# EPA's Ocean Survey Vessel *Bold*

## 2010 Annual Report
## Monitoring and Assessing the Health of Our Oceans and Coastal Waters

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**Cover Photo: The OSV *Bold* docked in Philadelphia, PA.**

Photo by: Alan Brocavich, U.S. EPA

# Executive Summary

**The OSV *Bold* off the south coast of Vieques, Puerto Rico, in the Caribbean Sea.**
Photo by Douglas Pabst, U.S. EPA

The mission of the U.S. Environmental Protection Agency's (EPA's) Ocean Survey Vessel *Bold* (OSV *Bold*) is to support EPA's efforts to monitor and assess the health of our oceans and coastal waters. The information gathered by the OSV *Bold* allows EPA to more effectively identify and control pollution sources, whether from land or the ocean. Acting as a floating laboratory, the OSV *Bold* is helping to chart a healthier course for our oceans.

# Executive Summary

This is the fifth OSV *Bold* Annual Report. It highlights the ship's 2010 scientific survey accomplishments, capabilities, and the unique role that this vessel plays in supporting EPA's monitoring and assessment programs. In 2010, the OSV *Bold* supported scientific surveys in a variety of geographic areas, including the Atlantic Coast, the Gulf of Mexico, the Florida Keys, and the Caribbean Sea. The survey missions included monitoring ocean dredged material disposal sites, coastal eutrophication and toxicity assessments, monitoring ocean outfalls, assessing critical coral reef habitats, and monitoring hypoxia in the Gulf of Mexico. During this period, the OSV *Bold* completed 29 oceanographic surveys, involving hundreds of sampling locations, while spending 238 days at sea.

**2010 Survey Highlights:**

- Conducted monitoring for seven potential or active ocean dredged material disposal sites to confirm that the disposed dredged material is not endangering human health or the marine environment.
- Assessed coastal eutrophication and toxicity in the Mid-Atlantic Bight, New York Bight, and New England to ensure any contaminants are below levels needed to sustain marine life.
- Assessed the impact of an invasive coral species within the Florida Keys National Marine Sanctuary to determine its negative effects on the existing aquatic ecosystem.
- Gathered data on Gulf of Mexico hypoxia to help support Gulf hypoxia models that will be used to develop Gulf restoration strategies.
- Monitored two ocean discharge outfalls in the Mid-Atlantic Bight and in Puerto Rico to assess levels of human pollution and any adverse impacts to benthic organisms.
- Surveyed coral reef environments in the Caribbean Sea and Florida waters to gather data used to develop biocriteria which helps to indicate aquatic health.
- Gathered marine debris data in the Mid-Atlantic Bight and Caribbean Sea to help classify the amount of existing debris and the adverse impacts it has on marine wildlife or humans.
- Supported Federal, State, Territorial, and academic partners.

In addition to supporting a large variety of scientific surveys, the OSV *Bold* hosted three public education events in Boston, Massachusetts, New York, New York, and Ponce, Puerto Rico, in 2010. During the events, EPA scientists and OSV *Bold* crewmembers gave tours and conducted presentations for hundreds of visitors.

# Introduction

Our oceans and coasts are unique resources that support a wide diversity of life. We depend on these complex ecosystems to provide us with places to live, play, relax, and work. Our national economy is linked in several ways to the productivity of our oceans and coasts. For instance, in 2007, the coastal economy contributed more than $13.7 trillion to American prosperity, and supported more than 135 million jobs, according to market data from the National Ocean Economics Program. Of no less value are the marine resources that are difficult to measure economically, such as the beauty of our oceans and coasts, their cultural significance, and the vital ecosystem functions they provide.

Photo by Jean Brochi, U.S. EPA

**Sunset off the OSV *Bold* in the Long Island Sound.**

Human actions can adversely affect our oceans and coastal waters. Polluted sediments from industrial and agricultural activities and operations can significantly affect aquatic ecosystems. Wastewater improperly discharged from shore or from vessels can be a threat to public health and marine life. Exposure to toxic chemical and pathogenic contamination can negatively affect the entire food web. If improperly managed, ocean and coastal resources can be damaged by habitat modification, dredging, construction, and other human activities.

Photo by Charles LoBue, U.S. EPA

**Coral reef habitat off the coast of Puerto Rico.**

The future health of our ocean and coastal resources depends on our actions today. To restore and protect these resources, EPA undertakes many efforts to identify and control problems threatening the health of our oceans and coastal waters. Gathering information and analyzing data to support management decisions are critical elements of marine resource protection. The OSV *Bold* supports EPA-regulated activities by surveying oceans and coasts to: monitor and sustain the health of our coastal waters and shores; protect human health; support economic and recreational activities; and influence actions that safeguard healthy habitats for fish, plants, and wildlife.

# The Ocean Survey Vessel *Bold*

The OSV *Bold* was constructed by the Tacoma Boat Building Company of Tacoma, Washington, and was first commissioned on October 16, 1989, as the United States Naval Ship (USNS) *Vigorous*, a Tactical Auxiliary General Ocean Survey class vessel. The vessel was later renamed the USNS *Bold* and served on many surveillance missions in the Pacific Ocean for the U.S. Navy. The Navy decommissioned the USNS *Bold* in 2004. EPA acquired the ex-USNS *Bold* on March 31, 2004, to replace the *Peter W. Anderson*, EPA's previous ocean survey vessel. EPA began scientific surveys with the OSV *Bold* on August 8, 2005.

