



Prepared in cooperation with the Massachusetts Office of Coastal Zone Management

Geological Sampling Data and Benthic Biota Classification: Buzzards Bay and Vineyard Sound, Massachusetts

By Seth D. Ackerman, Adrienne L. Pappal, Emily C. Huntley, Dann S. Blackwood, and William C. Schwab

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Conversion Factors, Datums, and Abbreviations

SI to Inch/Pound

Multiply	By	To obtain
Length		
centimeter (cm)	0.3937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
kilometer (km)	0.5400	mile, nautical (nmi)
Area		
square kilometer (km ²)	0.3861	square mile (mi ²)
Mass		
kilogram (kg)	2.205	pound avoirdupois (lb)

Particle size in phi units can be converted to millimeters (mm) as follows: $\text{mm} = 2^{-\text{phi}}$. Vertical coordinate information is referenced to mean lower low water (MLLW).

Horizontal coordinate information is referenced to the World Geodetic System of 1984 (WGS 84).

Abbreviations

CMECS	Coastal and Marine Ecological Classification Standard
CZM	Massachusetts Office of Coastal Zone Management
FGDC	Federal Geographic Data Committee
GIS	geographic information system
GPS	Global Positioning System
MassGIS	Massachusetts Office of Geographic Information
MOF	[USGS] Marine Operations Facility
MV	motor vessel
NGDC	[NOAA] National Geophysical Data Center
NOAA	National Oceanic and Atmospheric Administration
RV	research vessel
SEABOSS	SEABed Observation and Sampling System
USGS	U.S. Geological Survey
UTC	Coordinated Universal Time
UTM	Universal Transverse Mercator
WGS 84	World Geodetic System of 1984

Geological Sampling Data and Benthic Biota Classification: Buzzards Bay and Vineyard Sound, Massachusetts

By Seth D. Ackerman,¹ Adrienne L. Pappal,² Emily C. Huntley,² Dann S. Blackwood,¹ and William C. Schwab¹

Abstract

Sea-floor sample collection is an important component of a statewide cooperative mapping effort between the U.S. Geological Survey (USGS) and the Massachusetts Office of Coastal Zone Management (CZM). Sediment grab samples, bottom photographs, and video transects were collected within Vineyard Sound and Buzzards Bay in 2010 aboard the research vessel *Connecticut*. This report contains sample data and related information, including analyses of surficial-sediment grab samples, locations and images of sea-floor photography, survey lines along which sea-floor video was collected, and a classification of benthic biota observed in sea-floor photographs and based on the Coastal and Marine Ecological Classification Standard (CMECS). These sample data and analyses are used to verify interpretations of geophysical data and are an essential part of geologic maps of the sea floor. These data also provide a valuable inventory of benthic habitat and resources. Geographic information system (GIS) data, maps, and interpretations, produced through the USGS and CZM mapping cooperative, are intended to aid efforts to manage coastal and marine resources and to provide baseline information for research focused on coastal evolution and environmental change.

Introduction

This report presents sea-floor sampling data and the biological classification of sea-floor photographs collected in 2010 from Buzzards Bay and Vineyard Sound, Massachusetts (fig. 1). The survey area covered approximately 670 square kilometers of the sea floor that was also mapped with geophysical systems between 2009–2010 in water depths from 3 to 46 meters (m). This report adds to the series of data reports (Ackerman and others, 2006, 2013; Andrews and others, 2010, 2013; Barnhardt and others, 2006, 2009, 2010; Pendleton and others, 2011; Turecek and others, 2012) produced by a cooperative mapping program of the U.S. Geological Survey (USGS) and the Massachusetts Office of Coastal Zone Management (CZM) (web address: http://woodshole.er.usgs.gov/project-pages/coastal_mass/). The sea-floor sampling data in this report were obtained during a USGS research cruise in 2010 aboard the research vessel (RV) *Connecticut* (fig. 2). These data were collected to verify the geophysical data obtained during USGS research cruises in 2009 and 2010 (aboard the motor vessel (MV) *Megan T. Miller* and the MV *Scarlett Isabella*) and one

¹U.S. Geological Survey

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National Oceanic and Atmospheric Administration (NOAA) hydrographic survey in 2004 (aboard the NOAA Ship *RUDE*).

The overall goal of this cooperative program is to characterize the sea floor and shallow subsurface inside the 3-mile limit of State waters by using high-resolution geophysical techniques, sediment sampling, and sea-floor photography and videography. The products developed and knowledge gained in this project have broad applicability to scientific and resource-management issues in the region. Sampling data are used to verify interpretations made from seamless geophysical datasets and are a key component of geologic and habitat mapping efforts. Seabed-characterization maps and geospatial data collected and published through this mapping cooperative help scientists understand the processes that have shaped the coast, and how it has evolved over time, thereby helping them to evaluate the vulnerability of coastal environments to storms, sea-level rise, and long-term climate change. This report adds to a science foundation that will be the basis for managing marine habitats, addressing offshore development projects, and assessing environmental changes caused by natural processes or human activities.

Data Collection and Processing

Survey Operations

The USGS collected sea-floor sampling data from September 9 to 14, 2010, aboard the RV *Connecticut* (during USGS Field Activity 2010–005–FA), by using the SEABed Observation and Sampling System (SEABOSS; Valentine and others, 2000) to verify geophysical data at 301 sampling sites in Buzzards Bay and Vineyard Sound, Massachusetts (fig. 3). SEABOSS sites were chosen on the basis of changes in dynamic range in the acoustic backscatter data and preliminary interpretations of other geophysical data collected between 2004 and 2010 (fig. 4).

The SEABOSS contains forward- and down-looking video cameras, a digital still camera, and a modified Van Veen sediment sampler. The elements of the SEABOSS are contained within a stainless steel framework, measuring 110×110 centimeters (cm) and 118 cm tall and weighing 167 kilograms (368 pounds) overall. The frame has a stabilizer fin that orients the system as it drifts over the seabed. The digital camera, a Minolta DiIMAGE A2, is mounted in a machined Delrin housing with a flat port and is set for 3264×2448 pixel images at the “fine” setting for compression. The system also has a PHOTOSEA strobe. Two lasers are set 20 cm apart (both as they are mounted on the SEABOSS frame and as seen in photographs and video on the seabed) for scale measurements. The red laser dots can usually be seen in the photographs, their visibility depending on the sea floor’s bottom type and distance from the camera. A third laser is positioned at an angle so that when it intersects the other lasers, the SEABOSS is at the optimum height (approximately 75 cm above the sea floor) for a still photograph. After the camera is powered up, it is set to a manual focus and a default focus distance. The default focus distance is slightly less than the optimum height above the sea floor to account for optical distortion under water. All of the system’s elements are powered from the surface vessel through a conducting cable.

On this survey, the SEABOSS was deployed from the RV *Connecticut* off the ship’s A-frame on the stern (fig. 5). When the vessel arrived at a target site, the SEABOSS was deployed. At a typical site, the vessel and sampler drifted with the winds and currents for approximately 5–15 minutes, during which continuous video was collected and high-resolution still photographs were taken at irregular intervals, usually beginning with the start of a SEABOSS deployment; photographs were taken at least once per minute as well as just prior to the taking of physical sediment samples. Typically, at the end of

a SEABOSS deployment, the system would be lowered to the sea floor, triggering the sampler to close and collect a relatively undisturbed surficial sediment from the sea floor. After the sample is brought to the deck of the ship, the upper 2 cm of the sediment grab is subsampled with a calibrated stainless-steel shovel and stored for grain-size analysis at the USGS sediment laboratory at the Woods Hole Coastal and Marine Science Center.

Surficial Sediment Samples and Grain-Size Analyses

Surficial sediment samples were acquired at 246 of the 301 SEABOSS locations (figs. 3 and 4). Sediment samples were usually collected at the end of each camera tow, and samples were not typically collected in rocky areas. The upper 2 cm of sediment were bagged and taken to the USGS sediment laboratory for grain-size analysis. Grain-size analyses were completed using procedures outlined by Poppe and others (2005). The data analyzed include sample location, bulk weight, percent of sample in each 1-phi size class from -5 phi to 11 phi, sediment classification, kurtosis, and other sediment-related statistics. These data are available in geospatial format in appendix 1 (Geospatial Data) and spreadsheet format in appendix 2 (Textural Analyses).

Sea-Floor Photography and Video

High-resolution digital photographs and standard-definition analog videos of the sea floor were collected at all 301 locations within the study area (figs. 3 and 4). At each station, the USGS SEABOSS (fig. 5) was towed slightly above the sea floor at speeds of less than one knot. Because the recorded position is actually the position of the Global Positioning System (GPS) antenna on the survey vessel, not the SEABOSS sampler, a conservative estimated horizontal accuracy of the sample location is ± 30 m. Photographs were obtained using a Konica-Minolta DiMAGE A2 digital still camera, and continuous video was collected from a Kongsberg Simrad OE1365 high-resolution color video camera, usually for 5 to 15 minutes. Digital bottom photographs are available as JPEG images in appendix 3 (Bottom Photographs). Continuous video data are not included in this report but can be available upon request.

The photographs are geospatially located through a series of Python scripts that are run within an ArcGIS Toolbox. This process uses a common date and time field to match the photographs with the survey navigation data. The result is a geographic information system (GIS) shapefile containing the photograph name, other important Exchangeable image file format (Exif) metadata extracted from the JPEG header, and latitude and longitude for each photograph. The shapefile is also hotlink-ready for use in Esri ArcMap, enabling users to click on the photograph location on the map and view the photograph.

Several of the attributes in the bottom-photographs dataset were calculated in Esri ArcGIS using the Spatial Join tool. This tool was used to calculate the closest SEABOSS video survey trackline, the field number of the nearest surficial sediment sample, the sediment classification of the closest sample, and the distance in meters to the nearest sample for each bottom photograph. Additional information about the processing steps can be found in the metadata for the bottom-photographs dataset in appendix 1 (Geospatial Data).

Biological Classification of the Photographs

Nearly all of the 2,426 sea-floor photographs taken during U.S. Geological Survey (USGS) Field Activity 2010-005-FA were reviewed and classified by Massachusetts Office of Coastal Zone Management (CZM) biologists according to the Coastal and Marine Ecological Classification Standard (CMECS), specifically the Benthic Biotic Component (Federal Geographic Data Committee, 2012). Of

these, 2,265 photographs (fig. 6) were of suitable resolution for the benthic biology in their imagery to be classified.

CMECS is a hierarchal system that provides a way to classify ecological units by using a standard format. In the CMECS Benthic Biotic Component, biotic classification units are defined by the dominance of sessile or relatively nonmobile fauna; taxa with the greatest percent cover in the observational footprint are deemed the most dominant and are classified as the Biotic Group. Because additional taxa and groups of interest can co-occur with the dominant taxa group in any given photograph, two co-occurring biotic groups (Co-occurring Element Modifiers) and two associated taxa (Associated Taxa Modifiers) were added as modifiers to the classification scheme. Adding modifiers to the dominant biotic group increases the amount of biological information available from the imagery without adding a significant time burden to the visual analysis of the photographs.

The analyzed images are useful for creating maps of existing biological resources and identifying important habitat areas and habitat associations. For example, the classified images can be used to map and identify the following: areas of high relief and structure necessary for sessile organisms such as sponges and bryozoans to attach (figs. 7 and 8), areas of hard substrate at depths shallow enough to accommodate photosynthesis in benthic macroalgae (figs. 9 and 10), areas of soft sediment suitable for species such as those that burrow (figs. 9 and 10), and the distribution of nonnative species, can affect habitat quality (figs. 11, 12, and 13). The biological information derived from the digital photographs allows for a more complete assessment of benthic habitat conditions.

