

Acoustic monitoring of fish and their interactions with the Ocean Renewable Power Company (ORPC) device



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Outline

- Approach to determining a strategy
 - Scientific approach (before/during and project/control)
- Near-field monitoring of fish
- Strategies to assess vertical distribution of fishes
- Strategies and techniques for post-deployment monitoring

Take home

- Communication is key
- Interactions monitoring must consider periods of fish activity
- Baseline vertical distribution of fishes will be important for assessing risk of interaction
- Monitoring after device deployment will require innovative approaches

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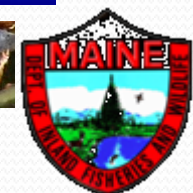
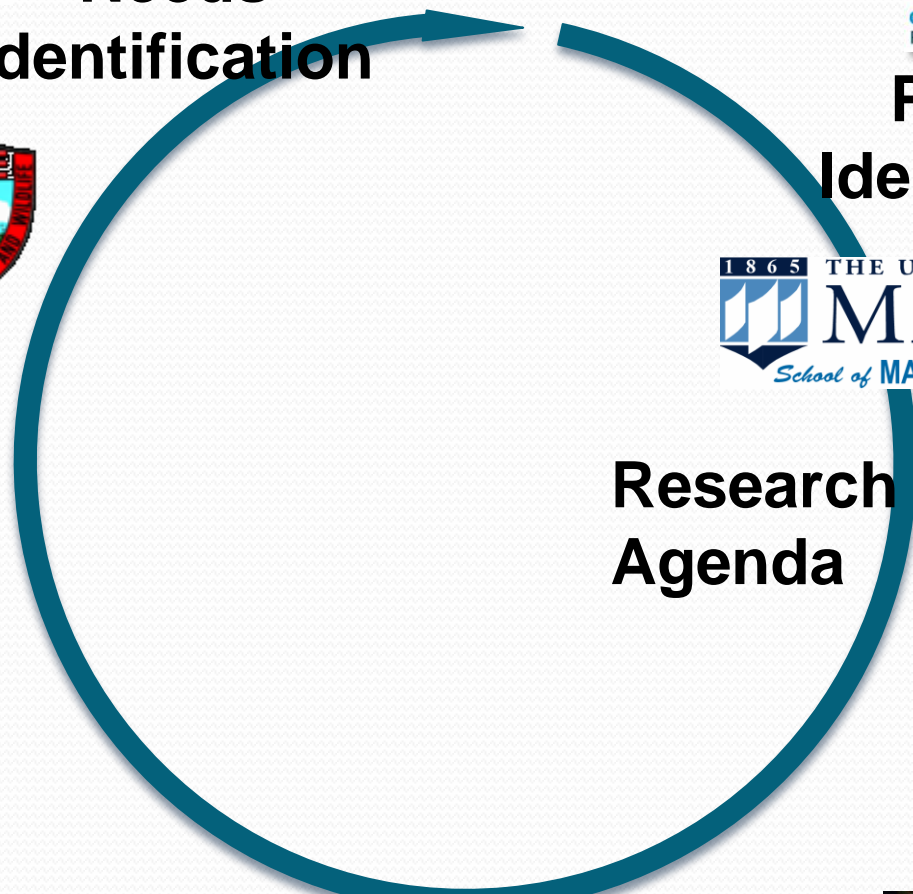
Problem Identification



Research Agenda

Collaborative Research Projects

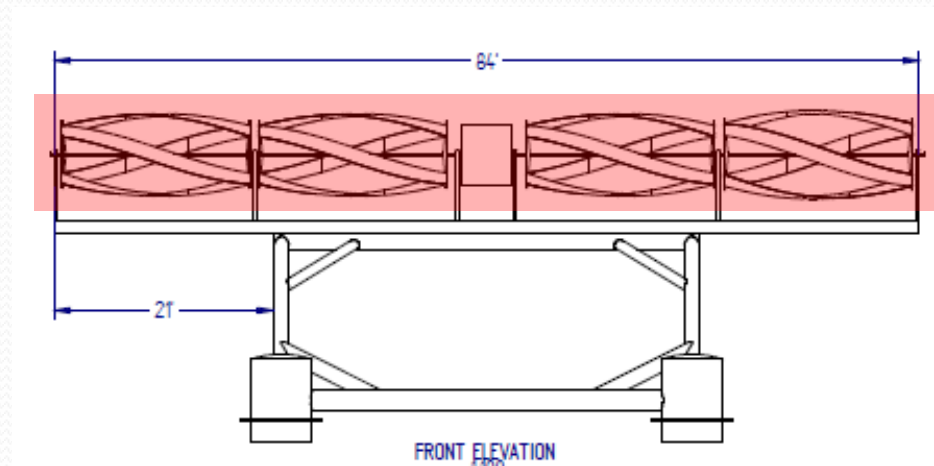
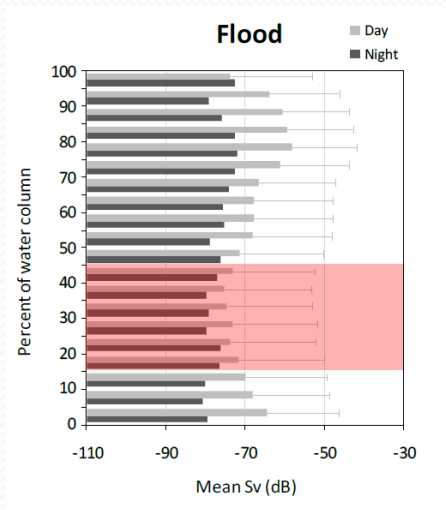
Needs Identification



Results & Model Development

What information is needed?

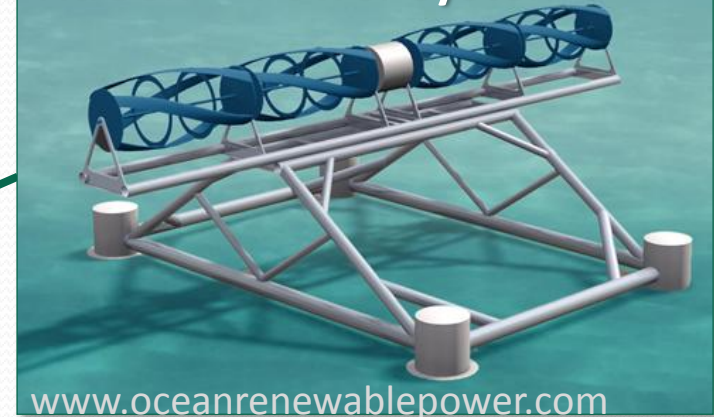
- How do fish interact with the tidal device?
- Where are fish in the water column?
 - when are they there?
 - what are they?
- ***Ultimately: How does the tidal device affect this?***



Near-field monitoring of fish... in Cobscook Bay, Maine



TidGen™ Power System

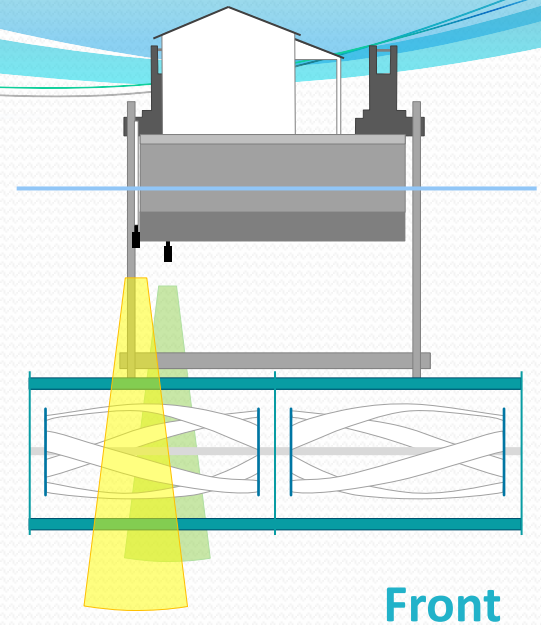
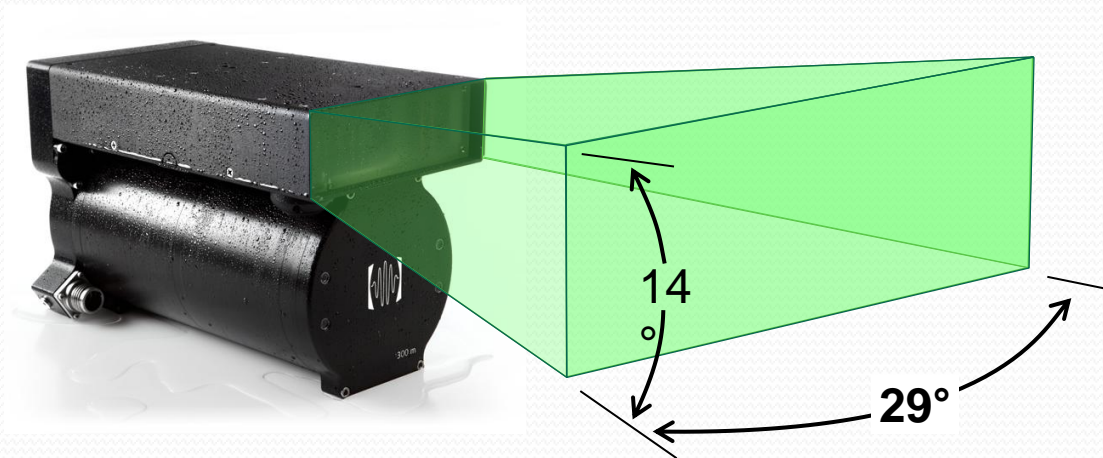