The OSV *Bold* underwent dramatic changes in her conversion from a military surveillance vessel to an ocean and coastal water monitoring vessel. EPA improved the deck machinery and added wet and dry laboratories, including a data acquisition laboratory where information is transmitted from the sampling equipment to computers. Sampling equipment includes a side scan sonar that provides digital acoustic images of the ocean floor and a Conductivity, Temperature, Depth (CTD) water profiler that measures physical water characteristics throughout the water column in real-time. For a detailed list of scientific facilities and technical equipment on the


Photo by Alan Brocavich, U.S. EPA

**The OSV *Bold* docked in Philadelphia, PA.**

## OSV *Bold* Quick Facts

**Overall Length: 224 feet**
**Width: 43 feet**
**Draft: 15 feet**
**Water Displacement: 2300 tons**
**Operating Speed: 11 knots**
**Ship Operating Crew: 19**
**Scientific Berths: 20**

OSV *Bold*, see Appendix 1.

The OSV *Bold* is managed by EPA's Oceans and Coastal Protection Division, in the Office of Water. In 2010, the EPA Vessel Manager, Kennard Potts, provided direction to Seaward Services, Inc. Seaward Services provided the sea-going crew; handled the operation and maintenance of the vessel; provided logistic support and contract management; and provided engineers, when needed, specializing in marine, mechanical, electrical, electronic, acoustical, or ocean engineering.

The OSV *Bold* provides EPA and its partners a platform to gather the scientific data needed to assess the marine environment and to make informed decisions to protect these resources and human health. In 2010, the OSV *Bold* supported surveys along the Atlantic Coast, in the Gulf of Mexico, in the Florida Keys, and in the Caribbean Sea. EPA's partners in 2010 included the U.S. Army Corps of Engineers; U.S. Geological Survey; National Oceanic and Atmospheric Administration; U.S. Navy; Florida Department of Environmental Protection; Puerto Rico Environmental Quality Board; Puerto Rico Department of Natural and Environmental Resources; Virginia Department of Environmental Quality; Connecticut Department of Environmental Protection; New Hampshire Department of Environmental Services; New Hampshire Fish and Game; and the Massachusetts Office of Coastal Zone Management.


**The OSV *Bold* Ship's Crew.**

Scientific surveys conducted onboard the OSV *Bold* address requirements of Federal statutes such as the Clean Water Act, the Marine Protection, Research, and Sanctuaries Act, and the Caribbean Basin Economic Recovery Act. The surveys provide scientific information and data to support EPA's mission to protect and enhance ocean and coastal waters through a variety of programs, including partnerships and regulatory actions, as well as response to emergencies. Surveys are conducted by scientists from various EPA offices, including Regional offices, the Office of Water, and the Office of Research and Development, states and territories, academic institutions, and other partners. All surveys are conducted under the leadership of EPA-certified Chief Scientists, who must complete a rigorous certification program before being able to serve in that capacity.

# Green Activities Onboard the OSV *Bold*

The OSV *Bold* supports EPA's mission to protect ocean and coastal environments. Staff and crew are dedicated to operating the vessel in the most environmentally sustainable way possible. Best management practices coupled with the latest technologies ensure that the vessel is not degrading the resources that we seek to protect. New technologies and best management practices are utilized to reduce the impact of sewage, oil, and hull coatings that are part of the normal operation of the vessel.

The OSV *Bold* is in compliance with all domestic and international requirements for discharges resulting from normal operations, including the 2008 Vessel General Permit (VGP), issued under EPA's National Pollutant Discharge Elimination System (NPDES). The VGP regulates discharges incidental to the normal operation of vessels operating as a means of transportation. The VGP includes general effluent limits applicable to all discharges, as well as general effluent limits applicable to 26 specific discharge streams; narrative water-quality based effluent limits; inspection, monitoring, recordkeeping, and reporting requirements; and additional requirements applicable to certain vessel types. EPA is dedicated to maintaining compliance with all discharges under the scope of the permit, and will work with individual states to ensure that the OSV *Bold* meets all requirements established for State waters.

## No Discharge Practices

The discharge of untreated or partially-treated human waste from vessels can contribute to high bacteria counts and subsequent increased human health risks. These problems can be particularly harmful in lakes, slow-moving rivers, marinas, and other bodies of water with low exchange rates. Blackwater (sewage) and graywater (wastewater from showers, sinks, laundries, and kitchens) are kept in holding tanks on the OSV *Bold*. The waste in the holding tanks is usually pumped to an onshore facility at the end of a mission. If a holding tank fills during a survey cruise, a marine sanitation device treats and disinfects the waste. After treatment, waste (containing blackwater and graywater) is disposed of only beyond three nautical miles from the shoreline, in accordance with Federal law.

In addition, all shipboard-generated garbage, cooking oils, and greases are collected and disposed of at onshore facilities. Any liquid collected in the bilge (compartment holding water at the bottom of a ship) is disposed of onshore in special reception facilities. Strict rules apply to disposal of all chemicals used in ship laboratories.

## Lower Sulfur Dioxide Emissions

Whenever available, the OSV *Bold* uses an ultra low-sulfur fuel that significantly

reduces harmful sulfur dioxide air emissions. Sulfur dioxide, an air pollutant that ships generate from burning fuel, can travel over long distances. It contributes to respiratory illness and to the formation of acid precipitation.

### Better Hull Coating

Hull coatings prevent corrosion and biological growth. These coatings reduce drag and increase fuel efficiency of a vessel. The hull coating on the OSV *Bold* does not contain organotin (which is a toxic chemical), or pesticides, and is certified as compliant with the International Maritime Organization's International Convention on the Control of Harmful Anti-fouling Systems on Ships. Information collected by EPA and the Department of Defense (DoD) indicates that the hull coating used on the OSV *Bold* has the lowest copper leach rate of hull coatings approved for use on DoD vessels. A lower leach rate means a lower impact to surrounding waters.

Photo by Alan Brocavich, U.S. EPA

### Non-toxic Fire-Fighting Foam

In the event of a fire onboard the OSV *Bold*, EPA uses an environmentally protective fire-fighting foam. This protein-based foam ensures efficient fire control and can handle any fire on the ship.