The biological information from the photographs might also improve the accuracy of bottom-type interpretation. For example, heavy accumulations of *Crepidula* sp. could be incorrectly interpreted as hard bottom, on the basis of the backscatter intensity data alone (figs. 14 and 15). Relief created from benthic species such as soft-sediment sponges and hard corals that would not necessarily be identified as structure in a geological context can also be mapped (figs. 16, 17, 18, and 19).

The classification of the benthic biota is included in the bottom-photographs dataset. These data are available as a spreadsheet, shapefile, or Google Earth KMZ file (fig. 20) in appendix 1 (Geospatial Data). Additional information about the classification process and its accuracy can be found in the metadata for the bottom-photographs dataset in appendix 1 (Geospatial Data).

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Figures

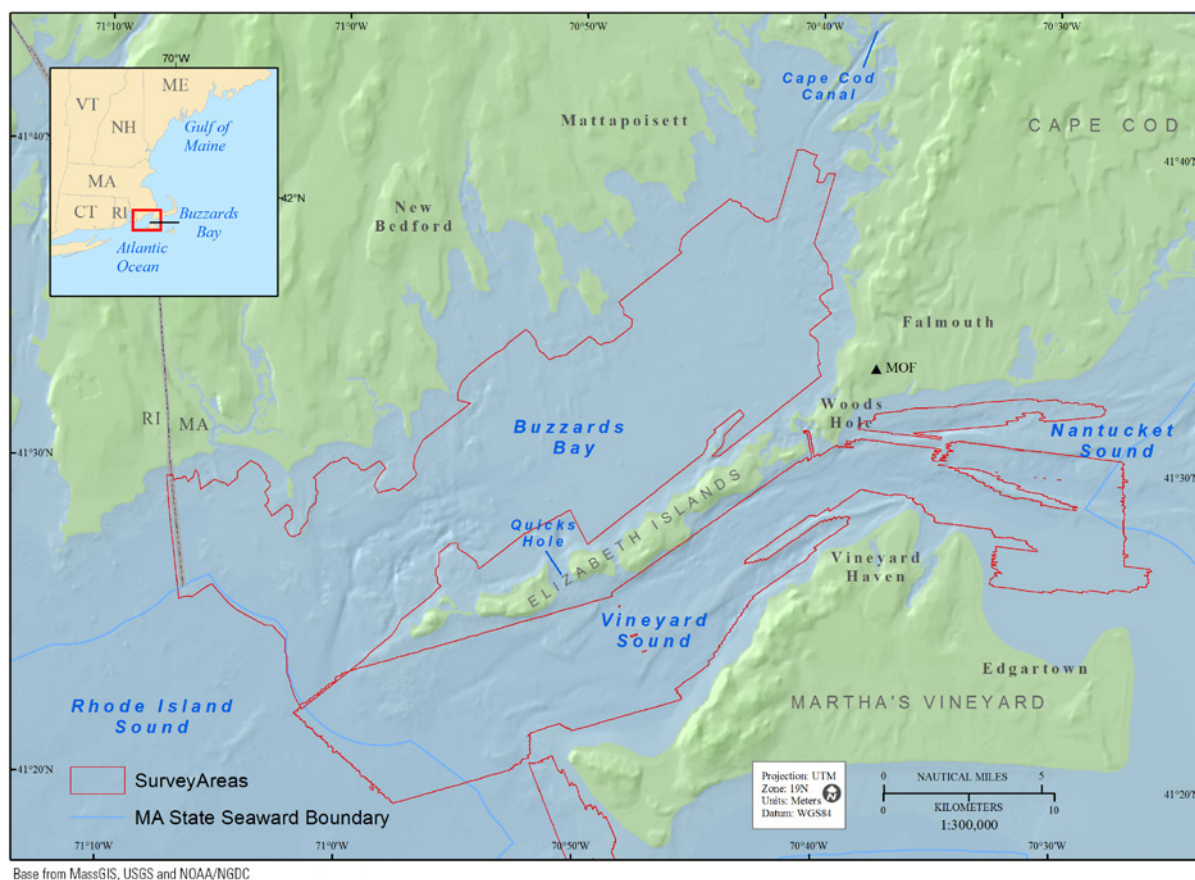
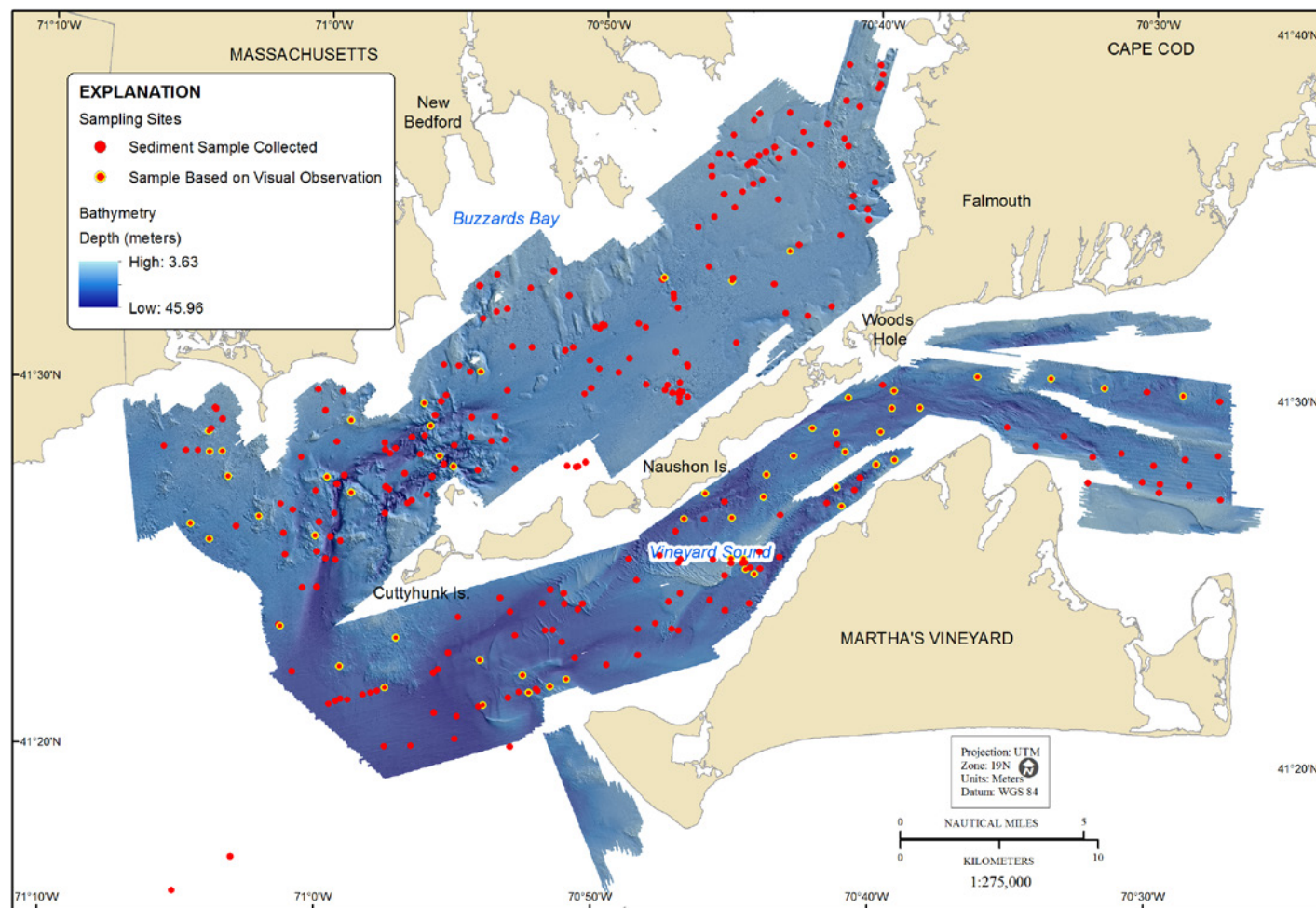


Figure 1. Map showing the location of the area targeted for sampling (outlined in red) offshore of Massachusetts in Buzzards Bay and Vineyard Sound. Sampling was generally done in the area coincident with newly acquired geophysical data from 2009 and 2010. MOF, [U.S. Geological Survey] Marine Operations Facility; UTM, Universal Transverse Mercator; WGS 84, World Geodetic System of 1984.



Figure 2. Photograph of the research vessel (RV) used for the sampling survey, the RV *Connecticut*.



Base from U.S. Geological Survey Open File Reports 2012-1002 and 2012-1006

Figure 3. Map showing SEABed Observation and Sampling System (SEABOSS) sampling sites (red dots) over depth-colored shaded-relief topography of the sea floor in the study area. Bathymetry is from U.S. Geological Survey Open-File Reports 2012-1002 and 2012-1006. Is., Island; UTM, Universal Transverse Mercator; WGS 84, World Geodetic System of 1984.

