

Northwest National Marine Renewable Energy Center

University of Washington, Seattle, WA 98195

Research Cruise Report

Admiralty Inlet, Washington

November 8-10, 2010

R/V Jack Robertson, University of Washington Applied Physics Lab



Survey Crew

Capt. Andrew Reay-Ellers, University of Washington, Applied Physics Lab

Jim Thomson, University of Washington, Applied Physics Lab (PI)

Brian Polagye, University of Washington, Mechanical Engineering (co-PI)

Joe Talbert, University of Washington, Applied Physics Lab

Joe Graber, University of Washington, Mechanical Engineering

Adam Niblick, University of Washington, Mechanical Engineering

Michael Palodichuk, University of Washington, Mechanical Engineering

Danny Sale, University of Washington, Mechanical Engineering

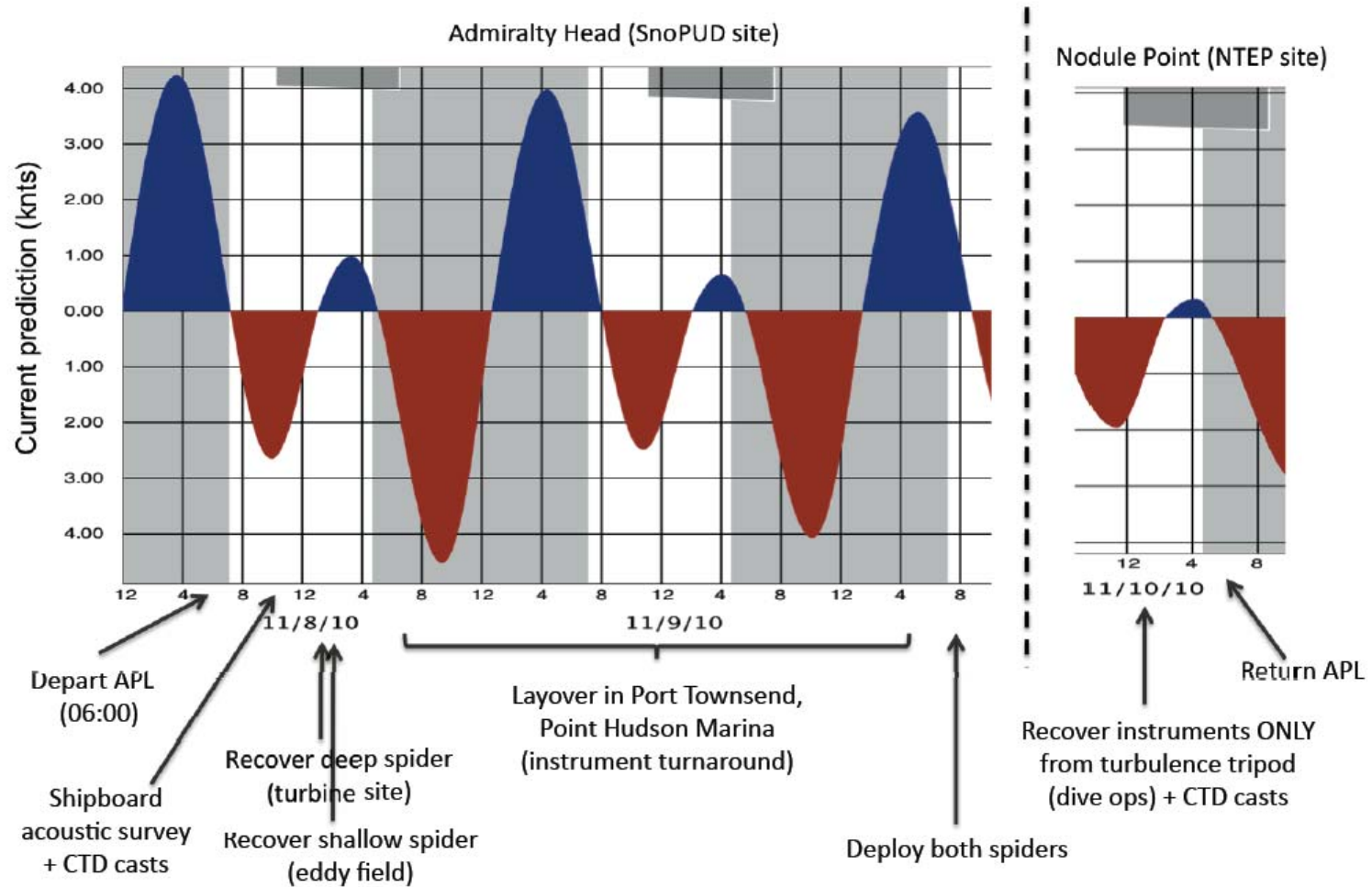
Cruise Summary

From November 8-10, 2010 the R/V Jack Robertson was on station in northern Admiralty Inlet for the retrieval and deployment of instrumentation in support of Snohomish Public Utility District's license application for the deployment of two OpenHydro hydrokinetic turbines. The two Mark II Sea Spiders were recovered without incident on November 8, turned around on November 9, and redeployed on November 10. The primary Sea Spider was redeployed at the approximate location of the proposed pilot project and the secondary Sea Spider was deployed directly under the ferry lane as part of a study to investigate the degree to which harbor porpoises in Admiralty Inlet may be habituated to loud noise. On the afternoon of November 10, 2010, the larger tripod for turbulence measurements was recovered from off Marrowstone Island and brought back to UW-APL.

Cruise Plan

Admiralty Inlet Survey & Turnaround

R/V Robertson, Northwest National Marine Renewable Energy Center (UW)



1 Daily Operations Summary

1.1 November 8, 2010

R/V Jack Robertson departed APL dock at 0600 and transited to Admiralty Inlet. While en route, completed fabrication of a “hairy rope” to suppress vortex induced vibration of hydrophone cables (i.e., “strum”).

