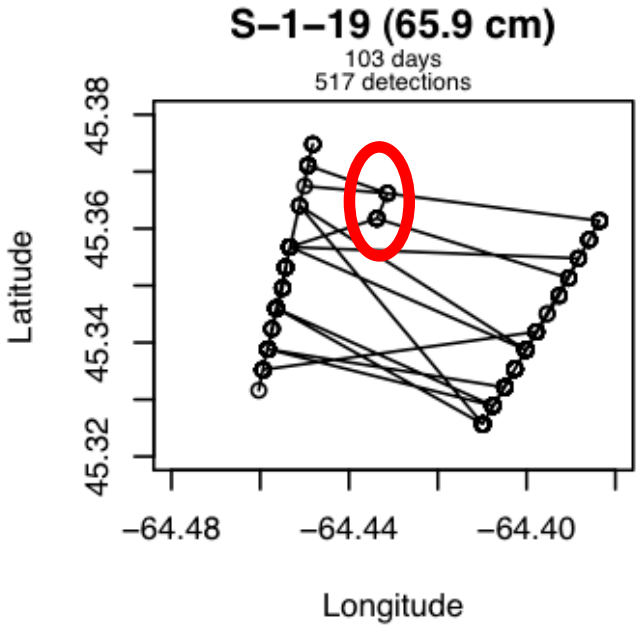
Striped bass tag detections & depths
(2011 – 2013)



