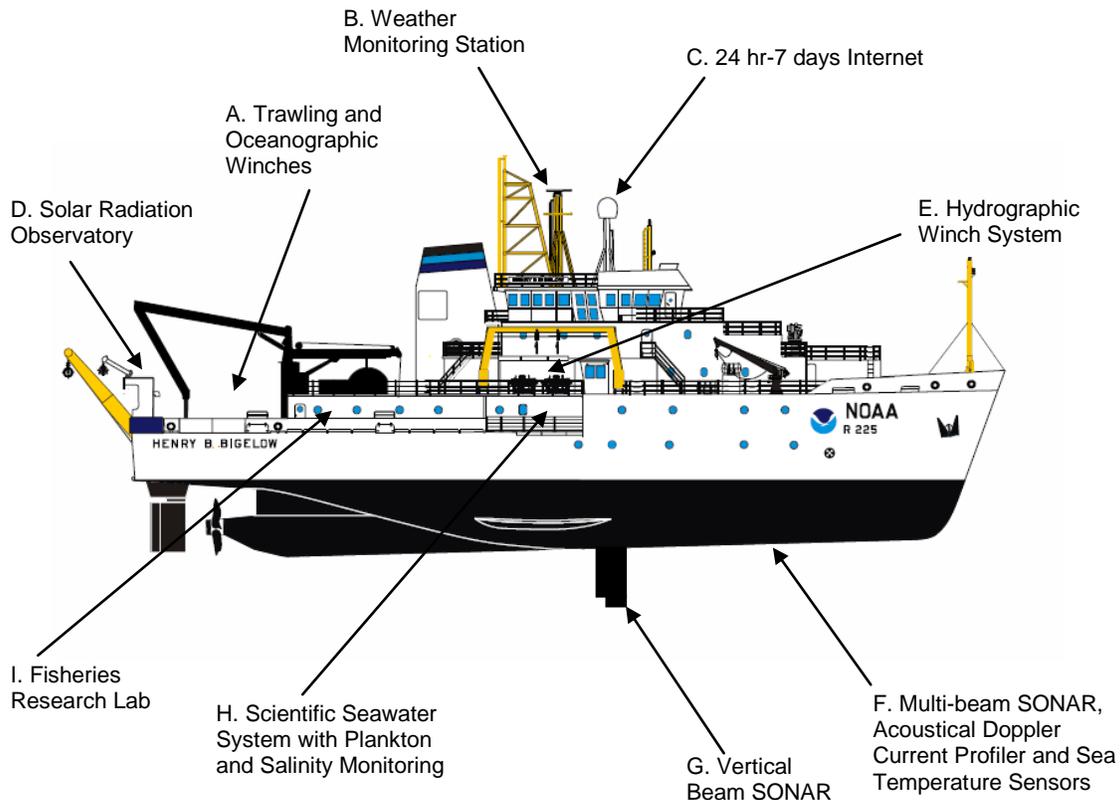


NOAA Ship *Henry B. Bigelow*

Description of Scientific Systems



Henry B. Bigelow

Fisheries Survey Vessel number FRV40 - 225
Commissioned on: July 16, 2007 for the
National Oceanic and Atmospheric Administration,
United States Department of Commerce.

Overall length	63.6m
Beam	15 m
Draft	6 m
Displacement	2476 metric tonnes full
Max Sustained Speed	14 kts
Max Compliment	39
Endurance	40 days

Introduction:

The NOAA Ship *Henry B. Bigelow* is a state of the art fisheries and oceanic research vessel whose mission is to monitor the health of the world's fisheries, oceans and climates. Its advanced, acoustically quiet hull design allows the *Bigelow* to study oceanographic life with minimal disturbance to it. Many sensors collect data continuously while the vessel is at sea. Data is collected by the shipboard Scientific Computing System (SCS). Through SCS data is stored, organized, coordinated with the ship's navigation and made immediately available to shipboard personnel and researchers elsewhere via the internet.