- Proposed project site
- Pilot project site
- ORPC research platform

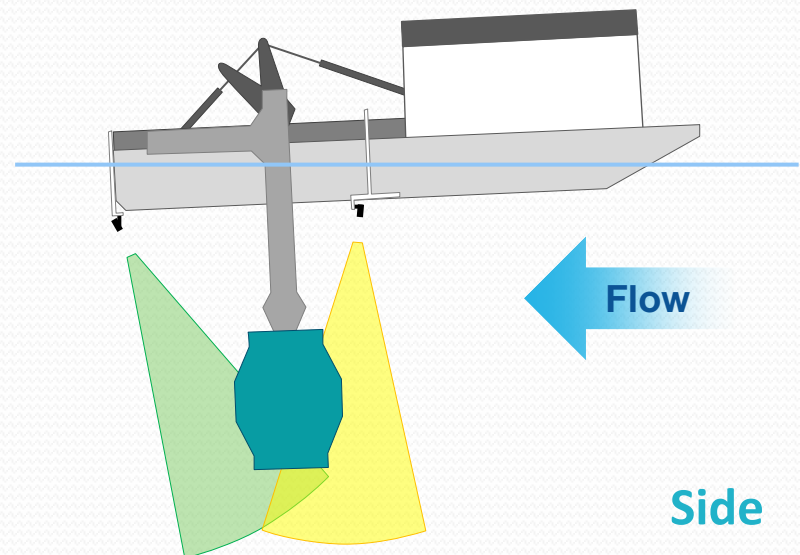


Ocean Renewable Power Company research platform

Research Platform



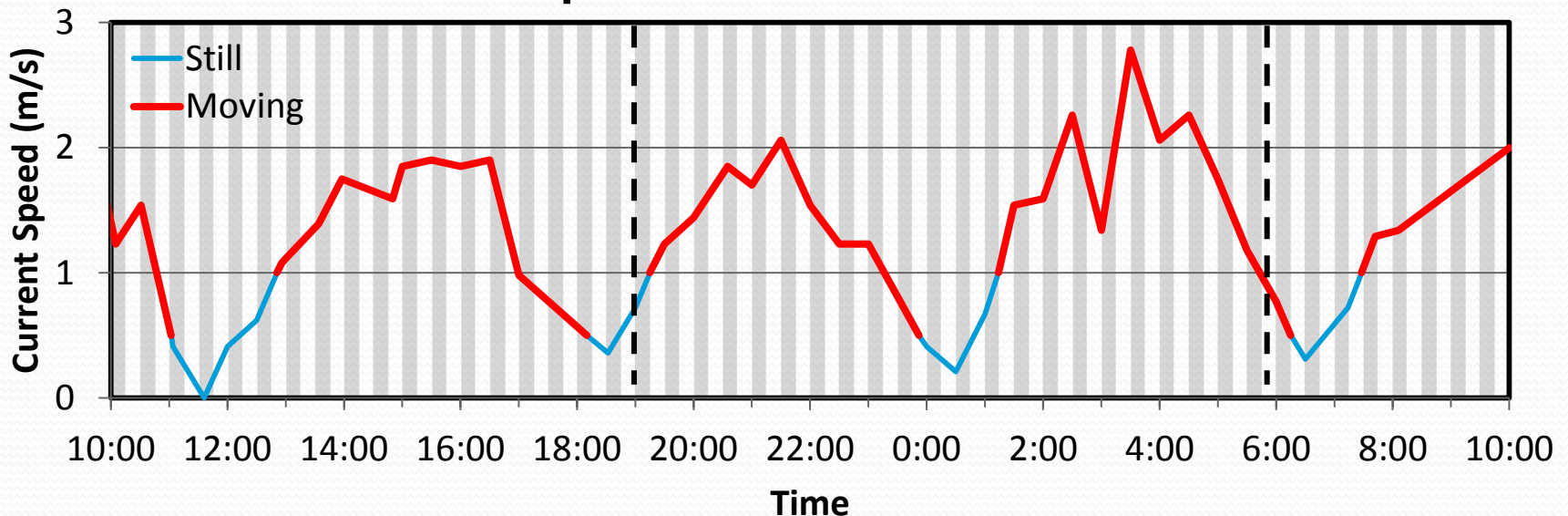
- DIDSON: Dual-frequency Identification Sonar
 - Acoustic “camera”
 - Operates at 1.8 MHz
 - Range ~ 12 m
 - Views a slice of the turbine .9 - 1.9 m wide



Data Collected

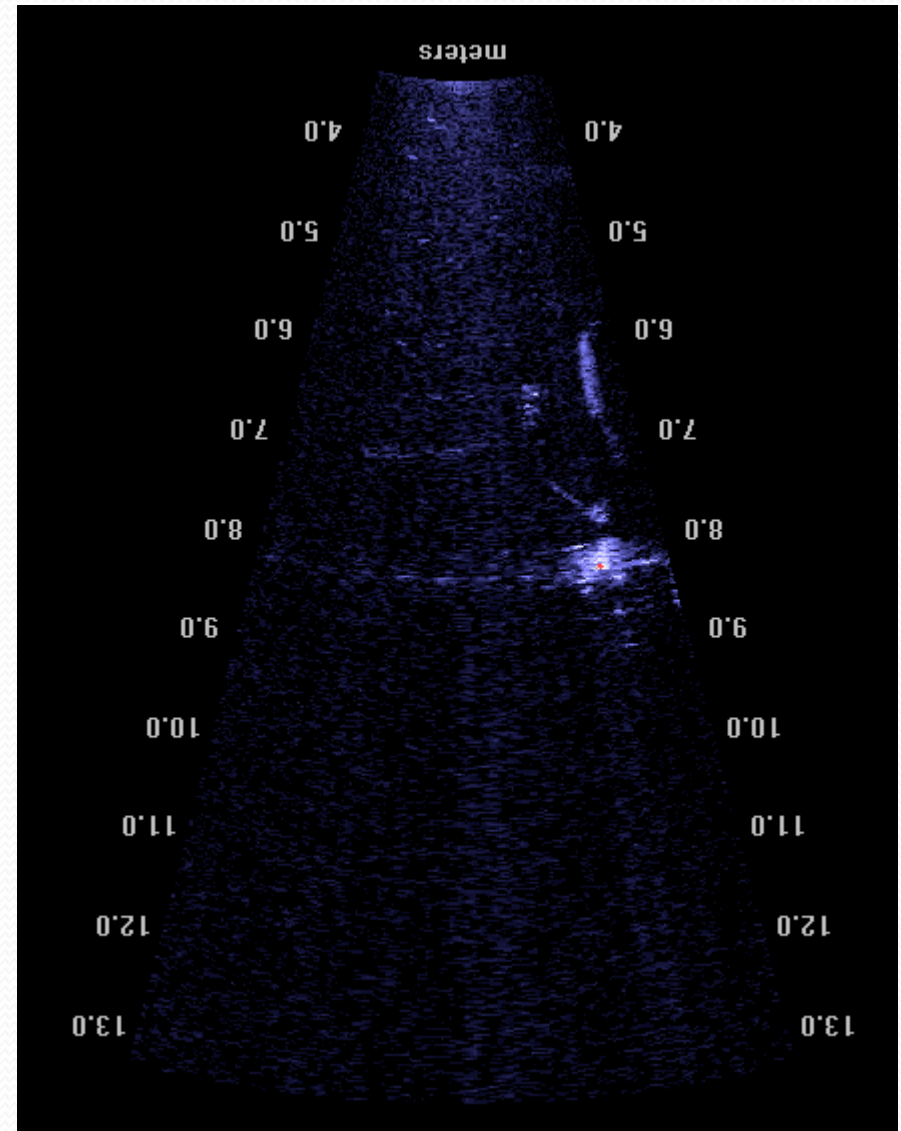
- 24 hours of footage
 - 10 am - 10 am, 9/8-9/9 2010
- Sub-sampled every other 15 minutes
- Recorded fish length, depth, behavior

