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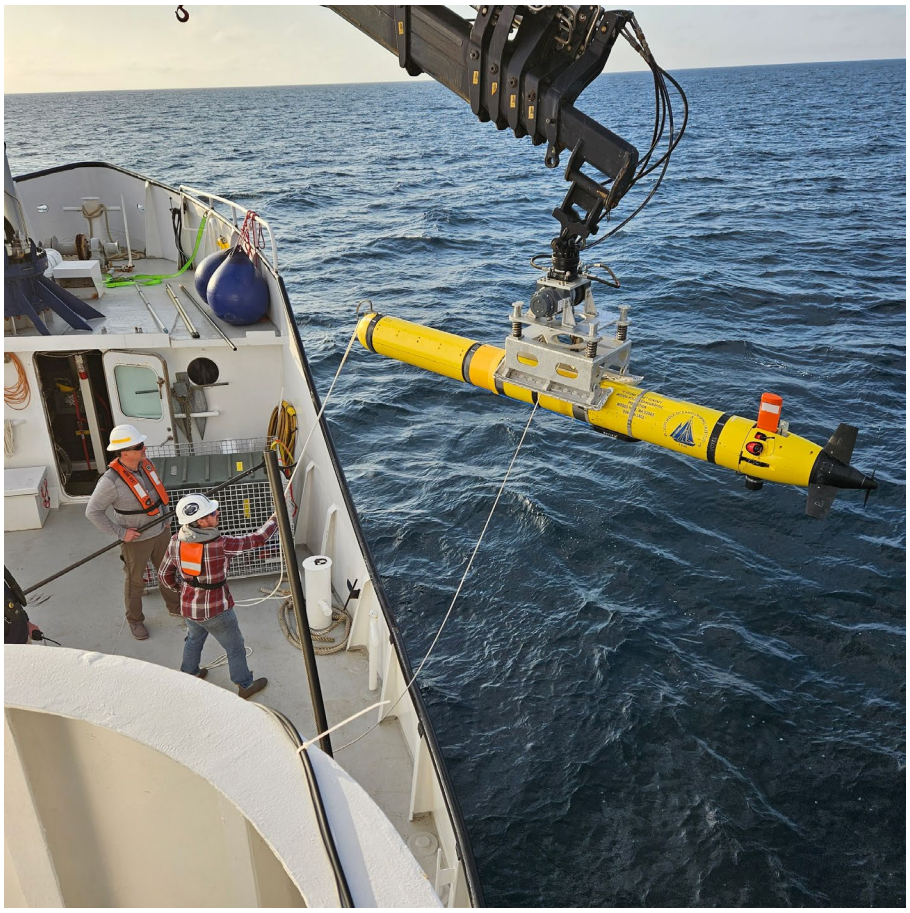
Cruise Report:
MDBC Expedition *R/V Oracle*,
March 11–15, 2024



July 2025

DWH MDBC Cruise Report 2025-02

DWH Mesophotic & Deep Benthic Communities Restoration

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Cover image credit: Erik Ebert/NOAA

For more information on MDBC Restoration, please visit:

https://coastalscience.noaa.gov/science-areas/restoration/gulf-mdbc-restoration/

and

https://www.fisheries.noaa.gov/southeast/habitat-conservation/mesophotic-and-deep-benthic-communities-restoration

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Cruise Report:
MDBC Expedition *R/V Oracle*,
March 11–15, 2024

Mapping, Ground-Truthing, and Predictive Habitat Modeling Project

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[1] CSS, Inc., under contract to NOAA, National Ocean Service, National Centers for Coastal Ocean Science
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July 2025

DWH MDBC Cruise Report 2025-02

DWH Mesophotic & Deep Benthic Communities Restoration

Deepwater Horizon **Mesophotic and Deep Benthic Communities Restoration**

This report is part of the NOAA Mesophotic and Deep Benthic Communities (MDBC) Series of publications that share the results of work conducted by the *Deepwater Horizon* MDBC restoration projects.

The 2010 *Deepwater Horizon* oil spill was an unprecedented event. Approximately 3.2 million barrels of oil were released into the deep ocean over nearly three months. The plume of oil moved throughout the water column, formed surface slicks that cumulatively covered an area the size of Virginia, and washed oil onto at least 1,300 miles of shoreline habitats. More than 770 square miles (2,000 square kilometers) of deep benthic habitat were injured by the oil spill, including areas surrounding the *Deepwater Horizon* wellhead and parts of the mesophotic reef complex located at the edge of the Mississippi–Alabama continental shelf.

Under the Oil Pollution Act, state and federal natural resource trustees conducted a Natural Resource Damage Assessment (NRDA). The Trustees assessed damages, quantifying the unprecedented injuries to natural resources and lost services. They also developed a programmatic restoration plan to restore injured resources and compensate the public for lost services.

In April 2016, a settlement was finalized that included up to $8.8 billion in funding for the *Deepwater Horizon* Trustees to restore the natural resource injuries caused by the oil spill as described in their programmatic restoration plan, Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement. The *Deepwater Horizon* Open Ocean Trustee Implementation Group is responsible for restoring natural resources and their services within the Open Ocean Restoration Area that were injured by the oil spill. The Open Ocean Trustees include NOAA, U.S. Department of the Interior, U.S. Environmental Protection Agency, and U.S. Department of Agriculture.

In 2019, the Open Ocean Trustee Implementation Group committed more than $126 million to implement four restoration projects to address the injury to MDBC. The MDBC projects are: Mapping, Ground-Truthing, and Predictive Habitat Modeling; Habitat Assessment and Evaluation; Coral Propagation Technique Development; and Active Management and Protection. NOAA and the Department of the Interior are implementing the projects, in cooperation with a range of partners, over eight years.

Together, the projects take a phased approach to meet the challenges involved in restoring deep-sea habitats. Challenges to restoration include a limited scientific understanding of these communities, limited experience with restoration at the depths at which these communities occur, and remote locations that limit accessibility.

More information about *Deepwater Horizon* restoration and the MDBC restoration projects is available at: www.gulfspillrestoration.noaa.gov.

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Background

The Mesophotic and Deep Benthic Communities (MDBC) Mapping, Ground-Truthing, and Predictive Habitat Modeling (MGM) project team led an operation to conduct a sea trial and short survey mission to evaluate the performance of the Voyis Recon LS laser and imaging sensor module (Voyis Imaging, Inc. [Voyis]) in a Remus 600 autonomous underwater vehicle (AUV). The team included AUV engineers from Woods Hole Oceanographic Institution (WHOI), vendor representatives from Voyis, and representatives from the Naval Surface Warfare Center – Panama City Division. The mission focused on two requirements for the MGM project: 1) conduct engineering and testing surveys in controlled shallow environments to test engineering and sensor control parameters in the AUV mission planning and operating systems, and calibrate the imaging and laser profiling sensor; and 2) conduct operational surveys in identified mesophotic benthic community targets 50–60 mi offshore Panama City, Florida, in 50- to 75-m water depth. The mission refined concepts of operations including 1) AUV imaging survey design, 2) laser and imaging data management, and 3) imaging and laser profiling data analysis, interpretation, and visualization.