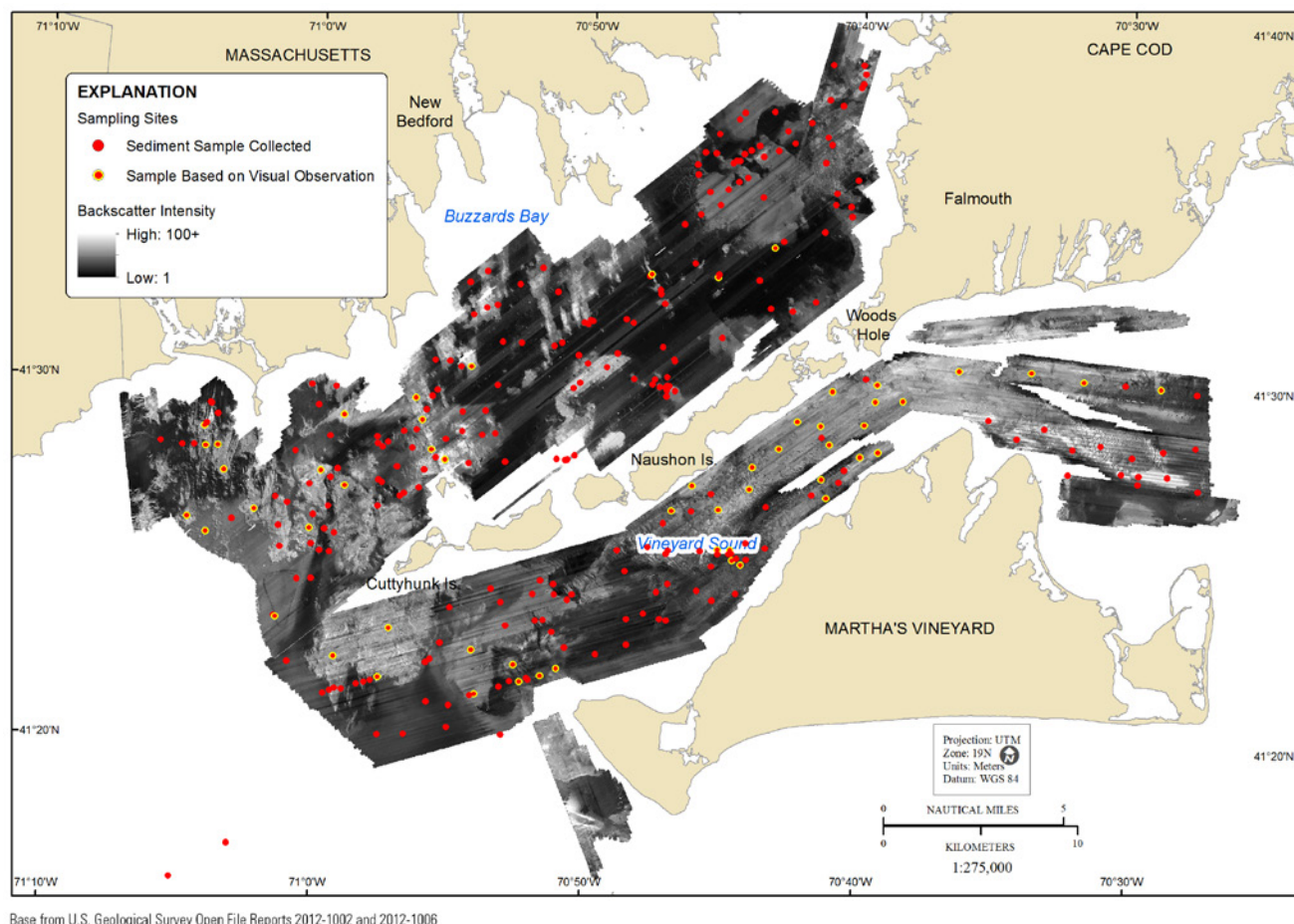


Figure 4. Map showing SEABed Observation and Sampling System (SEABOSS) sampling sites (red dots) overlaid on acoustic-backscatter intensity in the study area. Backscatter intensity is an acoustic measure of the relative hardness and roughness of the sea floor. In general, high values (light tones) represent rock, boulders, cobbles, gravel, and coarse sand. Low values (dark tones) generally represent fine sand and muddy sediment. Tonal variations can occur across track in the sidescan-sonar data as a result of changes in acquisition or processing parameters. Backscatter imagery is from U.S. Geological Survey Open-File Reports 2012–1002 and 2012–1006. Is., Island; UTM, Universal Transverse Mercator; WGS 84, World Geodetic System of 1984.



Figure 5. Photograph of the SEABed Observation and Sampling System (SEABOSS) during survey 2010-005 aboard the research vessel *Connecticut*. The SEABOSS system was used to collect video, photographic data, and sediment samples.

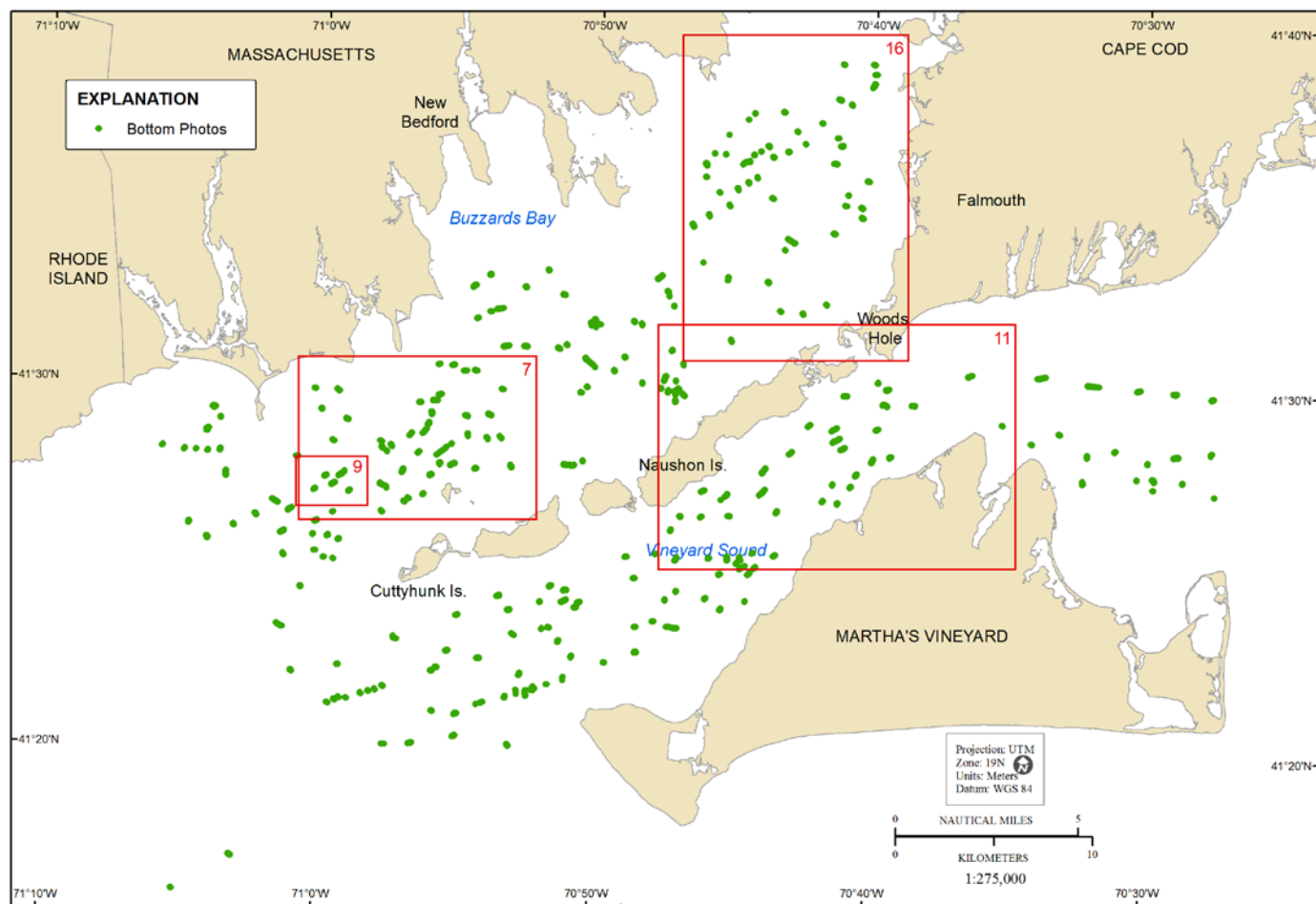
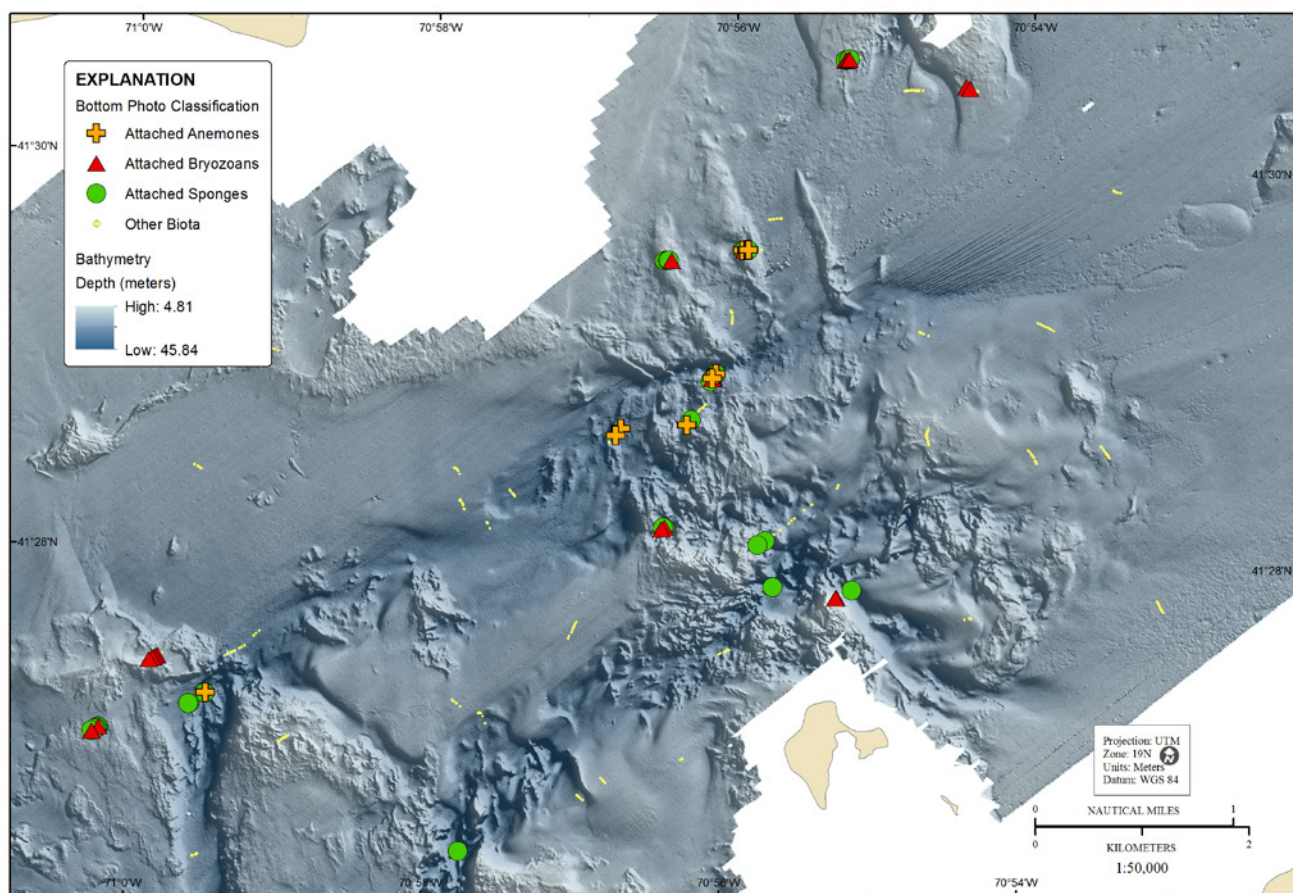


Figure 6. Map showing locations of 2,426 bottom photographs, which were classified according to the Coastal and Marine Ecological Classification Standard (CMECS), specifically the Benthic Biotic Component. Red rectangles indicate areas of detail shown in figures 7, 9, 11, and 16. Is., Island; UTM, Universal Transverse Mercator; WGS 84, World Geodetic System of 1984.



Base from U.S. Geological Survey Open File Reports 2012-1002 and 2012-1006

Figure 7. Map showing a high-relief area colonized by anemones, bryozoans, and sponges. See figure 6 for map location. See figure 8 for an example photograph (d3_PICT0864.JPG). Bathymetry is from U.S. Geological Survey Open-File Report 2012-1002. Is., Island; UTM, Universal Transverse Mercator; WGS 84, World Geodetic System of 1984.