Current Speed Data: Surface Flow Meter

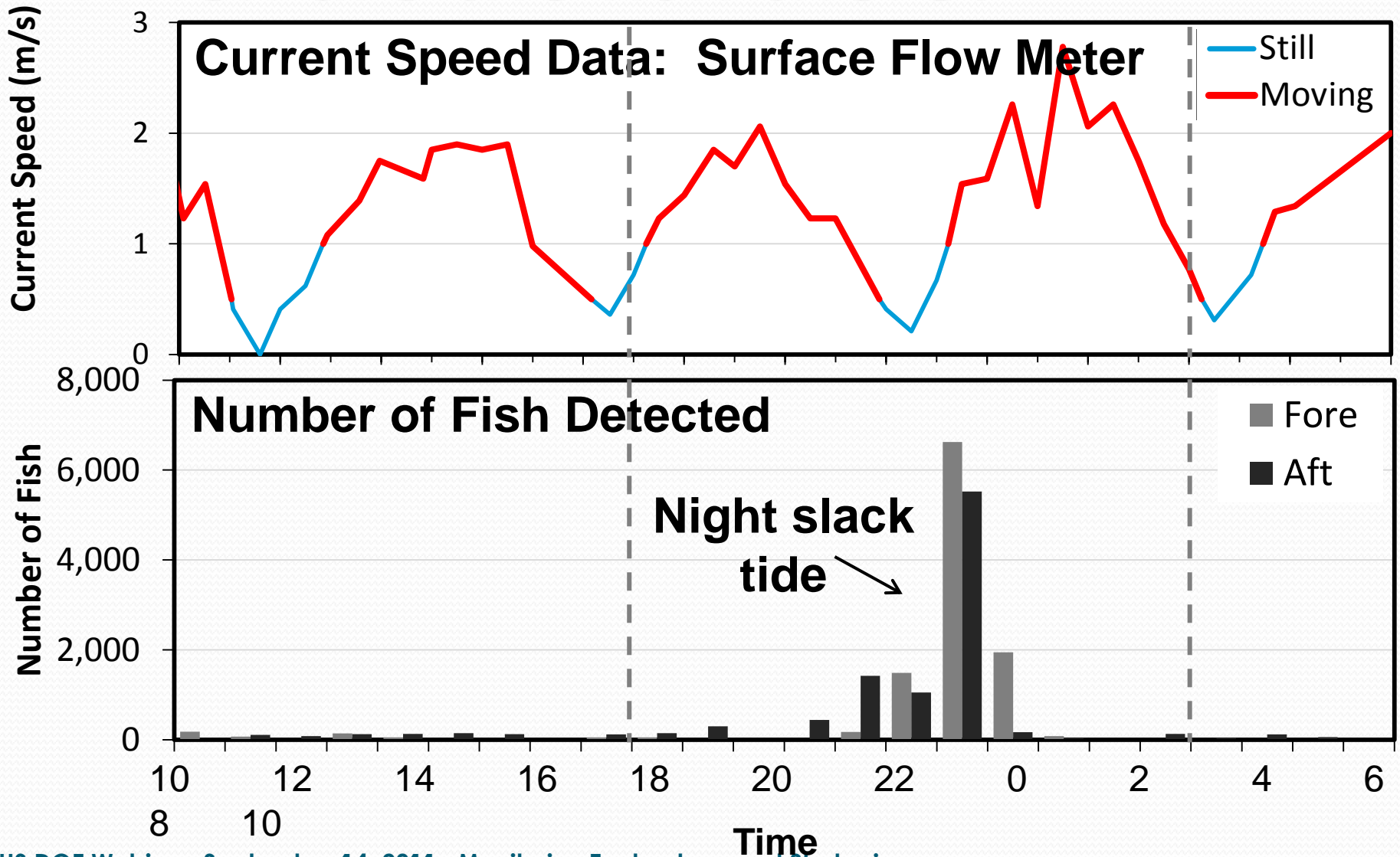


Questions

1. Do we see fish around the turbine? When?
2. What are they?
3. How do they behave around the turbine?
4. Does their behavior change with day or night, fish size?

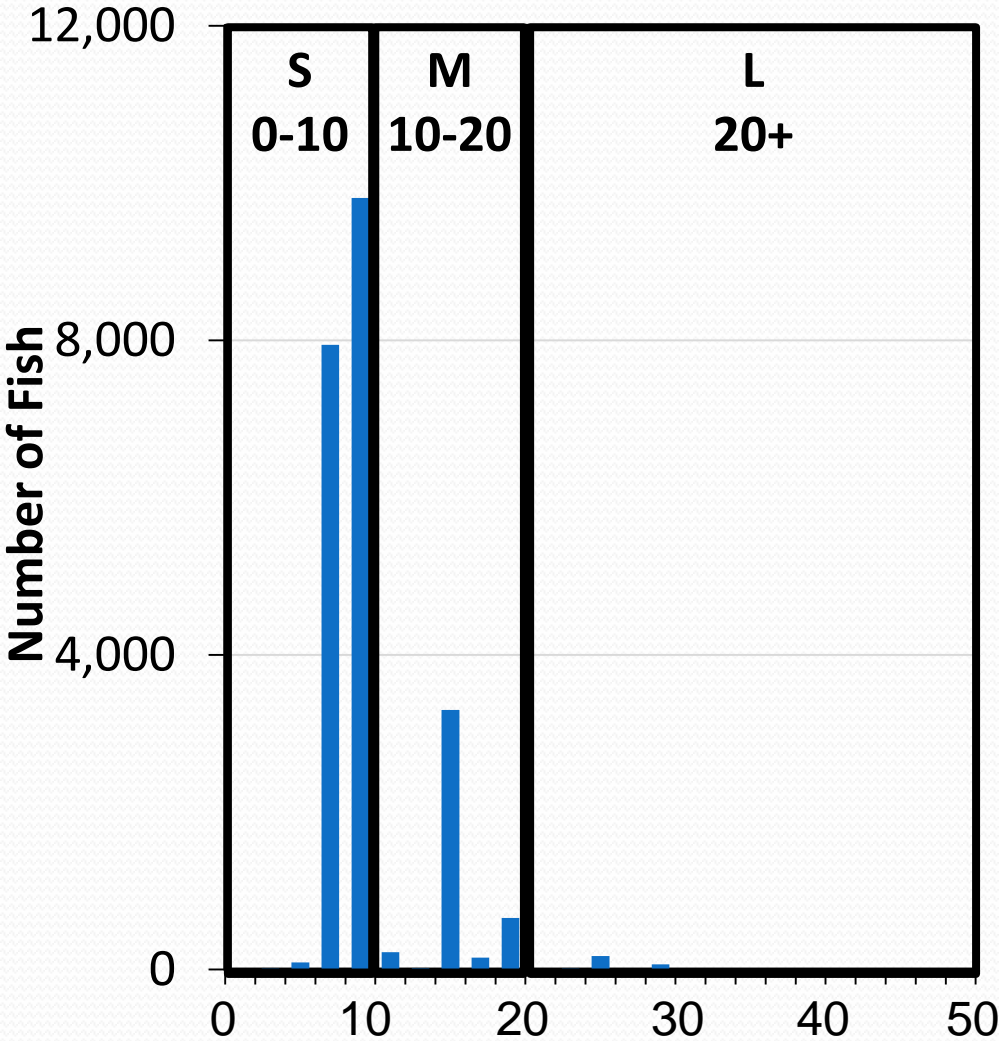


When are the fish there?

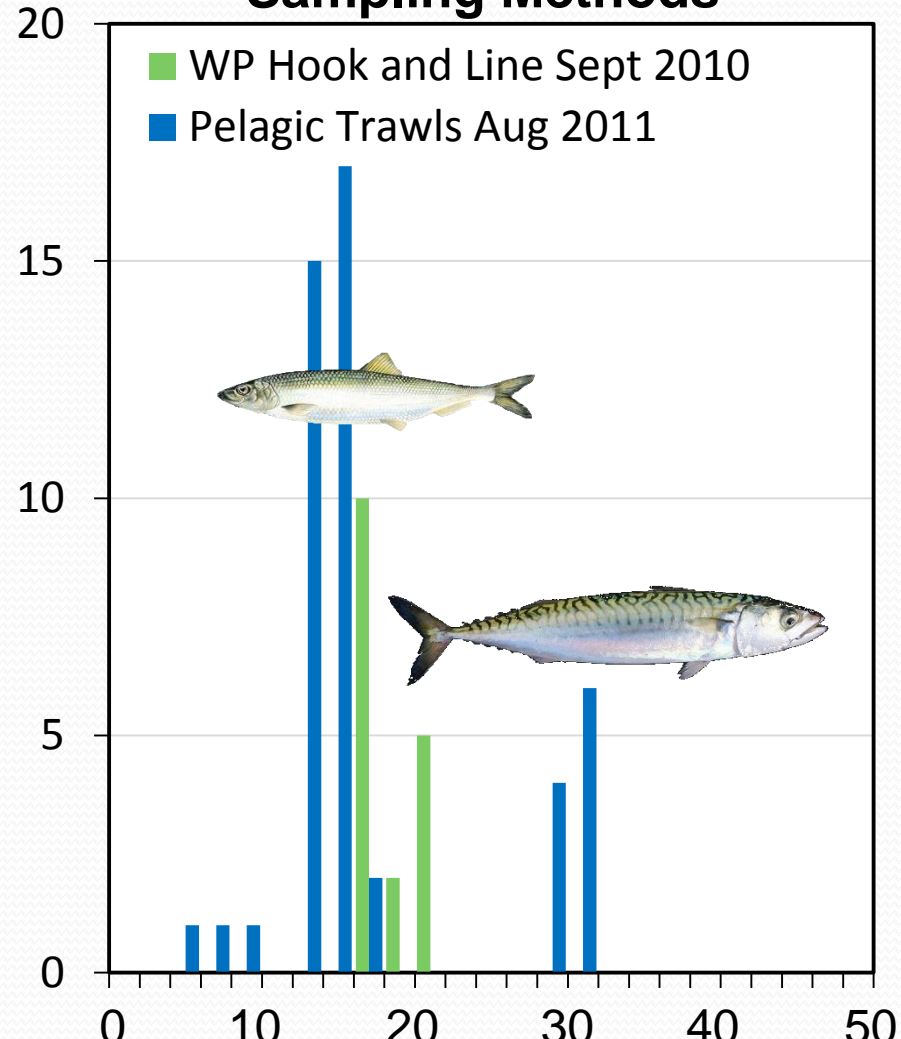


What fish are present?