Paused off Marrowstone Island at Nodule Point at 0920 for a CTD (conductivity, temperature, and depth) cast to collect evidence in support of the hypothesis that the water column there is well-mixed during periods of strong currents. This information is in support of a turbulence study with Pacific Northwest National Laboratory.

On station near Admiralty Head at 1035 for Sea Spider recovery. Currents at 1.5 – 2.0 m/s. Conducted a CTD cast to assess sound speed profiles while waiting for current speeds to drop.

Began primary Sea Spider recovery at 1050 once currents dropped to 0.5 m/s. Primary Sea Spider (#02) back on deck at 1110. Acoustic release woke up on first attempt, range to release consistent with deployment location (i.e., no tripod movement). Float appeared on surface approximately 10 seconds after acknowledgement of release code.

Began secondary Sea Spider recovery at 1115. Secondary Sea Spider (#03) back on deck at 1130.

Conducted drifting hydrophone test with “hairy rope” faring from 1200 to 1215.

Arrived at Point Hudson Marina (Port Townsend, WA) at 1245.

1.2 November 9, 2010

Layover day in Port Townsend to turn around both Sea Spiders.

Washington Dept. of Ecology technicians turned around the CTDO (conductivity, temperature, depth, and dissolved oxygen) sensor on the primary Sea Spider.

Graber and Sale departed for UW-APL, replaced by Palodichuk and Niblick.

1.3 November 10, 2010

R/V Jack Robertson departed Port Townsend at 0615.

Primary Sea Spider deployed at 0735 in approximately 55 meters of water. Deployment point was within 25m of previous deployment.

Secondary Sea Spider deployed at 0840 in approximately 47 m of water directly beneath ferry lane within 6m of target point.

Successfully ranged on acoustic releases for both Sea Spiders from 0905 to 0940 and then departed area.

Anchored off Nodule Point (Marrowstone Island) for turbulence tripod recovery operations at 1130. Dive operations at 1400 located the tripod (capsized, but not damaged). Messenger line attached for retrieval operation. A second dive at 1440 attached a recovery line to the tripod and the entire structure was recovered to deck by 1530.

