Development of a Portable Passive-Acoustic Bedload Monitoring Surrogate for Non-Experts

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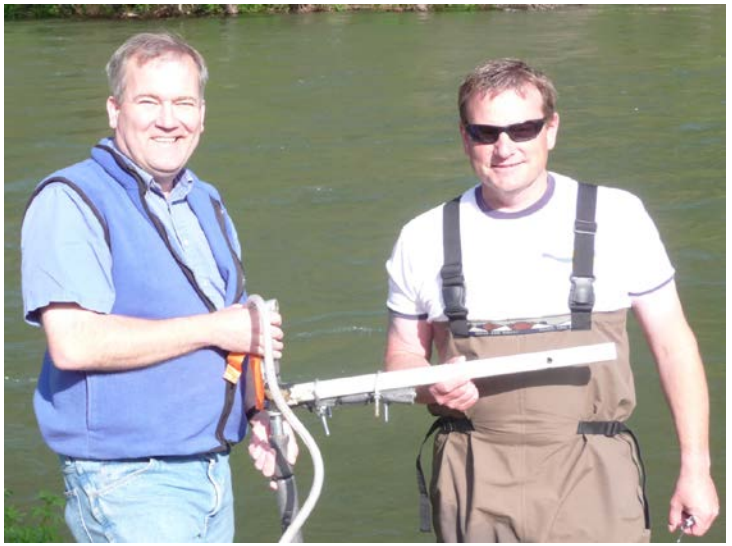
Background

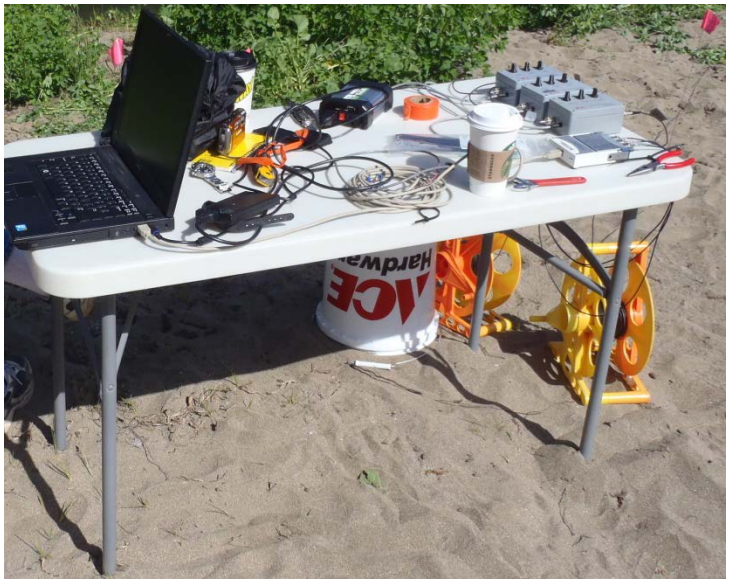
- Goal: to use passive acoustics to monitor self-generated noise in fluvial environments to determine bedload transport
- Developed a field-deployable system using lab-caliber equipment that was already available
- 3 data collection trips (1 to Trinity River, Weaverville, CA and 2 to Elwha River, Port Angeles, WA) with concurrent physical measurements by Graham Matthews & Associates
- Ongoing data analysis from recent summer deployment at Walnut Gulch, AZ

Current System

- Up to 4 RESON TC4013 hydrophones encased in PVC for protection (top picture)

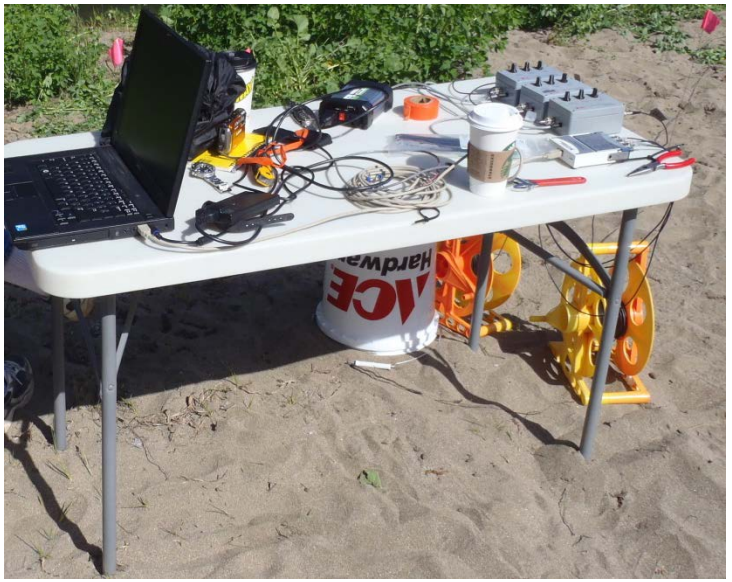


- RESON E6061 preamplifier required for each hydrophone
- NI 9215 four-channel DAQ module
- Laptop running data collection software