System Descriptions: (see image on cover)

A. Trawling and Oceanographic Winch Systems:

For fisheries surveys the *Bigelow* is capable of trawling the new Four Seam Fisheries Research net. Each Trawl winch has 3000m of cable used in conjunction with an advanced Rapphydema Auto Trawl System. This system is integrated with the auto pilot system allowing for a straight and accurate trawl at a constant speed. These winches constantly monitor cable tension and adjust to keep the net flying correctly and on the bottom. This system also allows for a quicker setting of the net than previous vessels. All of this data is feed into SCS and logged for post processing or stored in an Event.

The oceanographical winch system consists of 10,000m of cable and can be used for a variety of towed instruments.

C. 24 hr-7 day/week Internet Access:

A SeaTel satellite internet dome provides internet access to shipboard scientists while at sea. This allows for live communication and the exchange of ideas from any point in the world. Certain points in the ship also have wireless network allowing access to the ship's networks and the internet.

B. Weather Monitoring Station:

Weather data is continuously collected by the *Bigelow* anytime it is at sea. Two Young general purpose anemometers monitor the relative wind speed and direction. SCS combines this with the ships navigation to calculate the true wind speed and direction. Barometric pressure, humidity and air temperature are measured with a Vaisala Mod-PIB220, respectively. These data are uploaded daily to the Shipboard Automated Meteorological and Oceanographic System (SAMOS) via the satellite internet link and an associated event logger. This information and data from numerous other vessels is compiled and made available to researchers around the world.

<http://samoss.coaps.fsu.edu/html/index.php>

D. Solar Radiation Observatory:

Heat and light energy from the sun is monitored and logged by the *Bigelow* with Eppley Radiometers, model number PIR and PSP.

E. Hydrographic Winch System:

Information and samples from the water column may be collected by means of two Rapphydema HW-500 winches. One containing 4300 meters and another with 1200 meters of cable, both provide up to 5 tonnes of pull. Low voltage instrumentation can be deployed from the 1200 meter hydrographic while instruments require a power feed or deeper capabilities are deployed from the 4300 meter hydrographic winch. Water column profiles are routinely made by a Sea Bird Electronics 19 plus CTD or 9 CTD with a 12 sample bottle carousel used in conjunction with a Sea bird 36 and Sea bird 11+ deck box respectively. Plankton nets and other such research devices may also be deployed from this these winches on side sampling station.

F. Sea Temperature Sensors:

Sea temperature is constantly monitored via 3 separate sensor located at different depth on the *Bigelow's* hull. These sensors will be calibrated on a yearly basis.

Sea Temperature Sensors: 3 Furuno RD-30 sensors at:
Depth upper: 0.5 m below surface (approx)
Depth Middle: 1.0 m below surface (approx)
Depth Lower: 1.5 m below surface (approx)

G. Acoustic Sounders:

Acoustic devices are an increasingly important tool in oceanographic studies. The *Bigelow* deploys two scientific SONAR systems for the study of fish and plankton biomass.

The Simrad EK60 vertical beam echo sounder (VBES) has an array of four transducers at 18, 36, 120 and 200 kHz respectively. This provides information on water depth and locations and size of fish schools. The EK60's transducers are mounted on a movable centerboard that can be extended to a 3 and 6 meters position below the ships hull along with a flush mount and maintenance position giving access to the transducers from inside the ship. The 18 kHz transducer is the deepest penetrating SONAR onboard the *Bigelow* with an effective operating depth of 5000m.

The Simrad ME70 multi-beam echo sounder (MBES) operates at a frequency range from 70 and 120 kHz. This device has a configurable fan shaped array of sonar beams that surveys a swath of ocean at a time. The array can be configured from 1 to 45 beams with a maximum arch of 120 degrees and is steerable by +/-45 degrees athwart ship. The ME70



can acquire targets as close as a meter from the transducer face and as far away as 800m. This MBES is unique in that it acquires targets from both the water column and the sea floor. Currently there are only 3 of the systems in existence. Future upgrades will allow for International Hydrographic Organization quality bathymetric data collection. This will support *Henry B Bigelow's* dual purpose mission by allowing for hydrographic data collection anytime the ship is underway.

Note. These SONAR systems are set up in master and slave configuration or operated one at a time. Under some circumstances there is limited interference from the ship's navigational Doppler Speed log (307 kHz) and Fathometer (50 kHz) or other SONAR systems onboard. Most of these instruments are solely controlled from the bridge and can only be shut off with approval by the Commanding Officer. The interference is minor and is not always present.