### Ballast Water Management

Ballast water tanks temporarily hold water to provide draft (immersion depth of a vessel) and stability. Ballast water transported and discharged by vessels may carry organisms from one waterbody to another. This is a main pathway for introducing and spreading aquatic invasive species (non-native species that can cause harm to human health, the environment, or the economy). As standard operating procedure, any exchange of ballast water (emptying and refilling ballast tanks) is recorded and done by the OSV *Bold* at sea, to limit potential transfer of invasive species between different waterbodies.

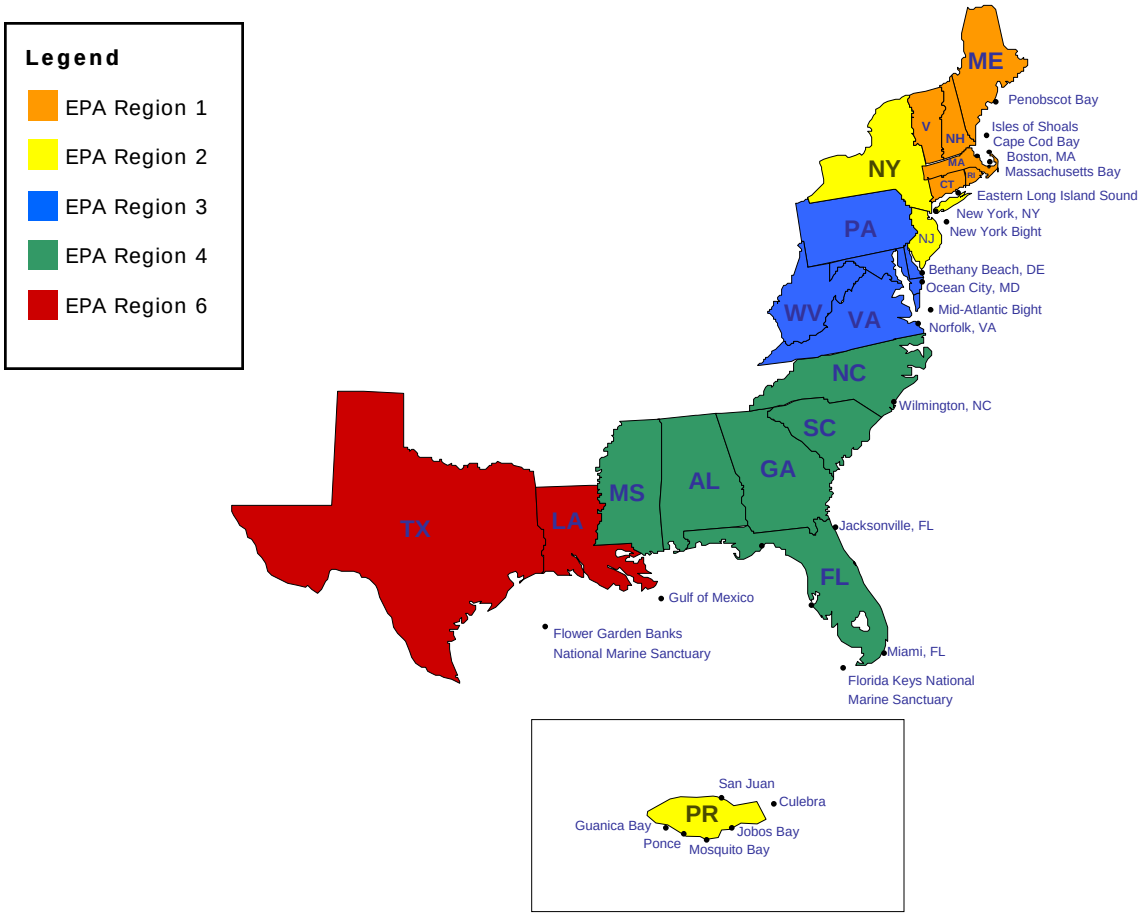
### Best Management Practices

Best management practices are employed in daily operations of the OSV *Bold*. Oil is carefully collected, and fueling of engines on rigid-hull inflatable boats is done with the utmost care to avoid spills. Special absorbent products and materials are used to collect drips of oil, grease, or fuel.

In addition, EPA supports shipyards that employ creativity and innovation to make their operations more environmentally sustainable.

# 2010 Scientific Survey Highlights

**Figure 1: Scope of OSV *Bold* Monitoring and Assessments in 2010.**




In 2010 the OSV *Bold* conducted scientific surveys in the Atlantic Ocean, the Gulf of Mexico, the Caribbean Sea, and the Florida Keys (see Figure 1). While spending 238 days at sea, the OSV *Bold* completed a total of 29 oceanographic surveys, involving hundreds of sampling locations. In addition, the OSV *Bold* held three educational events in Boston, Massachusetts, New York, New York, and Ponce, Puerto Rico.

## Assessment and Monitoring of Ocean Dredged Material Disposal Sites

The nation's ports, harbors, and navigable waterways are vital to the U.S. economy and national security. Dredging (the removal of sediments to maintain access to those important areas) has become increasingly significant as ships increase in size. Dredged material disposal must be conducted in a safe and environmentally acceptable manner under requirements of the Marine Protection, Research, and Sanctuaries Act (MPRSA), and the Clean Water Act (CWA). Under the MPRSA, EPA is responsible for designating ocean dredged material disposal sites (ODMDS) and for evaluating and concurring on dredged material ocean disposal permits issued by the U.S. Army Corps of Engineers. Additionally, the MPRSA requires that a site monitoring and management plan be prepared for each site before it may be used for dredged material disposal. An essential component of site monitoring and management plans is a characterization of baseline conditions before any disposal activity is conducted at the site so that changes in benthic (ocean seafloor) habitat resulting from disposal activities can be identified during future surveys.