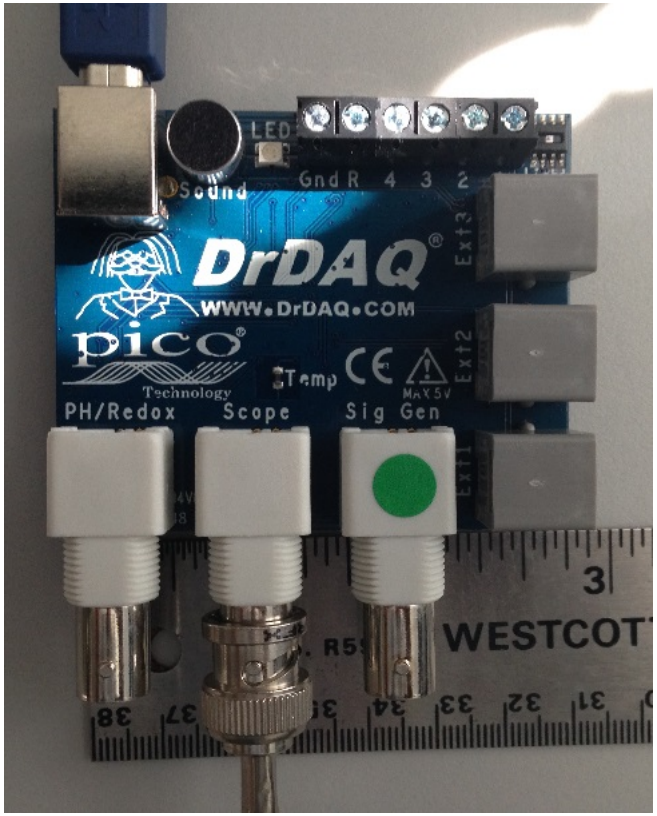
Limitations of Current System

- Bulky – numerous pieces of equipment
- Delicate – hydrophone cables are breakable and easily destroyed
- Sensitive to touch – erroneous external physical stimuli can skew data
- Not water proof – exposed electronics
- Finite battery life



Methods for Improvement
Data Collection

- Investigate the use of hand-held multi-channel data collection systems on the market
- Develop embedded post-processing signal analysis programs to quantify relevant transport metrics