Size Distribution from DIDSON Footage



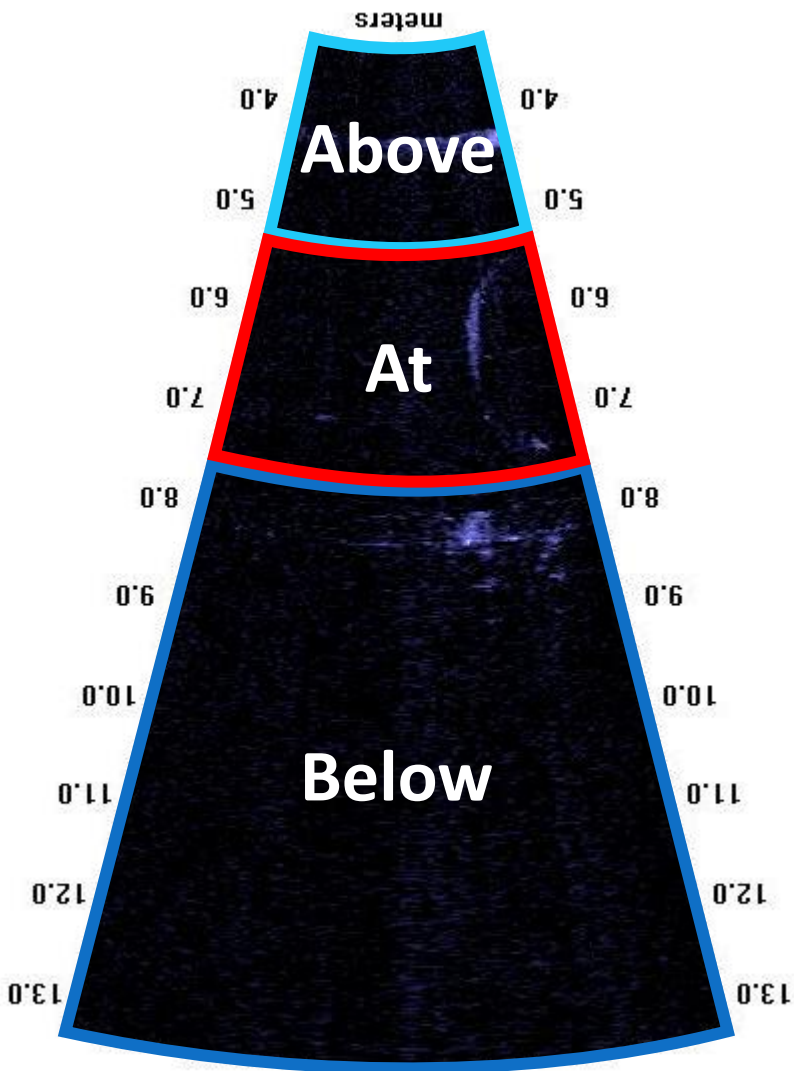
Sizes from Physical Sampling Methods



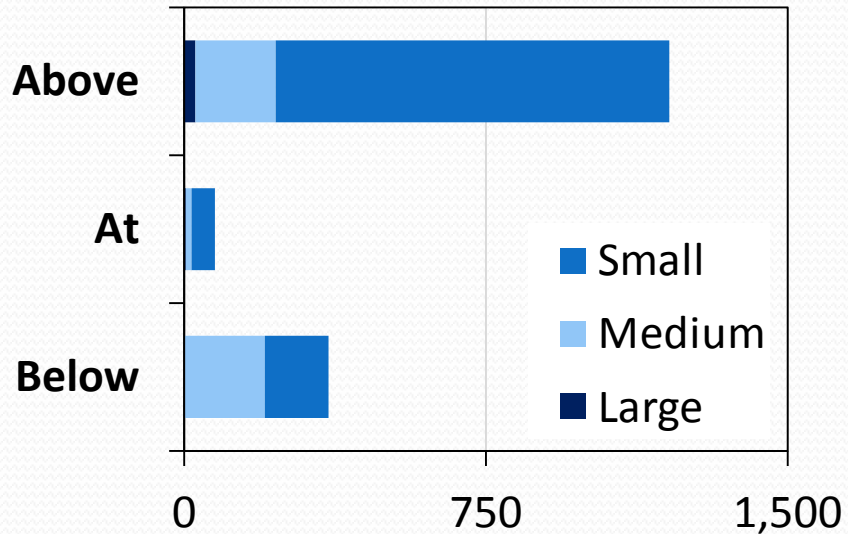
Fish Length (cm)

Fish Length (cm)

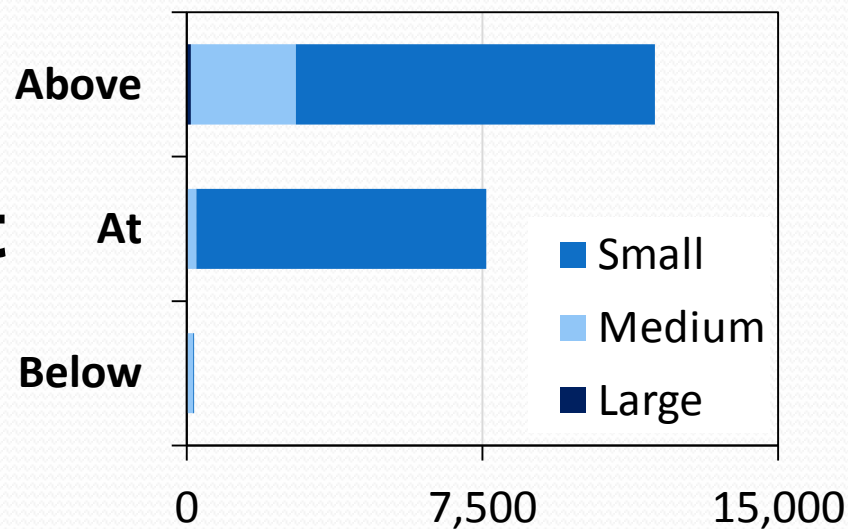
Where are the fish?



