

CRUISE RESULTS

NOAA Fisheries Research Vessel DELAWARE II
Cruise DE 11-08 (Parts I - III)

Atlantic Herring Acoustic Survey

CRUISE PERIOD AND AREA

Cruise operations were conducted on the continental shelf (depths to 350 m) in the Gulf of Maine and northern Georges Bank regions, including the Canadian Exclusive Economic Zone on eastern Georges Bank. The 2011 Fall Atlantic Herring Acoustic Survey was conducted during three parts between 7 September and 14 October 2011 (Figures 1-3). Part I of the survey (7-16 September) was dedicated to calibrating the scientific echo sounders on the *FSV Delaware II*, collecting acoustic and optical data with the Advanced Fisheries Tow Vehicle (AFTV), and conducting a collaborative experiment on Atlantic herring in the Georges Bank region. The annual systematic acoustic and biological survey of Atlantic herring was conducted in the Georges Bank region during Part II (19-30 September) and into Part III. Part III of the cruise (3-14 October) was dedicated to completing the herring survey, a fine-scale acoustic survey and experimental acoustic and optical measurements in the Georges Bank region as well as a systematic survey of Atlantic herring in the Jeffrey's Ledge, Platts Bank, Fippennies and Cashes Ledge areas. A net comparison test was also conducted during Part III of the cruise. This study compared the fishing efficiency of the older Irish Herring Midwater Trawl (IHMT) to the newer Polytron Midwater Trawl (PMRT).

OBJECTIVES

The Northeast Fisheries Science Center (NEFSC) conducts annual Atlantic Herring acoustic surveys each autumn on the historical spawning grounds of Atlantic herring (*Clupea harengus*) in the Georges Bank and Gulf of Maine regions. The main goal of this cruise was to provide timely and accurate fisheries-independent estimates of herring spawning stock biomass using state-of-the-art technologies. Operational objectives were to (1) calibrate the EK60 Scientific Sounder, (2) conduct a collaborative experiment with the *R/V Oceanus* (scientists from WHOI and NRL), (3) collect acoustic (DIDSON and EK60) and optical data with the Advanced Fisheries Tow Vehicle (AFTV), (4) conduct *in situ* target strength measurements with the EK60, (5) conduct acoustic surveys of selected Atlantic herring spawning stocks, (6) collect biological data to verify species-specific acoustic measurements using midwater trawls and underwater video, (7) collect marine mammal and bird observations, and (8) implement new electronic fish measuring board.

METHODS

Calibrations and Ambient Noise Tests of the EK60: Calibrations are required during each survey to ensure data quality and verify echo sounder performance. The EK60 was calibrated by suspending standard calibration spheres of known target strength under each transducer from three monofilament lines. A calibration sphere was centered in the far field of each transducer and moved throughout the acoustic beam beneath the vessel using remotely controlled downriggers. The 18-, 38-, and 120-kHz split-beam transducers were calibrated in Cape Cod Bay. Noise tests of the EK60 were conducted dockside and while the vessel was underway at 10 knots (survey speed).

Simrad EK60 Scientific Sounder: The Simrad EK60 Scientific Sounder was the primary sampling gear used during the acoustic surveys for providing species-specific abundance estimates. The EK60 operated three hull-mounted transducers (18-, 38-, and 120-kHz split-beam transducers). The EK60 was interfaced via TCP/IP Ethernet to the *FSV Delaware's* SCS server for data logging. RS232 connections were used for navigational (Differential GPS) input. The SCS Event Log was used to record all operational events (e.g., begin and end points of transects, stations, gear deployments, and other events that affect the track cruise and vessel speed) during the cruise.

