

Muriel Dunn<sup>1</sup>, Len Zedel<sup>1</sup> and Greg Trowse<sup>2</sup>

# Using Doppler sonar to evaluate fish populations in high-energy tidal channels:

Can Doppler sonar be used to count fish?

1



2



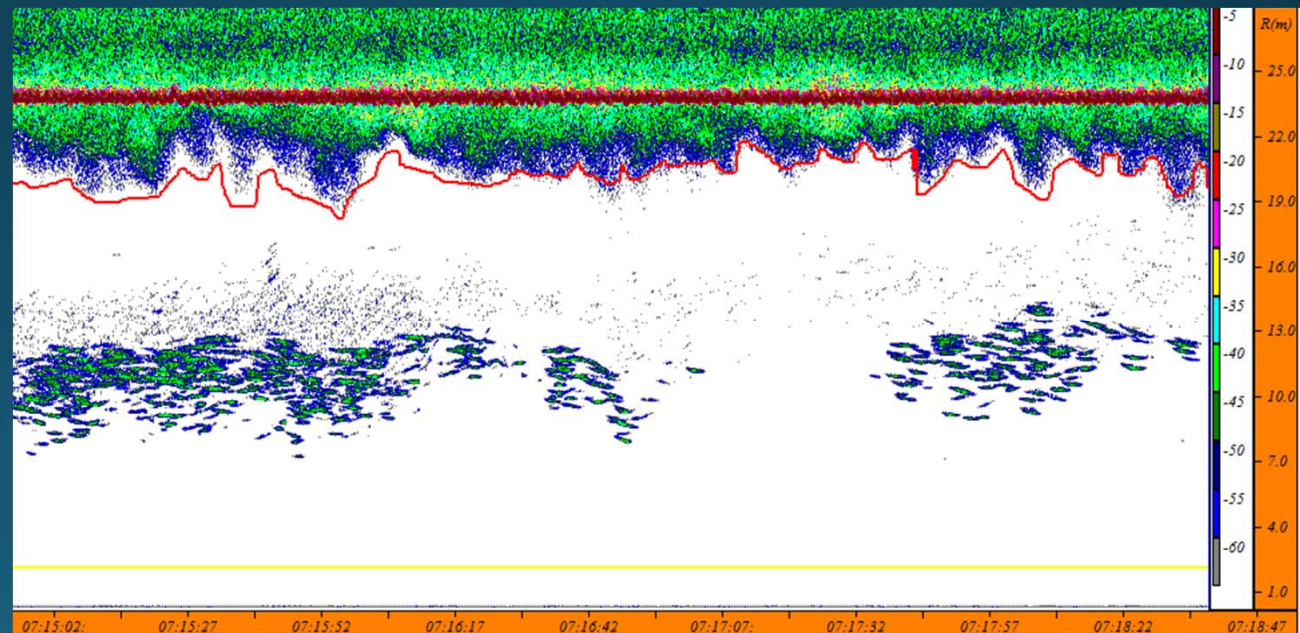
# What's the problem?

- Interactions and effect on fish by tidal turbines are a concern
- Most research based on conventional hydroacoustic sampling  
(Typically involves ship/boat surveys and significant user interaction)

Surface →

Bubbles →

Fish →



# Question

- Could Doppler sonar (ADCPs), normally used to measure water velocity, contribute information?
- Fish are detected by Doppler sonar and are known to corrupt the velocity signals
- BUT, you can actually measure fish velocities with
- Can ADCP fish counts be quantified?