Day



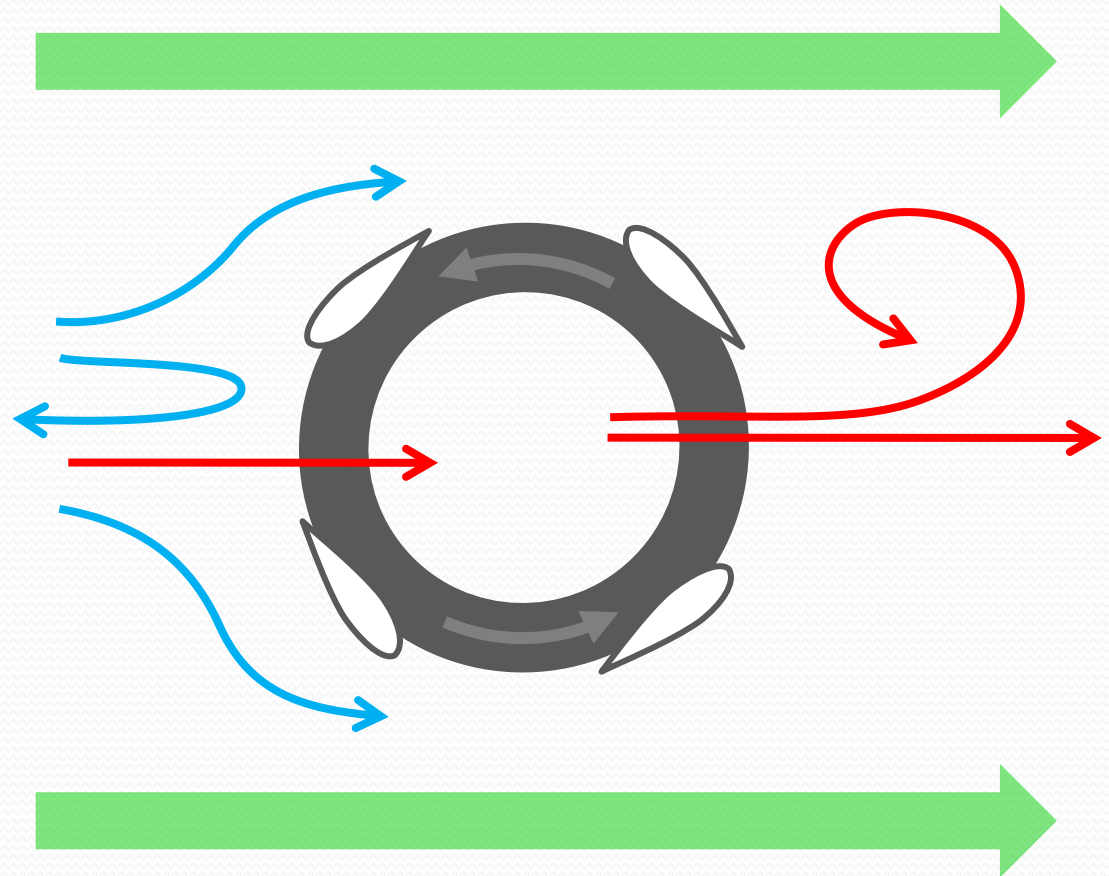
Night



Number of Fish

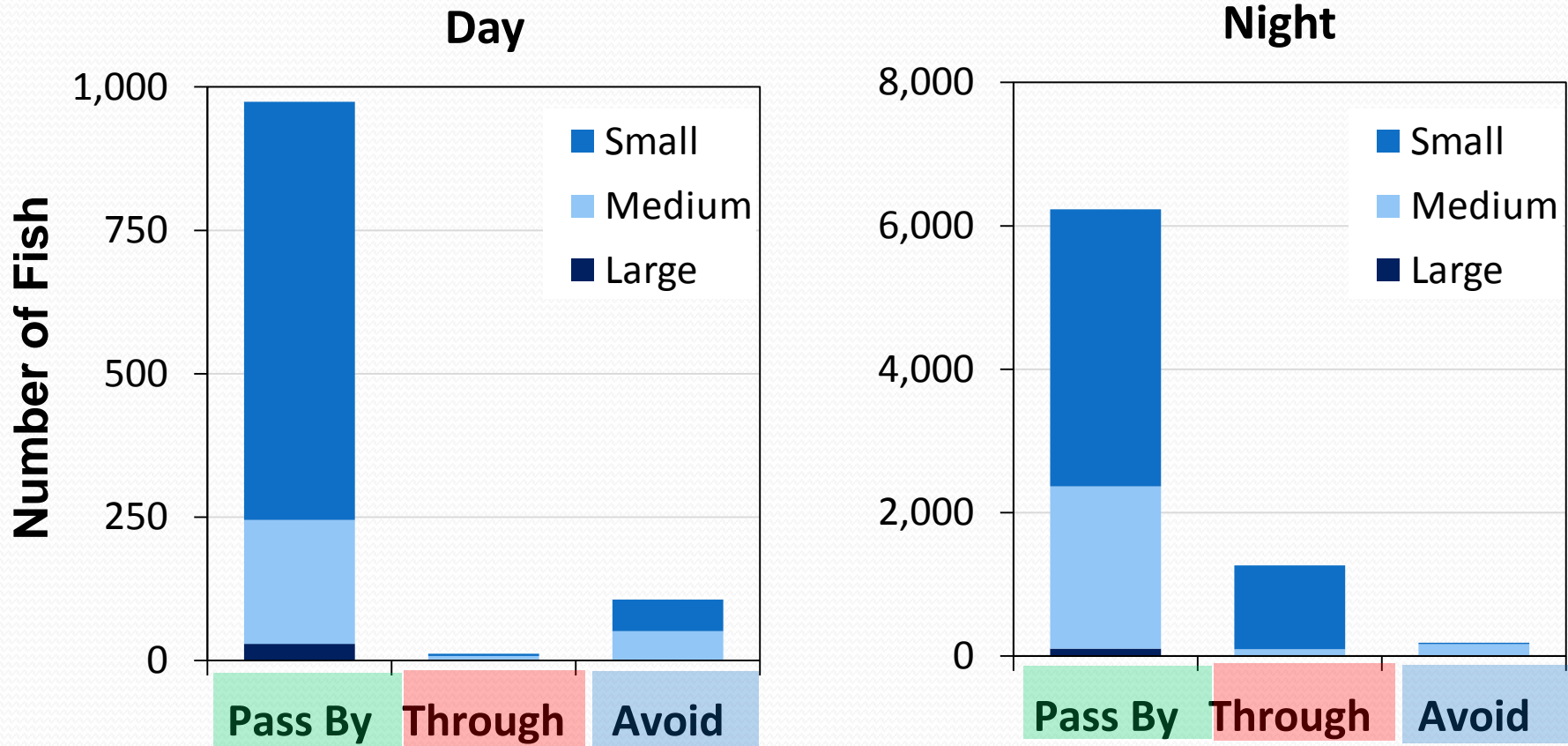
How do fish behave around the turbine?

- Pass By
- In Wake
- Through Turbine:
 - Into Turbine
 - Out of turbine:
 - Into Wake
 - Across
- Active Avoidance:
 - Above
 - Reverse
 - Below



Behavior: Day vs. Night

(looked at times when turbine was moving)



Conclusions from near-field study

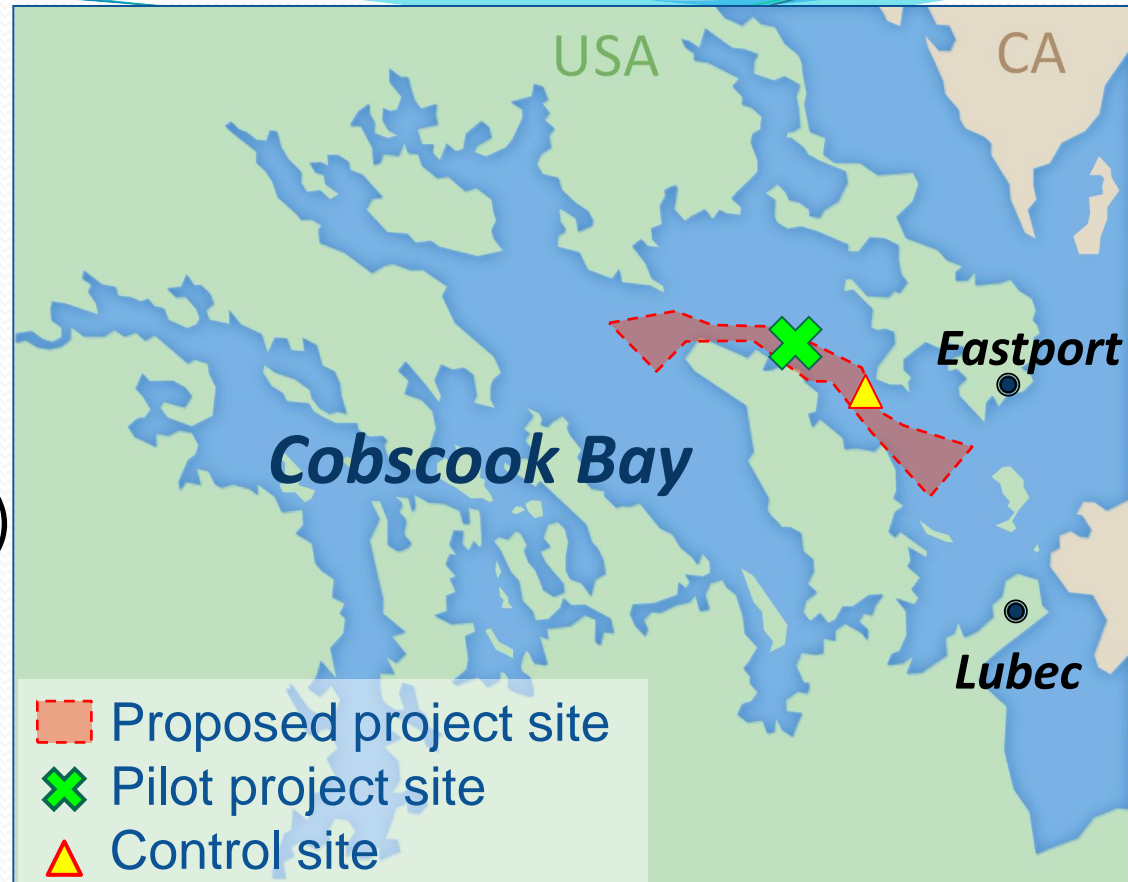
- Fish were almost always present, but most were present at night near the slack tide.
- Most fish observed were small.
- Fish that passed through tended to be small.
- A higher proportion of fish of all sizes avoid the turbine during the day.

