U.S. Department of Commerce
National Oceanic and Atmospheric Administration

NOAA Ship *Henry B. Bigelow*

A New Fisheries Survey Vessel

Introduction

National Oceanic and Atmospheric Administration (NOAA) ship *Henry B. Bigelow* is the second of four new fisheries survey ships to be built by NOAA, representing a significant achievement in NOAA's efforts to modernize its fleet of fisheries, oceanographic, and hydrographic survey ships. This 40-day endurance ship has been designed and built to modern commercial construction and safety standards by VT Halter Marine, Inc. under contract to NOAA. *Henry B. Bigelow* and her sister ships comply with all U.S. Coast Guard and American Bureau of Shipping criteria.

The ship is named after Henry Bryant Bigelow (1879-1967), a Harvard-educated zoologist whose work helped lay the scholarly foundation for oceanography as a scientific discipline. He was an internationally known expert on the Gulf of Maine and its sea life, and on the world's jellyfish, corals, and fishes. He served on the Harvard faculty for 62 years, published more than 100 scientific papers (many of them seminal works), and was the first director of the Woods Hole Oceanographic Institution. Bigelow's methods of interdisciplinary study and his goal of understanding the ocean as a whole are still fresh, dynamic, and stimulating our contemporary ecosystems-based approach to marine science.

Henry B. Bigelow

NOAA ship *Henry B. Bigelow* will support NOAA's mission to protect, restore, and manage the use of living marine, coastal, and ocean resources through ecosystem-based management. Its primary objective will be to study, monitor, and collect data on a wide range of sea life and ocean conditions, primarily in U.S. waters from Maine to North Carolina. The region includes Georges Bank, one of the world's best known and most productive marine areas. The region is also home to the nation's top-valued port, oldest commercial fisheries, and rare large whales and sea turtles. Data are used by a range of scientists who study variation in ocean conditions and sea life in order to better inform the nation's decisions about both using and sustaining the ocean's bounty. *Henry B. Bigelow* will also observe weather, sea state, and other environmental conditions, conduct habitat assessments, and survey marine mammal and marine bird populations.

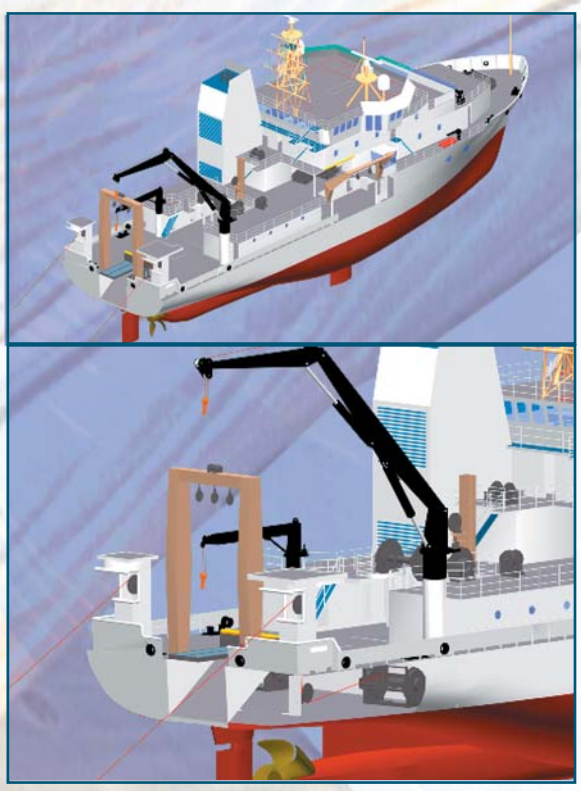
Henry B. Bigelow is a state-of-the-art research ship with multiple science mission capabilities. Foremost among these capabilities is the ship's "quiet" hull, a design feature that minimizes sound made by the ship underwater. This allows scientists to use hydroacoustic methods for surveying marine life, and significantly reduces changes in the natural behavior of animals owing to the ship noise. In addition, the vessel can collect a variety of oceanographic data while marine life surveys are underway, resulting in both richer and more efficiently collected data.