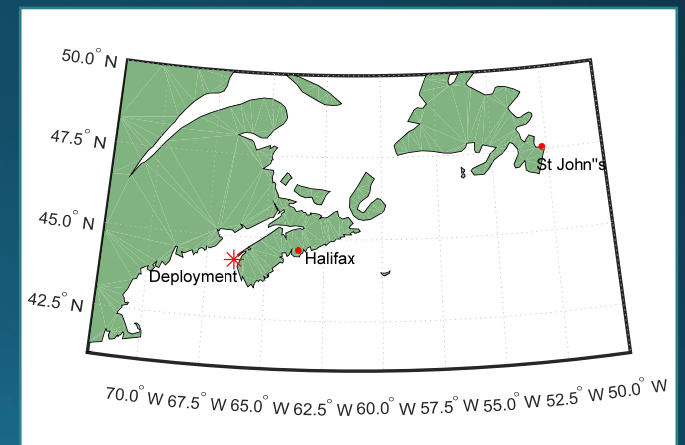


# Deployment Site: Grand Passage NS

## Two Deployments

- September 2018: 11-days
- September-December 2014: ~90 days

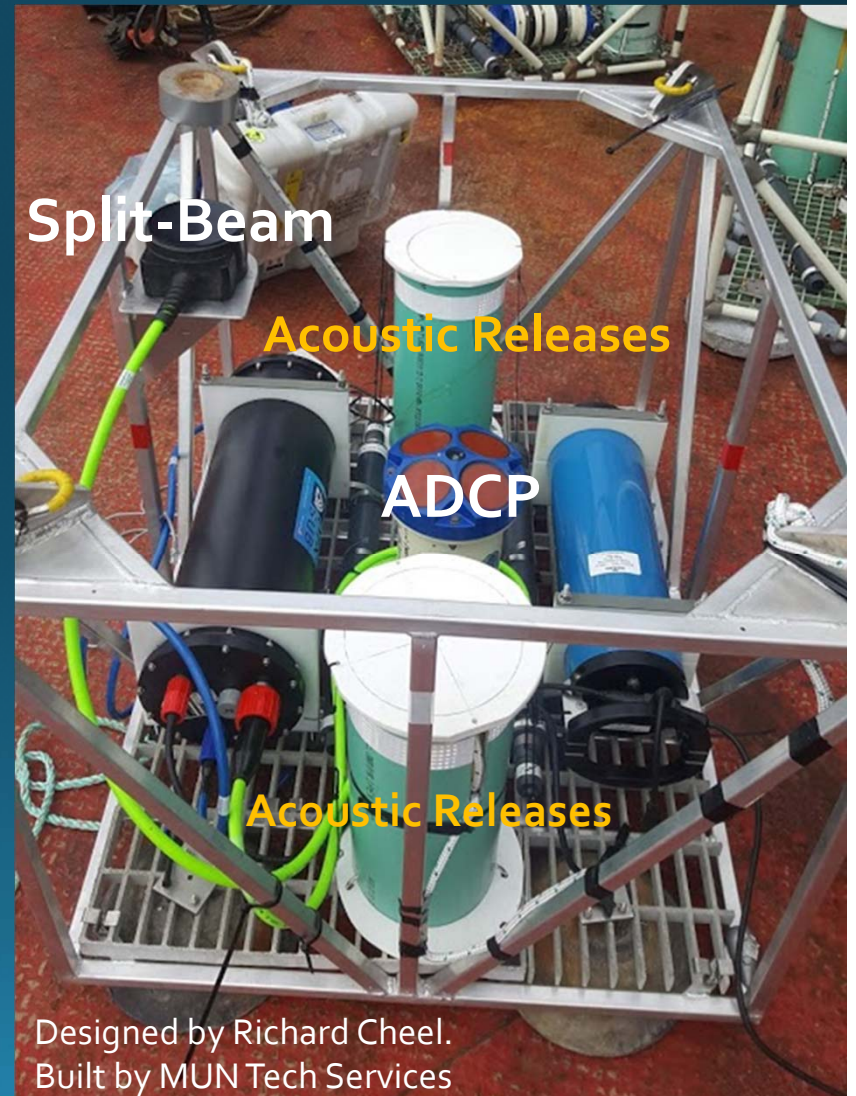
- Flow speed 2-4 m/s
- Tidal range ~ 5 m
- Water depth 25 m



# Equipment

- T-RDI ADCP Doppler sonar
- Biosonics DTX split beam sonar
- Self-contained, bottom-mounted frame

Parameter	ADCP	Split-beam
Frequency	600 kHz	120 kHz
Duty Cycle	20 mins on/20 mins off	20 mins on/ 40 mins off
Ping rate	1 pps	4 pps
Pulse length	0.08 ms	0.1 ms