One of the primary missions of the OSV *Bold* is to perform the required periodic monitoring of existing designated ocean disposal sites to confirm that dredged material is disposed of properly at the sites, that the dumping does not unreasonably degrade or endanger human health or the marine environment, and that the sites are functioning as expected. Under the MPRSA, ODMDS trend assessment surveys are required to assess the extent and trends of

Photo by Chris McArthur, U.S. EPA

**EPA scientists deploy sediment sampling equipment at the Miami, Florida ODMDS.**

environmental impacts of dredged material disposal. EPA scientists used the OSV *Bold* to assess and monitor conditions at several ODMDS. Along the coasts of Norfolk, Virginia, and Wilmington, North Carolina, EPA scientists used the OSV *Bold* to perform ODMDS trend assessments. EPA scientists collected samples of bottom sediment from various locations in and around the Wilmington and Norfolk sites to determine chemical and physical sediment characteristics. The scientists also collected biological specimens to detect any changes in species composition, presence, and abundance. The results of these surveys will be used to evaluate whether dredged material placed at the site has caused adverse impacts, as compared to areas left undisturbed.

At the Miami ODMDS, EPA scientists used the OSV *Bold* to map polychlorinated biphenyls (PCBs) and copper concentrations in the sediment and organisms living within the disposal site. This survey was performed as a result of a prior Miami ODMDS trend assessment survey where the concentrations were found to be elevated. The results of the survey will be used to determine the persistence and extent of the contaminants' impacts and any potential means of mitigation.

Photo by Robin Lacey, MA Coastal Zone Management

**EPA and MA Division of Fisheries scientists collect sediment samples from Cape Cod Bay.**

Conditions near the San Juan Harbor, Puerto Rico, and Massachusetts Bay ODMDS were assessed by EPA scientists to determine if dredged material is being disposed of outside of the boundaries of the designated disposal site. In both locations, the OSV *Bold* used side scan sonar to map evidence of dredged material discharges found outside site boundaries.

The Historic Area Remediation Site (HARS) off the coast of New Jersey is an ODMDS that is managed to receive dredged material that is suitable for remediating historic contamination. Onboard the OSV *Bold*, scientists conducted a side scan sonar survey to map the seafloor bottom throughout the site. Additionally, a Sediment Profile Imaging (SPI) survey was performed to assess benthic sediment and biological conditions in areas fully remediated.

In 2010, EPA scientists also used the OSV *Bold* to collect chemical, physical, and biological seafloor process data from Eastern Long Island Sound (ELIS) which will supplement data gathered at ELIS in 2007 and 2003, as well as data collected from Western Long Island Sound (WLIS) and Central Long Island Sound (CLIS) ODMDS

in 2009. The data will support dredged material management efforts by providing a complete digital side scan sonar data set for all LIS dredged material disposal sites. This survey was designed to further characterize the sites and to provide information to evaluate the current management of the sites.

Another important mission of the OSV *Bold* is to locate and evaluate new areas to receive dredged material and to support the potential designation of new disposal sites. Prior to designating a disposal site, EPA scientists are required to ensure that activities at the proposed site will not affect areas of natural, scientific, historical, or cultural significance.

Along the coasts of Jacksonville, Florida, and Portsmouth, New Hampshire, EPA scientists used the OSV *Bold* to characterize areas for potential disposal of dredged material. The Jacksonville ODMDS requires expansion to support future disposal of dredged materials, and as a result of several OSV *Bold* reconnaissance surveys, two locations surrounding the Jacksonville ODMDS have been identified as potential areas for site expansion or new site designation. These two areas were characterized during two seasonal surveys in 2010. The survey results will be presented as an EPA Environmental Impact Statement and used to select the most environmentally appropriate location. Near the Isles of Shoals, New Hampshire, two areas were mapped using side scan sonar to determine if they were geologically suitable for dredged material disposal; one of the investigated areas was found to be suitable for future disposal activities.

Photo by Cara Crawford, ORISE/U.S. EPA

**EPA scientists retrieve a trawl net off the coast of Jacksonville, Florida.**

## EPA's Coastal Eutrophication and Toxicity Assessments

The OSV *Bold* supported three surveys examining eutrophication and toxicity in coastal waters in 2010. Eutrophication is caused by an excess of chemical nutrients, such as nitrogen and phosphorus. Significant coastal eutrophication can lead to hypoxia, an environmental condition where dissolved oxygen (DO) is less than two milligrams per liter, which is a level that can no longer sustain most marine life. Coastal eutrophication can also lead to alterations in the plankton community, such as the condition known as "red tide" (an increase in toxic, naturally-occurring microscopic algae).

Along the Mid-Atlantic Bight, the OSV *Bold* supported an established coastal

monitoring plan assessing eutrophication. Water quality samples measuring nitrogen, phosphorus, and Chlorophyll-*A* were collected from North Carolina to New Jersey to determine if coastal eutrophication is increasing or declining (long-term nutrient trends), and what management actions should be considered to improve water quality.

In coastal New England, the OSV *Bold* continued coastal nutrient criteria development surveys which were conducted in 2004, 2005, and 2009. Along with sampling new stations, the majority of stations from the previous years' surveys were also sampled again, resulting in a total of 65 locations being sampled for phosphorus, nitrogen, and Chlorophyll-*A* concentrations, as well as various water column properties (e.g., temperature, conductivity, and DO). In all, nearly 220 water samples were collected off Massachusetts, New Hampshire, and Maine, with special focus on Saco Bay, Wells Bay, and sewage outfalls in Massachusetts Bay and southern Maine.