The operations also exposed the Navy Surface Warfare Center interagency partners and Voyis (sensor manufacturer) to the operations conducted by the National Oceanic and Atmospheric Administration (NOAA) and WHOI, as well as the objectives and mission requirements for the MDBC project.

Objectives of Mission

The primary objective of this mission was to serve as sea trials for evaluating the performance of the Voyis Recon LS imaging and laser profiling sensor integrated into the WHOI Remus 600 AUV. The sensor module had previously been integrated into the WHOI Remus 600 vehicle, but various components failed during a 2023 MDBC mission. Following the return of the sensor after warranty repairs and upgrades, this mission helped refine engineering parameters that could not be calibrated in the murky waters off Woods Hole, Massachusetts.

Specific objectives of this mission were to:

- Conduct surveys using the repaired Recon LS sensor module in the REMUS 600 AUV in mesophotic environments
- Refine camera and laser parameters to optimize data quality
- Perform patch testing to calculate sensor geometry and offsets relative to positioning and navigation
- Capture example images to evaluate large-area imaging and interpretation using photogrammetry
- Capture example laser data to define post-processing and interpretation steps

Science Team

The objectives of this cruise were carried out by scientists and technical operational support staff from NOAA, WHOI, Voyis, and the U.S. Navy (Table 1).

Table 1. Science team for the mission aboard the Ryan Marine R/V *Oracle*. FPC = Field Party Chief; AUV = autonomous underwater vehicle; LLS = laser line scanner; Ops = operations; Voyis = Voyis Imaging, Inc.; WHOI = Woods Hole Oceanographic Institution.

Last Name	First Name	Affiliation	Role on Cruise	Dates on Board
Taylor	Chris	NOAA	FPC	3/11/24–3/15/24
Bollinger	Mike	NOAA	Imagery Tech	3/11/24–3/15/24
Ebert	Erik	NOAA	LLS Tech	3/11/24–3/15/24
Packard	Greg	WHOI	AUV Lead	3/11/24–3/15/24
Marin	Fred	WHOI	AUV Tech	3/11/24–3/15/24
Shaver	Luke	Voyis	Voyis Representative	3/11/24–3/15/24
Ogden	Darryl	Navy	Ops Observer	3/11/24–3/15/24
Krajewski	Jeff	Navy	Ops Observer	3/11/24–3/15/24

Operations

Operational Overview

Ryan Marine R/V *Oracle* cruise OR-24-01 was planned to conduct sea trials of the Recon LS imaging and laser line scanner (LLS) payload on the WHOI Remus 600 AUV. The laser line scanner optimally should be run at night. The plan was to conduct dock side tests during the day and use nearshore targets (Barge; Figure 1) as calibration in the evening for the first two days. After testing in shallow water over a known target (a barge sunk by the Naval Surface Warfare Center), the mission continued at offshore mesophotic habitat sites ~50 nautical miles (nmi) from shore (Figure 1). The offshore sites would help pilots and analysts refine mission plan parameters to be put into practice during future planned MDBC missions with this payload.

All surveys were conducted under existing environmental compliance for the MDBC portfolio of projects. A brief cruise itinerary is included in Table 2, and all dive deployment locations are indicated in Table 3.

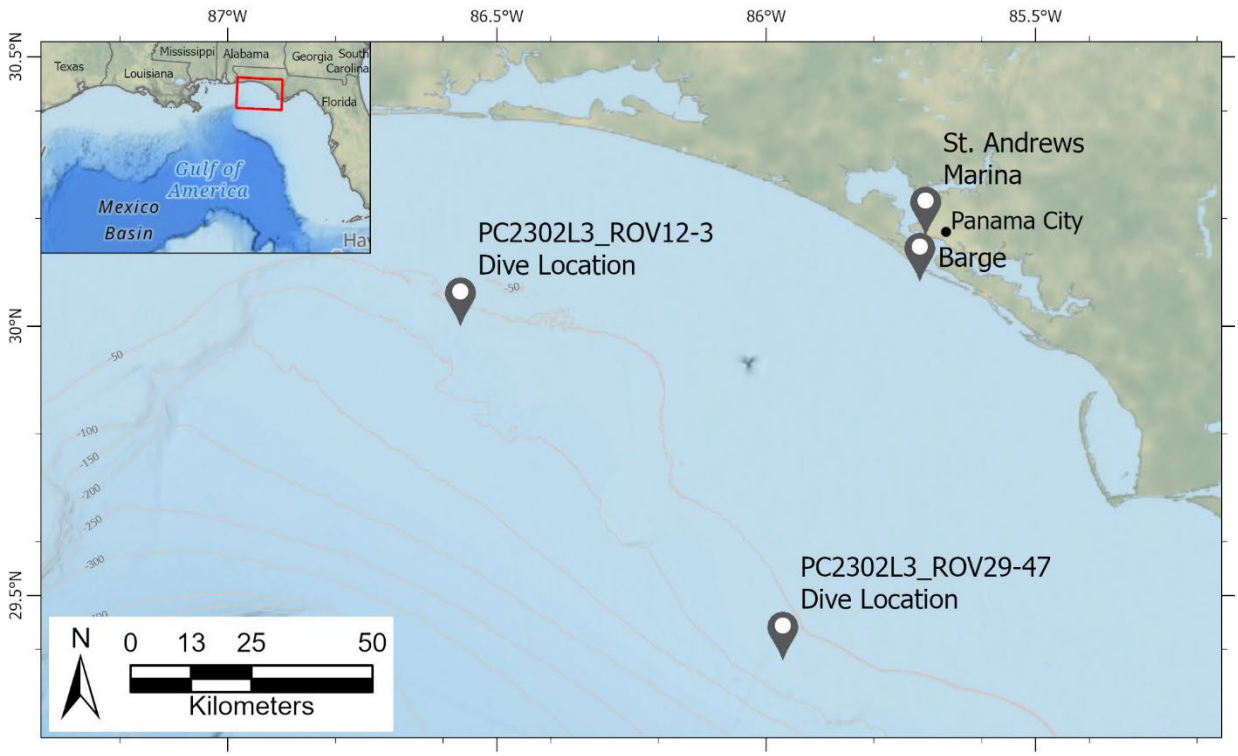

Figure 1. Mobilization port and operational locations for mission OR-24-01. All locations had multiple AUV deployments. AUV = autonomous underwater vehicle.

March 9, 2024

Team members from WHOI and Voyis arrived and staged the AUV in the Ryan Marine shop facility (505 Enterprise Road, Panama City Beach, Florida 32407).

March 10, 2024

NOAA team members Taylor and Bollinger arrived and navigated to the R/V *Oracle* docked at St. Andrews Marina (3151 West 10th Street, Panama City, Florida). Ryan Marine crew, WHOI, and Voyis team members moved the AUV from the shop facility to the ship. All available science parties set up the AUV monitoring, charging, and data download stations. Ryan Marine crew staged the crane for AUV operations and moved the AUV to the forward deck of the ship.