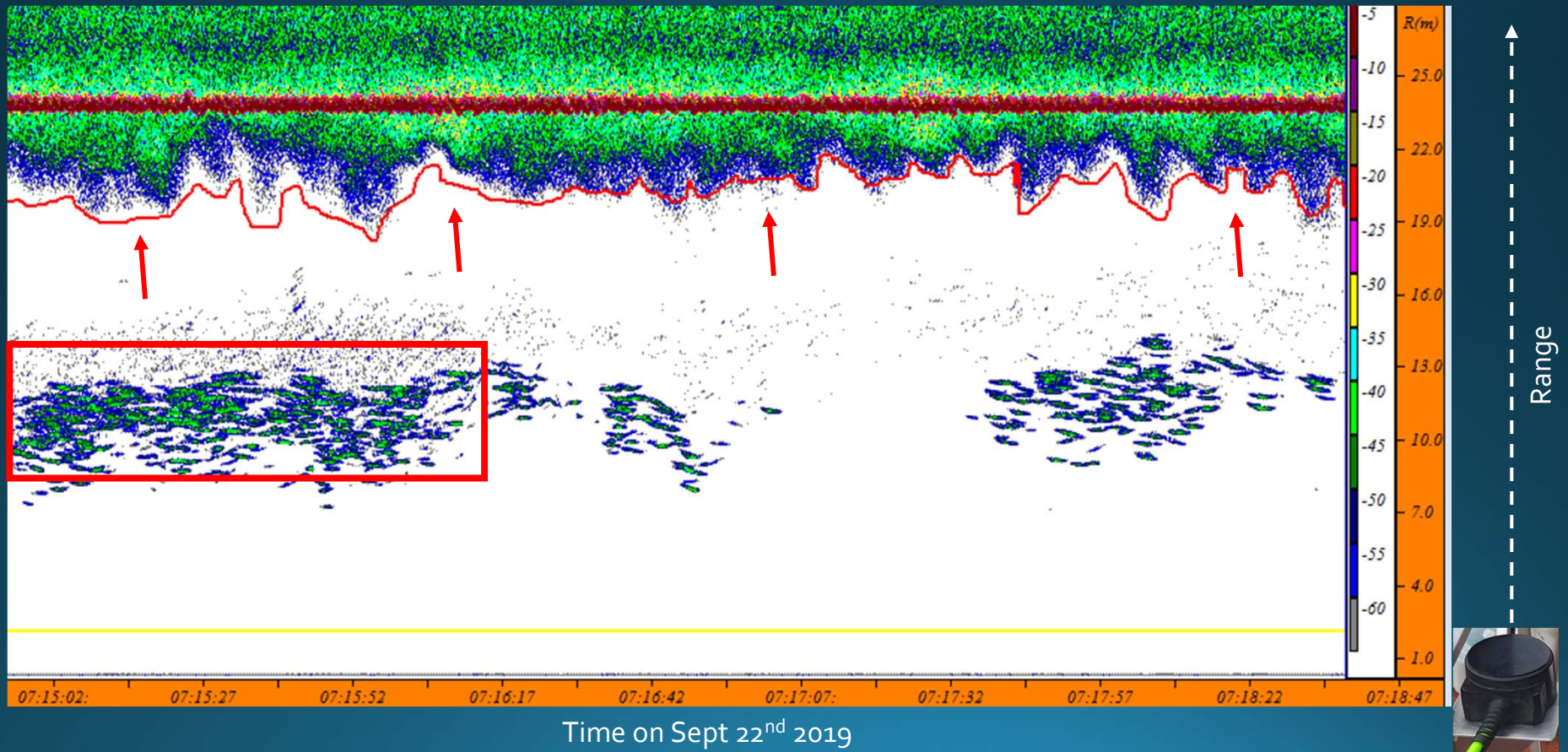


# Split-beam Echosounder

- Industry standard for fish detection
- Nice image, fish visible for humans

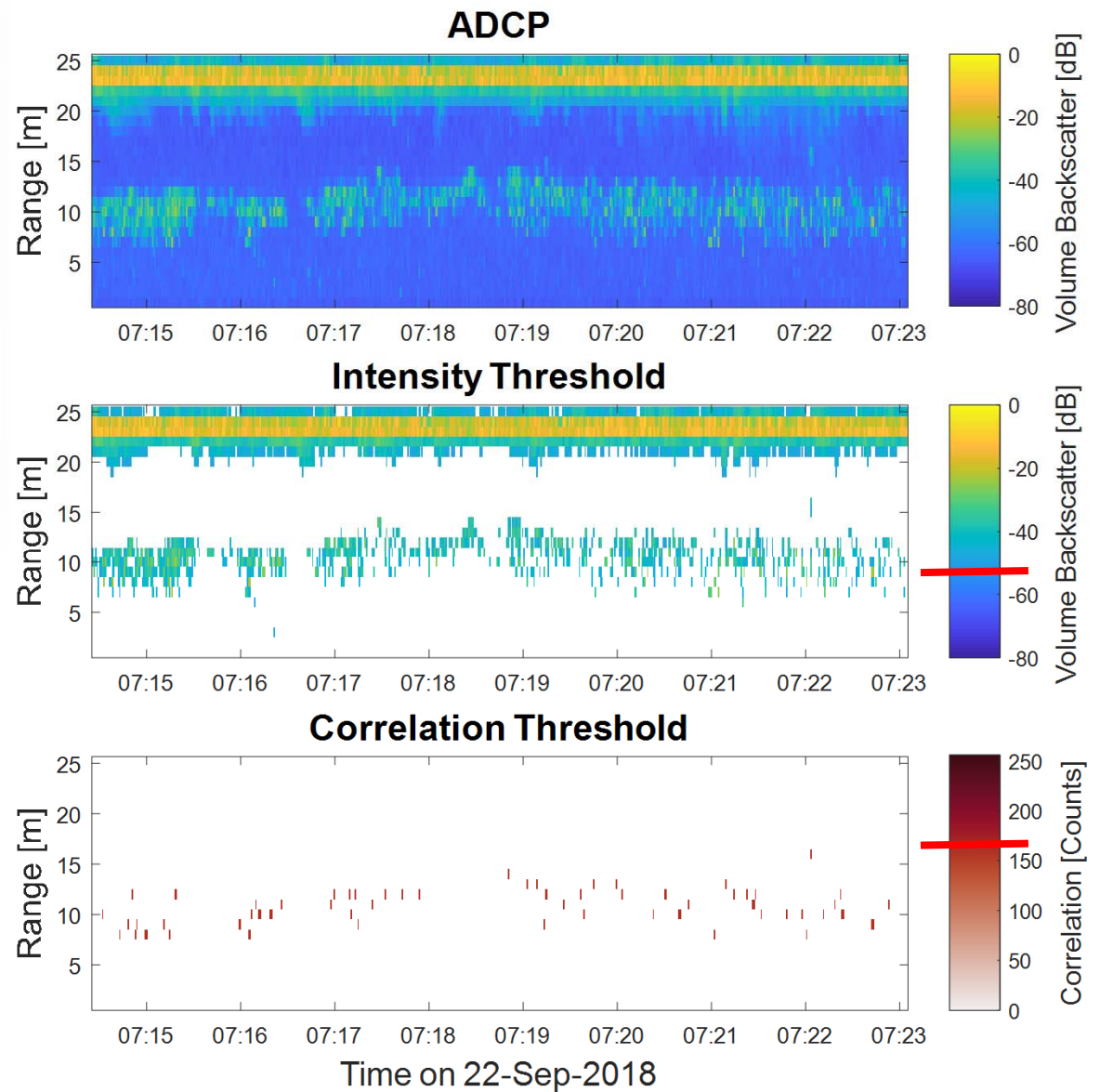
( ~ 3 minutes of data shown)

(Display from SONAR-5)