Advanced Fisheries Towed Vehicle (AFTV): The AFTV is designed to deploy integrated acoustical, optical, and environmental sensors for verifying acoustic backscatter from the water column and seafloor. The AFTV is deployed using a portable fiber optic winch system equipped with 2000 m of 0.322 cable, and has an overall weight of about 5,000 lb. The cable has three single mode fiber optic and three copper conductors, and has an 11,000 lb/ft breaking strength rating. The AFTV towbody weighs about 900 lb and is approximately 7 ft in length. The AFTV also has a 100 lb counter weight arranged about 20 m in front of the towbody to dampen the vessel motion for maintaining the horizontal stability of the towbody. This requires a two point deployment approach using the vessel's A-frame and articulating crane on the aft deck. The AFTV is configured with an EK60 38 kHz, CTD, motion sensor, DIDSON sonar, and various underwater cameras and lighting. The AFTV was towed intermittently at relatively slow speeds (1-3 knots) above the seafloor and throughout the water column to collect *in situ* target strength data and verify acoustic backscatter.

Dual-frequency IDentification SONar (DIDSON). A DIDSON sonar was installed on the AFTV throughout all three legs of the cruise. The DIDSON uses acoustic lens technology to collect very high resolution acoustic data. Using the DIDSON, individual fish and their behavior can be monitored out to approximately 20 meters from the towbody. The DIDSON was located in the forward portion of the AFTV and was mounted on a Sidus pan and tilt assembly to allow for a variety of viewing angles.

Acoustic Survey Operations: EK60 data were collected continuously throughout the cruise. During the surveys, a constant ship speed of 10 ± 1 knots was maintained. Vessel speed was reduced to no less than 8 knots during rough seas. EK60 operations were generally suspended when seas exceeded 2 m. Each transect was assigned a sequential number throughout the cruise. A transect was defined as a portion of the cruise track

with a constant heading and ship speed. All scientific gear deployments were also assigned a unique, sequential deployment number.

EK60 Target Strength Measurements: Target strength measurements with the hull-mounted EK60 split-beam transducers and with the AFTV-mounted 38-kHz EK60 split-beam transducer (ES38-DD) were collected on selected fish aggregations. The vessel was positioned over aggregations, and the towbody was deployed from the vessel's aft A-frame. The AFTV would then be towed behind the vessel for between 1 to 2 hours at about 2 knots while collecting video and acoustic data.

Myriax Echoview Post-processor: Echoview (Myriax Ltd.) software v. 4.7. was used for data acquisition and post-processing of EK60 data during the cruise. Echoview was used to conduct preliminary post-processing of EK60 data at sea, which involved removing extraneous bottom echoes and/or water column noise. Echoview was also used to partition acoustic backscatter to Atlantic herring. EK60 data and Echoview files were logged and archived directly to the SCS system via a TCP/IP Ethernet connection. Three computers were set up for the acoustic data. One computer was used for EK60 data acquisition. This computer was located in the SCS room and was part of the SCS system. The other two computers were set up in the dry lab, with one computer used for post-processing and the other used for viewing data in real time.

Polytron Midwater Trawl (PMRT): The PMRT midwater trawl was recently purchased to replace the older Irish Herring Midwater Trawl (IHMT) that has been in use on previous surveys. The PMRT is a hybrid design, and incorporates features from both the High Speed Midwater Trawl (HSMRT) and the Irish Herring Midwater Trawl (IHMT) that have been in use for the past 10 to 12 years. The PMRT was designed to be fished at speeds of about 4 knots. The PMRT was deployed during survey operations, and targeted on acoustic backscatter. The PMRT was towed at about 4 knots, depending on trawl performance and water currents. The duration and depth of the trawls were not standardized, and the Chief Scientist or Watch Chief communicated with the bridge officers as to the haul duration and depths. The Simrad FS70 trawl sonar was deployed with every trawl. Officers recorded the time, date, navigational, and station data in the ship's Scientific Computer System (SCS) for each trawl. This data was then pulled into the Fisheries Scientific Computer System (FSCS). The scientists recorded the catch and ITI data for each station deployment using the FSCS on-board entry system. The PMRT was the primary biological sampling tool used during the three legs of the Herring survey.