Departed Marrowstone Island at 1630 and arrived back at the APL docks around 2000 after delay at the Ballard Locks.

2 Shipboard Surveys

During this cruise, three shipboard surveys were carried out.

A CTD (conductivity, temperature, and depth) cast was conducted off Nodule Point to verify the assumption that the water column is well-mixed during periods of strong currents. This assumption is being used to relate measurements of turbulence by a point instrument (Doppler velocimeter) to similar measurements by a profiling instrument (Doppler profiler) in collaboration with Pacific Northwest National Laboratory.

A CTD cast was conducted in northern Admiralty Inlet off Admiralty Head. This information is helpful to determine site-specific sound speed profiles for ambient noise investigations.

A shipboard drifting hydrophone survey was conducted to test the effectiveness of the “hairy rope” faring at minimizing vortex induced vibration in the hydrophone cable (i.e., “strum”). Chris Bassett, the graduate researcher leading efforts on ambient noise measurements, was not aboard due to his impending PhD qualifying exam (he passed), and is now reviewing the survey results.

3 Sea Spiders

3.1 Instrument status

During this deployment, tripod instrumentation consisted of:

Primary Sea Spider (#02)– deployed in 55m of water

- ADCP (475 kHz Nortek, 1:00 ensembles): velocity
- CTDO (SeaBird 16+): salinity, temperature, pressure, dissolved oxygen (on loan from WA Dept. of Ecology)
- Onset CT: temperature (salinity also recorded, but standard conditions exceed maximum range)
- Fish tag receiver (Vemco VR2W): fish tag detections
- Echolocation hydrophone (Chelonia TPod): analog echolocation hydrophone
- Echolocation hydrophone (Chelonia CPod): digital echolocation hydrophone
- Two hydrophones (Loggerhead, 7 seconds continuous recording every 10 minutes): ambient noise, focus on applying coherence method to remove pseudo-noise from recordings

Secondary Sea Spider (#03) – deployed in 30m of water

- ADCP (600 kHz Nortek, 1:00 ensembles): velocity and wave spectra
- Onset CT: temperature (salinity also recorded, but standard conditions exceed maximum range)
- Fish tag receiver (Vemco VR2W): fish tag detections
- Echolocation hydrophone (Chelonia CPod): digital echolocation hydrophone
- Hydrophones (Loggerhead, 7 seconds continuous recording every 10 minutes): ambient noise

Upon recovery, all instruments were functional and data were offloaded successfully.

3.2 Instrument replacement/reconfiguration

The primary Sea Spider was redeployed at the center of the proposed deployment area for the two OpenHydro turbines and will continue to characterize the biological and physical environment at this location. The secondary Sea Spider was redeployed to the east of Admiralty Head directly under the ferry lane. The intention of this deployment is to assess whether statistically significant gaps occur in harbor

porpoise echolocations after the passage of the passenger ferry (i.e., is the noise from the ferry causing avoidance behavior). This would help regulatory agencies to understand whether the harbor porpoise population in this area has become habituated to loud noise due to its proximity to the ferry lane and shipping traffic.

Primary Sea Spider – deployed in 55m of water

- ADCP (475 kHz Nortek, 1:00 ensembles): velocity (switching to 3 s single pings on January 31st to collect approximately a fortnight of higher resolution velocity data)
- CTDO (SeaBird 16+): salinity, temperature, pressure, dissolved oxygen (on loan from WA Dept. of Ecology)
- Fish tag receiver (Vemco VR2W): fish tag detections
- Echolocation hydrophone (Chelonia TPod): analog echolocation hydrophone
- Echolocation hydrophone (Chelonia CPod): digital echolocation hydrophone
- Two hydrophones (Loggerhead, 7 seconds continuous recording every 10 minutes): ambient noise, focus on applying coherence method to remove pseudo-noise from recordings
- Sediment trap: sediment advected through project area