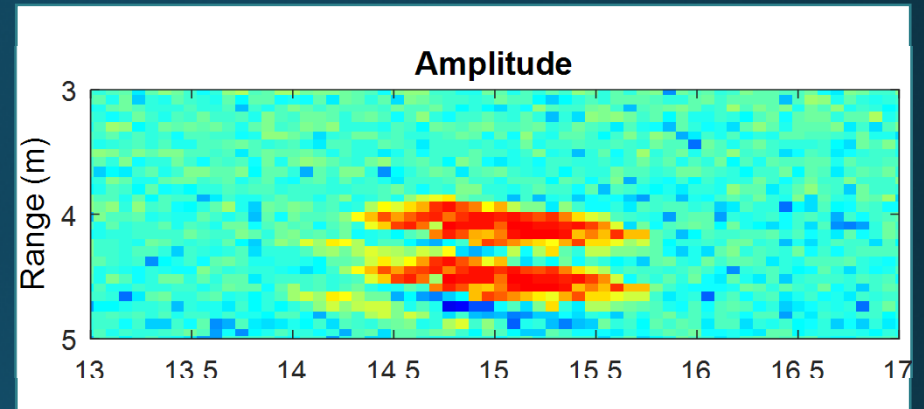
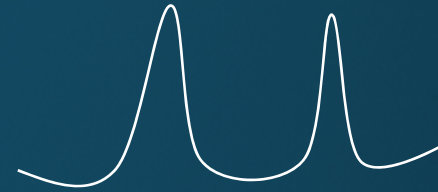
# Fish detection with ADCP

- Broadband Acoustic Monitoring for Fish (BAMFF) toolbox
- 8 minutes of data
- Intensity and correlation thresholds
- Validates approach for detecting fish

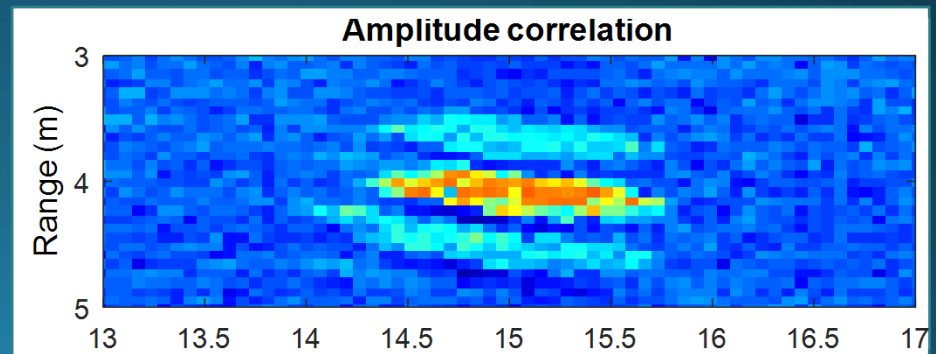
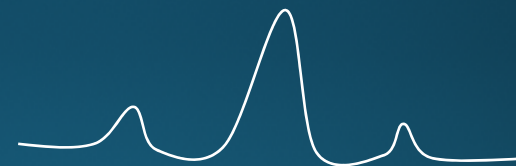