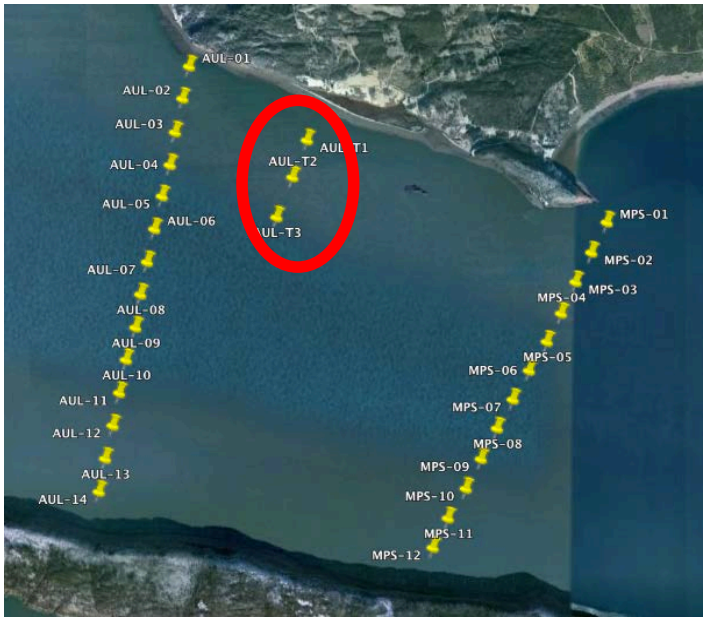
1 day



103 days



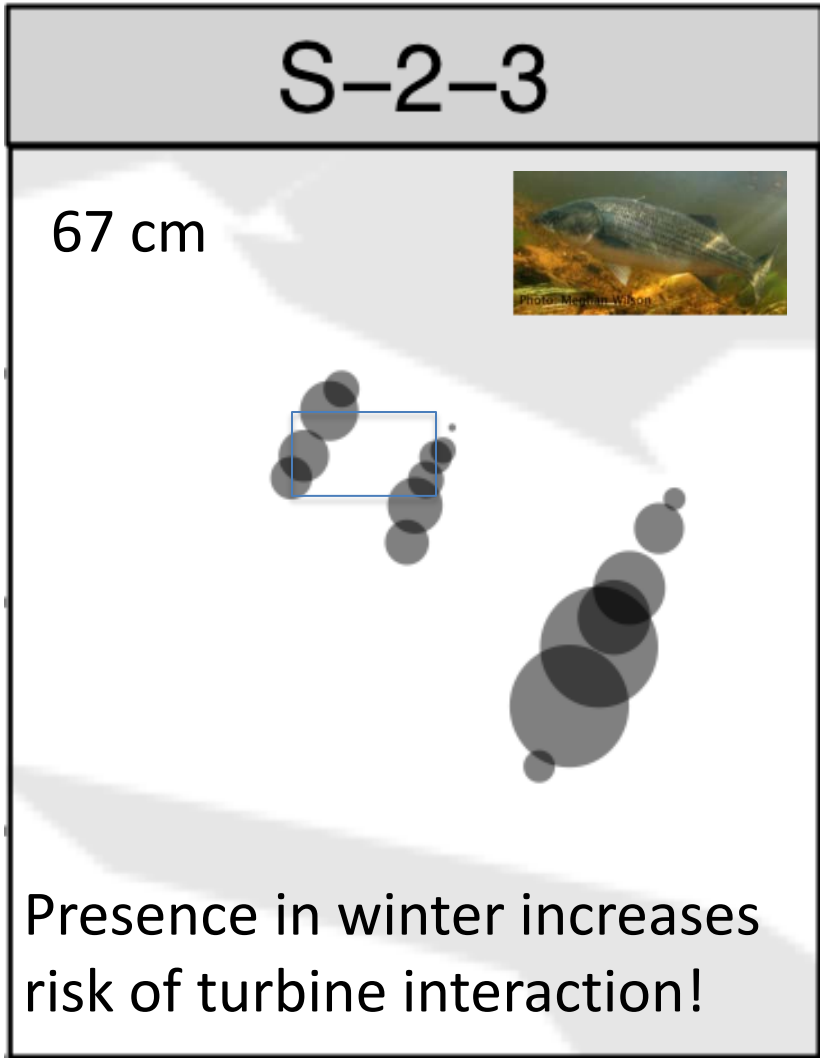
More than a migratory route!



Bass frequent the FORCE site
- <u>potentially</u> at risk
- vertically migrate

Tagging cannot address avoidance behaviour!