March 11, 2024

NOAA team member Ebert arrived along with local crew and Navy observers. The team ran tests of the laser and camera with the AUV suspended over the side of the ship and tethered. Pulse repetition rate for the camera and laser were tuned at the dock to optimize rates for both data streams. In the afternoon, the ship made way to a barge survey site, just outside St. Andrew Bay. The team conducted four AUV dives (001–004) between 3/11/24 21:19 (UTC) and 3/12/24 05:45 (UTC) (Figure 2). The last dive was intended to be a patch-and-calibration test to determine lever

arm offsets between the inertial navigation system and the sensor payload. The patch test was not completed because water column turbidity yielded low visibility from the vehicle to the seabed, especially for the LLS, and the vehicle was not able to get sufficient overlap of the barge structure to complete patch test calculations. The ship recovered the AUV and steamed back to port.

March 12, 2024

The day was spent downloading and organizing data from the deployments the day before. In the afternoon, the ship departed for the barge survey site. Objectives included rerunning a patch test over the barge and testing mission plans for photogrammetric development over the barge. The vehicle remained deployed for all four dives (dives 005–008) from 3/12/24 23:12 (UTC) to 3/13/24 6:13 (UTC) (Figure 2). Upon retrieval, it was found that the sensor payload hard drive that stores the photo and laser data was corrupted. The team suspected this was a result of too many users accessing the drive at the same time, overtaxing the drive. The ship transited offshore to the MDBC remotely operated vehicle (ROV) Dive PC2302L3_ROV29-47 (Harter et al., 2025) dive site slated for the next day's operations.

March 13, 2024

The team addressed the failed hard drive in the morning with technical support from Voyis, by removing the sensor payload module from the AUV and opening the pressure vessel. The hard drive was pulled out of the instrument, reformatted, and stress tested. After passing the tests, the hard drive was reinstalled in the instrument, and the sensor payload was reinstalled in the AUV. The ship arrived at the offshore location identified during the MDBC ROV Dive PC2302L3_ROV29-47 (Harter et al., 2025). The objectives were to test photogrammetric mission plans over known high-relief, hard bottom seafloor structure from ROV dives. Dives 009 and 010 (Figure 3) were at this site. Preliminary review of data from the dives indicated that the high-relief, hard bottom seafloor structure at this site was not as well-defined as anticipated due to a misinterpretation of the previously collected ROV data. To find high-relief bottom and accomplish the objective of the sea trial, the team decided to relocate to a new site for the next day's operations.

March 14, 2024

The team transited during the day to Destin Dome, and the site covered by the PC2302L3_ROV12-30 ROV dive (Harter et al., 2025) and continued with data management and review of the data from the previous night's collection. Objectives for this night’s dive were to test photogrammetric development over known high-relief, hard bottom seafloor structure. Low-altitude missions like this are challenging to plan with relatively coarse bathymetry. All dives (011–015) on this night took place over a high-relief ledge with an east–west orientation (Figure 4). DIVE011 carried out photogrammetric development with crosshatching. DIVE012 was a quick exploratory dive for visualization of the western extent of the feature and to give WHOI team members time to plan more complicated vehicle behavior for DIVE013. On DIVE013, the vehicle ran parallel to the isobath, ascended to make a turn, descended, and ran along the isobath again (Figure 5). No cross hatching was done this time as the relief of the feature was greater than the altitude of the vehicle

for surveying, and the team wanted to avoid potential seabed interactions. This dive method was duplicated for DIVE014 but moved further to the south to increase photogrammetric coverage. The objective of DIVE015 was to run a calibration patch test over the seafloor feature. This presented mission planning challenges to avoid contact with the seabed. These dives were completed between 3/14/24 22:50 (UTC) and 3/15/24 08:51 (UTC).

March 15, 2024

The DIVE015 survey was completed in the middle of the night, at which time the AUV was recovered and the ship began to transit back to Panama City. During transit, data management was completed, and data were duplicated to all partners who needed copies. Demobilization was begun by packing workstations. Upon arrival at the dock, local partners from the Navy disembarked, and NOAA, WHOI, and Voyis personnel finished data transfer and continued with demobilization.

March 16, 2024

NOAA personnel departed first thing in the morning. WHOI personnel finished disassembling the AUV and shipped it back to WHOI. Data were sent to Microsoft Azure via Data Box.

Table 2. Cruise itinerary for OR-24-01. AUV = autonomous underwater vehicle; WHOI = Woods Hole Oceanographic Institution; Voyis = Voyis Imaging, Inc.; ROV = remotely operated vehicle; PC = NOAA Ship Pisces.

Date	Operations Conducted	Location	Brief Description
3/9/2024	Mobilization	Panama City, FL	AUV, WHOI, and Voyis arrive and mobilize at Ryan Marine's warehouse.
3/10/2024	Mobilization	Panama City, FL	AUV assembled and moved to ship. Taylor and Bollinger arrive.
3/11/2024	AUV Operations	Panama City, FL	Morning – Ebert and local crew arrive. Day trip – engineering dives over Navy targets.
3/12/2024	AUV Operations	Panama City, FL	Depart dock in afternoon. Evening – dives over Navy targets.
3/13/2024	AUV Operations	50 nmi WSW of Panama City	Daytime – transit to coral targets identified on PC2302L3_ROV29-47. Nighttime – dives over coral targets.
3/14/2024	AUV Operations	50 nmi W of Panama City	Daytime – transit to Destin Dome; coral targets identified on PC2302L3_ROV12-30. Nighttime – dives over coral targets.
3/15/2024	Transit, Demobilization	50 nmi W of Panama City	Morning – transit back to Panama City. Afternoon – demobilize.
3/16/2024	Demobilization	Panama City, FL	Finish demobilization. Return travel for NOAA, WHOI.

Table 3. List of AUV dives for OR-24-01. AUV = autonomous underwater vehicle; PCB = Panama City Beach. All dates and times are reported in UTC.

Dive	Date (UTC)	Time (hh:mm)	Locality	Latitude (decimal degrees)	Longitude (decimal degrees)	Altitude (m)	Duration (hh:mm)
DIVE001	3/11/2024	21:19	Adjacent to barge off PCB	30.0817050	−85.7158096	7,5,3	1:36
DIVE002	3/12/2024	0:55	Adjacent to barge debris	30.0796287	−85.7155473	5,3	0:17
DIVE003	3/12/2024	2:04	Barge	30.0774962	−85.7137576	5,3	0:19
DIVE004	3/12/2024	4:13	Patch test over barge debris	30.08331691	−85.71628	4, fixed depth – 9 m	1:32
DIVE005	3/12/2024	23:17	Barge	30.08122082	−85.71511285	4	0:25
DIVE006	3/13/2024	0:22	Barge spoke pattern	30.08016951	−85.71449567	4	0:57
DIVE007	3/13/2024	2:10	Barge laser exposure test	30.80141953	−85.7157812	4	0:40
DIVE008	3/13/2024	4:38	Barge	30.08103326	−85.71585392	4	1:35
DIVE009	3/13/2024	22:57	PC2302L3_ROV29-47	29.37918201	−85.96536339	7,5	1:18
DIVE010	3/14/2024	1:06	PC2302L3_ROV29-47	29.37917378	−85.96548361	7,5	7:06
DIVE011	3/14/2024	22:55	PC2302L3_ROV12-30	30.00515191	−85.55124243	7,5	2:31
DIVE012	3/15/2024	2:45	PC2302L3_ROV12-30	30.00459601	−86.55286915	5	0:23
DIVE013	3/15/2024	3:34	PC2302L3_ROV12-30	30.00201783	−86.55745797	5	0:58
DIVE014	3/15/2024	5:11	PC2302L3_ROV12-30	30.00056247	−86.56095558	5	1:22
DIVE015	3/15/2024	7:40	PC2302L3_ROV12-30	29.99765971	−86.56628807	7	1:11

Locations

There were three main operation areas utilized for the OR-24-01 mission (Table 4): A barge just outside of the St. Andrew Bay (Figure 2), the location of MDBC ROV dive PC2302L3_ROV29-47 (Figure 3), and the location of MDBC ROV dive PC2302L3_ROV12-3 (Figure 4).