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- **Strategies to assess vertical distribution of fishes**
- Strategies and techniques for post-deployment monitoring

Strategies for assessing effects on fish

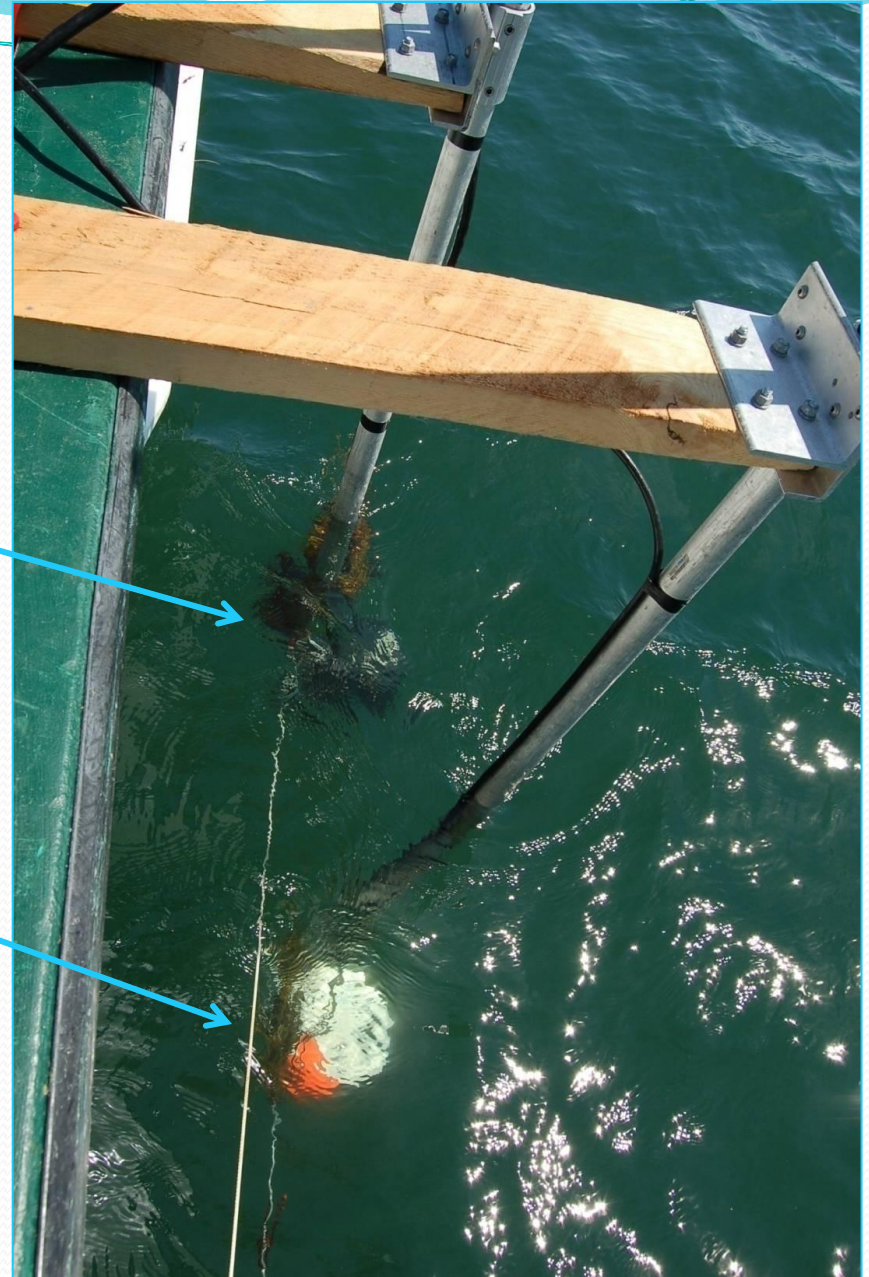
- Objective: *document spatial and temporal changes in fish distribution at proposed project sites.*
- Stationary (site-specific) down-looking acoustics
 - Baseline
 - Control for reference



Year	Winter	Spring	Summer	Fall
2009			Aug, Sept	
2010	Feb, Mar	May, June	Aug, Sept	Oct, Nov
2011	Jan, Mar	May, June	Aug, Sept	Oct

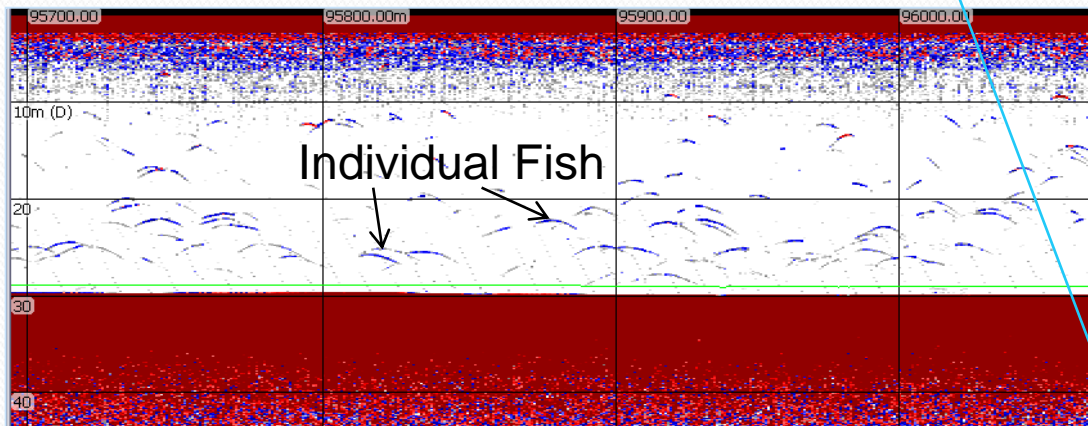
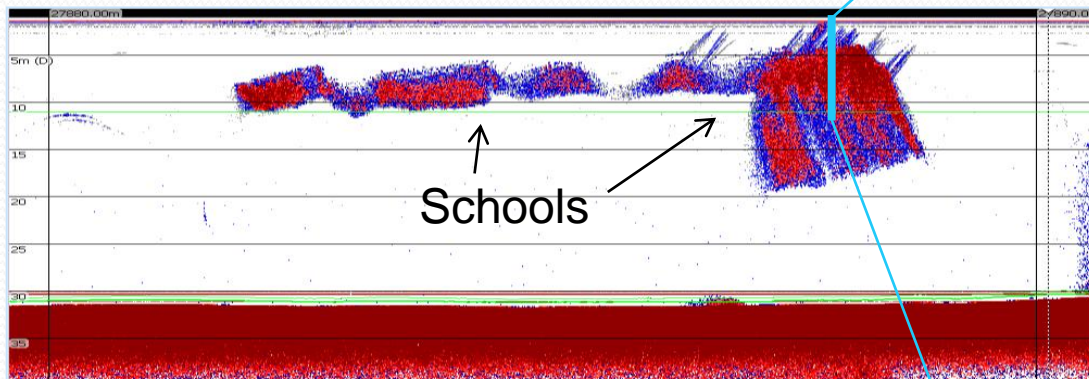
Baseline Setup

- DIDSON: Dual-frequency IDentification SONar
 - 1.1 and 1.8 MHz
 - Views upper 10 m
- SIMRAD dual-frequency single-beam echo sounder
 - 38 kHz and 200 kHz
 - Views entire water column

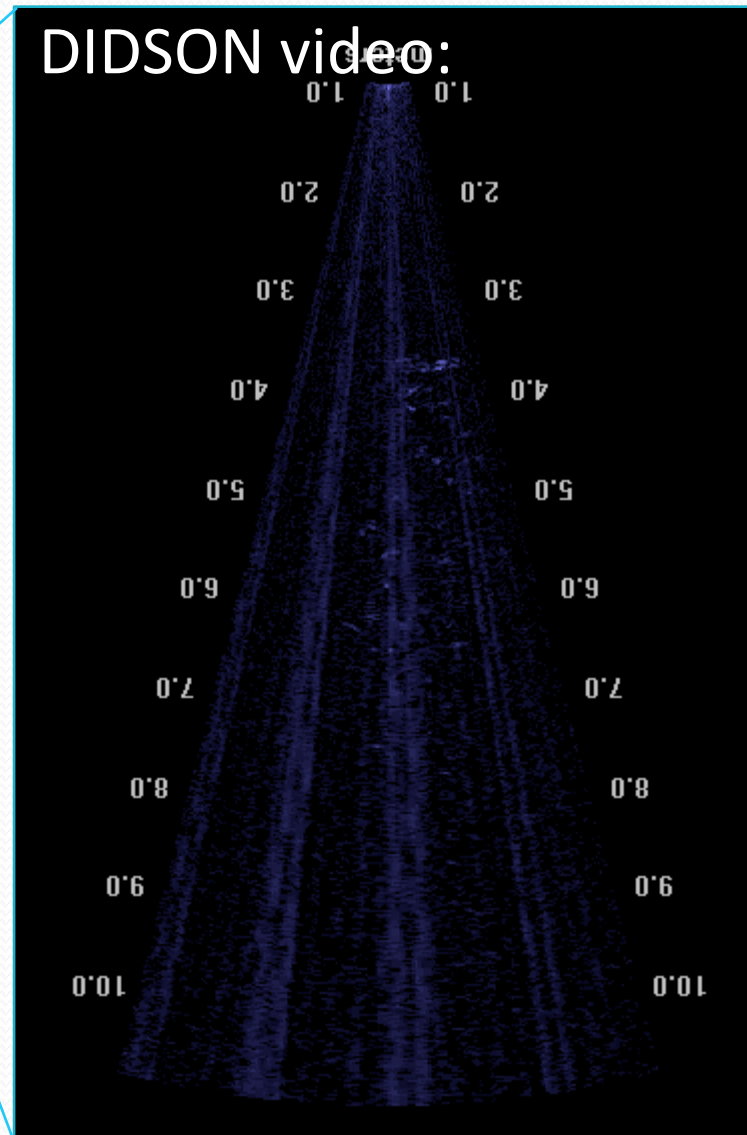


Survey Data

SIMRAD echograms:

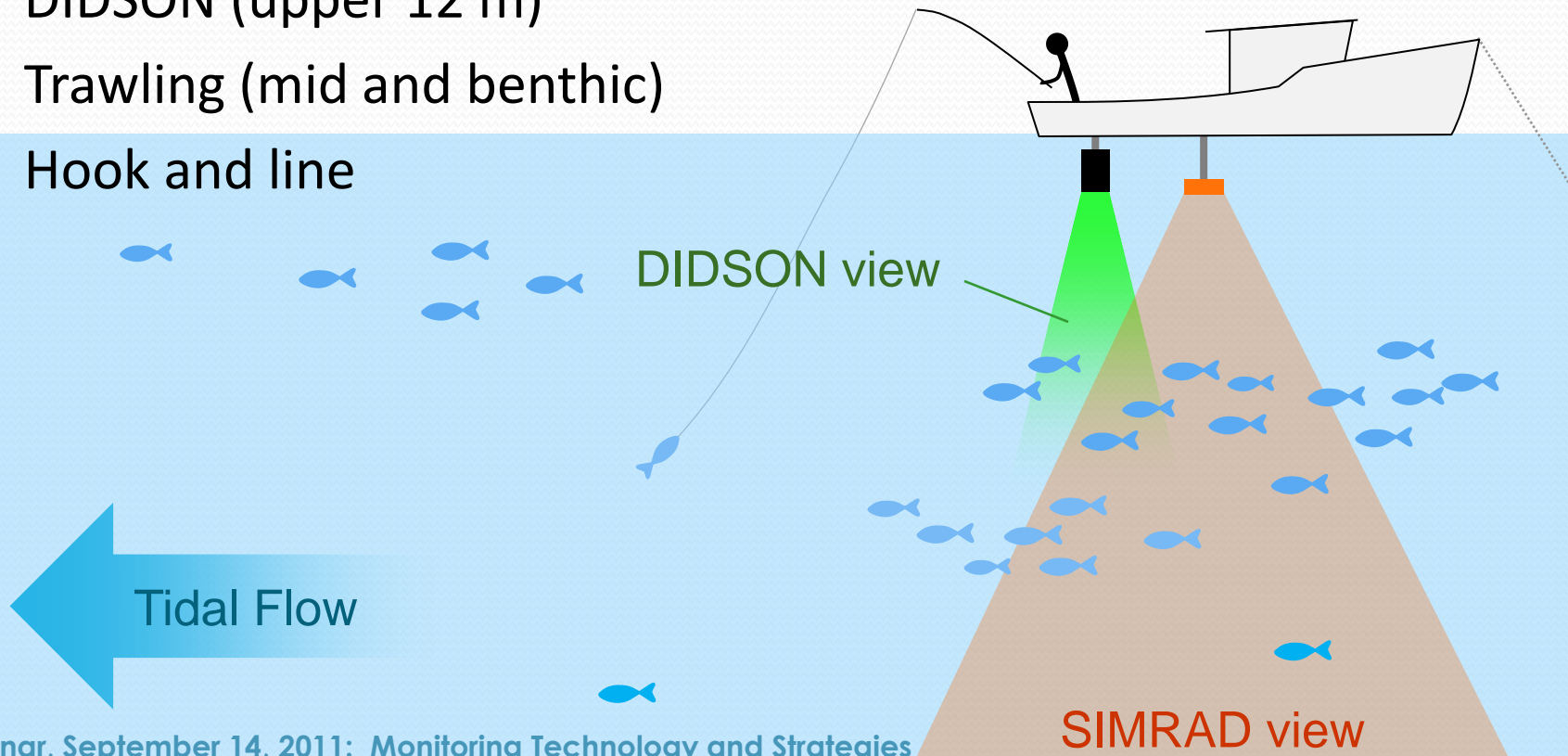


DIDSON video:



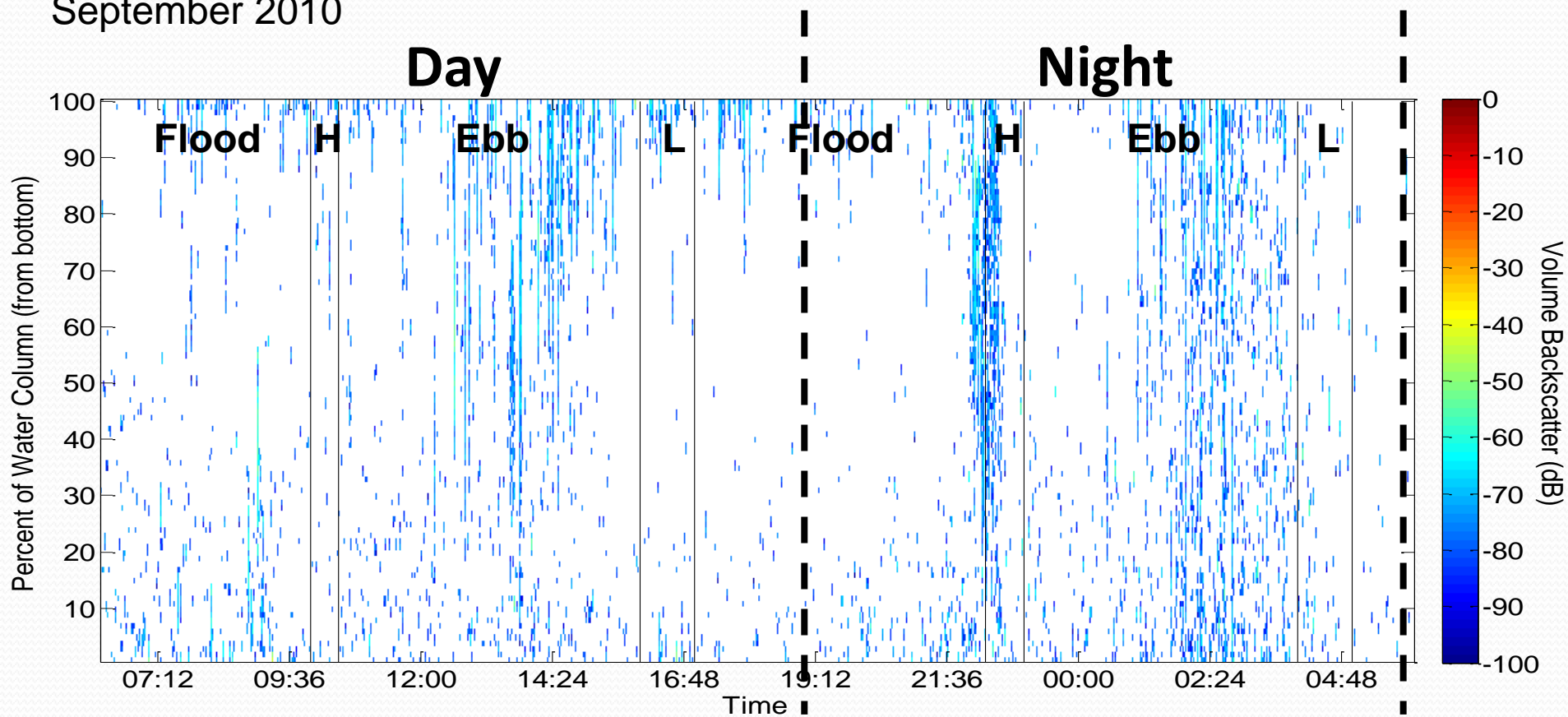
Baseline Surveys

- 24-hour continuous acoustic surveys from moored boat
- Vertical profile of water column
- Species identification
 - DIDSON (upper 12 m)
 - Trawling (mid and benthic)
 - Hook and line