In New York and New Jersey coastal waters, low levels of DO have been documented as a result of excessive coastal eutrophication. These conditions have led to hypoxic areas, particularly during the summer months, when high sea surface temperatures create a highly-stratified water column with oxygen-depleted bottom waters. As a result, these hypoxic conditions can lead to severe negative impacts on local benthic populations of fish and invertebrates. In the Summer of 2010, the OSV *Bold* monitored coastal waters in the New York Bight from New York Harbor to Cape May, New Jersey, to provide data on nutrient and DO concentrations and to assess hypoxic or potential hypoxic conditions. EPA scientists used the vessel's water profiler to measure conductivity, temperature, depth, DO, and additional physical properties. The data collected will be used to alert New York-New Jersey Harbor stakeholders of potential or actual low oxygen conditions, to assist in the development of nutrient Total Maximum Daily Loads (TMDLs) (maximum amounts of nutrients that a water body can receive and still safely meet water quality standards), and to ensure that nutrient conditions are adequately represented in the model used by EPA to describe and predict eutrophication throughout the New York-New Jersey Harbor.

### Gulf of Mexico Hypoxia Assessment and Monitoring

Over the past few decades, hypoxic waters have been investigated on the Northern shelf of the Gulf of Mexico along coastal Louisiana and Texas. In 2010, the OSV *Bold* supported an assessment and monitoring survey within these hypoxic waters.

The size of the Gulf hypoxic zone varies each year, depending on natural and human-influenced factors; however, during four summers in the past decade it was measured to be in excess of 20,000 square kilometers. Current evidence indicates that the development, extent, and persistence

of hypoxia in the Gulf of Mexico are primarily caused by excessive nutrient (e.g., nitrogen and phosphorus) loading from the Mississippi-Ohio-Missouri River Basin, from anthropogenic sources.

Hypoxia monitoring and assessment by the OSV *Bold* supports the "Action Plan for Reducing, Mitigating, and Controlling Hypoxia in the Gulf of Mexico." The Hypoxia Action Plan was released by the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, a Federal and State agency working group, in 2001, with a revised Action Plan released in 2008. The Plan calls for expanded long-term monitoring programs, enhanced research and modeling efforts, and increased stakeholder education and national awareness programs.

From 2005 to 2007, the OSV *Bold* supported five Gulf Hypoxia monitoring surveys. The primary focus of these surveys was to measure shelf-wide water column chemistry and biological processes. During the surveys, sediment monitoring was performed in only limited areas; however, to accurately understand the entire shelf, ocean sediment data needs to be collected from additional areas.

In 2010, the OSV *Bold* supported research efforts to characterize the magnitude of, and variability in, physical, chemical, and biological properties, processes, and deposition rates of ocean sediments within the hypoxic zone. These monitoring activities will better define the spatial and temporal extent and dynamics of the entire hypoxic zone by combining sediment process information with existing water quality measurements. The data will also further refine a predictive model for Gulf of Mexico hypoxia, and should reduce scientific uncertainty about nitrogen and phosphorus

Photo by Chris McArthur, U.S. EPA

**EPA scientists sort through biological samples collected off the coast of Jacksonville, Florida.**

loadings, and the formation, extent, duration, and severity of the hypoxic zone.

### Ocean Outfall Monitoring

In 2010, the OSV *Bold* supported two surveys assessing impacts of ocean outfall discharges on coastal waters.

Along the Mid-Atlantic Bight, EPA scientists collected samples to investigate water quality near three ocean outfalls in Delaware, Maryland, and Virginia. Additionally, water samples were collected near a proposed new outfall in Delaware to establish baseline conditions. At all outfall sites, levels of bacterial contamination due to *Enterococci* (bacteria used as an indicator organism to assess human pollution within marine and estuarine waters) were assessed. The objective was to determine the impact of the disposal of pollutants, in accordance with the requirements of Section 403(c) of the Clean Water Act.

Photo by Alan Brocavich, U.S. EPA

**EPA scientist collects water quality data off the coast of Virginia.**

The second ocean outfall study took place in the Caribbean Sea, off the northern Puerto Rico coast. EPA scientists surveyed an ocean outfall where the Bayamon and Puerto Nuevo Regional Wastewater Treatment Plants (RWWTP) and the Bacardi Corporation Distillery Wastewater Treatment Plant are authorized to discharge wastewater. Recent monitoring near the outfall has shown the presence of pesticides and heavy metals in sediments within the vicinity of the outfall. Such pollutants may adversely impact benthic organisms. During the survey, EPA used bioassays to assess the toxicity of sediments at the boundary of the mixing zone near the outfall. Using SPI and side scan sonar equipment to provide benthic mapping of sediment types, EPA will evaluate if sediment conditions near the outfall (i.e., at the boundary of the mixing zone) are different from areas further away from the outfall.

### Fish Waste Disposal Site Assessment and Monitoring

The OSV *Bold* supported the annual survey of a fish waste disposal site off the Virginia Capes to determine what type of organisms are present at the dump site and to evaluate the effect of this disposal on the marine environment. During the survey, scientists collected data to ensure no recreational or commercially viable species were in the area. The survey results con-

