# AEON Dec 2022/Feb 2023 Cruise Report
# M/V Warren Jr
# 11-14 Dec 2022, 10–15 Feb 2023
# Boston, MA to Boston, MA

Photo credit: Jennifer Miksis-Olds

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**Cruise Summary**

This cruise report covers two separate at-sea efforts in support of the Acoustic and Environmental Observation Network in the NW Atlantic (AEON) in the Gulf of Maine. AEON collects acoustical and environmental data at 5 locations ( 3 in US waters and 2 in Canadian waters) The first effort aboard the MV Warren Jr. took place from 11-14 December 2022. This effort serviced 2 of the 5 project lander sites (Figure 1). Bad weather required the effort to be cut short, and a second effort was undertaken to service the final 3 of 5 ocean landers 10-15 February 2023 (Figure 1). The Dec 2022 effort sailed with Canadian Foreign Vessel Research License 349032 to cover the period 11-21 Dec 2022. The Feb 2023 effort sailed with Canadian Foreign Vessel Research License 349032 to cover the period from Feb 1-March 15, 2023.

The objectives for these two cruise efforts were to recover bottom landers at 5 sites (Table 1), re-deploy 5 landers at the same sites, collect CTD profiles to characterize hydrographic conditions at the sites, conduct net sampling to collect biological specimens at each site, and conduct fine-scale (roughly 5 n.mi by 5 n.mi) multi-frequency acoustic surveys at each site. We were able to successfully recover 2 landers at sites AEON 4 JOB and AEON 5 WIB in Dec 2022. The remaining 3 landers were successfully serviced during the Feb 2023 cruise effort.

AEON site naming conventions were modified during this cruise to provide additional geographical information that a numerical system did not capture (Table 1: NEC=Northeast Channel, ECS=Eastern Coastal Shelf, GEB=Georges Basin, JOB=Jordan Basin, WIB=Wilkinson Basin. All the AEON site number identifiers will be retained, as these site numbers are identified in ONR environmental paperwork and approvals. The 3-letter geographical site information will be added to each site.

| Station | Lat | Long |
|---|---|---|
| AEON1 NEC | 42.30 | -65.98 |
| AEON2 ECS | 42.84 | -66.73 |
| AEON3 GEB | 42.62 | -68.14 |
| AEON4 JOB | 43.81 | -67.68 |
| AEON5 WIB | 42.87 | -70.06 |

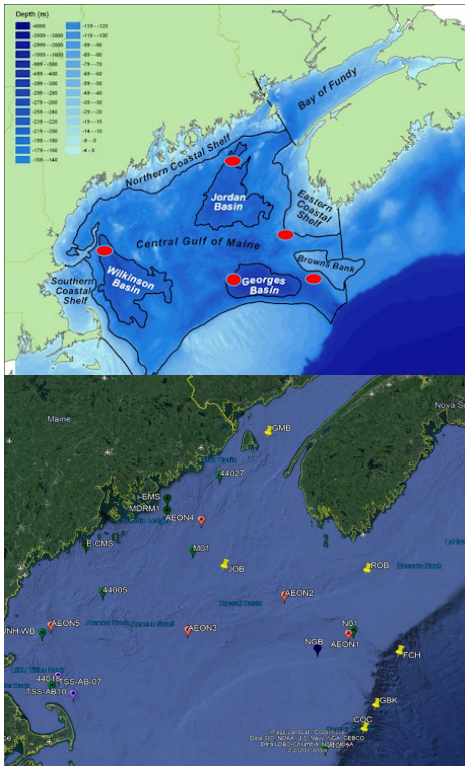


*Figure 1. AEON lander locations. Image in the top right shows the AEON locations in reference to local basins and bathymetry. Image in the bottom right shows AEON locations in relation to other sampling platforms that do not include acoustics.*

*Table 1. Summary of sampling that occurred at each site location during the AEON Dec 2022/Feb 2023 research cruises*.