A Simrad ES60 operating at 50 kHz and 200 kHz is located on the bridge. This unit is used for navigational purposes and only serves as back up for scientific operations.

Ocean currents beneath the ship are monitored by means of an Acoustic Doppler Current Profiler (ADCP), model Ocean Surveyor by RD, Instruments. This system operates at 153 kHz and has 4 comparative beams. Effective range is 150 meters in its present configuration.

These SONAR systems are connected to a 3 terabyte server providing approximately 300 continuous days of combined storage.

Along with these SONAR systems there are three hydrophones located on the *Bigelow*. These instruments are on the centerboard, above the propeller and in the transducer void amid ship. These devices are able to record ocean sounds via the USN recording and detection package Ishmael 1.0 or a more simple MP3 creating software suite.

The SONAR systems aboard the *Bigelow* are fed transducer face sound velocity data from a thermosalinograph. An XBT or CTD is available from obtaining sound velocity profiles when necessary.

H. Scientific Sea Water System:

This system uses a Sea Bird Electronics model 45 Thermo-Salinograph (TSG) to measure salinity, conductivity and both internal and external water temperature. This TSG also calculates sound velocity in the seawater it is testing

The external temperature probe is a Sea Bird Electronics model 38 temperature probe mounted (calibration pending) at the inlet pipe located in the bow thruster room

Plankton populations are monitored via a Satlantic FIRE Fluorometer measuring the quantity and excitement of planktonic chlorophyll.

All of these systems are piped into a seawater system totally dedicated to scientific purposes. Seawater is delivered by 2 Webster model 1C4HX0700 pumps supplying a continuous flow of uncontaminated seawater that is accessible at the side

Sampling Station, Dry Lab, Wet Lab, Chemistry Lab, Chemistry Alcove and on the back deck.

I. Fisheries Research Wet Lab:

A state of the art fish sorting, weighing, lengthing and sampling apparatus that interfaces directly with the ship's scientific computer network. This system includes four ergonomically designed work stations that can be manned by either one or two persons. Three of these stations have a Marcel M2200 M02 30 kg motion compensated load cell scale, Scantrol FishMeter FM100 fish board for entering lengths and other data and a Zebra bar code label printer and reader for the tagging of specimens to be processed at a later date. This lab also includes a work station capable of recording weight counts via a wireless Eilon 0.5 tonne sling scale used for large individual specimens, a Marcel M2000 X01 30 kg flow scale used in incorporation with a conveyor belt for total catch weight and a 50 kg motion compensated Marel M2200 M02 load cell used to weigh baskets of specimens. Each station has a waterproof touch screen that allows for the efficient recording of all data parameters. All of these stations are connected to a main Fisheries Scientific Computer System server (FSCS) that logs and stores data 100% digitally.

Future modification to this system include an expert fish identification system to aid in fish classification and a small 5kg load cell for weighing juvenile and smaller fishes more accurately.

Specimen Preservation:

Biological samples can be collected and preserved aboard the vessel via chemical or freezing methods. There are 3 separate refrigeration units onboard. The largest unit is a walk-in adjustable temperature freezer with shelves and easy access to the Fisheries Research Wet Lab. There are also two smaller deep-freezers supplying approximately 0.6 cubic meters each at -18°C and -80°C .

Chemical preservation takes place in fume hoods located throughout the ship with preservation solutions stored in the HAZMAT locker.

Net Sensors Suites:

All aspects of the Four Seam Net can be monitored in real or near-real time from the ship. The acoustically linked sensors communicate with the ship via 2 hydrophones mounted on the centerboard. When fully extended from the flush mounted position these hydrophones extend 3 meters below the keel to increase sensor range and communication. The hydrophones are angled 15 degrees outward from the ship's centerline. The 4 separate sensor suites are:

Simrad FS70 (Turtle), this system uses a separate cable feed power and data link to the ship giving real-time data about the net. It consists of a rotating SONAR head that gives a “Donut” view of the net opening, seafloor, fish as they pass through the net opening and any other objects in the water column. Furthermore, net depth, water temperature, head rope height, altitude off bottom, area of net opening, wing spread, net symmetry, seafloor composition and numerous other characteristics can be monitored with this device.