Irish Herring Midwater Trawl (IHMT): The IMHT midwater trawl was used as a backup net to collect biological samples and verify species composition of acoustic backscatter for the first two legs, and then as the primary net for the 3rd leg. The IMHT was designed to be fished at speeds of about 4 knots. The IMHT was deployed during survey operations, and targeted on acoustic backscatter. The IMHT was towed at about 4 knots, depending on trawl performance and water currents. The duration and depth of the trawls were not standardized, and the Chief Scientist or Watch Chief communicated with the bridge officers as to the haul duration and depths. The Simrad FS70 was deployed with

every haul. Officers recorded the time, date, navigational, and station data in FSCS, while the scientists recorded the catch and ITI data for each station deployment. Catch data was recorded using the FSCS on-board entry system.

Simrad FS70 Trawl Monitoring and Third-wire Winch System: The trawl was monitored during fishing operations using the FS70 trawl sonar. The Simrad FS70 Trawl Monitoring System was newly installed on the *FSV Delaware II* for this survey. The FS70 third wire trawl sonar replaced the older FS903 trawl monitoring system. The FS70 is a third-wire device that provides real-time trawl performance information through its sonar images of the trawl opening. The scientific party recorded FS70 measurements on hardcopy forms at specified intervals during each deployment. The FS70 data was also recorded to the system's computer hard drive for archiving purposes.

Scientific Computer System (SCS) and Fisheries Scientific Computer System (FSCS): The SCS system is a PC-based server, which continuously collects and distributes scientific data from various navigational, oceanographic, meteorological, and sampling sensors throughout the cruise. The SCS Event Log program was configured for NEFSC Fisheries Acoustic Survey operations, and was used by the scientists to document all operational events (*e.g.*, begin and end of transects and deployments). Dates and times were synchronized using the vessel's GPS master clock and Dimension IV software. The FSCS system was used for on-board data logging of the biological and catch data.

Conductivity-Temperature-Depth (CTD) Profiler: A Seabird CTD profiler was deployed at the beginning and ending of each transect, and at the beginning of each scientific gear deployment to define the hydrographic conditions in the study area. Water bottle casts were also deployed twice per day to collect salinity samples.

Vemco Minilog Probes: Temperature-depth probes (set at a 2 sec sampling rate) were attached to the midwater trawl headrope and footrope during trawl hauls.

Biological Sampling: Trawl catches were sorted by species, weighed and measured (to the nearest cm FL) according to standard NEFSC procedures. For Atlantic herring, subsamples were taken for each trawl haul for detailed lengths (FL in mm), individual weights (to nearest 0.1 g), sex/maturity staging, and otolith samples (freeze herring whole). Subsampling protocol was 1 fish per centimeter length class for herring less than 25 cm and 3 fish per centimeter length class for herring 25 cm and longer. The FSCS system was used for on-board entry and auditing of trawl station and biological data. Biological data were transferred to the NEFSC for auditing.

RESULTS

Part I

Part I was dedicated to calibrating the hull-mounted EK60 transducers, collecting data with the Advanced Fisheries Tow Vehicle (AFTV), and conducting a collaborative experiment with scientists from the Woods Hole Oceanographic Institution (WHOI) and

the Naval Research Laboratory (NRL). The AFTV was loaded on the *Delaware II*, and initial testing, trouble shooting, and evaluation was completed on the 8th of September. The *Delaware II* departed the Fisheries dock on Sept. 8th, and headed to Cape Cod Bay to calibrate the EK60. A test deployment of the AFTV was conducted on 8 September to educate new deck crew members on the intricacies of deploying and retrieving the AFTV. The 18-, 38-, and 120-kHz EK60 echo sounders were successfully calibrated in Cape Cod Bay on 8 September. S_v and TS gain setting changes were within tolerance levels ($\pm .25$ dB). A CTD profile was collected at the calibration site. The calibration site was located about five miles southwest of Provincetown, MA. After the calibrations were completed, the vessel steamed to Jeffreys Ledge to begin a systematic survey of herring in this area. Numerous trawls, CTDs, and AFTV deployments were conducted in this area. On 11 September, the *Delaware II* proceeded to the Franklin Swell area to begin the experiment on Atlantic Herring with WHOI scientists. We conducted joint operations with the *R/V Oceanus* on the northern edge of Franklin Swell (Fig. 1). The WHOI scientists were using a broadband echo sounder and the NRL were using a long-range (out to approximately 10 km radius) sonar system. The *FSV Delaware II* collected EK60 data and biological data. At the conclusion of the experiment, the *FSV Delaware II* steamed back to Woods Hole and arrived the morning of Sept. 16.