Secondary Sea Spider – deployed in 47m of water

- ADCP (600 kHz Nortek, 1:00 ensembles): velocity and turbulence (experimental)
- Fish tag receiver (Vemco VR2W): fish tag detections
- Echolocation hydrophone (Chelonia CPod): digital echolocation hydrophone
- Hydrophones (Loggerhead, 7 seconds continuous recording every 10 minutes): ambient noise
- Sediment trap: sediment advected through project area
- PAR (WET Labs): photosynthetically active radiation as a proxy for visible light

3.3 Platform condition

Unlike the previous recovery (August 2010), neither platform was significantly fouled during the deployment, consistent with previous experience during this time of year. Specifically:

Primary Sea Spider – deployed in 55m of water

- A few small shrimp
- Red algae on the head of one hydrophone
- Barnacle growth on composite test panels colonized during May – August 2010 deployment
- Tripod frame and instrument cases generally free of fouling (barnacles, algae, chitin)
- Corrosion noted on several of the stainless (316) fasteners in contact with the delrin cheeks used to mount instruments.
- New “bolt cap” sacrificial zinc anodes were successful in protecting several stainless fasteners.

Secondary Sea Spider – deployed in 30m of water

- No shrimp or red algae
- Moderate barnacle colonization
- Large sea urchin on one of the delrin cheeks.
- Corrosion noted on several of the stainless (316) fasteners in contact with the delrin cheeks used to mount instruments.
- New “bolt cap” sacrificial zinc anodes were successful in protecting several stainless fasteners.

4 Tidal Turbulence Tripod

The Tidal Turbulence Tripod deployed in May was recovered on November 10, 2010. After establishing a 3-point mooring, dive operations were able to locate the tripod, determine it had capsized (probably during the previous recovery attempt in August), and attach a recovery line. The tripod was recovered to the deck and was in generally good condition, with minimal biofouling or corrosion. Instruments had already be removed during May dive ops, thus nothing was damaged when the tripod capsized.

5 Lessons Learned

5.1 Dive Operations

Dive operations to deploy and recover the Tidal Turbulence Tripod off Marrowstone Island have been problematic in currents exceeding 1 m/s (which are relatively low from a tidal energy perspective). Instrumentation was successfully recovered and redeployed in May 2010, but subsequent operations were problematic (e.g., in October 2010, the tripod could not be located during an attempt to deploy additional instrumentation). While the deployment site is well within the range of divers (20m), they could not work effectively in currents greater than 0.5 m/s. Difficulties locating the tripod (via acoustic transponder) were exacerbated by prematurely removing the ground chains used in the initial May 2010 deployment. In spite of the higher costs in terms of equipment, non-recurring engineering, and ship time, acoustic releases for instrumentation deployment and recovery are recommend for future stand-alone instrumentation deployments, regardless of deployment depth if currents are expected to exceed 0.5 m/s.

5.2 Acoustic Releases

The Mark II Sea Spiders (#02 & 03) incorporate acoustic releases which are able to both receive and transmit (i.e., releases can communicate back to deck box on surface). The Mark I Sea Spider (#01) incorporated acoustic releases which were only able to receive commands. During recovery operations this contributed to ambiguity about the state of the tripod. If a release code had been transmitted and a recovery float did not appear on the surface the release might not have received the release code, the release might have received the code but a mechanical problem prevent float release, or the tripod could have been transported by currents out of the project area. This ambiguity contributed to a number of delays in tripod recovery during field operations in 2009 and 2010. The recovery procedure for the Mark II Sea Spiders involves sending a coded pulse to wake up the release (which is acknowledged by the release), a coded pulse to arm the release (which is also acknowledged), and a final pulse to release the float (which is also acknowledged). This allows for much more effective trouble shooting during recovery operations. While “receive-only” releases are less expensive, “transmit and receive” releases are a recommended best practice and less costly over the lifetime of the release (e.g., higher release cost offset by lower vessel costs for recovery).