Unexpected winter presence / Surface Temp 0-3°C

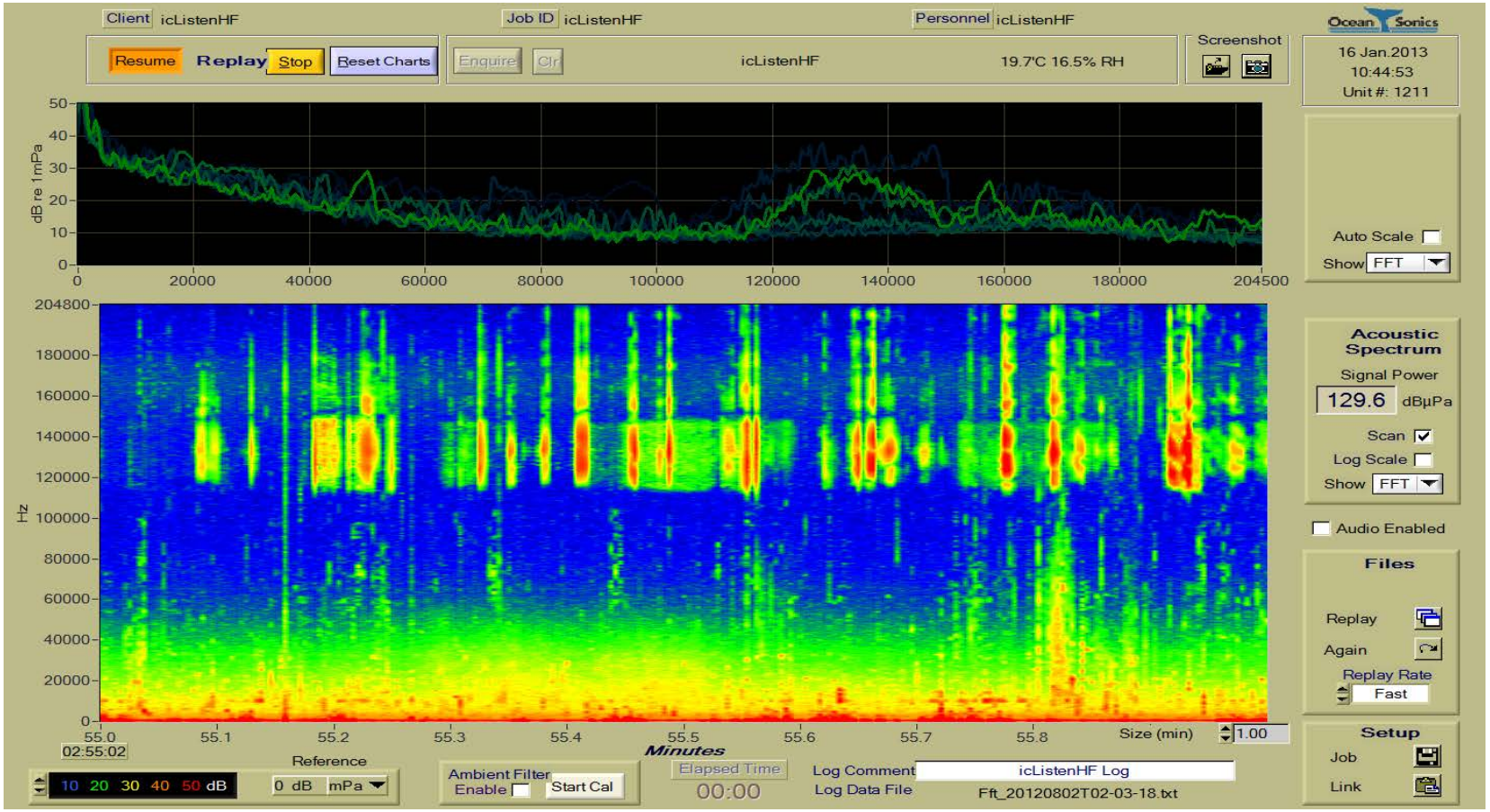


December 2012 – April 2013

Baseline Studies: Harbour Porpoise Detection / Presence

- CPOD – porpoise detector
- Seasonal peaks related to food (herring) abundance
- Detection limitations due to
  1. Ambient noise
     - Flood >> Ebb
     - Spring >> Neap
     - Site effects
  2. Flow noise at sensor tip

icListen HF Smart Hydrophone (Ocean Sonics)
(FFT; 60 sec Screenshot – Lucy Software)



- Porpoise click trains, 120–140 kHz
- Detection range up to 500 m (>1000 m in ocean)