Mission Systems

Henry B. Bigelow has been designed for a wide range of fisheries research, with capabilities for midwater trawling, bottom trawling, hydroacoustic surveys, and oceanographic and hydrographic operations. In addition, capabilities are included for handling specialized gear such as MOCNESS frames, floating and moored buoys, towed vehicles, dredges, and bottom corers. All fluid system discharges are on the port side of the ship to avoid contamination of sampling devices deployed from the starboard side. Marine mammal and bird observation stations are included to track and identify protected species such as North Atlantic right whales, humpback whales, and harbor porpoises.

An integrated bridge system with dynamic positioning capability ensures trackline, course, speed, and heading are maintained during scientific evolutions. The engine room is designed for unmanned operations. Centralized controls for fishing systems, ship speed, and maneuvering are provided at the Aft Control Station (ACS) on the bridge. Speed and maneuvering controls are also located at the main bridge console and at the two bridge wings. In addition, local controls are provided for each winch and lifting device. The ACS is located to give the vessel operators maximum visibility of the working deck. A closed-circuit TV system is included for visibility of below-deck winches and selected areas of the deck. Virtually all instrumentation onboard is connected to an integrated instrument monitoring and data logging system. A centerboard (drop keel) is provided so that critical scientific transducers can be lowered away from the ship out of the region of hull-generated flow noise.

Most of the main deck is reserved for mission functions. The aft working deck has open space for fishing, oceanographic, and other over-the-side operations, with an additional deck space at the starboard side sampling station for fishing and hydrographic work. Space and support connections are provided for a laboratory van on the aft working deck. Laboratories and the working deck are designed to efficiently process scientific samples in a protected environment out of the weather and are easily reconfigurable to accommodate the varied needs of individual scientific cruises.



Fishing Operations

Henry B. Bigelow is capable of trawling in water depths up to 1,000 fathoms. A split drum net reel is located over the forward end of the trawlway, which can stow two nets, either of which quickly can be put into service. Many of the features common to modern commercial fishing vessels, such as Gilson and outhaul winches and a net sonde winch, are included in the design. Each of the two trawl winches can deploy 4,000 meters (13,120 ft) of 28.5 mm (1 1/8 in) diameter trawl warp. Each winch can generate up to 35 metric tons of line pull. Smaller sampling nets and towed fishing gear can be deployed over the stern, over the side of the working deck, or from the starboard side-sampling station. Longlining and other types of fishing are also possible.

Two extendible boom cranes, one articulated and one telescoping, service the working deck. The articulated boom provides additional operating flexibility to the ship. Each crane can lift a maximum of 3,636 kg (8,000 lb) and can be used to lift the cod end of the trawl net to dump the net onto the sorting table. Once on board, the catch is brought into the fish laboratory for sorting, weighing, length measurements, and sex and age characterization for selected samples.

The shape of the trawl net is monitored during fishing operations.

Wireless and hardwired systems are used to monitor the shape of the trawl net during fishing operations. These systems work in conjunction with an autotrawl system that sets trawl depth and trawl wire tension, and permits adjustments to the net configuration. Inertial Reference System and Global Positioning System receivers provide information to scientific sensors and navigation systems to plot the position of the ship with a high degree of accuracy.

Modern fisheries management relies heavily on sonar systems. The most critical such system on *Henry B. Bigelow* is the Scientific Sonar System, which can accurately measure the biomass of fish in the survey area. The Scientific Sonar System is the primary survey tool for selected pelagic (off-bottom) fish, with trawling used as a means to verify the species composition of observed fish schools and to obtain biological information.

Oceanographic and Hydrographic Operations

As a complete survey platform, *Henry B. Bigelow* carries equipment and systems to conduct fisheries, oceanographic, and hydrographic research in most areas of the U.S. Exclusive Economic Zone. *Henry B. Bigelow* can support ongoing fisheries and oceanographic research by deploying and recovering floating and bottom-moored sensors. Surface buoys up to eight feet in diameter can be handled through hinged doors on each side of the working deck. Water temperature, conductivity, and fluorescence can be measured as a function of depth using the hydrographic winches and a CTD system. Local water currents are measured with an Acoustic Doppler Current Profiler, while a multibeam sonar system provides information on the content of the water column and on the type and topography of the seafloor while underway.

The ship is equipped with multiple sonar systems to meet its missions.