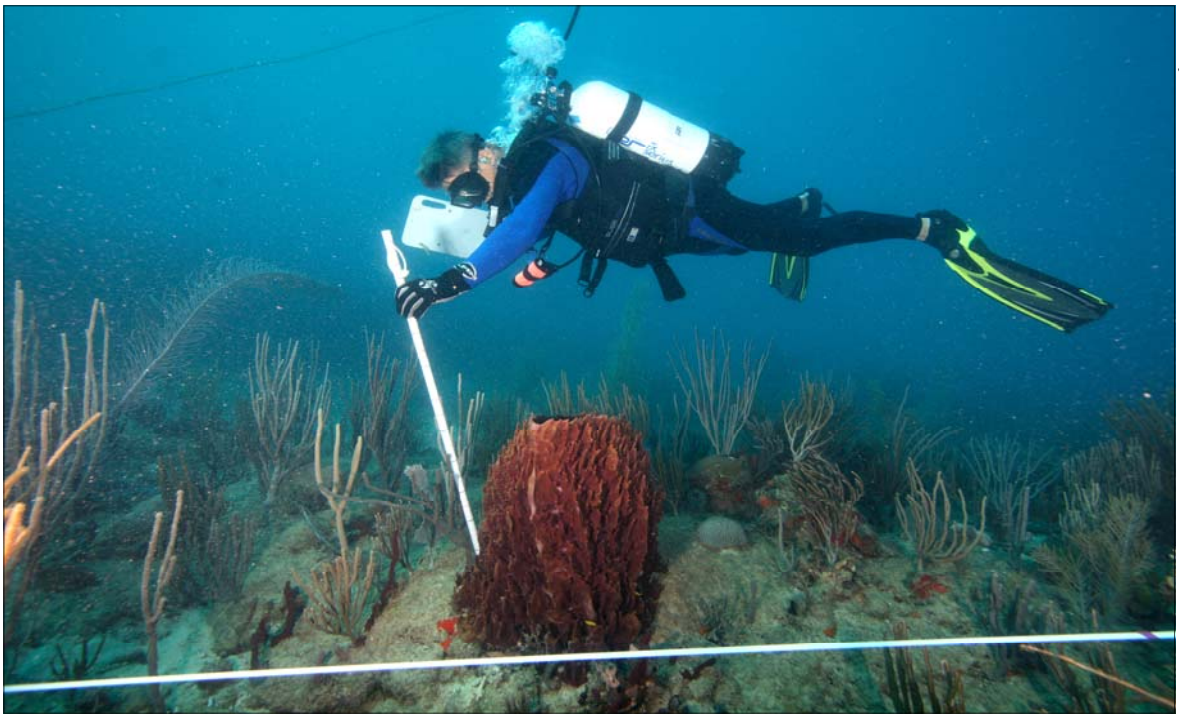


Photo by Charles LoBue, U.S. EPA

**EPA scientist collects coral reef data in Puerto Rico.**

cluded there were no recreational or commercial species within the site and that it is being used appropriately.

### Aquatic Invasive Species Impact Assessment

Aquatic invasive species have affected all coastal waters of the U.S., including the Florida Keys, Caribbean, and the Gulf of Mexico. The most common sources of aquatic invasive species include escapes from aquaculture sources, ballast water discharges, and accidental or deliberate introductions. Invasive species can affect aquatic ecosystems both directly or indirectly by reducing native populations and altering run-off dynamics. Consequently, many commercial and recreational activities can be influenced.

In 2010, EPA scientists performed surveys in both the Florida Keys National Marine Sanctuary and the Flower Garden Banks National Marine Sanctuary to characterize existing populations of orange cup coral, known scientifically as *Tubastraea coccinea* (*T. coccinea*), and to assess the impacts of this non-native coral species. *T. coccinea* has the potential to adversely impact native coral reef communities by several factors, including: (1) its ability to kill tissues in native corals; (2) its high reproduction rates; (3) its ability to out-compete native coral species for important resources; and (4) the lack of a natural predator in Florida waters.

In both locations, EPA scientists collected tissue samples from the non-native coral and photographed both invasive and native coral colonies. These data will aid scientists in determining the colony population growth and recruitment rates (the rate at which free swimming coral larvae settle onto coral reefs) in the non-native species. These data will also help to determine if the presence of *T. coccinea* results in low

levels of biodiversity and low recruitment rates in the native coral species.

## Coral Reef Monitoring and Biocriteria Development

Coral reefs are declining worldwide due to rising sea water temperature, as well as effects from local stresses, such as excessive nutrient and sediment overloading, contaminants from land-based sources, and direct physical damage to coral populations. Coral reefs are extremely important ecosystems because they provide habitat for numerous fish and invertebrate species. The structure and presence of a strong and diverse coral community supports tourism, fisheries, and research opportunities, as well as guarding shorelines from erosion by waves and currents. Corals also provide important measures of water quality and general ecological health.

In November and December 2010, a coral condition survey was performed off the southern Puerto Rico coast. The primary objective of this survey was to characterize composition, size, and health of corals in the waters along the southern coast of Puerto Rico, particularly the Guanica Bay, Ponce, and Jobos Bay watersheds, and to determine what coral reef measurements are responsive to human disturbances. During the survey, sampling locations were chosen based on specific areas of disturbance, such as pour points (the outlet of a watershed) or other point sources of pollution. The data collected will provide a baseline assessment of coral conditions around Puerto Rico, and will help the Puerto Rico Environmental Quality Board (EQB) and Puerto Rico Department of Natural Resources (DPNR) create an effective long-term monitoring and assessment strategy for the coral reefs in Puerto Rico. The recorded measurements will also help scientists to calculate sensitive indices to describe the conditions of the reefs. These indices will then become metrics, or indicators, for detecting impairment of the water body. Standards based on these metrics can be used to create biological criteria (or biocriteria) which can aid in monitoring and managing coastal water quality. Moreover, biocriteria are powerful management tools, since biological communities are reliable indicators of aquatic health.

Photo by Jim Demmers, Georgia Tech

**Aquatic invasive species, *Tubastraea coccinea* (orange cup coral).**

In 2010, the OSV *Bold* also conducted a survey in the Flower Garden Banks National Marine Sanctuary (FGBNMS) in the Gulf of Mexico. The survey assessed fish, stony corals, octocorals, sponges, large invertebrates, and measured cover and rugosity (indicator of the amount of available habitat available for colonization) on coral banks in the northwestern Gulf of

Mexico. The data collected will be used to assess current reef conditions and determine anthropogenic causes of reef decline. Additionally, since FGBNMS is mostly undisturbed, the data will be used to represent the natural reference condition for coral reefs in the Caribbean and western Atlantic, which will assist in developing coral reef biocriteria.

### Marine Debris Monitoring

Marine debris (any persistent solid waste material that is directly or indirectly discharged into or abandoned in the aquatic environment) is a problem in oceans, coasts, and watersheds throughout the world. It can result from human activities anywhere within the watershed, such as an overturned trash can on land, litter left on a street or beach, or trash thrown overboard from a vessel.