icListenHF

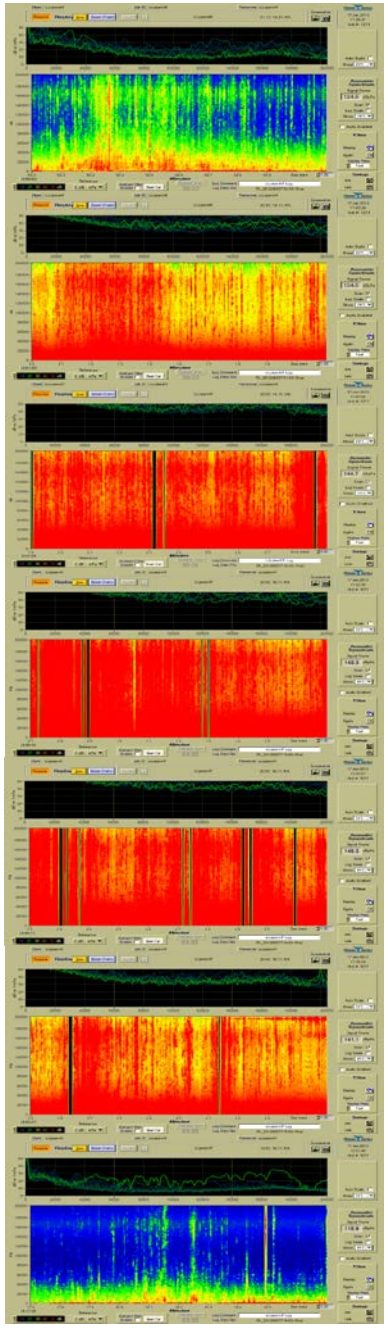
Noise Interference

Spring vs Neap tides

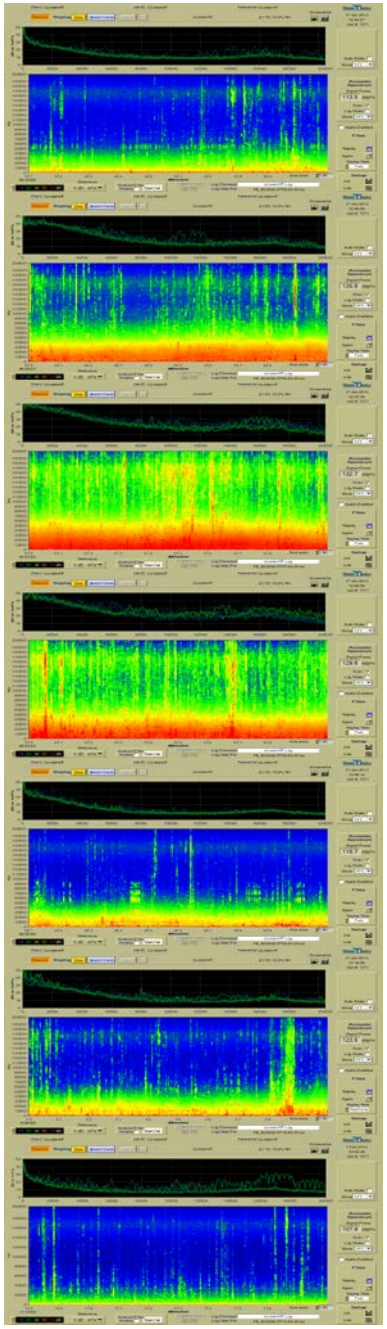
- Shrouding to reduce noise effects?

(Porskamp, 2013)