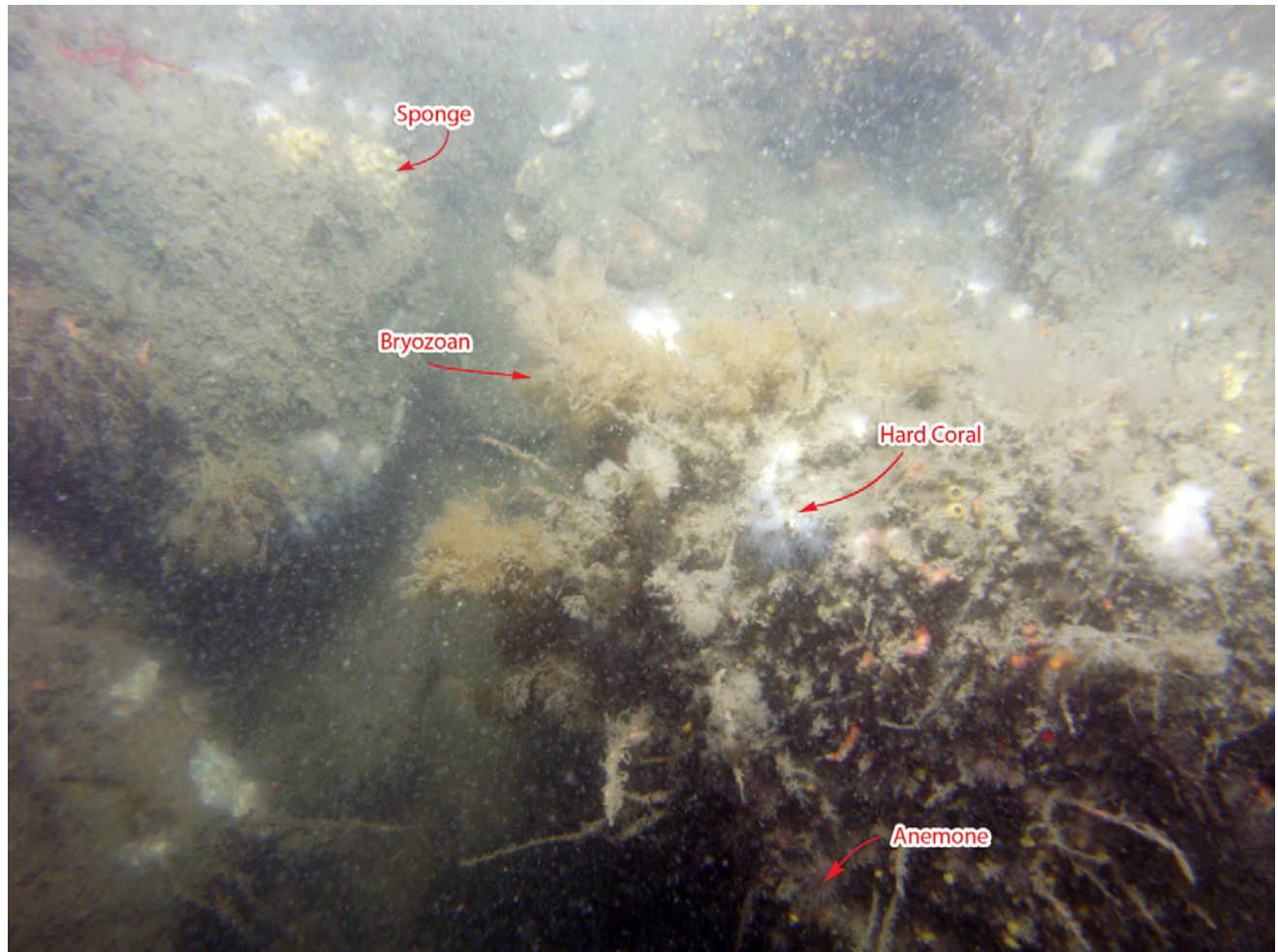
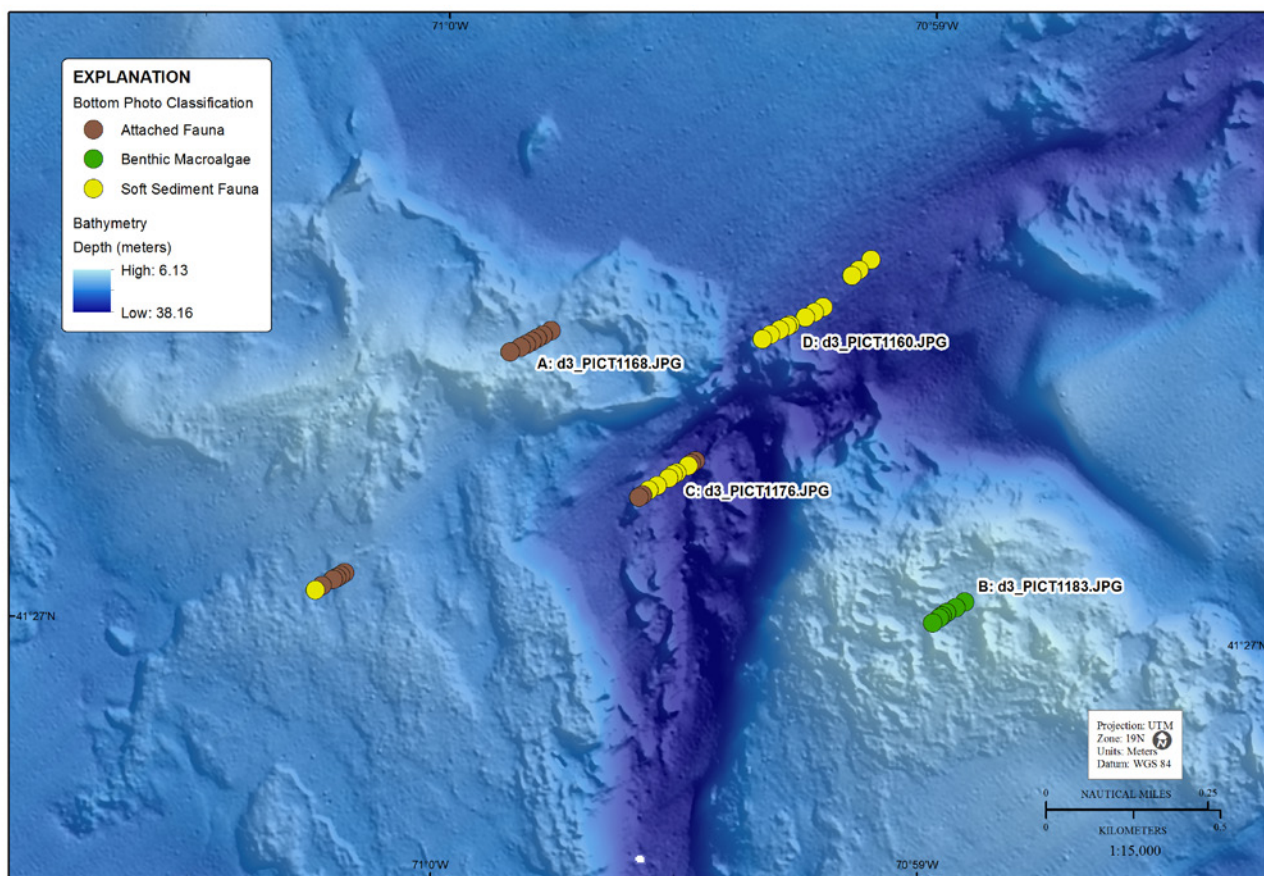


Figure 8. Photograph d3_PICT0864.JPG, taken along SEABed Observation and Sampling System (SEABOSS) video trackline 112, of bryozoans, anemones, sponges, *Astrangia* sp. (hard coral), and other species colonizing hard substrate. See figure 7 for photograph location. Scale of the photographs are generally 0.5 to 1.0 meters across, depending on the height of the SEABOSS when the photograph was taken. The scale of this photograph is 80 centimeters across.



Base from U.S. Geological Survey Open File Reports 2012-1002 and 2012-1005

Figure 9. Map showing a channel feature and the distribution of primarily soft-sediment species within the channel and benthic macroalgae (seaweeds) and other attached sessile species in the areas of higher elevation and relief. See figure 6 for map location. See figure 10 for example photographs (A, d3_PICT1168.JPG; B, d3_PICT1183.JPG; C, d3_PICT1176.JPG; D, d3_PICT1160.JPG). Bathymetry is from U.S. Geological Survey Open-File Report 2012-1002. UTM, Universal Transverse Mercator; WGS 84, World Geodetic System of 1984.

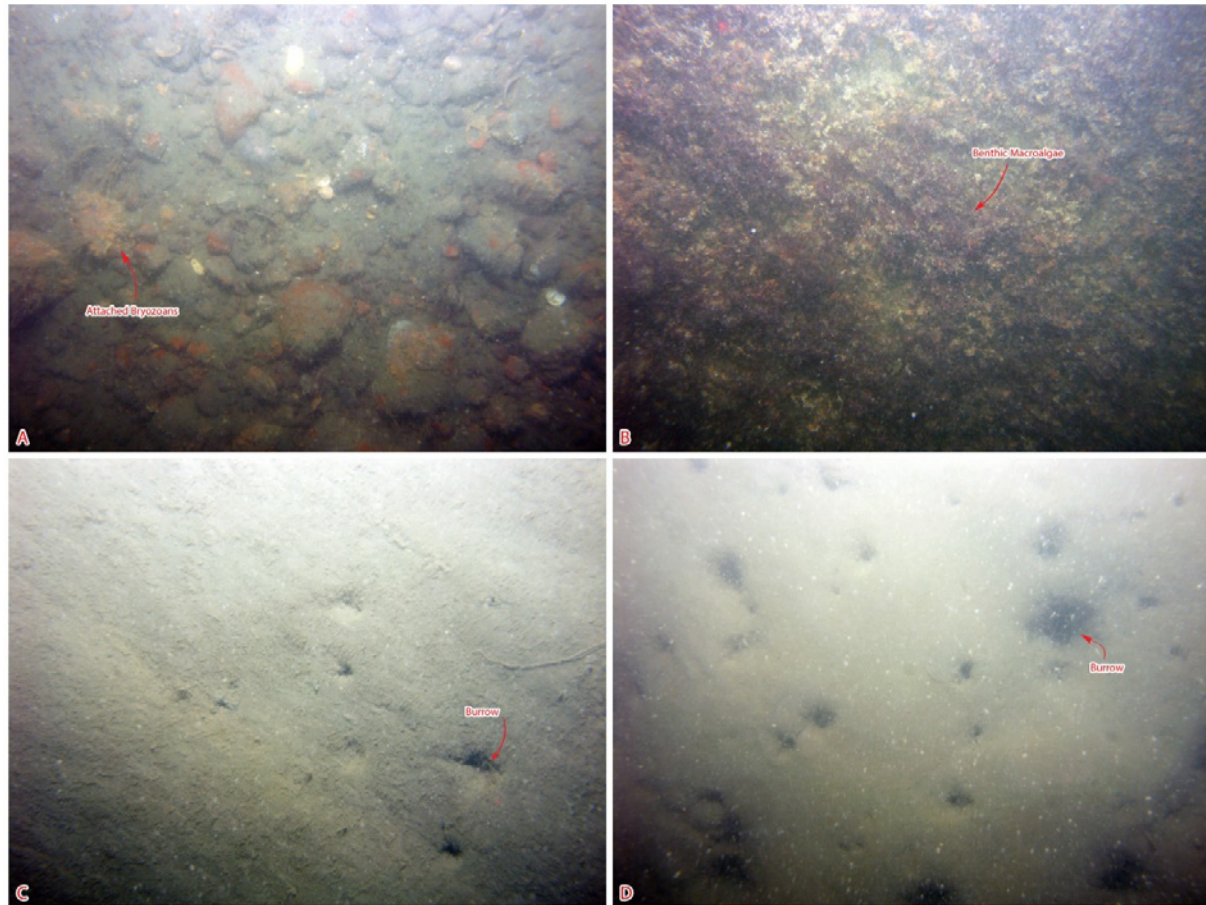


Figure 10. Photographs of *A*, attached fauna west of the channel, *B*, benthic macroalgae east of the channel, *C*, soft-sediment fauna in the channel, and *D*, soft-sediment fauna at the mouth of the channel. See figure 9 for photograph locations. Photograph *A*, d3_PICT1168.JPG, taken along SEABed Observation and Sampling System (SEABOSS) video trackline 156; *B*, d3_PICT1183.JPG, trackline 158; *C*, d3_PICT1176.JPG, trackline 157; *D*, d3_PICT1160.JPG, trackline 155. The scale of these photographs are *A*, 80 centimeters (cm) across; *B*, 60 cm; *C*, 50 cm; *D*, 60 cm.