Table 4. Locations of key features focused on during OR-24-01.

Name	Description	Latitude	Longitude	Depth (m)
Barge	Low-relief barge sunk off Panama City Beach	30.0822056	−85.7146799	14
Pavement Outcrops: PC2302L3_ROV29-47 dive location	Location of ROV dive PC2302L3_ROV29-47	29.3786967	−85.9690569	62
Destin Dome: PC2302L3_ROV12-30 west end	Location of ROV dive PC2302L3_ROV12-3. Large rocky ledge feature. Good coral cover and presence of marine debris.	29.9992461	−86.5676795	58
Destin Dome: PC2302L3_ROV12-30 east end		29.9992306	−86.5632575	58

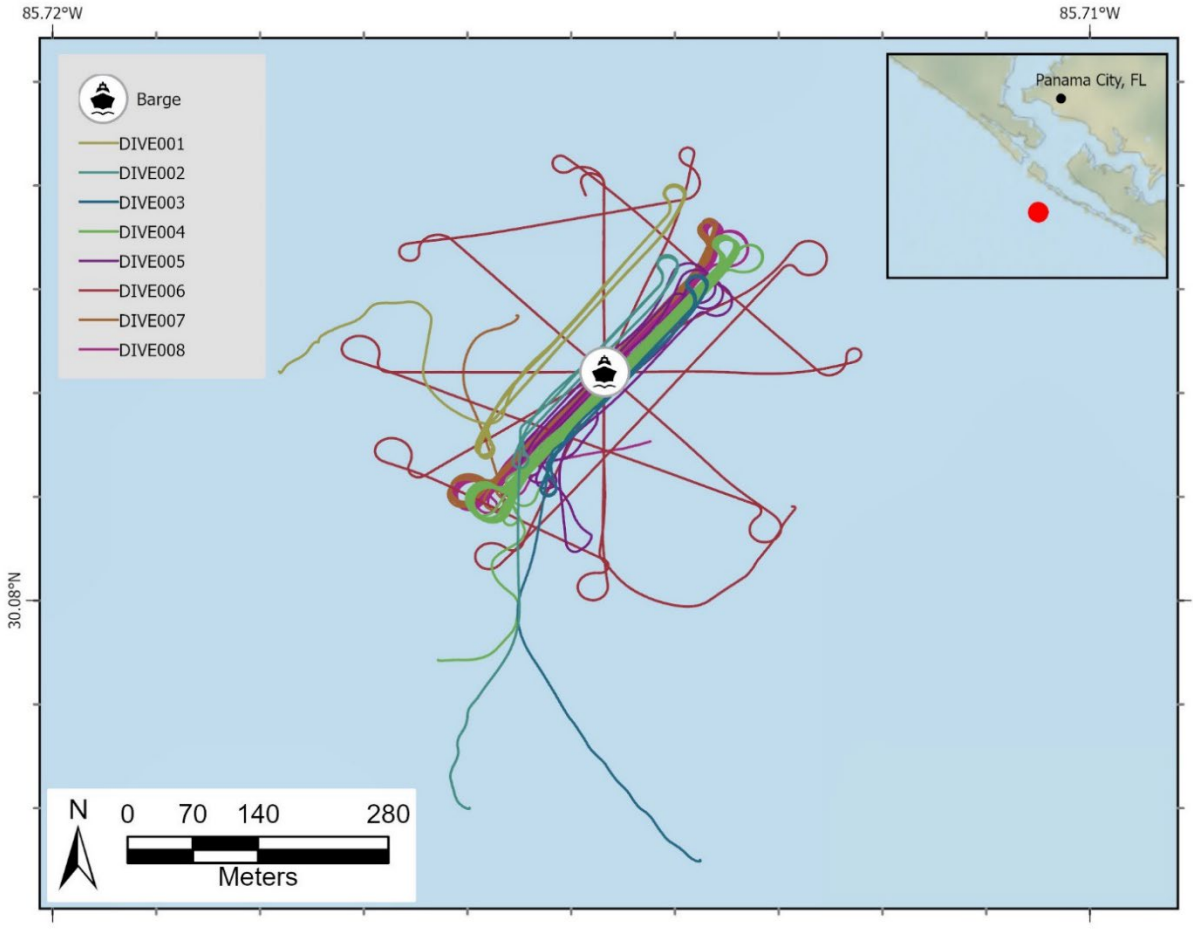

Figure 2. AUV track lines from the inshore dives that centered around Navy targets and a sunken barge.