# Correlation

- Pulse pair convolved with discrete target



- Autocorrelation of return signal with lag

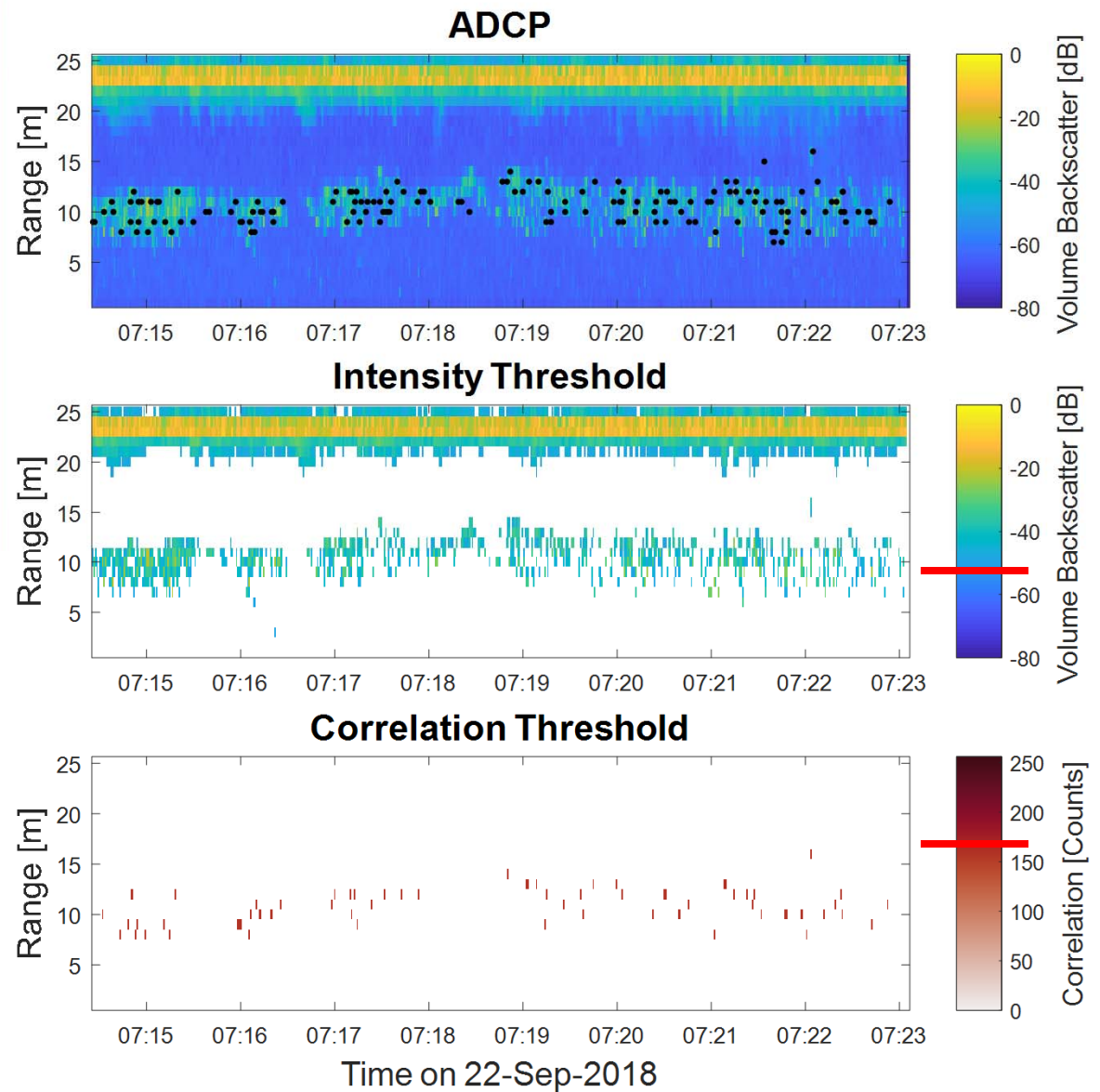




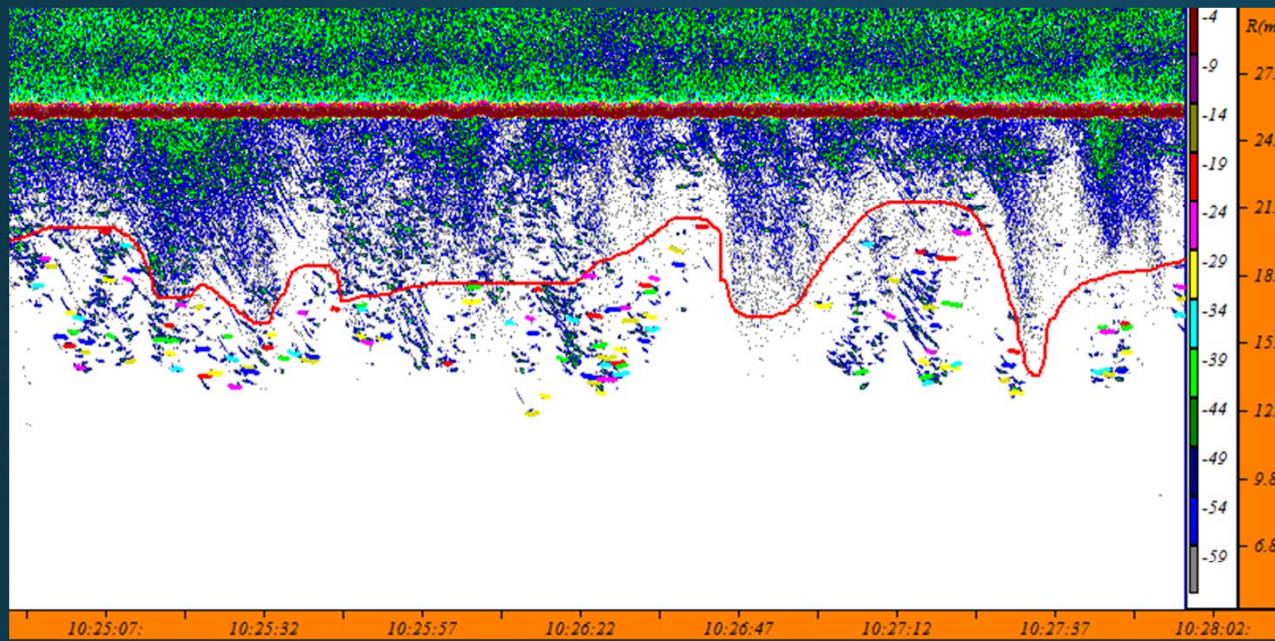
# Fish detection with ADCP

- Broadband Acoustic Monitoring for Fish (BAMFF) toolbox
- Intensity and correlation thresholds
- Validates approach for detecting fish

(For T-RDI ADCP, correlation of 128 is normal)