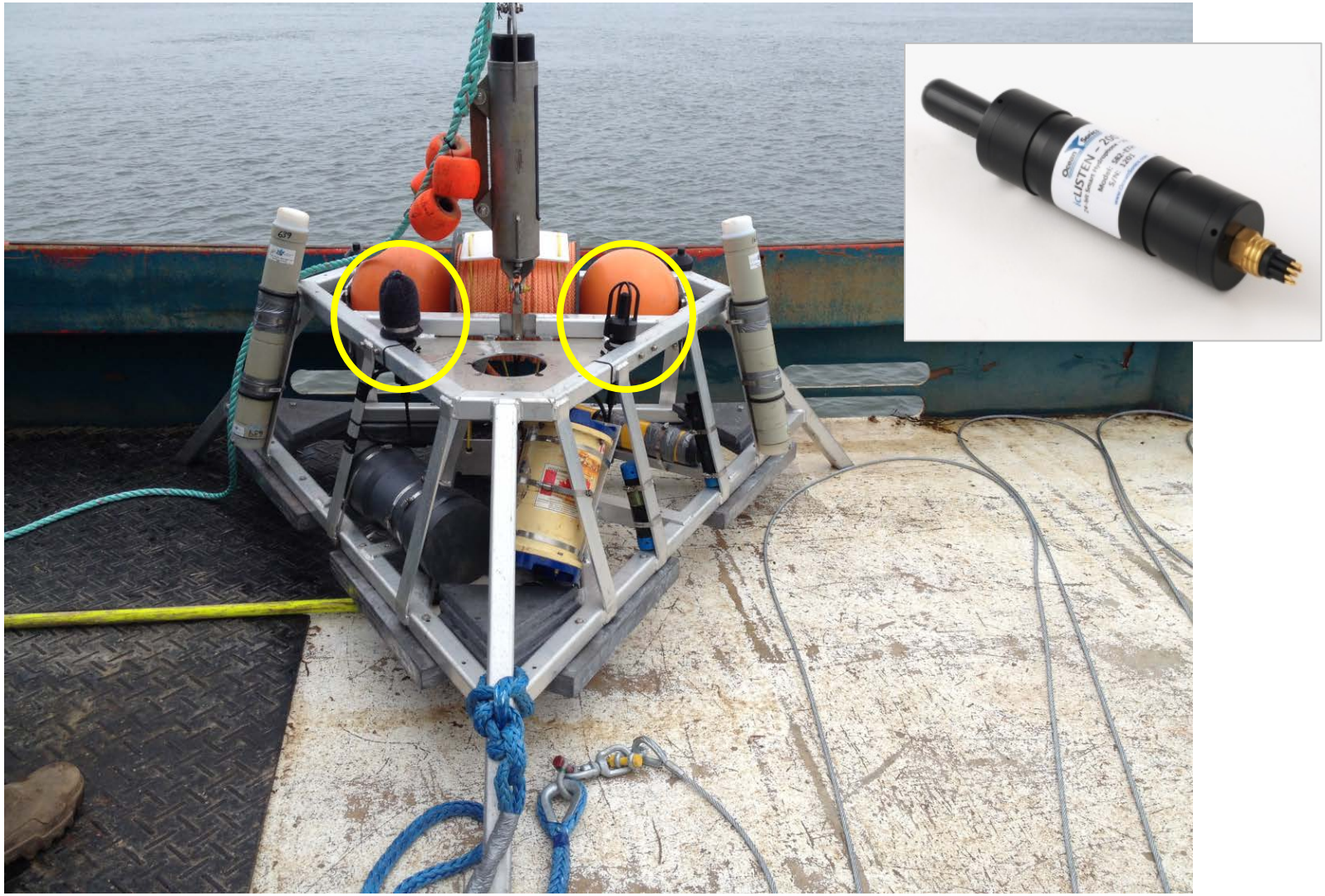
Spring Cycle



Neap Cycle



Hydrophone Performance Testing: June 2014



Ocean Sonics

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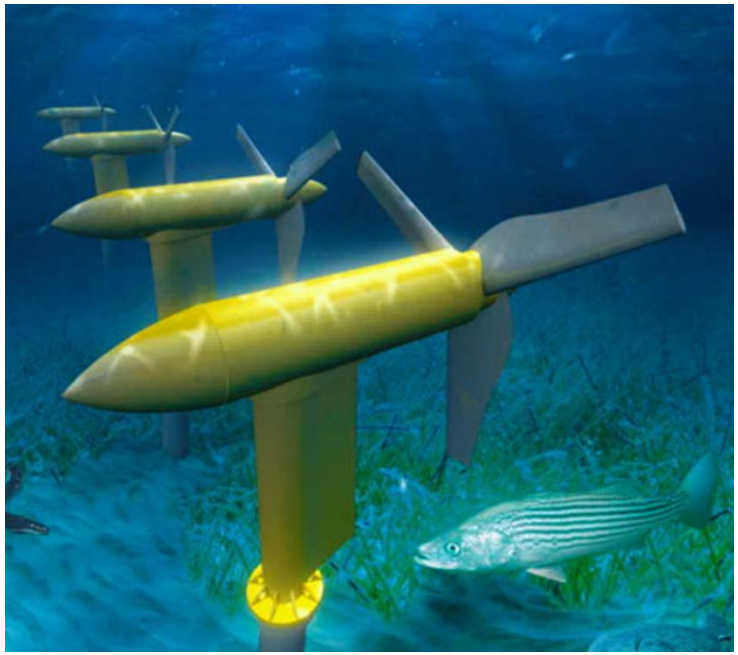
Detecting Marine Life – Turbine Interactions

Near-field Behavior

- Avoidance likely to vary with
  - species and animal size
  - physiological state / season
  - flow conditions