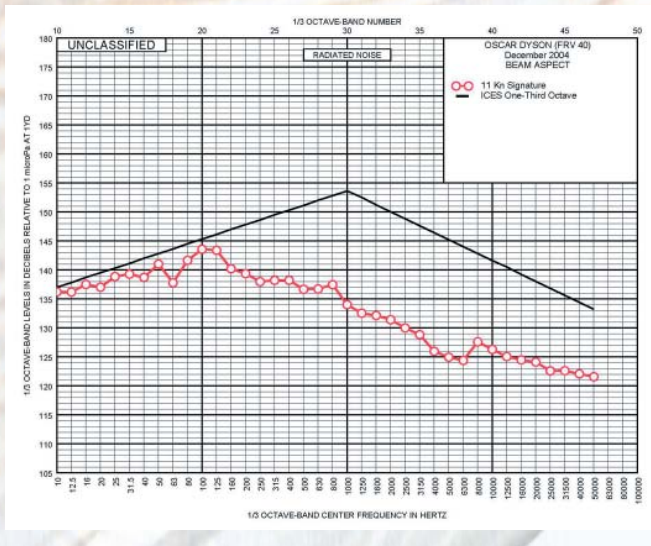
A traction-type oceanographic winch can deploy up to 5,000 meters (16,400 ft) of wire up to 17 mm (0.681 in) in diameter. It is located below the main deck and configured to support operations with the large, hydraulically operated stern gantry. The oceanographic winch can accommodate wire rope, electromechanical cable, and fiber optic cable as needed. Up to 13 metric tons of line pull can be generated by the oceanographic winch.

Two hydrographic winches serve the Side Sampling Station via the side A-Frame. Each hydrographic winch can deploy 3,500 meters (11,480 ft) of 9.5 mm (0.375 in) electromechanical wire. The A-Frame is configured so that up to three scientific packages can be rigged and ready for sequential operations. One hydrographic winch can also be rigged to serve the stern gantry.

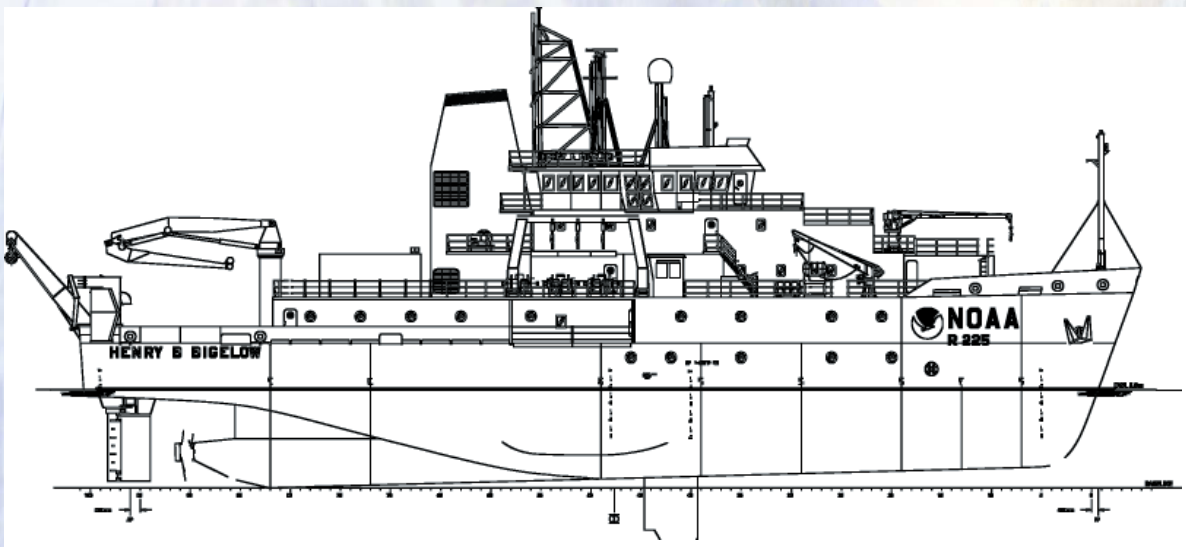
Noise Control

Underwater radiated noise has been shown to influence fish behavior, and sonar self-noise can limit the effectiveness of hydroacoustic surveys and other functions. The International Council for Exploration of the Seas (ICES) has established a standard for ships' underwater radiated noise in order to effectively employ hydroacoustic stock assessment techniques. *Henry B. Bigelow* has been designed and constructed to meet this ICES noise standard. This reduced noise signature will improve NOAA's ability to accurately assess fish stocks and to compare standardized data with the international fisheries scientific community.