During this portion of the cruise 104 deployments (6 AFTV, 65 CTD profiles, and 32 trawl deployments) and 51 transects were completed.

Part II

The goal of Part II was to conduct the annual systematic acoustic survey of Atlantic herring along the northern edge of Georges Bank and southern Gulf of Maine. Survey operations included EK60 acoustic data acquisition, midwater trawl hauls, CTD profiles, and AFTV deployments. The vessel departed Woods Hole on Sept. 20 and steamed to the northeast peak of Georges Bank. The vessel arrived on station on Sept. 21 and commenced the survey (Fig. 2). The survey consisted of parallel transects oriented north-south with 8 nmi spacing between transects. Survey speed was consistently 10 ± 1 knots. CTD profiles were completed at the beginning and end of each transect and immediately prior to or immediately after each trawl haul. Trawl location were selected on an *ad hoc* basis to sample the acoustic backscatter.

This portion of the survey was completed on Sept. 30, with a total of 37 trawls, 67 CTD profiles, 3 AFTV deployments, and 37 transects (parallel and crossover) completed.

Part III

The first portion of Part III was dedicated to completing the herring survey (Fig. 3). The *Delaware II* departed Woods Hole on October 4th and steamed to Georges Bank to resume transects that were not completed during Leg 2 of the survey. All Leg 2 transects were completed on October 7th. The second portion of Part III was dedicated to conducting a net comparison study between the newer Polytron Midwater Trawl (PMRT) and the Irish Midwater Trawl (IHMT). Testing commenced on the morning of October 7th. A total of six trawls (three during the day and three at night) were conducted using

the PMRT net. Once the six trawls were completed, the *Delaware II* deck crew removed the PMRT net, and installed the older IHMT net. Again, six trawls were performed using the IHMT net (three trawls during the day and three trawls at night). The net comparison study was completed on October 9th. The Irish Midwater Trawl (IHMT) remained on the net drum for the remainder of the cruise and was used on all subsequent trawls. The remainder of Part III of the Herring Acoustic Survey was dedicated to systematic parallel transects along the Fippennies and Cashes Ledges as well as parallel transects along Jeffreys Ledge.

Part III was completed on October 14th, with a total of 26 IHMT trawls, 15 PMRT trawls, 62 CTD profiles, 4 AFTV deployments, and 20 transects.

DISPOSITION OF DATA

Data and results were archived at the Northeast Fisheries Science Center (NEFSC). Data and results are available on CD-ROM or other media. Cruise reports and results are also available at the NEFSC website:

<http://www.nefsc.noaa.gov/femad/ecosurvey/acoustics/>

SCIENTIFIC PERSONNEL

National Marine Fisheries Service, NEFSC, Woods Hole, MA

Michael Jech (Chief Scientist – Parts I and II)	Research Fishery Biologist	Parts I, II, III
Joseph Godlewski (Chief Scientist – Part III)	Electronics Engineer	Parts I, III
Robert Alexander	Gear Specialist	Part I
Anthony Wood	Research Fishery Biologist	Part I
Robert Johnston	Research Fishery Biologist	Part II
Mark Wuenschel	Research Fishery Biologist	Part II
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Francine Stroman	Fisheries Biologist	Parts I, II, III
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Volunteers

Phillip Schuler		Part I
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Elizabeth Council		Part II