In support of developing a standardized protocol for marine debris collection onboard the OSV *Bold*, EPA scientists performed marine debris surveys in waters around Puerto Rico and the Mid-Atlantic Bight to determine the amount and type of marine debris present in the areas. During the surveys, only very small pieces of debris were found suggesting future surveys should focus on predetermined strategic areas of potential debris accumulation (i.e., areas near currents, gyres, and ocean outfalls). All debris collected was counted and categorized, and will be further analyzed in a laboratory. The data collected will be used to determine potential sources of the marine debris present and help to determine the appropriate marine debris prevention efforts.

### Support to Federal, State, and Academic Partners

In 2010, the OSV *Bold* supported Federal, State, and academic partners in a number of oceanographic surveys.

Using the OSV *Bold*, EPA scientists partnered with the Connecticut Department of Environmental Protection (DEP) to characterize seafloor features in two areas of Eastern Long Island Sound (ELIS) Atlantic Sturgeon have previously been observed. Utilizing side scan sonar the survey showed that Atlantic Sturgeon habitat varies among the two sites. In addition, with a combination of side scan, video, and grab sampling performed during the survey, USGS scientists will be able to create improved seafloor texture maps (based on existing high resolution bathymetric maps from NOAA) for use in evaluation of benthic habitats for research and monitoring purposes.

In August 2010, the OSV *Bold* was used by the Virginia Department of Environmental Quality (VADEQ) to collect water and sediment samples along the Virginia coastline in conjunction with the National Coastal Condition Assessment. During the survey, 50 stations were sampled for both water and sediment quality. Continuous profiles were measured for nitrogen, phosphorus, chlorophyll, bacteria (Enterococci), total suspended solids, pH, conductivity,

salinity, dissolved oxygen, temperature, and water clarity. Surface water samples were also collected and tested for dissolved and total trace metals (e.g., calcium, magnesium, and iron) and polycyclic aromatic hydrocarbons (PAHs). Sediment samples were analyzed for metals, total organic carbon, grain size, and benthic population and distribution. This information will be used to create a baseline for nutrients, metals, PAH, and a benthic index along the Virginia coast.

The new National Ocean Policy and Framework for Coastal and Marine Spatial Planning directs the federal government to develop regional coastal and marine spatial plans within five years in cooperation with states and Indian tribes, in consultation with fishery management councils, and with input from other stakeholders. In 2010, EPA supported this directive by partnering with the Massachusetts Office of Coastal Zone Management (CZM) and the Massachusetts Division of Marine Fisheries to validate sediment maps of various marine habitats in Massachusetts waters, one of the priority objectives of the 2009 Massachusetts Ocean Management Plan. Using the OSV *Bold*, maps were validated by collecting samples of sediment, seafloor organisms, and by photographing bottom materials.

Mosquito Bay, located on the island of Vieques, is the most pristine of Puerto Rico's three bioluminescent bays due to the stable and abundant populations of the dinoflagellate, *Pyrodinium bahamense*. This biological property makes Mosquito Bay a very unique ecosystem that is of great esthetic, historic, and economic value. There is concern, however, that excessive loading of nutrients and sedimentation are negatively impacting the ability of Mosquito Bay to maintain its bioluminescent nature. Consequently, EPA has launched an initiative to assist local authorities in preserving the bioluminescent nature of Mosquito Bay, as well as other Puerto Rico bioluminescent bays. During the survey, EPA collected baseline data from six stations throughout Mosquito Bay to help the Puerto Rico Environmental Quality Board (EQB) initiate the Ambient Water Quality Monitoring Program for Mosquito Bay. The data obtained during the survey will be reviewed by EQB to identify if conditions violate the EPA Ambient Aquatic Life Water Quality Criteria for dis-

Photo by Chris McArthur, U.S. EPA

**EPA scientists extract tissue samples from Spiny Crabs collected at the Miami, FL ODMDS in the OSV *Bold* wet laboratory.**

solved oxygen under the Clean Water Act. The data will also be used by EQB to assess Mosquito Bay for the antidegradation requirements of its CWA designation (Class SA), and to assist EQB in establishing future monitoring stations.

As marine aquaculture continues to become more economically feasible, an increased number of facilities will need to be permitted. In order to properly set discharge limits for these facilities, a monitoring protocol must be developed to assess the impacts of the discharges (e.g., organic matter and nutrient loading). In November 2010, EPA scientists began developing a monitoring protocol to assess these impacts on the coastal Caribbean environment. During the survey, baseline conditions in the area surrounding a permitted aquaculture facility off Culebra, Puerto Rico were documented. This will allow EPA to establish stations and baseline water conditions to detect any changes in the marine environment that may result from the facility going into commercial production.

## Public Education on EPA's Oceans and Coastal Programs

When in port between scientific surveys, the OSV *Bold* is used for environmental education on challenging issues facing the health of marine waters. In 2010, the OSV *Bold* hosted over 1,000 people at three educational events in Boston, Massachusetts; New York, New York; and Ponce, Puerto Rico. During the events, scientists and crew members described the OSV

Photo by Chris McArthur, U.S. EPA

**EPA scientists sort epifauna samples collected off the coast of Jacksonville, Florida.**

*Bold*'s scientific facilities, sampling equipment, and dive operation capabilities to the public. Scientists and OSV *Bold* crew also demonstrated state-of-the-art technology and scientific methods used for oceanographic surveys. Additionally, the Boston event was supported by various partners, including the Massachusetts Coastal Zone Management Program, Massachusetts Bays Program, New England Aquarium, University of Massachusetts- Boston, and Urban Harbors Institute.