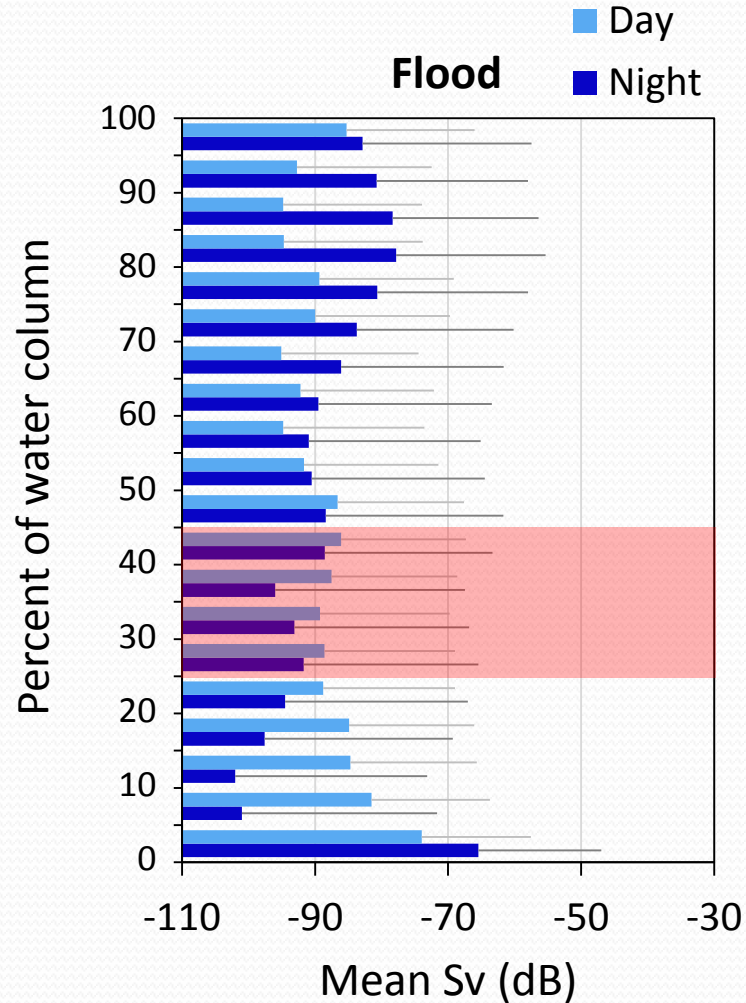
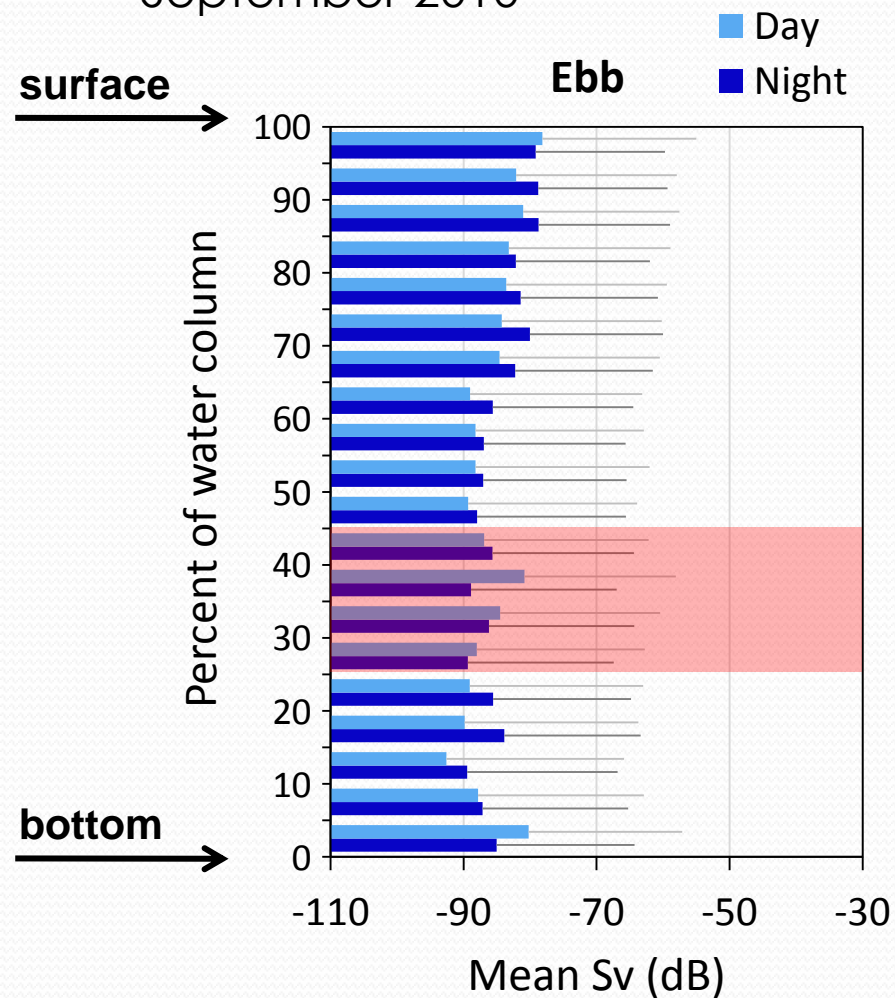
Volume backscatter: relative index of fish density

September 2010



Vertical distributions

September 2010



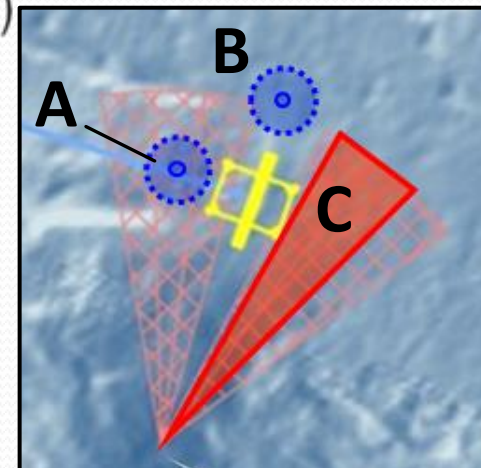
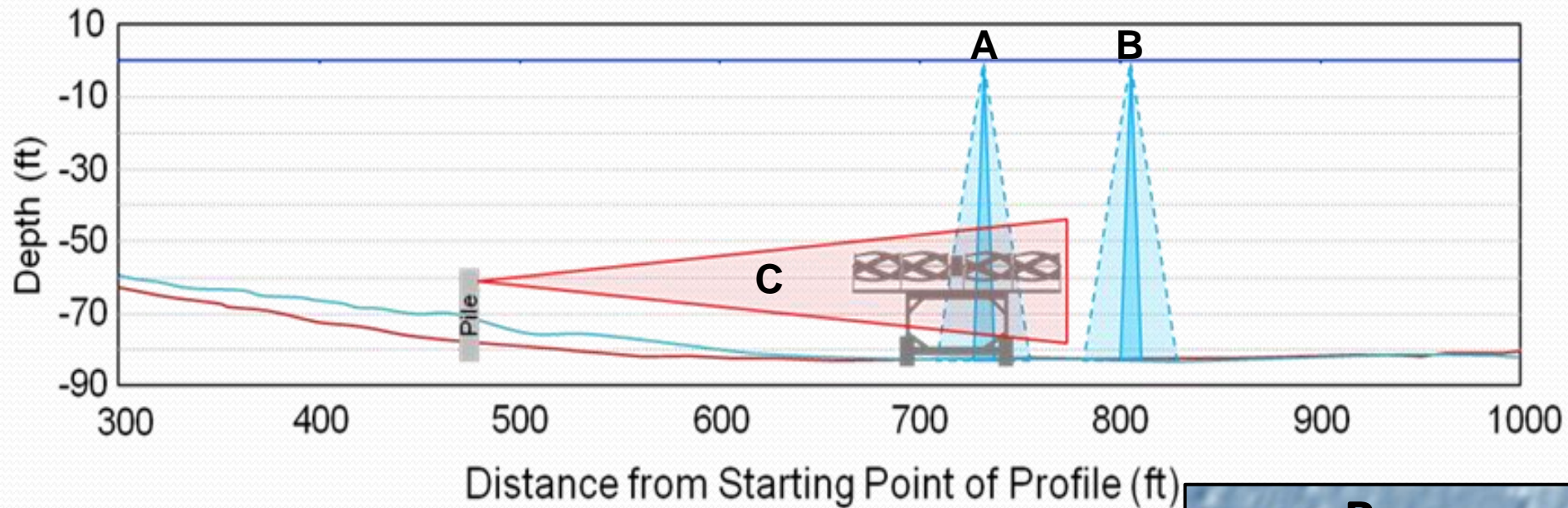
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Strategies & Techniques

- Split beam hydroacoustics
- Pre- (2009 – 2011) and post-deployment (2012-2013) comparisons
 - control and project sites
- Application of both down-looking and side-looking acoustics for near-field effects

Post-deployment acoustics sampling



Take home

- Communication is key
- Interactions monitoring must consider periods of fish activity
- Baseline vertical distribution of fishes will be important for assessing risk of interaction
- Monitoring after device deployment will require innovative approaches

Special Thanks to:



- Michael Peterson
- Rich Kimball
- Huijie Xue
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- Alex Jensen
- Jeff Vieser
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- Captain Butch Harris and crew (Skip Harris, Rob Gordon, Darius Neptune, Matt LaChance)
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