| Site | Lander Recovered | Lander Deployed | CTD casts | Ring net tows | Fine-Scale Acoustic Survey |
|---|---|---|---|---|---|
| AEON 1 | Yes | Yes | 1 | 1 | Yes- complete |
| AEON 2 | Yes | Yes | 1 | 1 | No |
| AEON 3 | Yes | Yes | 1 | 1 | Yes- complete |
| AEON 4 | Yes | Yes | 1 | 1 | Yes- complete |
| AEON 5 | Yes | Yes | 1 | 1 | Yes- complete |

**Ocean Bottom Landers**

At all five sites, landers were successfully recovered, serviced, and re-deployed. Lander deployment was performed via the A-frame, winch and quick release. The lander was lifted and suspended over the aft of the vessel and then lowered into the water. Once the lander was fully submerged, the quick release was triggered, and the lander dropped. For each station, range measurements to the acoustic releases were taken at the four cardinal points around the lander approximately 500 m from the deployment site to calculate a more precise lander position on the seafloor. As the M/V Warren Jr's depth sounder was not accurate beyond 100 m, the depth was also calculated from these range measurements, therefore there is likely error in the depth estimates in Table 2. The deployed landers required minimal equipment refurbishment, with the exception of three VEMCO receivers, one SeaBird CTD, and an Apollo beacon. These were refurbished in the field (cleaned, inspected, data downloaded, batteries replaced) and redeployed.

*Table 2. Table: Lander deployment locations, depth and estimated bottom locations*

| Site | | Deployment Location | | Estimated Location | | Estimated Depth (m) | Drop Date | Time (UTC) |
|---|---|---|---|---|---|---|---|---|
| | Notation | Latitude N | Longitude W | Latitude | Longitude | | | |
| AEON1 | Decimal degrees | 42.303667 | -65.9881 | 42.303267 | -65.9875 | 243 | 2023-Feb 13 | 00:19 |
| | Degrees decimal minutes | 42° 18.220’ | 65° 59.286’ | 42° 18.196’ | 065° 59.250’ | | | |
| | Degrees minutes seconds | 42° 18' 13.2" | 65° 59' 17.16" | 42° 18' 11.76" | 65° 59' 15" | | | |
| AEON2 | Decimal degrees | 42.840867 | -66.7313 | 42.840617 | -66.731033 | 235 | 2023-Feb 13 | 12:11 |
| | Degrees decimal minutes | 42° 50.452 | 66° 43.878 | 42° 50.437’ | 066° 43.862’ | | | |
| | Degrees minutes seconds | 42° 50' 27.12" | 66° 43' 52.68" | 42° 50' 26.22" | 66° 43' 51.72" | | | |
| AEON3 | Decimal degrees | 42.621367 | -68.143467 | 42.621217 | -68.143733 | 186 | 2023-Feb-13 | 19:28 |
| | Degrees decimal minutes | 42° 37.282 | 68° 08.608 | 42° 37.273’ | 068° 08.624’ | | | |
| | Degrees minutes seconds | 42° 37' 16.92" | 68° 08' 36.48" | 42° 37' 16.38" | 68° 8' 37.44" | | | |
| AEON4 | Decimal degrees | 43.806267 | -67.680117 | 43.806167 | -67.6803 | 237.8 | 2022-Dec-12 | 15:32 |
| | Degrees decimal minutes | 43° 48.376’ | 67° 40.807’ | 43° 48.370’ | 067° 40.818’ | | | |
| | Degrees minutes seconds | 43° 48' 22.56” | 67° 40' 48.42" | 43° 48' 22.2" | 67° 40' 49.08" | | | |
| AEON5 | Decimal degrees | 42.866367 | -70.0636 | 42.866367 | -70.063383 | 159.9 | 2022-Dec-11 | 14:57 |
| | Degrees decimal minutes | 42° 51.982’ | 70° 3.816’ | 42° 51.982’ | 070° 03.803’ | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Degrees minutes seconds | 42° 51' 58.92" | 70° 3' 48.96" | 42° 51' 58.92" | 70° 3' 48.18" | | | |