Part I: 7 – 16 September 2011

Part II: 19 – 30 September 2011

Part III: 3 - 14 October 2011

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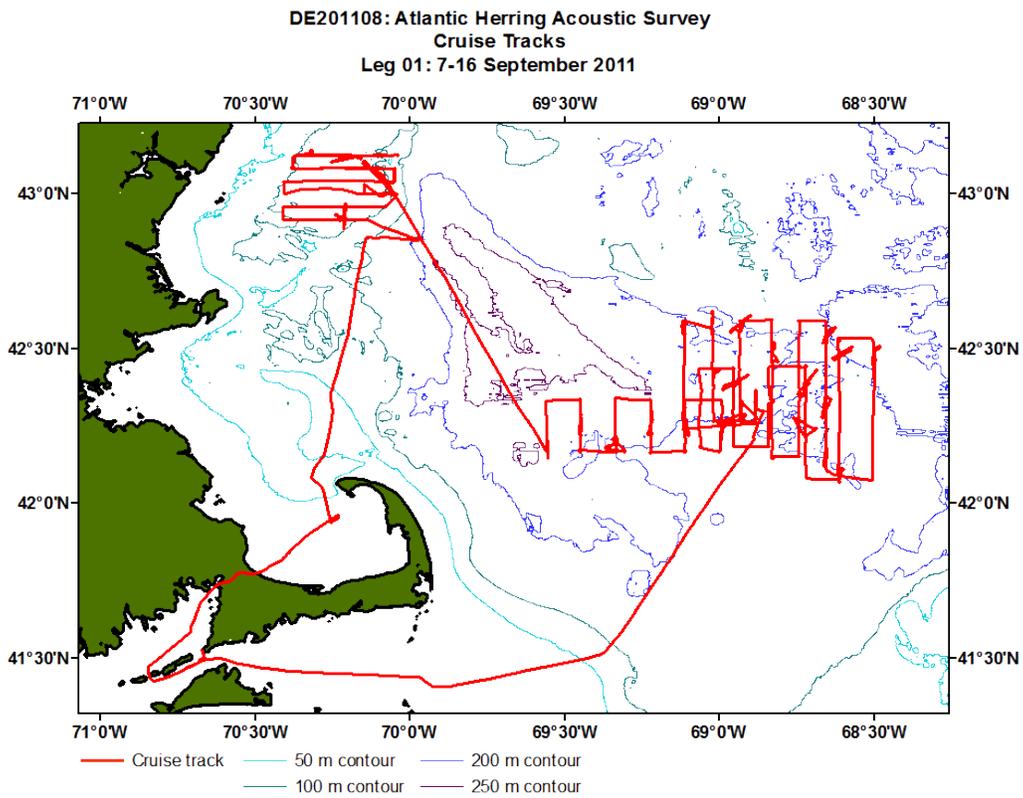


Figure 1. Part I (September 7-16, 2011) area of operations and cruise track for DE201108, Atlantic Herring Acoustic Survey.