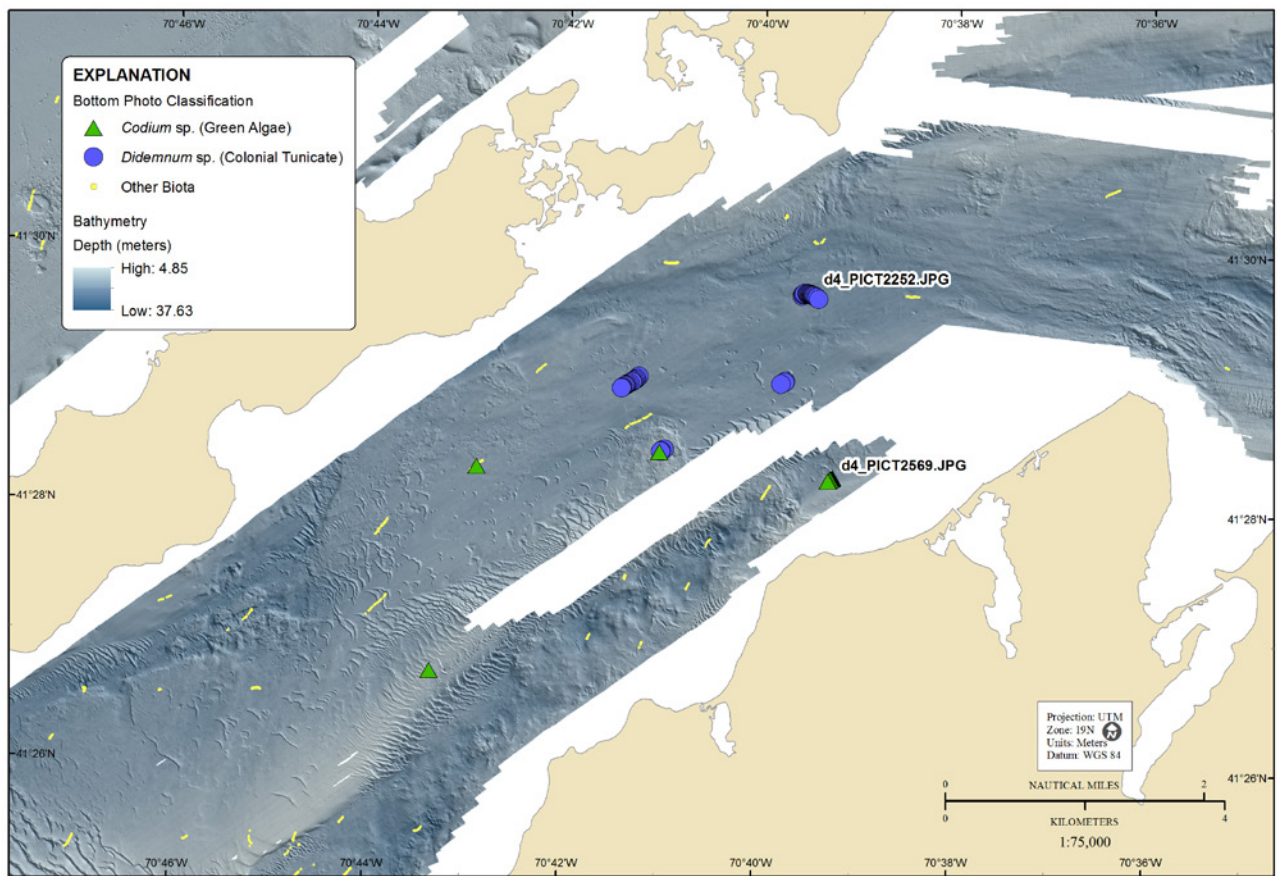


Figure 11. Map showing the distribution of nonnative species, including *Codium fragile* (likely *Codium fragile* ssp. *fragile*) and *Didemnum* sp. (likely *Didemnum vexillum*), identified in the classified bottom photographs. See figure 6 for map location. See figures 12 and 13 for example photographs (d4_PICT2252.JPG and d4_PICT2569.JPG, respectively). Bathymetry is from U.S. Geological Survey Open-File Reports 2012-1002 and 2012-1006. UTM, Universal Transverse Mercator; WGS 84, World Geodetic System of 1984.

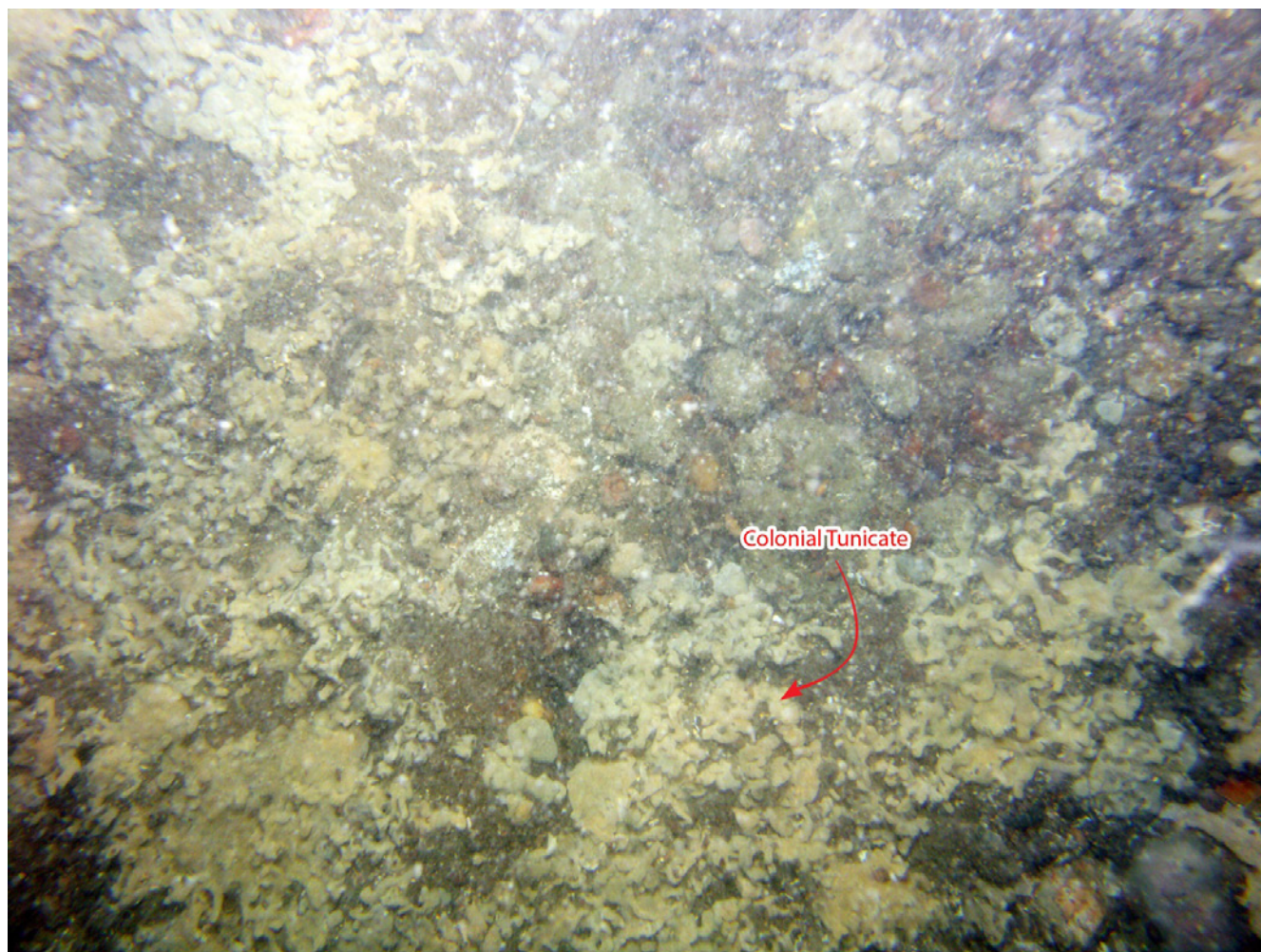


Figure 12. Photograph d4_PICT2252.JPG, taken along SEABed Observation and Sampling System (SEABOSS) video trackline 272, of a colonial tunicate, likely nonnative *Didemnum vexillum*, on cobbles in Vineyard Sound. See figure 11 for photograph location. The scale of this photograph is 1 meter across.