During recovery, upon arrival to each station, the lander was first communicated with via the acoustic releases and range was established. If the range was acceptable, the landers were released from the anchor. Once the lander was spotted on the surface, the vessel approached the lander from the aft and was hooked via a snap hook line that led into the A-frame and to the winch. Once this connection was made, snap hooks tied to taglines were also secured to the uprights on the lander to assist in controlling the lander as it was retrieved. The lander was then brought on board over the open aft through the A-frame and secured for transit.

At AEON1/NEC, the planned early morning window for retrieval was delayed due to the sudden change in weather conditions. Later in the afternoon, after winds and sea state decreased, a retrieval attempt was given the all clear. Both release codes were transmitted to the lander at 20:47 UTC on Feb 13, and the releases confirmed function. The lander did not surface, and upon returning to the release site coordinates it was determined that the lander was stuck in location at depth. At 23:30 UTC Feb 13, 2.5 hours after the release codes were sent, the lander beacon was spotted from the bridge and retrieval operations resumed. The lander recovery at all other locations surfaced within the expected time window. *Note: The deployment of AEON1/NEC was slightly further north than anticipated due to the strong currents and wind during deployment that pushed the vessel faster than expected during deployment.

**Net Sampling**

A 50 cm diameter (333 micron mesh) ring net was used to sample the zooplankton populations at all of the AEON sites (Figure 3, Table 1). A vertical haul from 100 m depth was conducted although wind and currents resulted in typical wire-angles of ~ 30-45° during the haul so the max depth sampled was likely less than 100 m. Samples were preserved on deck in a buffered seawater formalin solution and will be analyzed (identification and enumeration of taxa) post-cruise. The dominant organism in all samples were copepods (various species), although chaetognaths, ctenophores, and krill were also present in some samples.

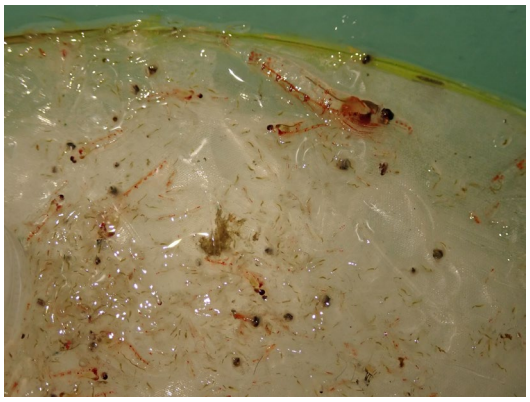

*Figure 3. Krill, gelatinous zooplankton, and copepods were all abundant in the cast at site AEON1/NEC (left). Net processing was challenging due to a lack of a seawater hose and a very wet and cold deck during the transfer and preservation of samples (right).*

**CTD Sampling**

A SeaBird 19+ CTD was deployed to a depth of 100 m at each station (Table 1), although similarly to the ring net wind and currents often resulted in a 30$^{o}$ wire angle on the deployment. Maximum depths sampled varied between 50 and 85 m as a result of this. Both the CTD and ring net were deployed with a 35 lb clump weight to try to ensure that the instruments would be pulled straight down. However, the trawl line used on the vessel was very thick (probably 1" in diameter) which resulted in significant in-water drag during the deployments.

**Fine-Scale Acoustic Survey**

The fishery echosounder transducer sled was attached to a pole mount ("track-pole") on the port side, midship of the vessel. The pole was raised out of the water during transits and lowered when acoustic surveys were conducted. The depth of the transducers was approximately 2 m. The transducer sled was equipped with a 38 kHz (split-beam, broadband), 120 kHz (split-beam, broadband), and 200 kHz (single-beam, broadband) transducers with EK80 wideband transceivers. A GPS puck was run through a mousehole on a conex shipping container on deck, and the echosounders and data recording computers were set up inside the van (Figure 4). Upon system power-up, it was discovered that the 120 kHz transducer was not working properly as it had significantly high noise levels. The cause of this issue was not able to be determined during the cruise. While data at 120 kHz was collected during the trip, we do not think it will be useful for analysis.