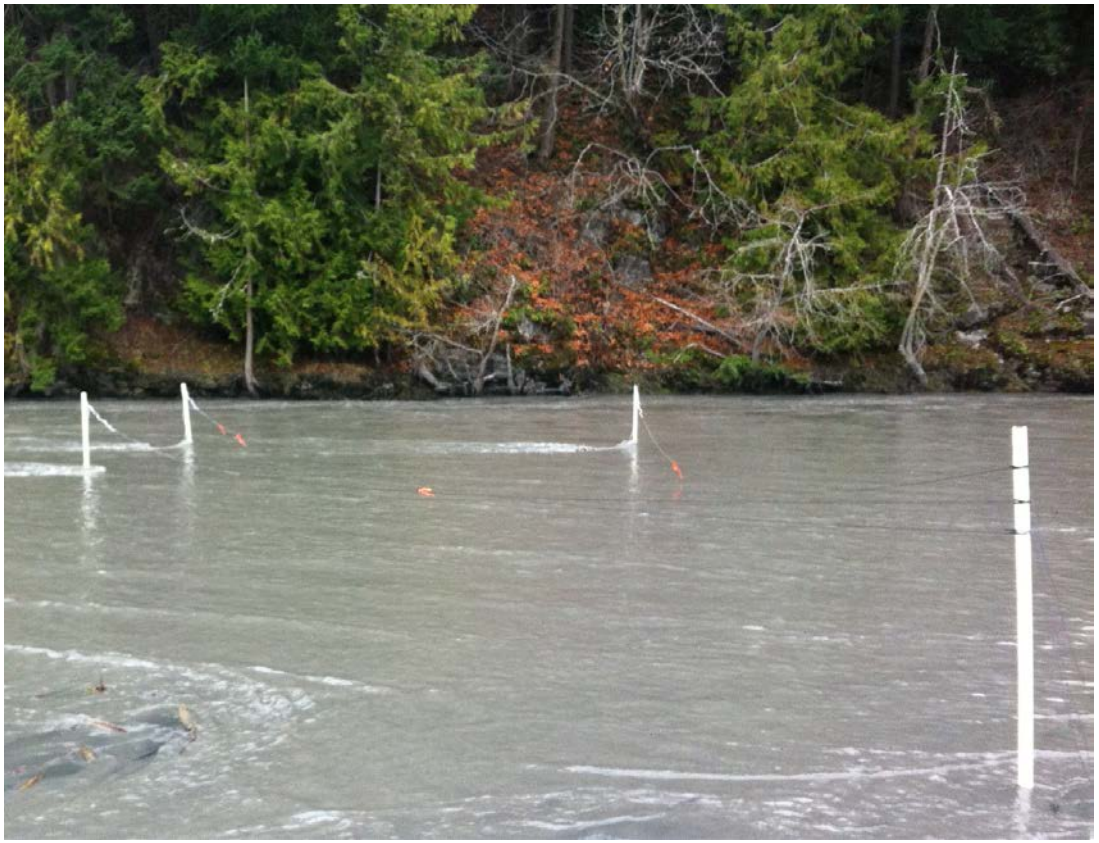


Other ideas:

- Develop method of charging laptop without inverter (generates noise which interferes with data)
- Find new device with substantially longer battery life

Methods for Improvement Deployment

- Current system is only deployable in wade-able environments.
- If time and resources allow, we will investigate other potential deployment methods.



Methods for Improvement of Hydrophones

- Test new hydrophones built for reliability and robustness
  - Facilities at NCPA in place to test hydrophones for sensitivity at frequencies of interest, power requirements, directionality, ease of mounting

- If the hydrophones tested prove unsatisfactory, develop new method of protecting the cable

Hydrophone Operating Parameters

- Frequency response of hydrophones (up to 25 kHz)
  - Determined by computer/data collector requirements
- Determine sensitivity of the hydrophones
  - Calibrated alongside lab-grade Reson hydrophones with known source signal from B&K hydrophone
- Power requirements of the hydrophones

Methods for Improvement for Hydrophones

HIGH TECH INC.

HTI-96-MIN

Specifications

Sensitivity
without preamp:
-201 dB re: 1V/µPa
(8.9 V/Bar)

with preamp:
max– -165 dB re: 1V µPa
(562 V/Bar)
min – -240 dB re: 1V µPa
(0.1 V/Bar)

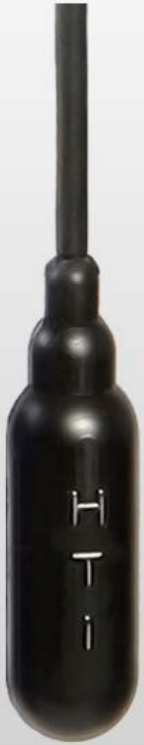
Frequency Response
2 Hz to 30 KHz

Equivalent Input Self Noise
RMS from 1 Hz to 1000 Hz:
78 dB re: 1 µPa
0.08 µBar
Spectral:
54 dB re: 1 µPa/√Hz @ 10 Hz
42 dB re: 1 µPa/√Hz @ 100Hz
42 dB re: 1 µPa/√Hz @ 1000Hz

Preamplifier Type
Current or Voltage mode

Maximum Operating Depth
10,000 feet
3,048 meters

Size 2.50" length X 0.75" dia.



Methods for Improvement Amplifiers

- Current system requires one amp per hydrophone and three connections per amp (one to power)
- Need to reduce size and number of connections, possibly by having electronics expert fabricate one device that will amplify all channels
- Possible that different hydrophones will have built-in amplifiers

Timeline
(July 1, 2014 – June 30, 2015)

Receive funding	Month 0
Design Modifications	Months 1-2
Build Modifications	Months 2-9
Calibrate new system	Month 9
Analyze data, perform additional experiments if needed	Months 10-11
Complete reporting, publish, and/or present results	Months 11-12

Expected Outcome

- The end product of this research will be a more reliable, portable and robust passive acoustic bedload monitoring system usable by non-experts acousticians.