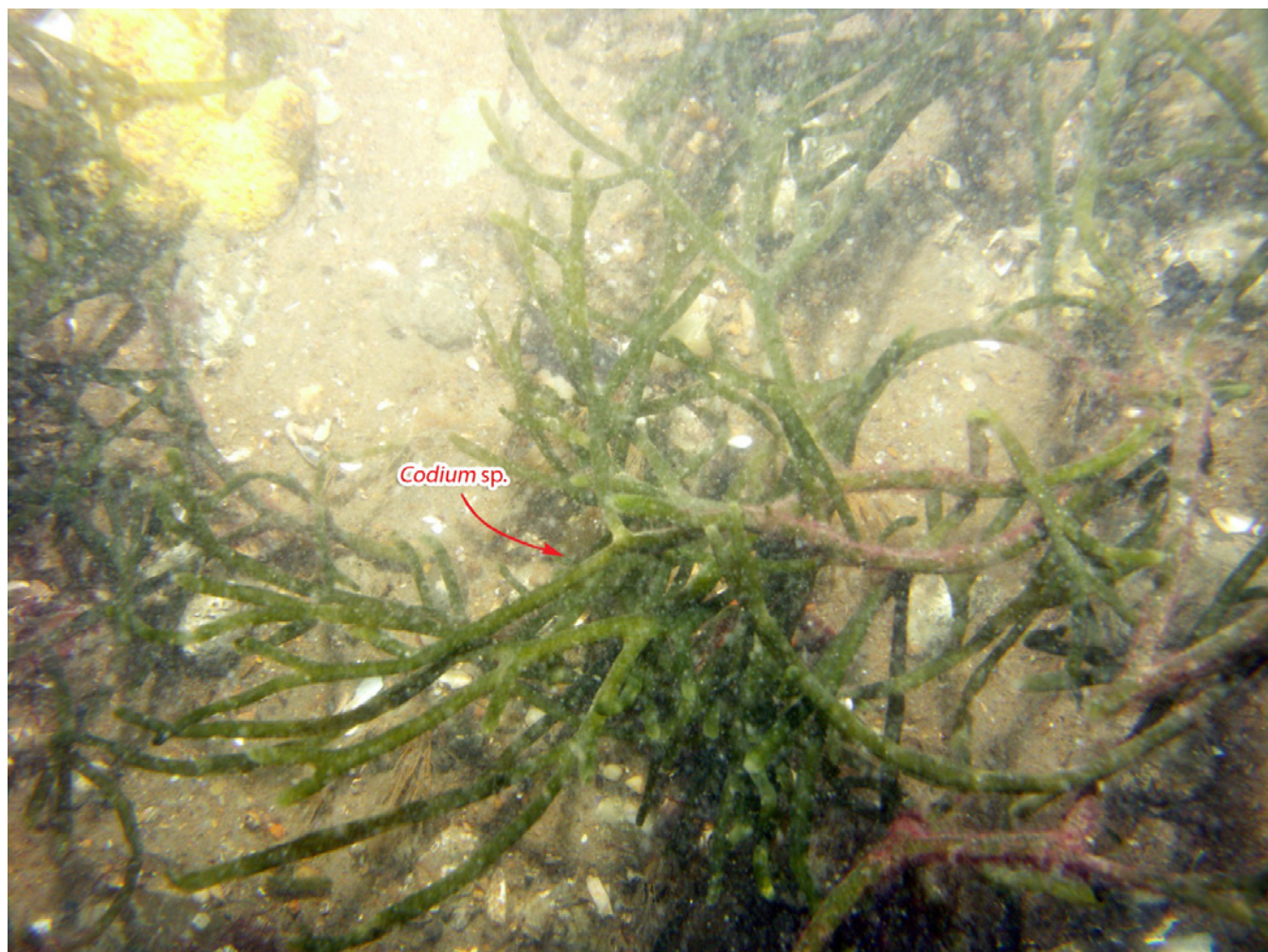
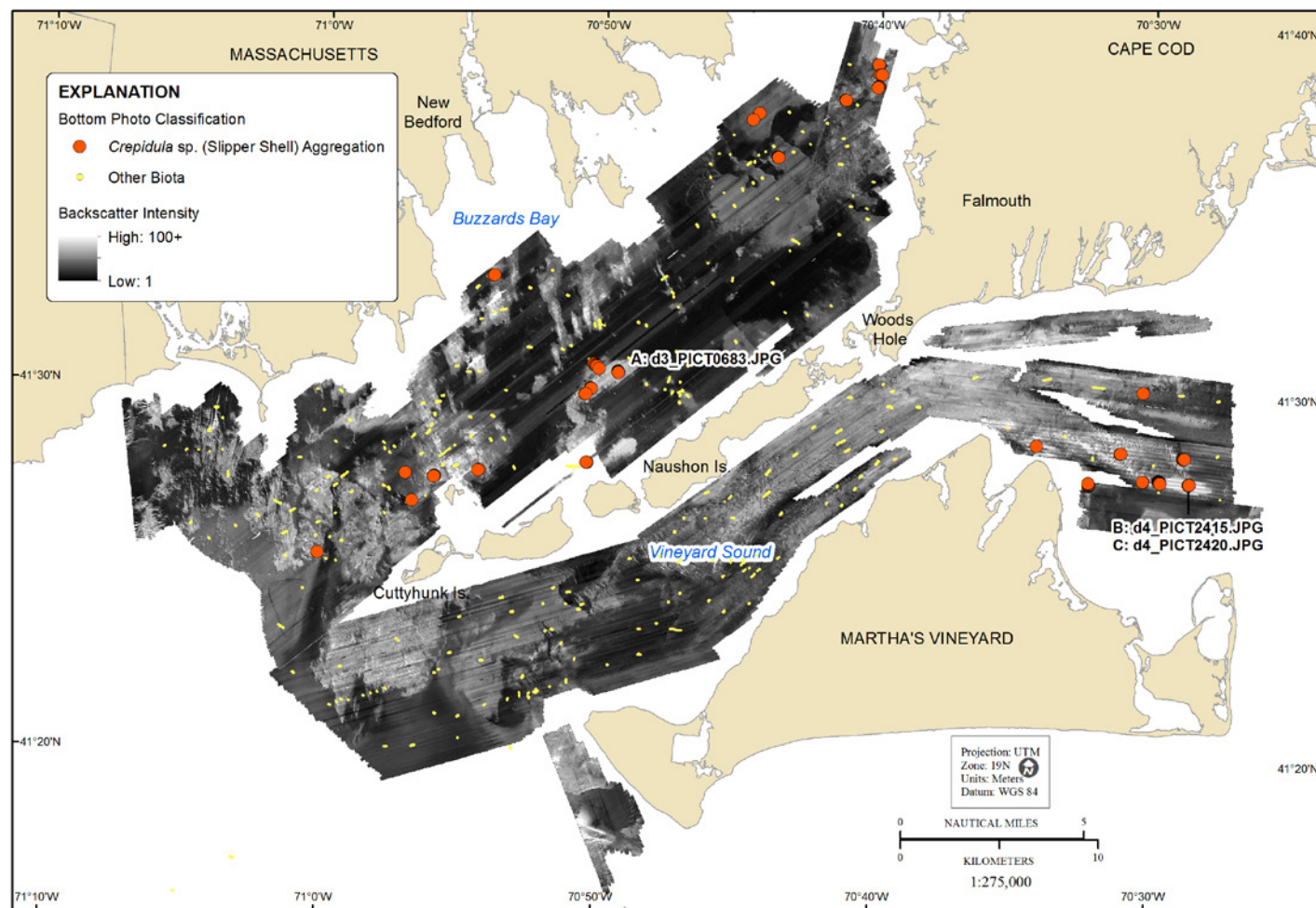


Figure 13. Photograph d4_PICT2569.JPG, taken along SEABed Observation and Sampling System (SEABOSS) video trackline 300, of the green algae *Codium* sp., likely the nonnative *Codium fragile* ssp. *fragile*. See figure 11 for photograph location. The scale of this photograph is 80 centimeters across.



Base from U.S. Geological Survey Open File Reports 2012-1002 and 2012-1006

Figure 14. Map showing *Crepidula* sp. (slipper shell) aggregations overlaid on backscatter intensity. See figure 15 for example photographs (A, d3_PICT0683.JPG; B, d4_PICT2415.JPG; C, d4_PICT2420.JPG). Backscatter imagery is from U.S. Geological Survey Open-File Reports 2012-1002 and 2012-1006. Is., Island; UTM, Universal Transverse Mercator; WGS 84, World Geodetic System of 1984.



Figure 15. Photographs of *Crepidula* sp. (slipper shell) aggregations, including reef formations (B and C). See figure 14 for photograph locations. A, Photograph d3_PICT0683.JPG, taken along SEABed Observation and Sampling System (SEABOSS) video trackline 94; B, d4_PICT2415.JPG, trackline 282, C: d4_PICT2420.JPG, trackline 282. The scale of these photographs are A, 60 centimeters (cm) across; B, 65 cm; C, 40 cm.

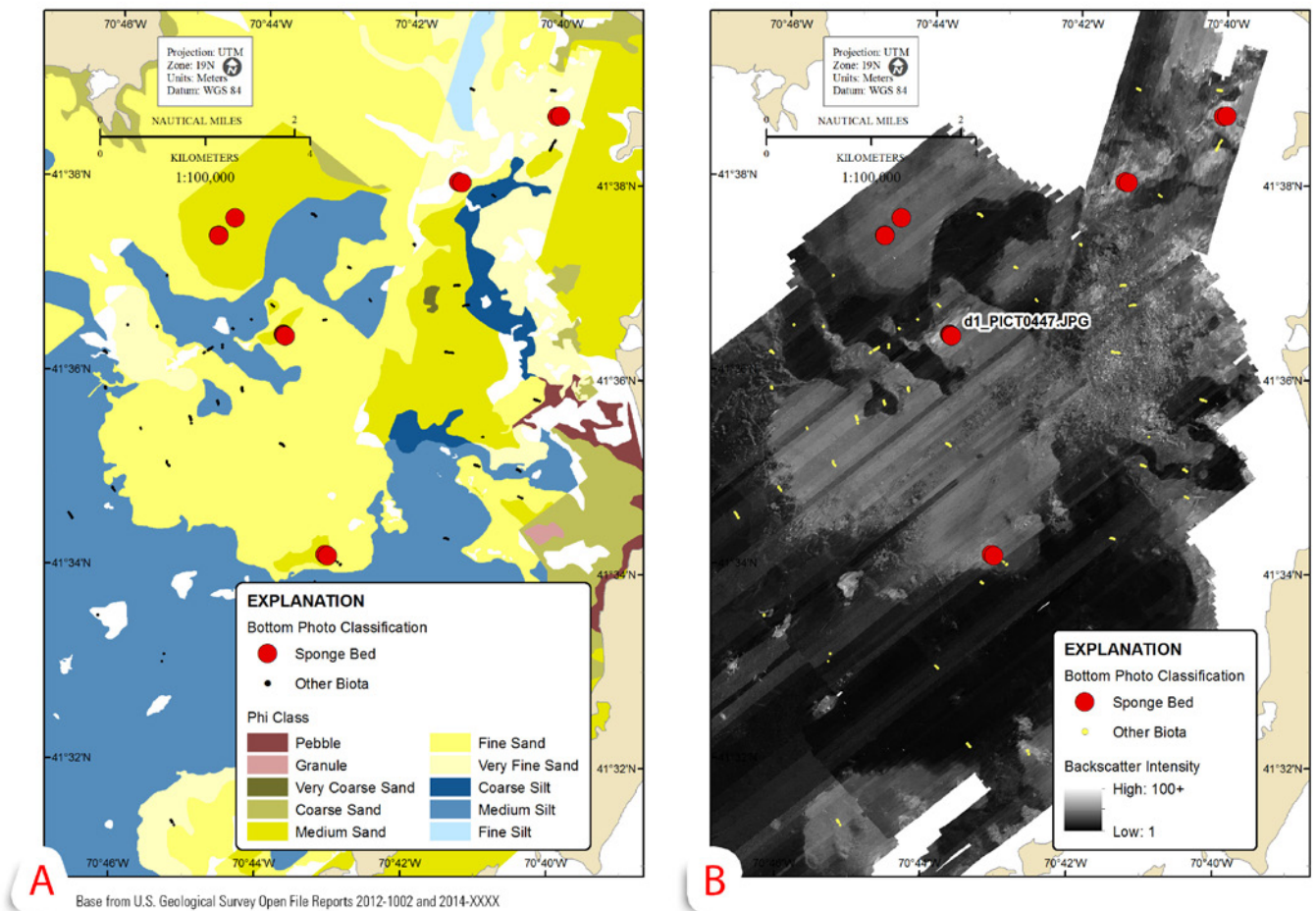


Figure 16. Maps showing soft-sediment sponges overlaid on *A*, sediment phi class, and *B*, backscatter intensity. See figure 6 for map location. See figure 17 for an example photograph (d1_PICT0447.JPG). Sediment phi classes are from U.S. Geological Survey Open-File Report 2014-1220 (Foster and others, 2014). Backscatter imagery from USGS Open-File Report 2012-1002. UTM, Universal Transverse Mercator; WGS 84, World Geodetic System of 1984.