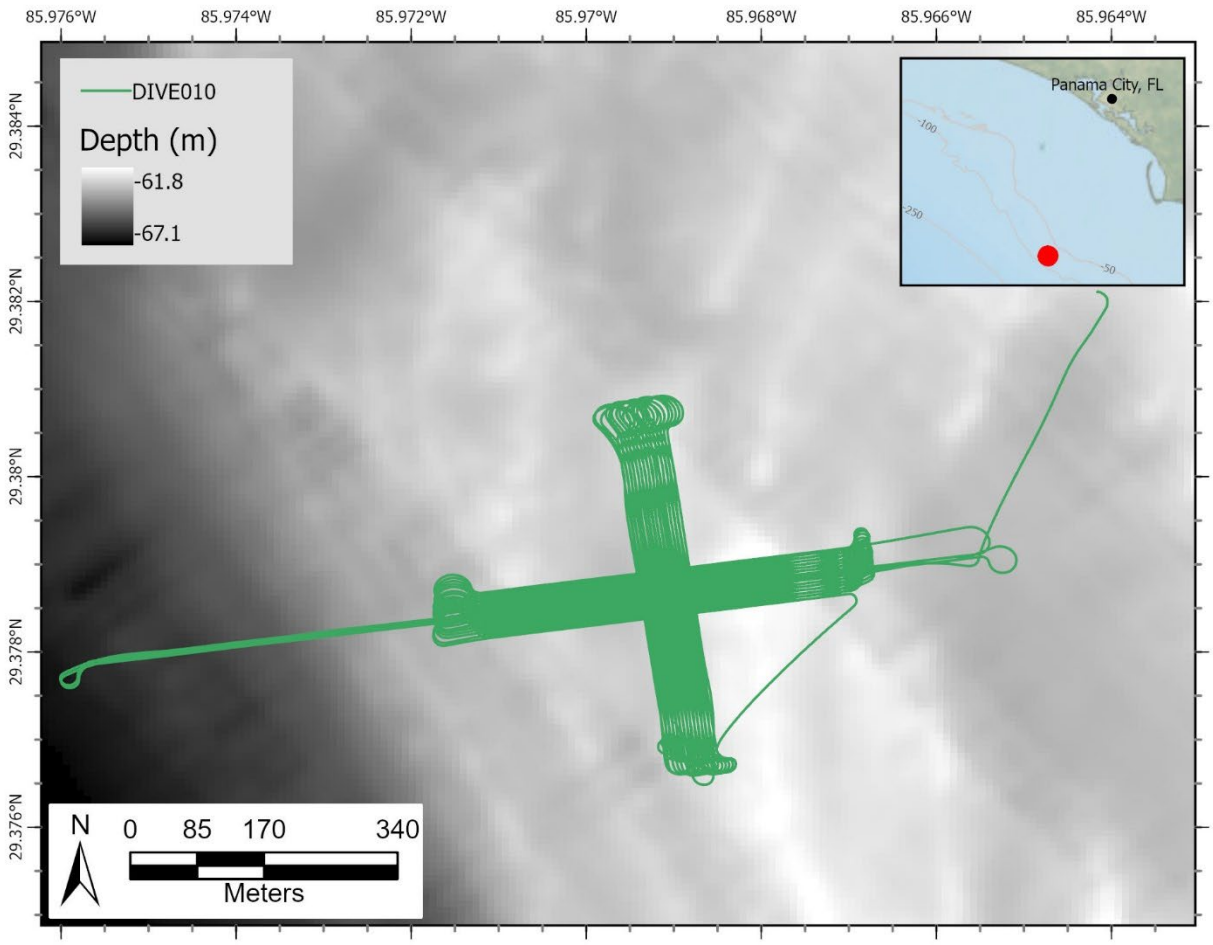

Figure 3. AUV track lines from the offshore sites at a southern subset of dives near the PC2302L3_ROV29-47 dive location. Bathymetry source: USGS, 2002.

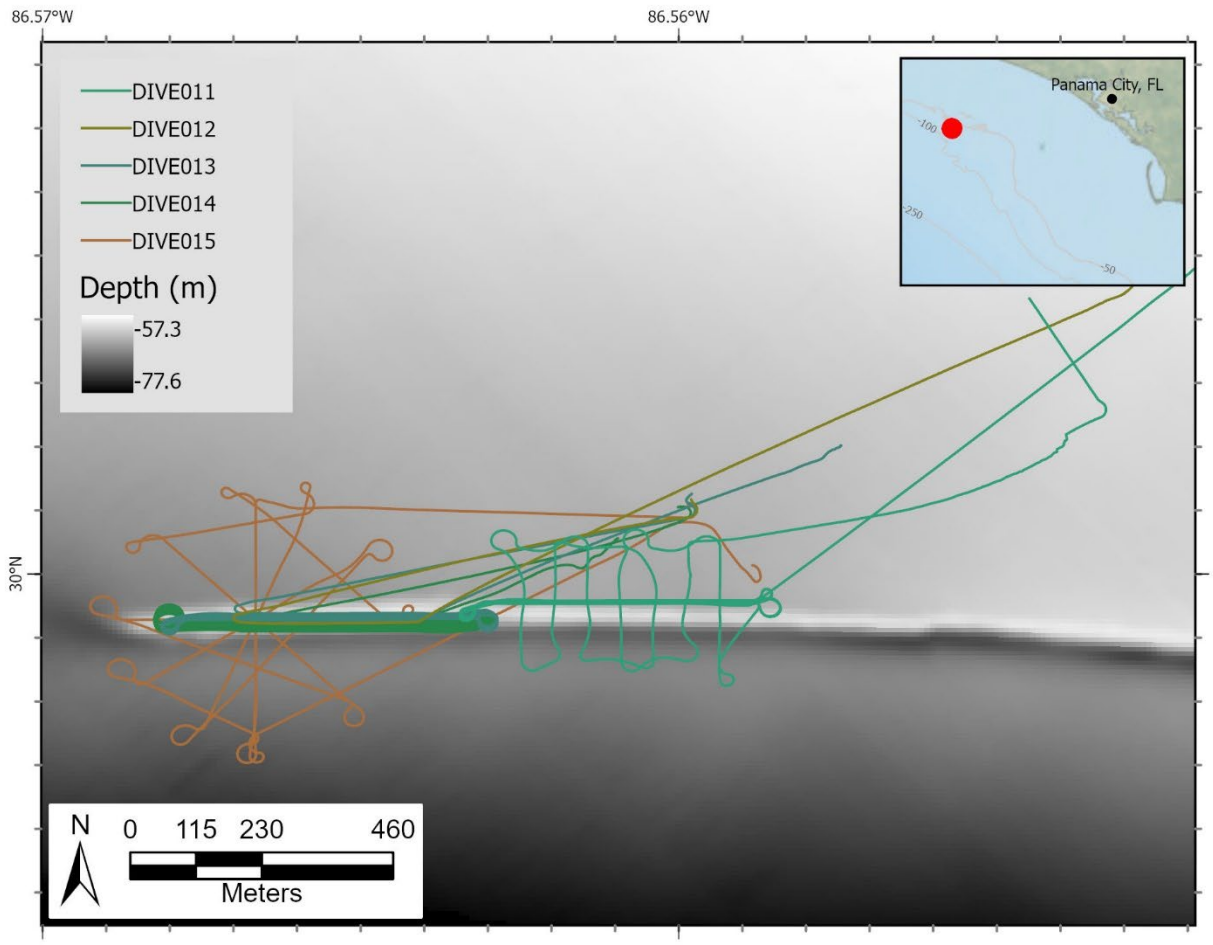

Figure 4. AUV track lines from the offshore sites at the rocky ledge near the PC2302L3_ROV12-30 ROV dive location targeted for coral observations. Bathymetry source: USGS, 2002.

Results and Discussion

Overall, the mission was successful. The team gathered useful data, and while there were challenges in each objective, information gained from this sea trial about the effects of different methodologies will be invaluable in future missions. Individual accomplishments to the mission objectives are outlined below.

The following is a summary of activities and accomplishments:

- 15 AUV dives
- 22.1 hr of deployment time
- 116 linear km were imaged
- 3.8 TB of data collected by the AUV
    - 242,365 images
    - 380 GB of LLS data

Sea Trial for the Voyis Recon LS Sensor Payload

The Recon LS sensor payload was tested and evaluated for operational missions. The team found limitations in data download rates from the sensor, but otherwise the platform operated successfully and is expected to satisfy MDBC project requirements.

Refine Camera and Laser Parameters

The team executed a number of iterations to assess the following parameters: vehicle altitude (height off bottom), camera exposure time, camera sampling frequency, strobe intensity, laser exposure time, and laser sampling frequency. DIVE013 and DIVE014 provided high-quality imagery. Optimal parameters for this mission are noted below for use in future missions with the caveat that each site is different in terms of visibility and rugosity, and may need adjustment.

- Profile Stills Exposure = 7,000 μs
- Still Frequency = 2Hz = 2 images/s
- Profile Laser Exposure = 20,000 μs
- Laser Frequency = 50,000 = 50 pulses/s
- Survey Altitude = 5 m
- Survey Speed = 1.3 m/s = 2.5 knots

Perform Patch Test to Calculate Lever Arm Offsets

The patch test is performed to fine-tune the lever arm offsets to give the LLS data in the correct pitch, roll, and yaw. Physical measurements are taken, but the patch test is meant to refine the parameters to millimeter scale.