Henry B. Bigelow has received extensive attention to both minimize the sources of noise and to ensure that systems are treated to reduce transmission of noise into the water. Examples are the propulsion motors, which are specially constructed and balanced to reduce noise and vibration, and the diesel generators, which are mounted on double-isolated raft systems. The hull form and highly skewed, five-bladed propeller were carefully designed and tested using U.S. Navy quieting techniques. Pumps, motors, ventilation and piping systems are all designed for low noise, with some critical systems resiliently mounted in the ship. Hull structure is treated in critical areas with special acoustic damping tiles. Airborne noise has been reduced throughout the ship for personnel safety and comfort.



The graph at the right shows the curve of ICES radiated noise standard and the first fisheries survey ship's acoustic range results. It is anticipated that the *Bigelow's* radiated noise curve will be similar or lower.



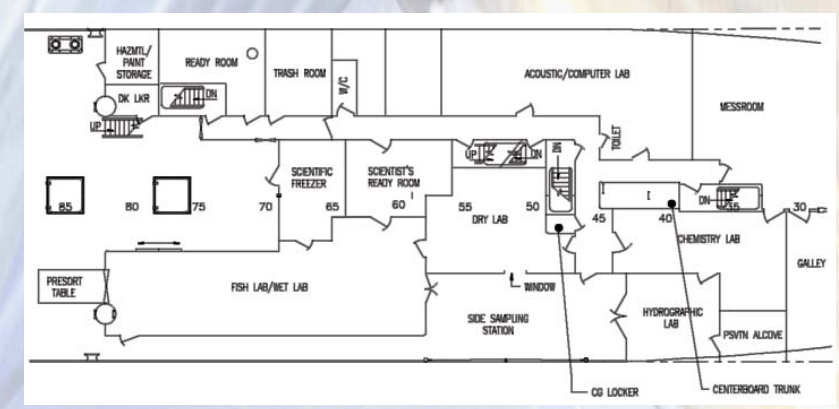
Principal Characteristics

Machinery Plant	Integrated Diesel Electric, 24-Pulse DC SCR Drive System
	Two 1,150kW(1,542 hp) Propulsion Motors on a Common Shaft
	One 720 kW (966 hp) AC Induction Azimuthing Bow Thruster
	Two 1,360 kW Diesel Generators
	Two 910 kW Diesel Generators
	One 4.3 m (14.1 ft) Diameter Fixed Pitch Propeller
Accommodations	39 persons, including 19 scientists
Length Overall	63.6 m (208.6 ft)
Breadth	15.0 m (49.2 ft)
Depth to Main Deck	8.65 m (28.4 ft)
Draft	5.90 m (19.4 ft) (Centerboard Retracted)
	9.05 m (29.7 ft) (Centerboard Extended)
Full Load Displacement	2479 mt
Light Ship Displacement	1840 mt
Speed, Sustained	14.0 kts
Speed, Hydroacoustic Survey	0 to 11.0 kts
Endurance	40 days/12,000 nm @ 12 kts

Mission Areas

Most of the main deck is reserved for mission functions. The aft working deck provides 145 sq m (1,560 sq ft) of open space for fishing and other over-the-side operations, with an additional 33 sq m (355 sq ft) of deck space at the Side Sampling Station. Space and support connections are provided for a laboratory van on the aft working deck. Large, easily reconfigurable laboratories are designed to accommodate the varied needs of individual scientific cruises:

- Fish/Wet Laboratory 56 sq m (602 sq ft)
- Chemistry Laboratory 27 sq m (290 sq ft)
- Dry Laboratory 14 sq m (150 sq ft)
- Hydrographic Laboratory 9 sq m (96 sq ft)
- Scientific Freezer 19 sq m (204 sq ft)
- Preservation Alcove 5 sq m (54 sq ft)
- Acoustic/Computer Laboratory 46 sq m (495 sq ft)



All working deck and laboratory areas are equipped with flush deck sockets to mount transient equipment. Each laboratory is also fitted with a Unistrut mounting system for easy reconfiguration in response to changing mission needs.

Additional mission areas include a large, walk-in scientific freezer, a conference room, a dive locker, and a ready room for scientists and crew preparing to go on deck. A large transducer room is provided in addition to the transducer mounting area on the bottom of the centerboard.