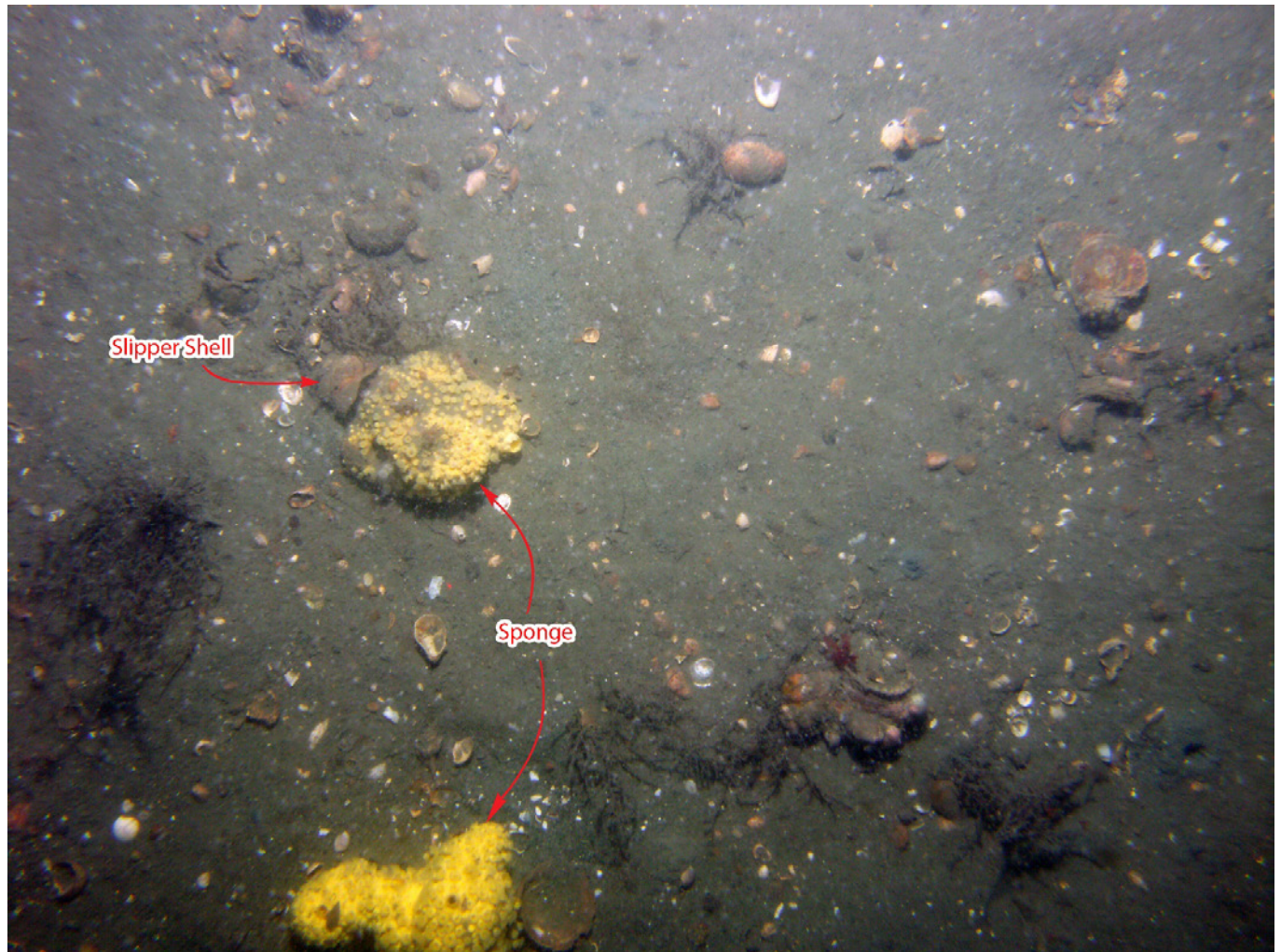
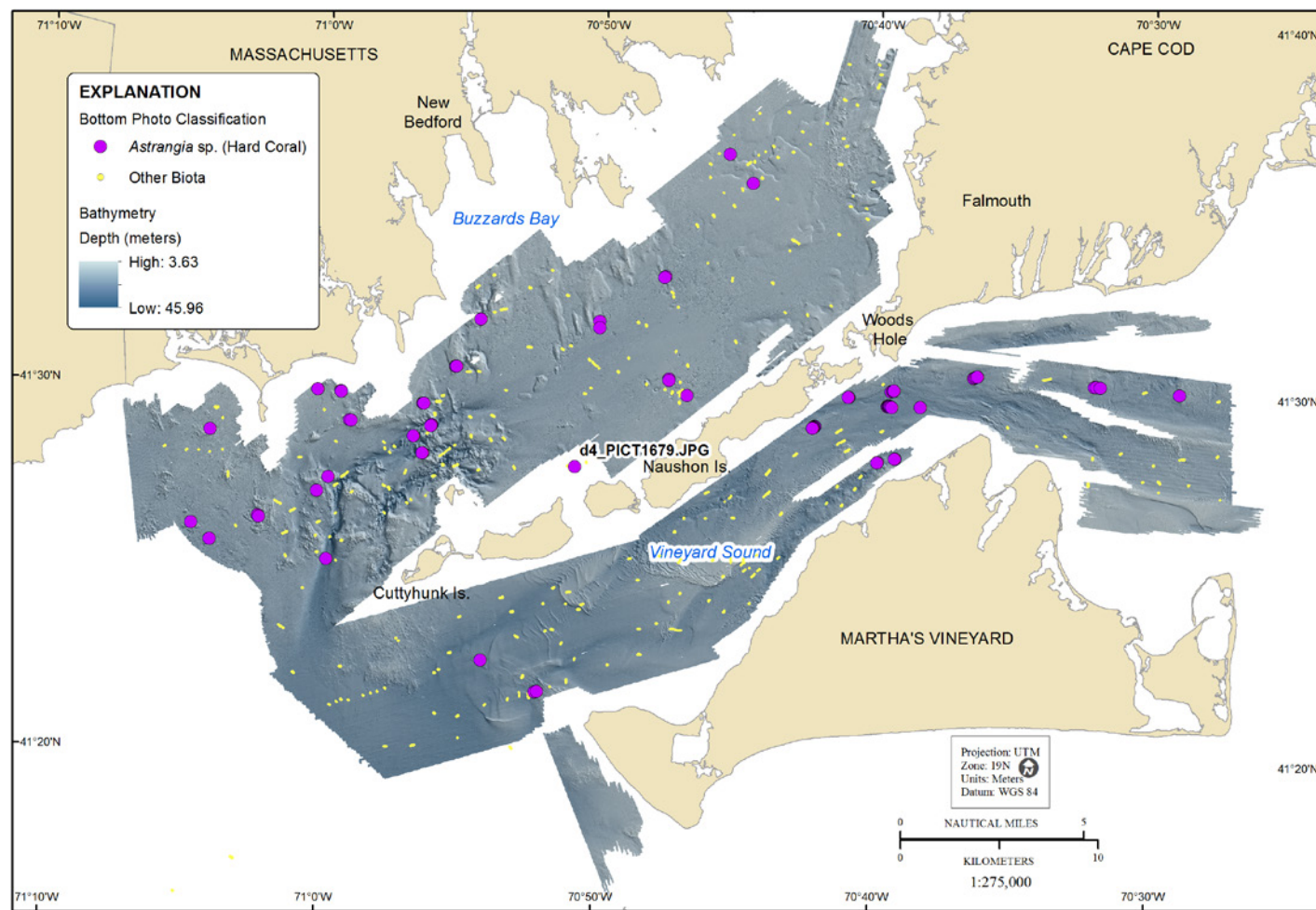


Figure 17. Photograph d1_PICT0447.JPG, taken along SEABed Observation and Sampling System (SEABOSS) video trackline 018, of *Cliona* sp. (sponge) and *Crepidula* sp. (slipper shell) on primarily soft substrate. See figure 16 for photograph location. The scale of this photograph is 60 centimeters across.



Base from U.S. Geological Survey Open File Reports 2012-1002 and 2012-1006

Figure 18. Map showing *Astrangia* sp. (hard coral) distribution. See figure 19 for an example photograph (d4_PICT1679.JPG). Bathymetry is from USGS Open-File Reports 2012-1002 and 2012-1006. Is., Island; UTM, Universal Transverse Mercator; WGS 84, World Geodetic System of 1984.

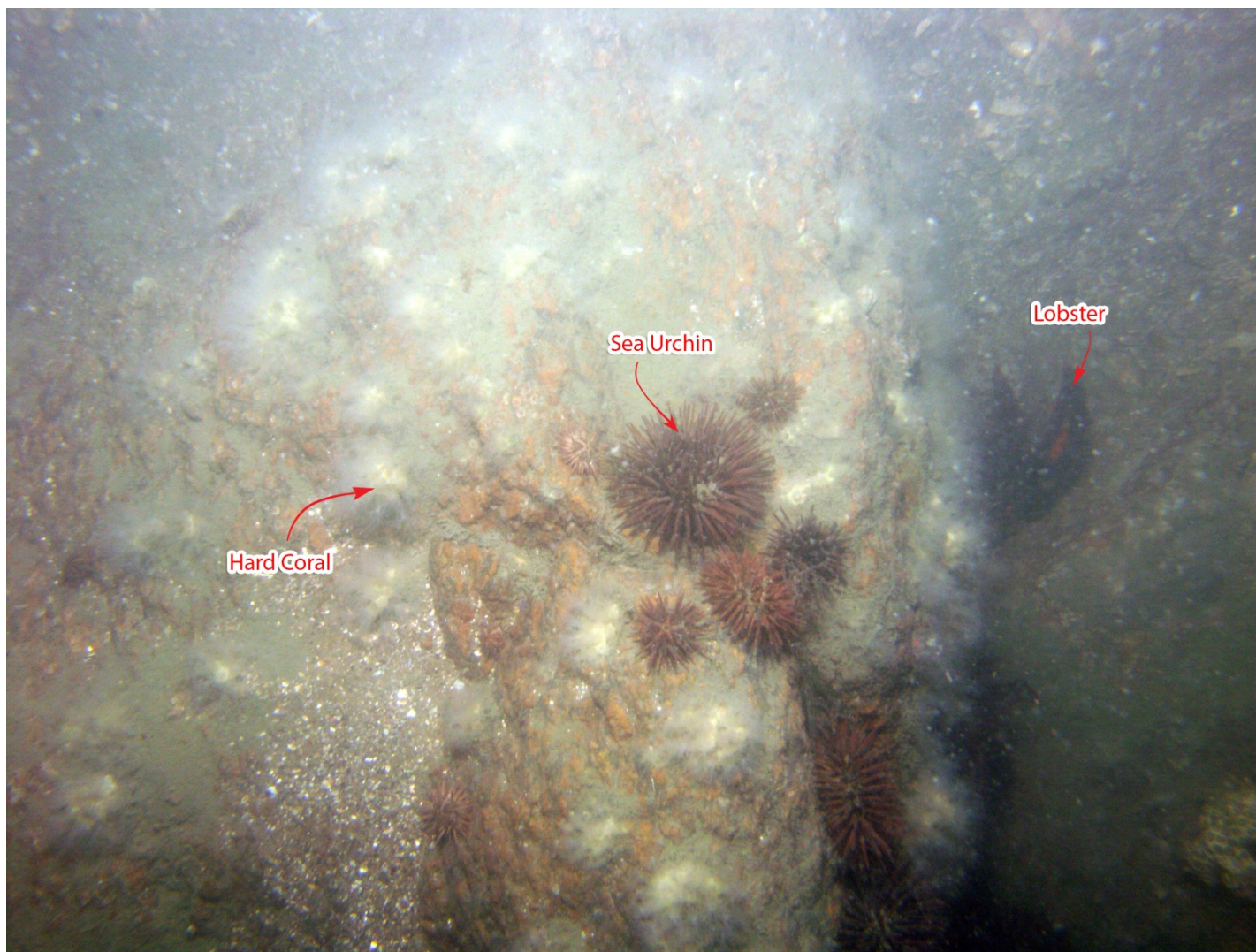


Figure 19. Photograph d4_PICT1679.JPG, taken along SEABed Observation and Sampling System (SEABOSS) video trackline 217b, of *Astrangia* sp. (hard coral) on a boulder. *Arbacia punctulata* (purple sea urchin) and *Homarus americanus* (American lobster) are also pictured. See figure 18 for photograph location. The scale of this photograph is approximately 60 centimeters across.