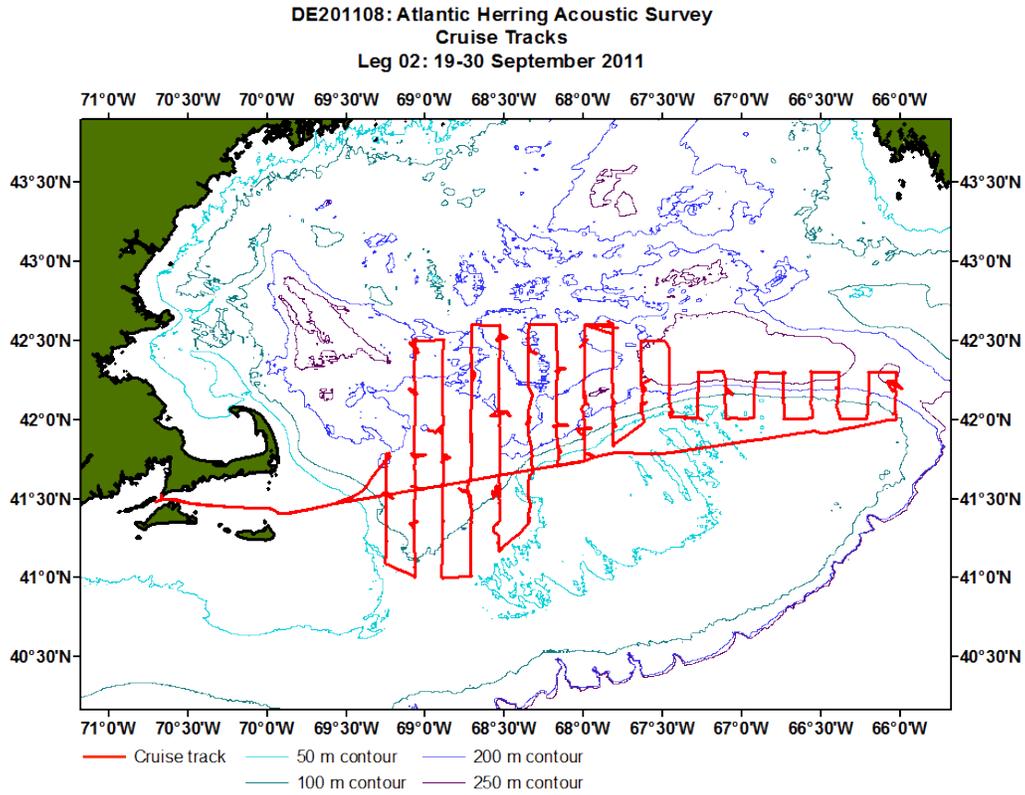


Figure 2. Part II (September 19-30, 2011) area of operations and cruise track for DE201108, Atlantic Herring Acoustic Survey.

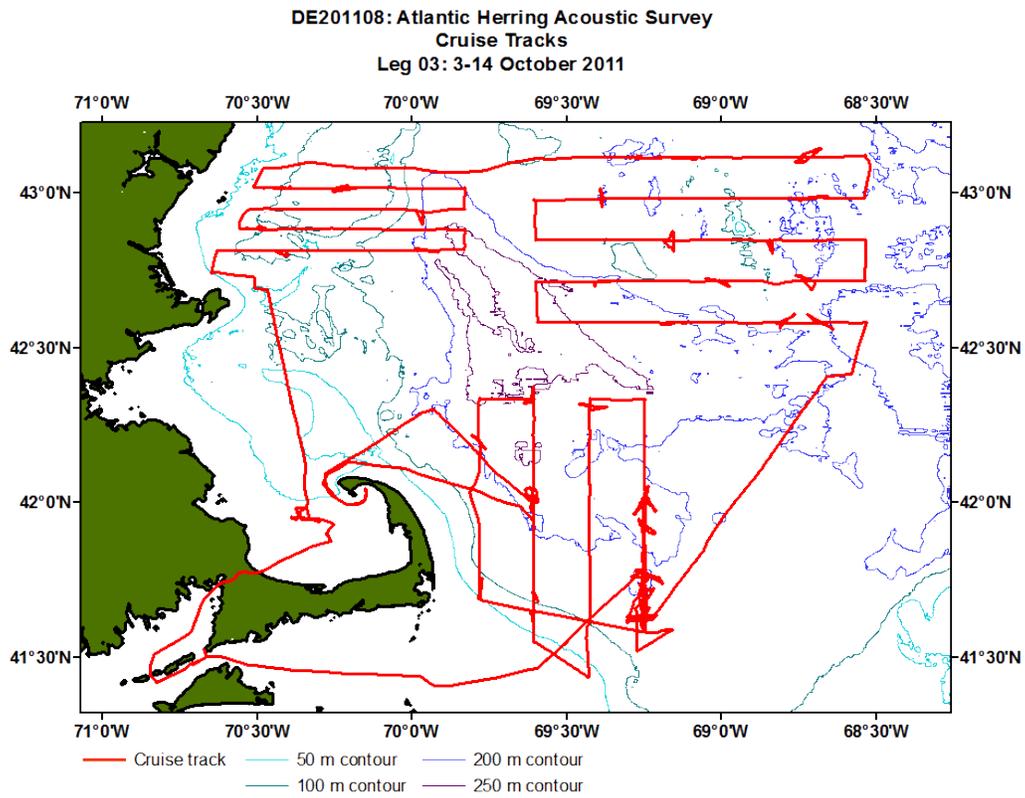


Figure 3. Part III (October 3-14, 2011) area of operations and cruise track for DE201108, Atlantic Herring Acoustic Survey.