While the patch test was performed, the results were nullified by having to take the sensor payload apart to replace the hard drive. The patch test was reattempted on DIVE015, but the data from that test were inconclusive because it was over an extensive natural seafloor structural feature that was imaged, rather than a discrete, well-defined structure like a box or a ship. These data are still usable to the centimeter scale as the offsets to the mechanical lever arm settings will be applied in post-processing.

Future calibrations and patch tests will be best accomplished using an artificial object on the seabed, such as a piece of debris, sunken boat, or similar object.

Capture Example Images for Photomosaics and Photogrammetry

This mission successfully captured images (Figure 5) for photogrammetry on dives 013 and 014. Examples of preliminary orthomosaics and models are included in Figures 6 and 7, respectively.

Figure 5. Example images from DIVE014. Top Left: a shark swims over of the seafloor structure. Top Right: *Muricea* sp. (White Coral) among other coral growing on hard bottom seafloor structure. Bottom Left: a grouper swims over hard bottom. Bottom Right: an abandoned anchor lies in the sand adjacent to a rocky outcrop.

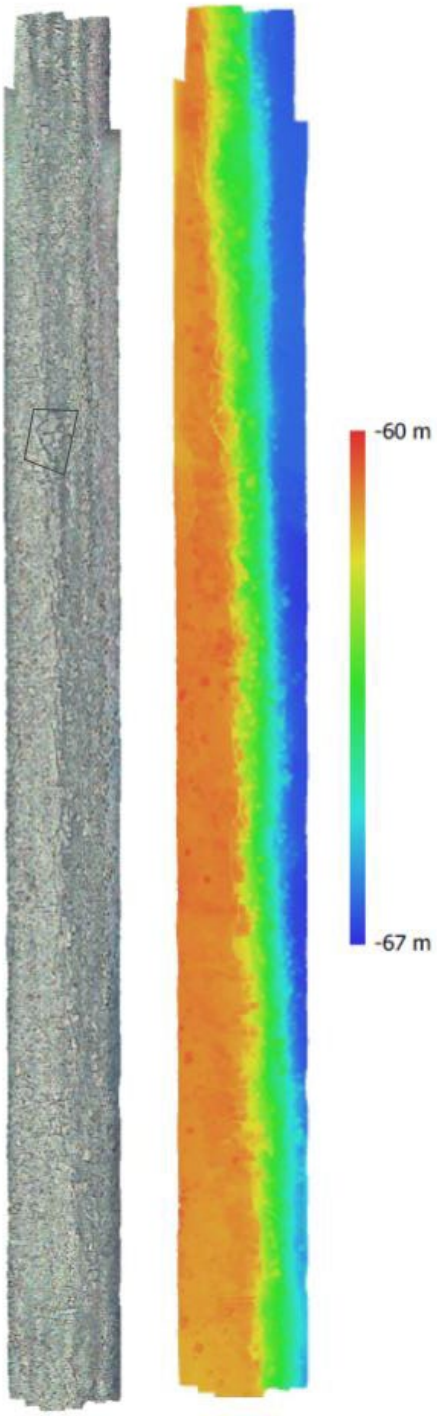

Figure 6. An example of the resulting photomosaic (left) and digital elevation model (right) from DIVE014. The image is 275 m long and 25 m wide, covering a depth range of 7 m at a resolution of 1.4 mm/pixel. The trapezoid in the photomosaic represents the approximate extent and view shown in Figure 7.

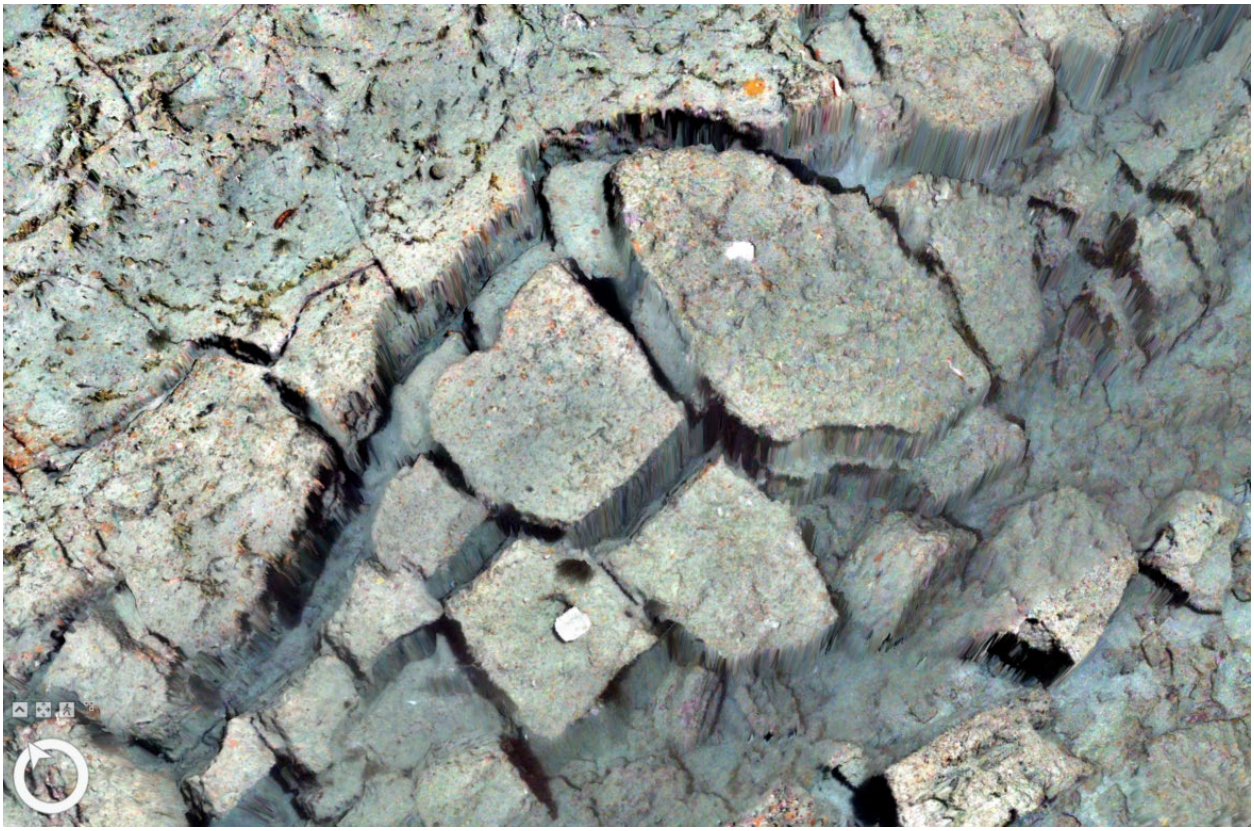

Figure 7. A zoomed-in example of an orthomosaic from DIVE014 draped over the digital elevation model visualized in ArcGIS Pro. The approximate extent is shown in Figure 6 and represents 18 million mesh vertices.