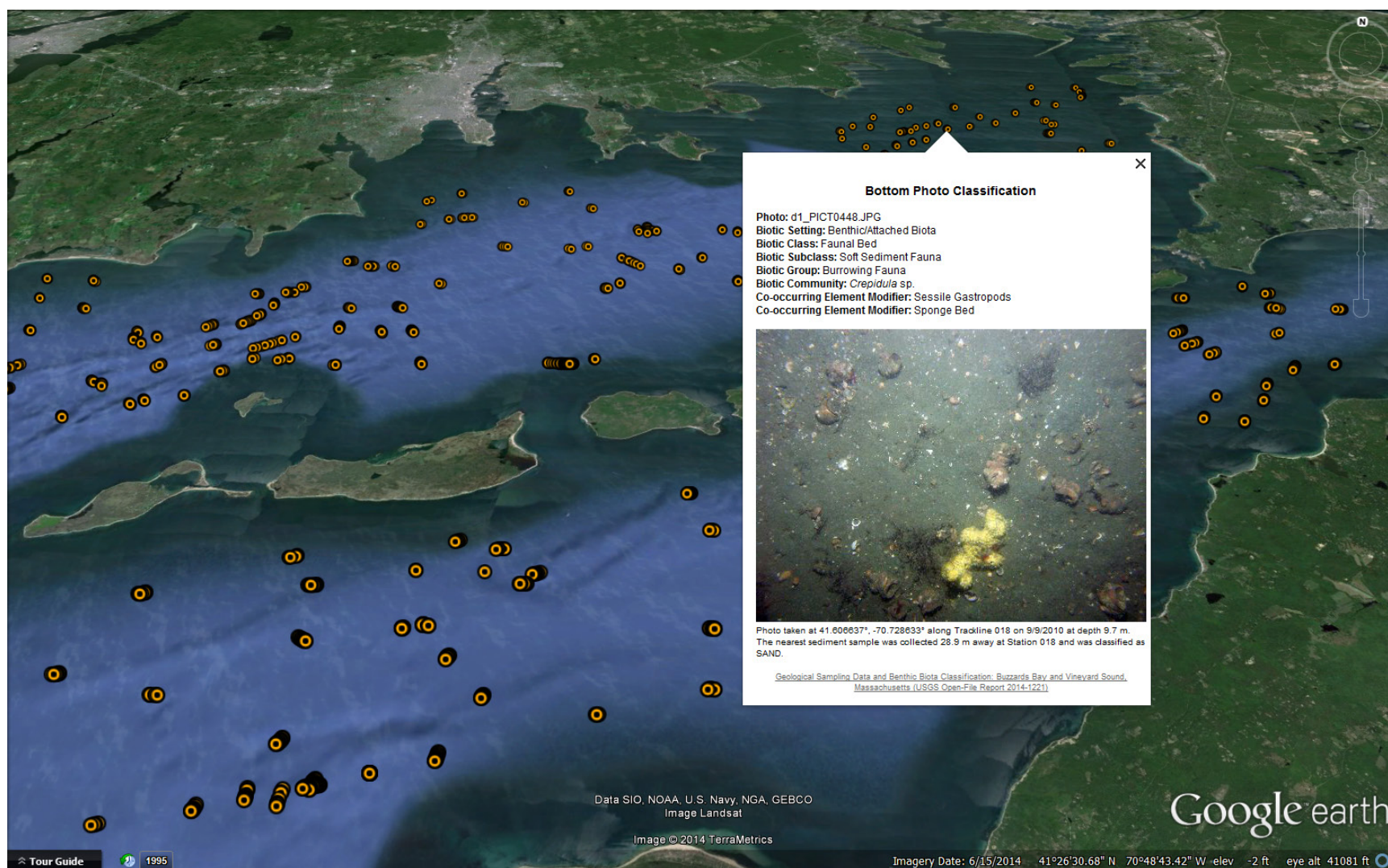


Figure 20. Screen capture of the Google Earth KMZ file that contains the Coastal and Marine Ecological Classification Standard (CMECS) classification of the bottom photographs.

Appendix 1. Geospatial Data

This section describes the data collected for this project, the location of the data, and how to access them.

Data Format and Projection

Most vector data are delivered as Esri shapefiles in the World Geodetic System of 1984 (WGS 84) geographic coordinate system. All spatial data are distributed with Esri-style metadata in extensible markup language (XML) format. Metadata are also provided for all spatial data in Federal Geographic Data Committee (FGDC) compliant text (TXT) and FGDC classic hypertext markup language (HTML) formats. Esri ArcCatalog 9.x can be used to examine the metadata in a variety of additional formats.

Data Access

The complete datasets from this project can be accessed in the following ways:

- With ArcGIS 9.2 or later, all shapefile and raster data can be viewed and manipulated. Download the shapefiles and organize them into the directory structure outlined below, then open the ArcMap document [2014_1221.mxd](#). This map document has all the data layers loaded in the table of contents and uses relative links for access to the data and hotlinked sea-floor photographs.
- Without any geographic information systems (GIS) software, view the data through ArcReader, a free mapping application distributed by Esri for Windows, Linux, and Unix operating systems. Download ArcReader from the Esri Web site (<http://www.esri.com/software/arcgis/arcreader/download.html>) and follow the directions for downloading and installing the free software. Once ArcReader is installed, all the data can be viewed by opening the published map file (PMF) named [2014_1221.pmf](#), which was created in ArcMap version 9.3.1.

Data Organization

The data are organized in folders on the Publications Warehouse Web site. Data layers can be downloaded individually using the table below. Individual layers are provided in compressed (ZIP) files. Files in a ZIP archive can be extracted with various free software that can be found online.



GIS—Top-level directory for all spatial data. Copy or download the files to this folder on a local hard drive. Note: The size of the uncompressed GIS directory on the DVD-ROM is approximately 8.24 gigabytes (GB)

2014_1221.mxd—ArcGIS 9.3 map document (created with Esri ArcGIS 10.1) with all data loaded in the ArcMap table of contents

2014_1221.pmf—Esri ArcReader map document (created with Esri ArcGIS 9.3 Publisher) for use with free ArcReader software. Download ArcReader at <http://www.esri.com/software/arcgis/arcreader/download.html>



hyperlink_images—Folder containing sea-floor photographs in JPEG format. The sea-floor photographs are hyperlinked to the BBVS_BottomPhotos_wBio layer in the ArcMap document (MXD) table of contents. Use the hyperlink tool in ArcGIS to click on these point locations and view the linked image (this should

work flawlessly if the entire contents of the GIS directory are organized according to the directory structure outlined in this appendix and if the sea-floor photographs are downloaded as described below)



shapefile—Folder containing shapefiles in geographic coordinate system WGS 84

BBVS_BottomPhotos_wBio.shp—Shapefile: Sea-floor photograph locations with biological classifications

BBVS_SeabossTrackline.shp—Shapefile: Tracklines along which sea-floor photographs and videos were acquired

BBVS_SedimentSamples.shp—Shapefile: Locations of sediment samples or visual description of the sea floor from real-time observations. Analyses from the USGS sediment laboratory are included in this shapefile for SEABOSS stations where physical samples were collected.



kmz—Folder containing KMZ files for viewing the bottom photographs with biological classification data in Google Earth (<http://earth.google.com/>)

BBVS_KMZ_BottomPhotos_wBio.kmz—Google Earth KMZ file: Sea-floor photograph locations with biological classifications




BBVS_KMZ_BottomPhotos_wBio_AttachedFauna.kmz—Google Earth KMZ file: Sea-floor photograph locations with biological classifications—subset containing only locations where BIO_SUBCL = ‘Attached Fauna’



navigation—Folder containing compressed (ZIP) navigation files from U.S. Geological Survey (USGS) survey 2010–005–FA and a script to parse the data

Data Catalog

Vector Data—The vector data are stored and delivered in shapefile format in geographic coordinates. The hyperlinks in the “Layer (metadata)” column are linked to the metadata for the shapefile. The link in the “Download” column provides access to a compressed ZIP file, which contains the shapefile and csv, if applicable. The KMZ file for the bottom photographs must be downloaded separately from the shapefile and metadata.

Layer (metadata)	Description	Preview	Download file (size)
BBVS_BottomPhotos_wBio	Sea-floor photograph locations with biological classifications		Shapefile (<1 MB) Google Earth KMZ (100 MB)
BBVS_SeabossTrackline	Tracklines along which sea-floor photographs and videos were acquired		Shapefile (<1 MB)
BBVS_SedimentSamples	Locations of sediment samples or visual description of the sea floor from real-time observations. Analyses from the USGS sediment laboratory are included in this shapefile for SEABOSS stations where physical samples were collected		Shapefile (<1 MB)

KMZ Data—These data are stored and delivered in Google Earth KMZ format. The hyperlinks in the “Layer (metadata)” column are linked to the metadata for the KMZ files. The link in the “Download” column provides access to a compressed ZIP file, which contains the KMZ files and metadata.

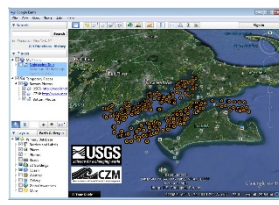

Layer (metadata)	Description	Preview	Download file (size)
BBVS_KMZ_BottomPhotos_wBio and BBVS_KMZ_BottomPhotos_wBio_AttachedFauna	Google Earth KMZ files: Sea-floor photograph locations with biological classifications (including a separate subset KMZ file containing only locations where BIO_SUBCL = ‘Attached Fauna’)		Google Earth KMZ (100 MB)

Image Data—To download these photographs in bulk (note: this could take a very long time), users can use the “wget” command in a Windows command prompt or terminal program in Linux, Unix, or Mac OS X operating systems. Change directory (“cd”) into the “GIS/hyperlink_images/seaboss/10005/” folder (following the directory structure outlined above in “Data Organization”). Then run the following command:

```
wget -r -ll -H -t1 -nd -N -np -A.jpg -erobots=off
```

http://pubs.usgs.gov/of/2014/1221/GIS/hyperlink_images/seaboss/10005/

Hyperlinked Images (metadata)	Description	Preview	Download file (size)
BBVS_SEABOSS_Photos	Sea-floor photographs in JPEG format		** See note above for downloading instructions (8.21 GB)

Navigation Data—The link in the “Download” column provides access to a compressed ZIP file, which contains the navigation files.

Navigation	Description	Download file (size)
BBVS_Sampling_nav	Navigation data from USGS survey 2010–005–FA (10005)	BBVS_Sampling_nav_files.zip (~10.7 MB)

Appendix 2. Textural Analyses

This section describes the sediment texture data collected for this project and how to access them.

Sediment Texture Laboratory Data

The analysis of sediment texture for 246 sediment samples collected during U.S. Geological Survey field activity 2010–005–FA is presented in a summary table in comma-separated value (CSV) format (BBVS_SedimentSamples.csv), which can be accessed with any text editor or spreadsheet program. These data are also available in appendix 1 (Geospatial Data) as an Esri shapefile. See Poppe and others (2005) for a full description of the procedures used for the analysis. Sediment sampling was conducted from September 9–14, 2010, aboard the research vessel RV *Connecticut*.