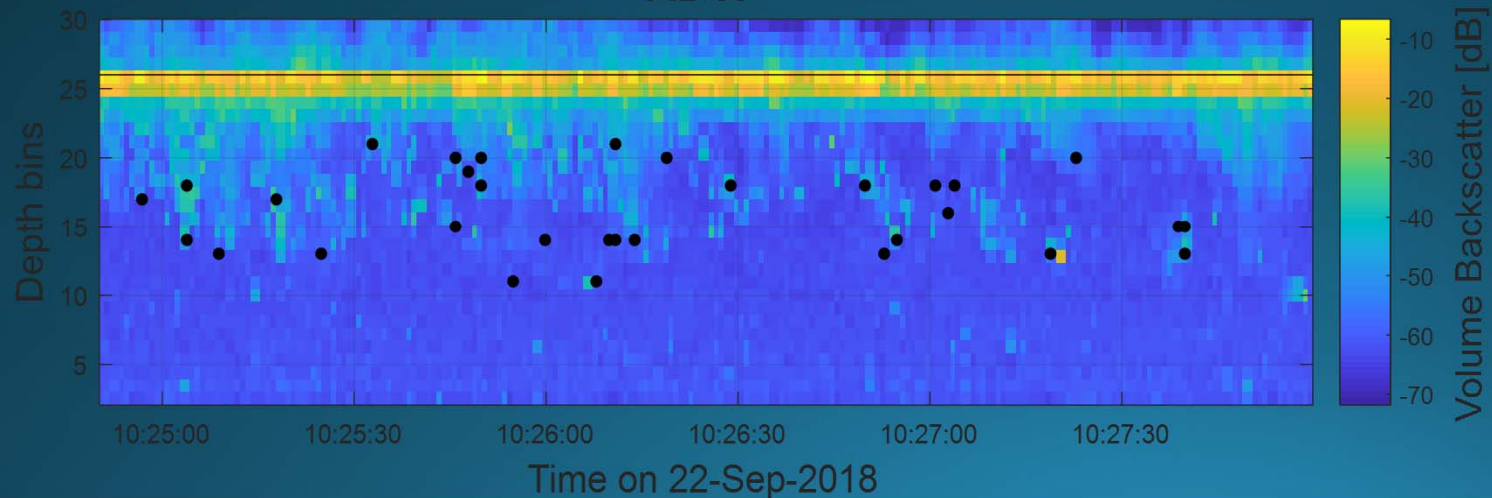


# Split-beam



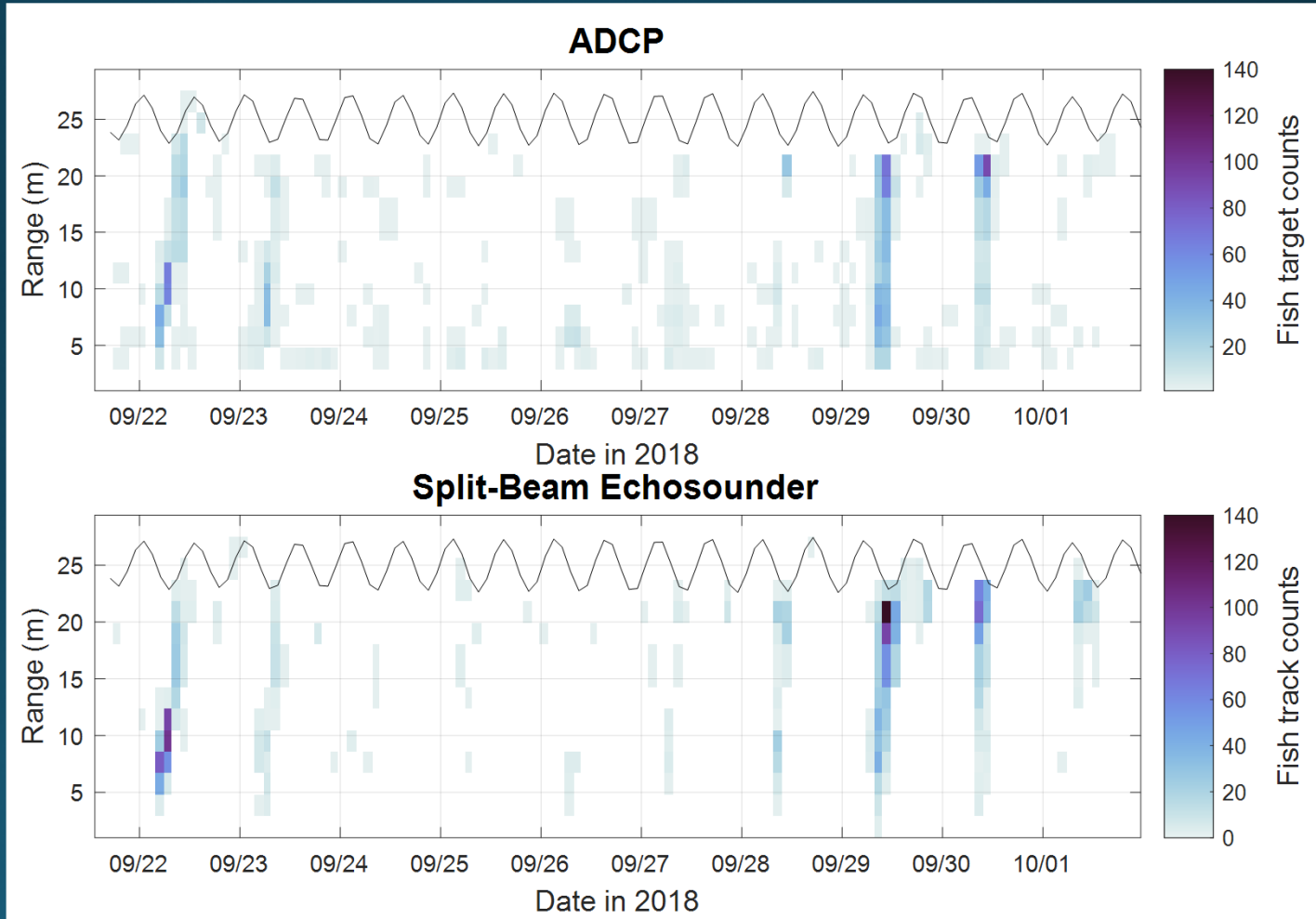
Dealing with  
bubble clutter

## ADCP ADCP



# Fish counts comparison

- Fish detectability
- Fish schools
- 11 days data
- 2 m depth bins
- 2 hour time bins