The Fine Scale Acoustic Survey (FSAS) consisted of 5 parallel transect lines each 5 n.mi. long, however due to time or weather constraints sometimes not all lines were fully completed. Survey speeds were ~ 4 kts, and the sea state was generally good throughout the survey (waves 1-2 ft), although conditions worsened during the course of some FSASs.

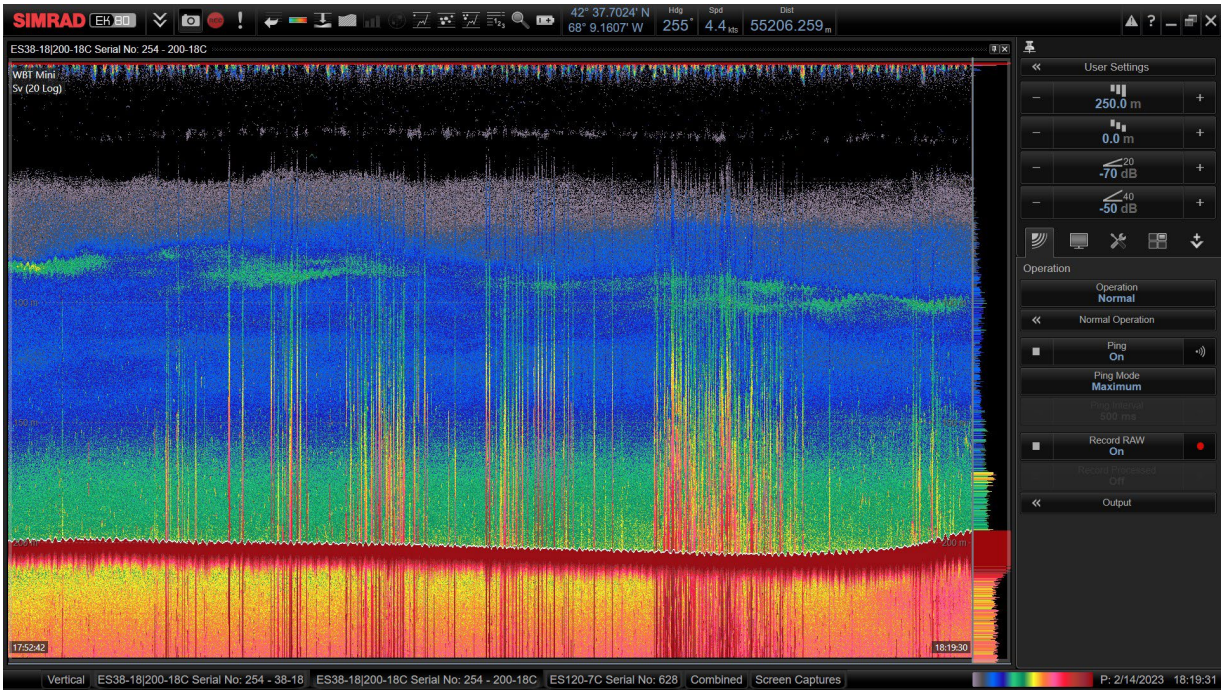


*Figure 4. Screenshot of the 200 kHz echogram during the fine-scale acoustic survey conducted on 14 February 2023 at the AEON3/GEB (Georges Basin) site. An intermittent scattering layer (green streak) can be seen at a depth of ~ 125 m in the water column. Surface noise (from bubble/waves) and engine noise (red streaks rising up vertically from the bottom of the echogram) can also be observed.*