In addition to the open house events held on the OSV *Bold*, educational outreach is also done through the OSV *Bold* website (http://water.epa.gov/type/oceb/assessmonitor/osvbold_index.cfm) and the OSV *Bold* Kids website (http://www.epa.gov/boldkids/). On both websites, people can learn about the OSV *Bold*, its mission, capabilities and equipment, surveys performed onboard, and survey results.

# Scientific Surveys in 2011

**EPA scientists collect coral samples under an oil platform off the coast of Texas and Louisiana in the Gulf of Mexico.**
Photo by Jim Demmers, Georgia Tech

OSV *Bold* surveys anticipated for 2011 include:

- Assessment and monitoring of ocean dredged material disposal sites
- Fish waste disposal site assessment and monitoring
- Ocean outfall monitoring
- Coral reef monitoring and biocriteria development
- Coastal eutrophication and toxicity assessments
- Marine debris monitoring

# Appendix 1: OSV *Bold* Facilities, Equipment, and Capabilities

## Scientific Facilities

Wet Laboratory: Equipped with sieve station (i.e., sieving table and trays); wash station with hot and cold freshwater and saltwater; ice machine (for sample preservation); refrigerator; electronic navigation data ports; and electronic navigation chart display with ship's location and navigation information.

Survey Operations Center: Equipped with refrigerators; freezers; sub-zero freezers; distilled water; computers; storage space; microscopes; and 85 linear feet of lab benches.

Microbiology Laboratory: Equipped with autoclave and incubator.

Data Acquisition Center: Equipped with computer systems to support digital data recorded from side scan sonar operations; water profiler deployment; and underwater video filming.

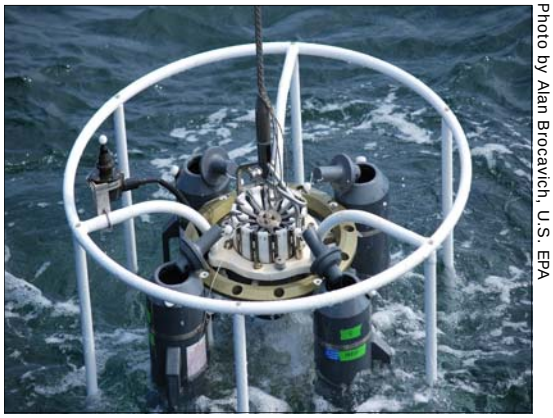


Photo by Alan Brocavich, U.S. EPA

**CTD water profiler instrument used onboard the OSV *Bold*.**

## Sampling Equipment

Side Scan Sonar: Produces digital acoustic images of ocean floor.

Conductivity, Temperature, and Depth Water Profiler: Measures physical water characteristics *in situ* in real-time throughout the water column.

Rosette Water Sampler: Collects water at specified depths in the water column.

Sediment Sampling Equipment: A variety of grabs and corers are used for the collection of sediments.

Dredges: Collect oceanic organisms from the seafloor and sediments.

Sampling Nets: Collect marine debris items and oceanic organisms, such as fish and plankton, from various depths in the water column.

A-Frame: Assists the deployment and retrieval of the side scan sonar and sediment sampling equipment.

## Diver Operation Capabilities

Rigid-Hulled Inflatable Boat (RHIB): At all times, the OSV *Bold* carries two RHIBs to support dive operations.

Dive Locker: Nitrox/Air compressor; 31 SCUBA tanks; diver communication devices (i.e., diver-to-diver, diver-to-surface); diver recall system for emergency situations; dry suits; and full-face masks available for use by certified diving personnel.

Photo by Jim Demmers, Georgia Tech

**Nitrox used onboard the OSV *Bold* during diving operations.**

# Appendix 2: Scientific Surveys and Public Education Events in 2010

| Survey/Event | Location | Month(s) |
|---|---|---|
| Assessment and Monitoring of Ocean Dredged Material Disposal Sites | Jacksonville, Florida | March, April, & September |
| | Miami, Florida | April |
| | Wilmington, North Carolina | May |
| | Eastern Long Island Sound | May & June |
| | Massachusetts Bay | June |
| | Isles of Shoals, New Hampshire | July |
| | HARS, New Jersey | August |
| | Norfolk, Virginia | August |
| | San Juan, Puerto Rico | November |
| Coastal Eutrophication and Toxicity Assessments | New England (Massachusetts, New Hampshire, and Maine) | June & July |
| | New York Bight (New Jersey to Massachusetts) | July & August |
| | Mid-Atlantic Bight (North Carolina to New Jersey) | August |
| Ocean Outfall Monitoring | Mid-Atlantic Bight (North Carolina to New Jersey) | August |
| | Northern Puerto Rico | November |
| Fish Waste Disposal Site Assessment and Monitoring | Southern Virginia | August |
| Aquatic Invasive Species Impact Assessment | Florida Keys National Marine Sanctuary, Florida | April |
| | Flower Garden Banks National Marine Sanctuary, Gulf of Mexico | October |

| Survey/Event | Location | Month(s) |
|---|---|---|
| Coral Reef Monitoring and Biocriteria Development | Flower Garden Banks National Marine Sanctuary, Gulf of Mexico | February & March |
| | Puerto Rico | November & December |
| Gulf of Mexico Hypoxia Assessment and Monitoring | Gulf of Mexico | September and October |
| Marine Debris Monitoring | Mid-Atlantic Bight | August |
| | Puerto Rico | November |
| Support to Federal, State, and Academic Partners | Eastern Long Island Sound | May |
| | Massachusetts | June |
| | Virginia | August |
| | Mosquito Bay, Puerto Rico | November |
| | Culebra, Puerto Rico | November |
| Public Education on EPA's Oceans and Coastal Programs | Boston, Massachusetts | June |
| | New York, New York | August |
| | Ponce, Puerto Rico | November |

# EPA's Ocean Survey Vessel *Bold*

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Monitoring and Assessing the Health
of Our Oceans and Coastal Waters


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