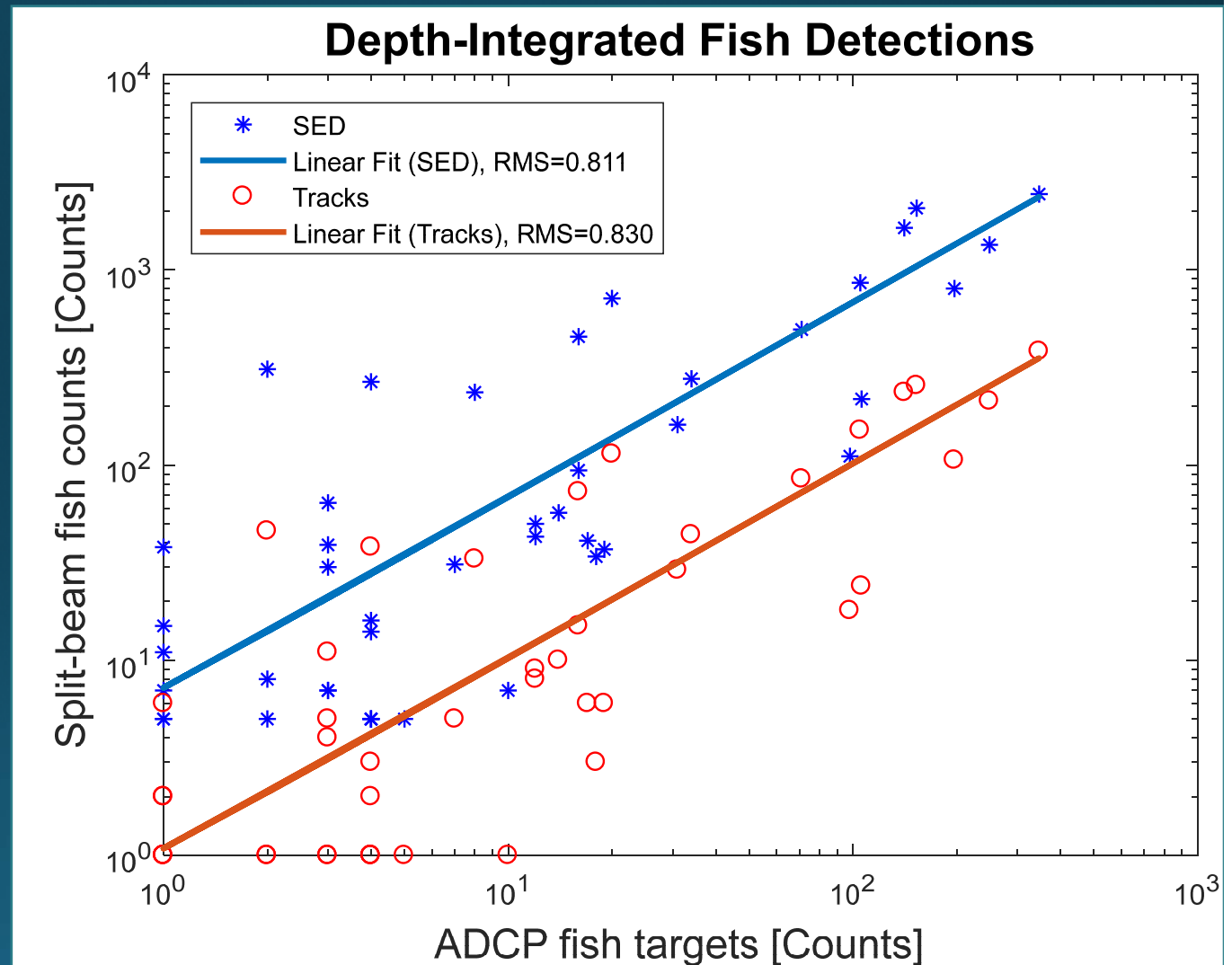




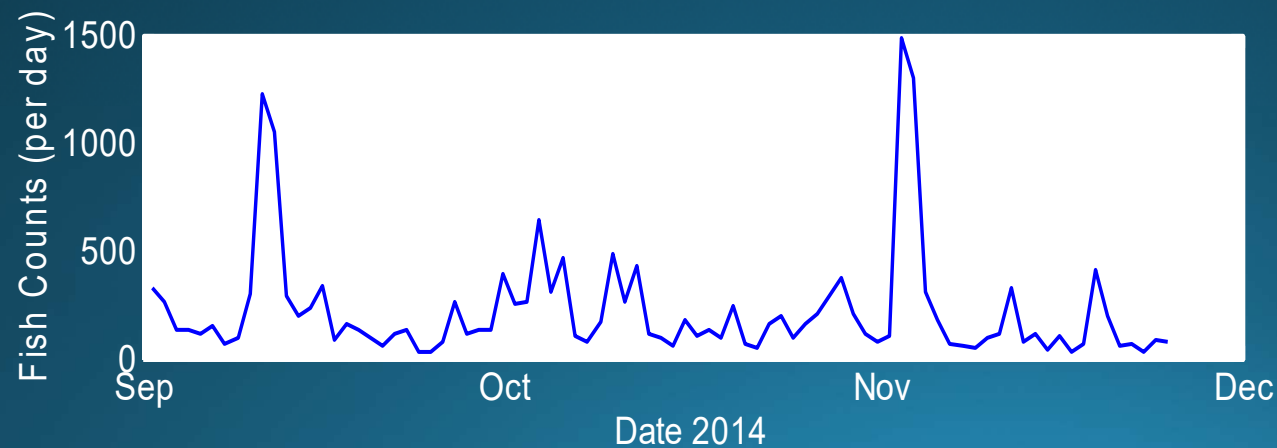
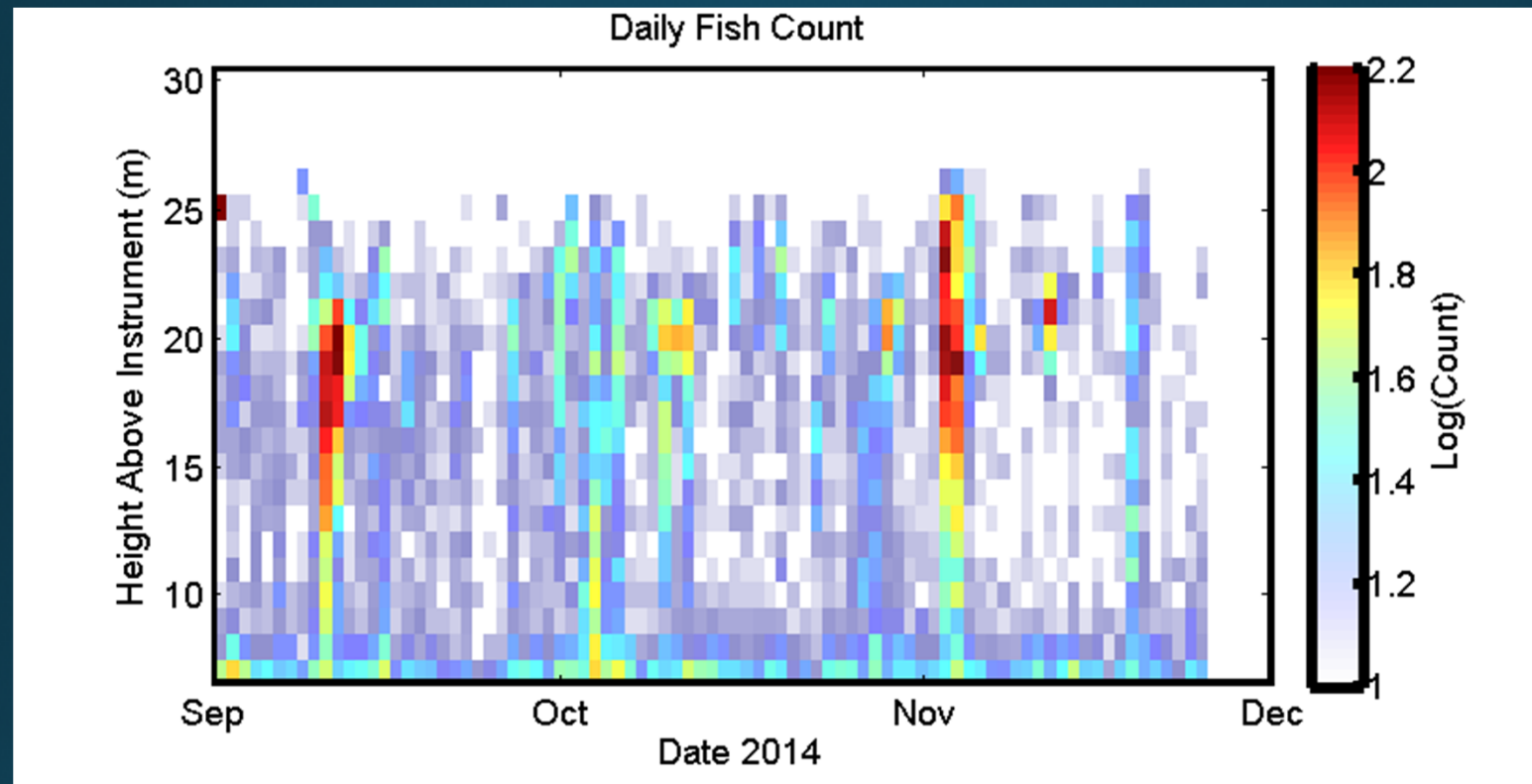
# Fish detection comparison

Slope  $6.8 \pm 0.3$   
 $R = 0.8$

Slope  $1.0 \pm 0.3$   
 $R = 0.8$



# Three Month ADCP deployment in Grand Passage



Daily fish counts  
1 - m bins

(Data kindly provided by Dr.  
Alex Hay, Dalhousie  
University)

# Conclusions

1. Doppler sonar (ADCP) can be used to detect fish in tidal channels. Use of signal correlation helps to detect fish while excluding false detections from bubbles.
2. Fish counts from ADCP data agree very well with split beam sonar results (correlation ADCP-Splitbeam  $\approx 0.8$ )



# Acknowledgements



Collaborations

Alex Hay  
Helge Balk





# “Fish!”<sup>1</sup>

As seen by upward looking camera  
during June 2019 deployment



1. Quote from Greg Trowse email, July 2019