Simrad ITI sensor suite consists of small acoustically linked sensors mounted on the net. This system provides: net depth, water temperature, head rope height, door spread, trawl eye opening and catch levels. The ITI system is updated on either a 30 or 60 second update basis. This suite has the longest battery life and slant range of the net sensor suites on the *Bigelow*.



Scanmar Remote net sensor system is an acoustically linked system capable of near-real time update rates to the ship via net-mounted transducers. This system provides: head rope height, wing and door spread, head rope depth and water temperature. Battery life is average and units are switched out every three day for charging and maintenance

Simrad PI32 sensor suite is an acoustically linked system that has a near-real time update rate. These compact net-mounted sensors constantly ping their data back to the ship at an adjustable update rate and channel. This system provides: wing/door spread, head rope height and depth along with water temperature.

These systems can only be deployed one at a time due to interference issues with the transducers and hydrophones. An exception to this is that certain sensors from the suites may be used with the FS70 (see image).

Electronics:

POSMV 320 is an integrated navigational and ship motion system designed to give extremely accurate location, heading, speed, along with heave, pitch and roll data. This information can be feed into any SONAR system and is logged in SCS or an event for post processing.

Personal computers are supplied by Dell and available in all labs and staterooms aboard the vessel. Most printers are networked and a plotter is available for larger items or charts.

Most labs have access to the ship’s closed circuit TV system with cameras located throughout the ship.

All labs have a display of the ship’s master clock set to Greenwich Mean Time not using Day Light Savings Time.

The computer lab is outfitted with a primary and secondary MX420 DGPS receiver. This is connected to a broadcast box making it possible to feed a NEMA navigation string to any instrument as required. A scanner and photocopier are available.

Bridge Systems:

The bridge is equipped with numerous dedicated systems such as: an ES60 SONAR system, Beir dynamic positioning and auto pilot system, X and S band Sperry Bride Master RADARs, Sperry weather station, MX420 DGPS receiver, weather fax, satellite telephone, primary and secondary VHF radios, internet access, SCS remote consol and master clock display, Doppler speed log with depth sounder, EM Speed log and a primary and secondary gyro compass. Nearly all of these systems are solely controlled from the bridge allowing for the scientific and operational systems to be totally independent. To complement this all scientific and fishing systems can be monitored from the bridge via remote consoles or SCS interfaces.

Software Packages:

The ship is equipped with numerous types of software packages to facilitate different missions. There are numerous computers located throughout the ship with access to basic Microsoft office programs and a lab dedicated to the use of more specialized applications. The software packages currently available on the *Bigelow* are: Microsoft Office including Access, Word, Excel, Power Point, Visio, Info Path, Outlook and Publisher, ESRI ArcGIS 3.1, EchoView4, SCS, FSCS, Nobeltec, Mat lab, FNet, AutoCAD, Ishmael 1.0 and numerous others. These packages are constantly being updated and added to providing a sound base for most scientific missions.

Hazardous Materials and Chemical Experiments:

HAZMAT storage is located on the aft deck of the *Bigelow* making it possible to safely store substance that pose a risk to the ship and crew. There are 3 fume hoods located throughout the ship providing a safe place to perform experiments or preserve specimens. All hazardous material must first be declared and cleared by the Commanding Officer before being brought aboard and require a Material Safety Data Sheet (MSDS)

Personal Comforts:

The *Bigelow* has many creature comfort not usually found on research vessels. Visitors to the ship are berthed in 2 person staterooms with a private bath and shower. Each stateroom has a porthole, Tempur-Pedic mattress, computer with 24hr/7day internet access, satellite television, climate controls and phone for both ship-board and outside parties via a voice of IP connection . Furthermore, each television on the ship has access to the navigational display on the bridge and the movie library.

The mess deck and lounge are equipped with 60 inch plasma television sets that have access to satellite programming and the ship's movie library.

The *Bigelow* also houses a gym with an elliptical machine, stationary bike, Bow Flex and free weights.

There is a full laundry facility onboard for extended trips with linens and detergent provided.

Images credited to NOAA, OMAO.