Current Methods of Detection

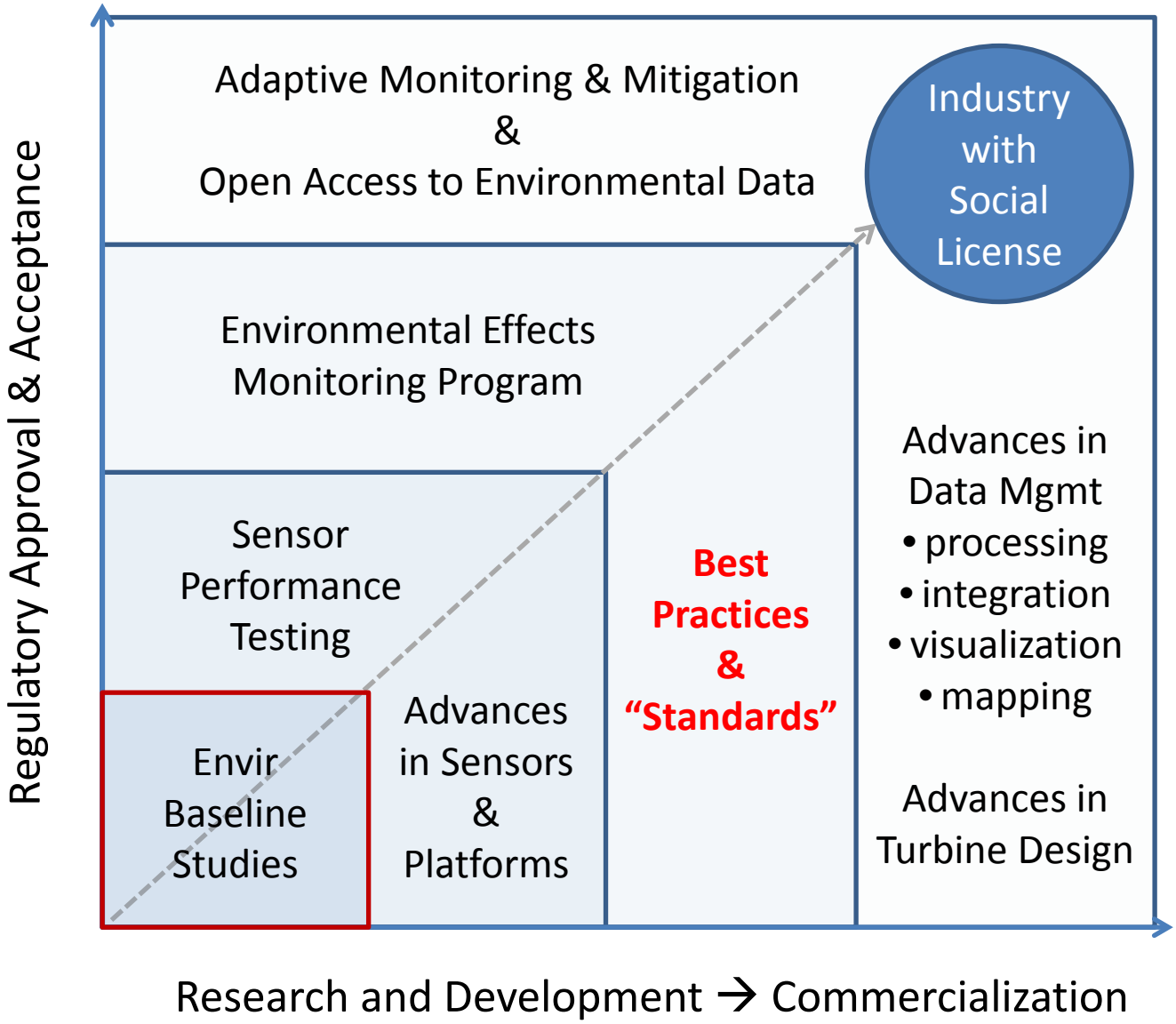
(with limited success at high flows):

- Sonar (split beam and multi-beam)
- Acoustic cameras
- Optical and other sensors

Need to advance sensor capabilities & sensor integration

- Research and innovation!

Approach to Addressing Environmental Research and Monitoring Needs



Take Home Messages

- Developers, regulators and other stakeholders need to be aware on the "unique challenges" in sensing marine life in a tide race
  - *Requires open communication and realistic expectations*
- Need innovation to improve detection efficiency of sensors at high current speeds
  - *Sensors, mooring platforms, monitoring protocols*
  - *Data processing and visualization*
- Requires collaboration across academia and industry
  - *Aim for global Best Practices!*

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