Capture Example Laser Data to Define Post-Process Steps

This mission successfully captured laser data and made steps towards defining the post-processing steps. The team discovered a bug in the processing software preventing the software from applying lever arm offsets. The bug was forwarded to Voyis, who have since remedied the issue. A more defined LLS workflow was developed, such as using LAZ data format in export because it carries an uncertainty value not found in the XYZ export, giving the team data acquisition rates that will improve data management calculations in the future.

Mission Challenges

The team found surveying at very low altitude (<8 m) challenging. The bathymetry that was available in the areas where these sea trials were carried out is 2- to 8-m resolution. Smaller-scale changes in relief may not be adequately reflected in the bathymetry surfaces, creating hazards to AUV navigation. Similarly, large changes in relief can create navigational challenges where the AUV attempts to follow a downward slope with the altimeter now angled backwards and not anticipating an approaching seabed.

To compensate for the terrain's rugosity and formation of the ridge at the final site, a dive plan was developed to transit at higher altitudes, drop down to a survey altitude over more predictable bathymetry, then return to higher altitudes to turn (Figure 8). This process was repeated for the entirety of the photogrammetry survey.

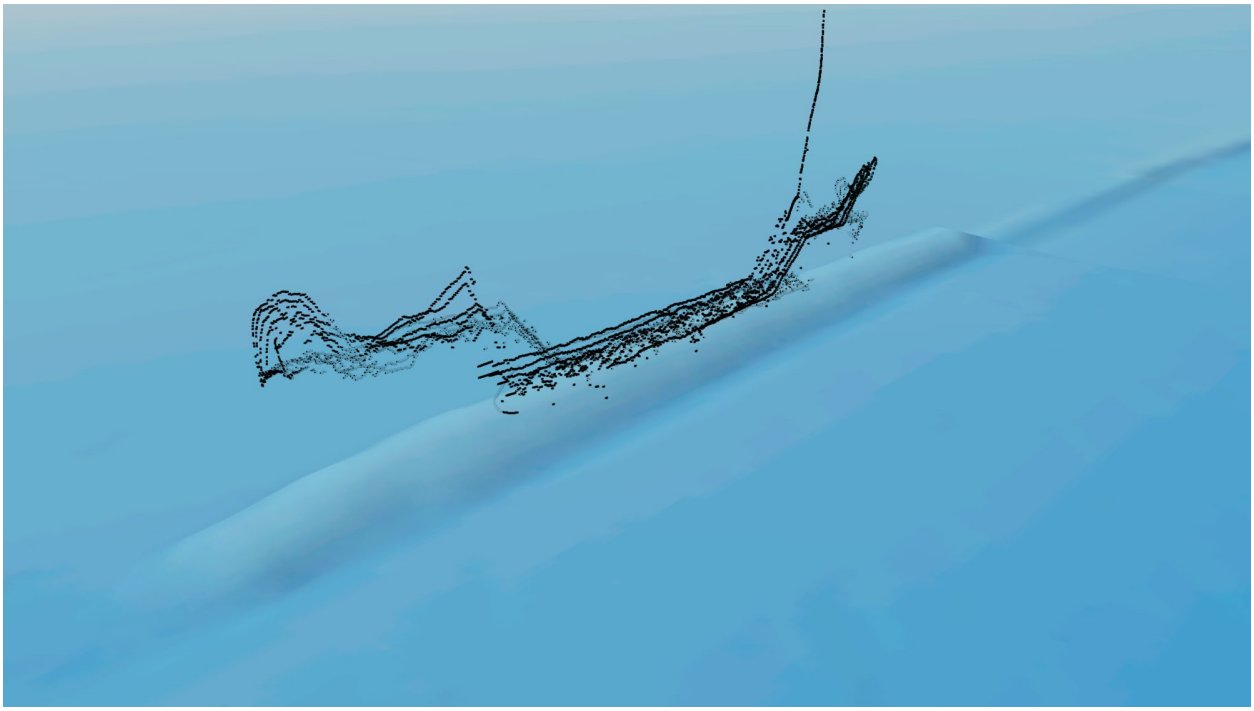

Figure 8. Screen capture of a 3D scene showing the vehicle track for DIVE013 (black and gray dots) over a 15-m-relief ridge line. The vehicle surveyed at about 7-m altitude then climbed to a fixed depth to make a turn so as to not come in contact with the seabed. After completing the turn, the vehicle descended and continued the survey. This was repeated for each survey line.

Data management also presented challenges. The Recon LS sensor payload has the potential to collect 2 TB of data over a 12-hr dive, and it takes a significant amount of time to transfer that data off of the vehicle. During a data transfer, the sensor payload's internal hard drive became corrupted and analysts were not able to recover the lost data. The cause was multiple access points into the AUV and sensor payload for data download and review. Going forward, a single point of access will be assigned to the analyst at sea. The team collected data rates and will work with the National Centers for Coastal Ocean Science IT on suitable at-sea and cloud data storage.

Dive Summaries

All times in this section are reported in Coordinated Universal Time (UTC). Date ranges in the section headings are to indicate dive day, as the Voyis operations occur at night and span two dates.

DIVE001 – Adjacent to Barge. March 11–12, 2024

The AUV started a survey at 21:19 March 11 (UTC) at the barge site. The objective was to make some exploratory passes near the known location of a sunken barge. The vehicle made a couple of passes, gradually stepping down in depth away from the barge to avoid any unknown obstructions (Figure 9). NOAA does not have multibeam bathymetry for this site. The Navy has some sidescan sonar that was used for mission planning. The dive ended at 22:55 March 11 (UTC), and the vehicle was sent on a subsequent dive without being recovered first.

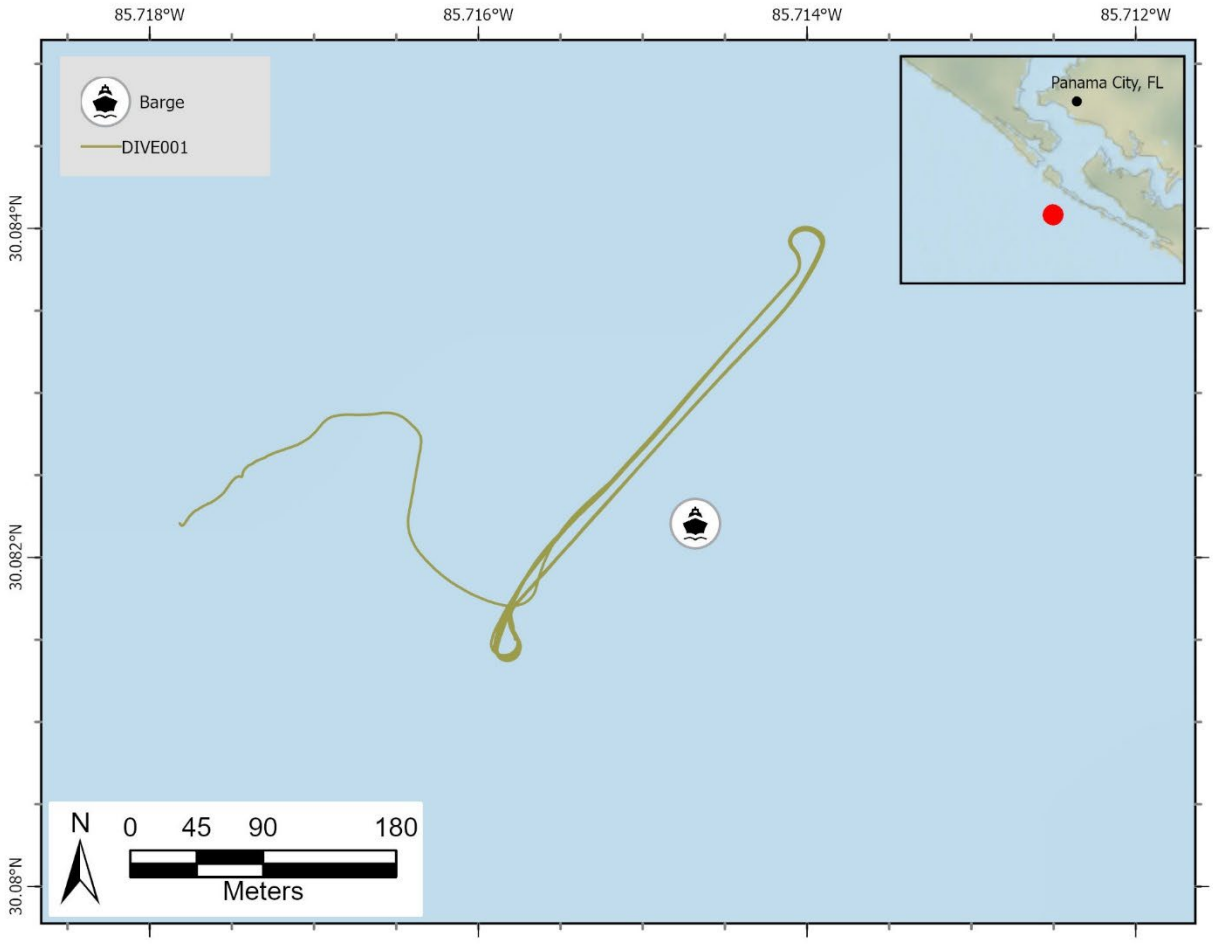

Figure 9. Map of the dive track for DIVE001. Location of the barge is noted.

DIVE002 – Adjacent to Barge. March 11–12, 2024

The AUV started a survey at 00:55 March 12 (UTC) at the barge site. The objective was to step closer to the barge to assess features about the barge (structure too high in water column, barge fragments not where the team thought they were, etc.) that would preclude further work at the site. The vehicle made its way back to the survey site after 2 hr adrift while the NOAA and WHOI teams reviewed data and created a new dive plan. The AUV made a couple of passes, gradually stepping down in depth away from the barge to avoid any unknown obstructions (Figure 10). The dive ended at 01:12 March 12 (UTC), and the vehicle was sent on a subsequent dive without being recovered first.

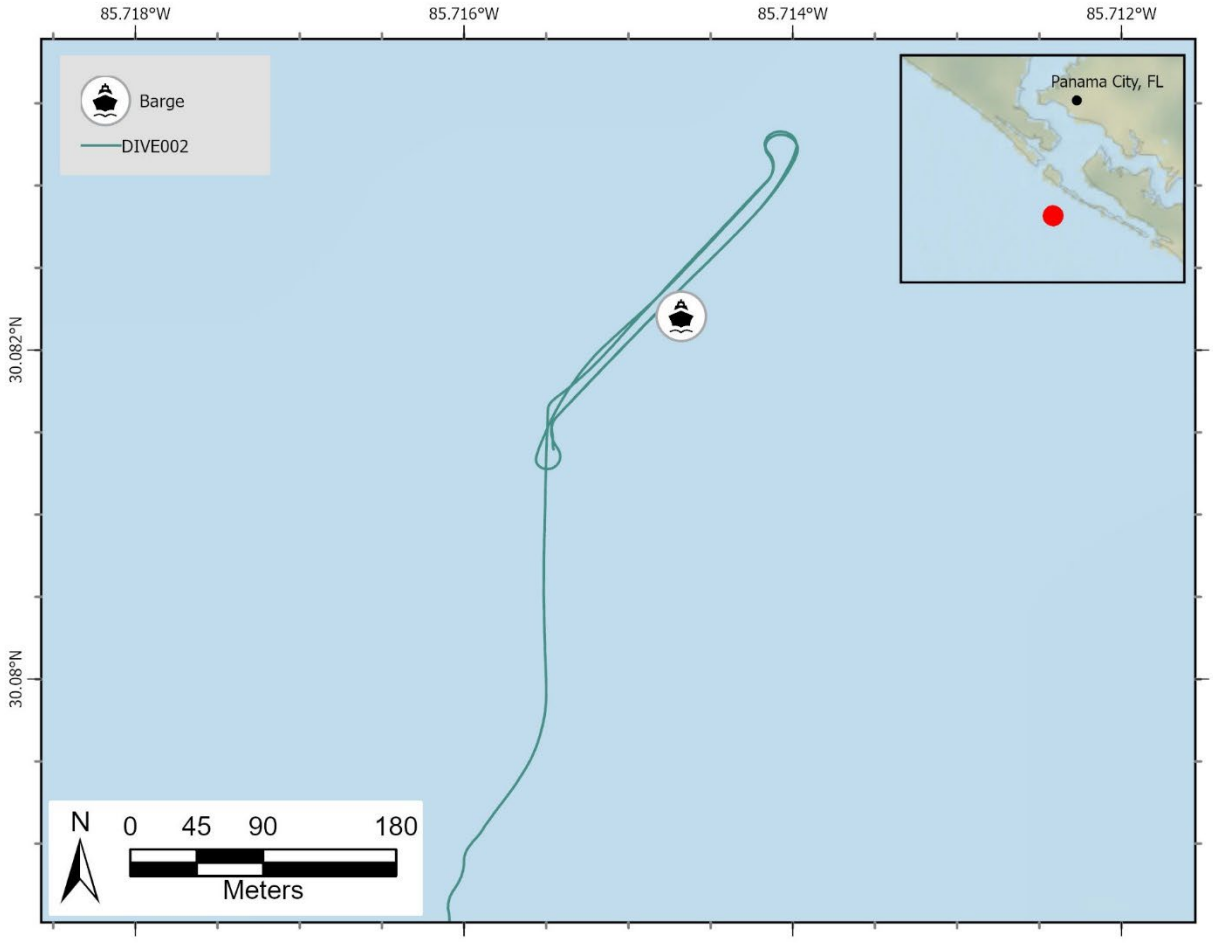

Figure 10. Map of the dive track for DIVE002. Location of the barge is noted.

DIVE003 – Barge. March 11–12, 2024

The AUV started a survey at 02:04 March 12 (UTC) at the barge site. The objective was to step closer to the southeast side of the barge to assess further work at the site. The vehicle made its way back to the survey site after 52 min adrift while the NOAA and WHOI teams reviewed data and created a new dive plan. The AUV made a couple of passes, gradually stepping down in depth away from the barge to avoid any unknown obstructions (Figure 11). The dive ended at 02:23 March 12 (UTC), and the vehicle was sent on a subsequent dive without being recovered first.

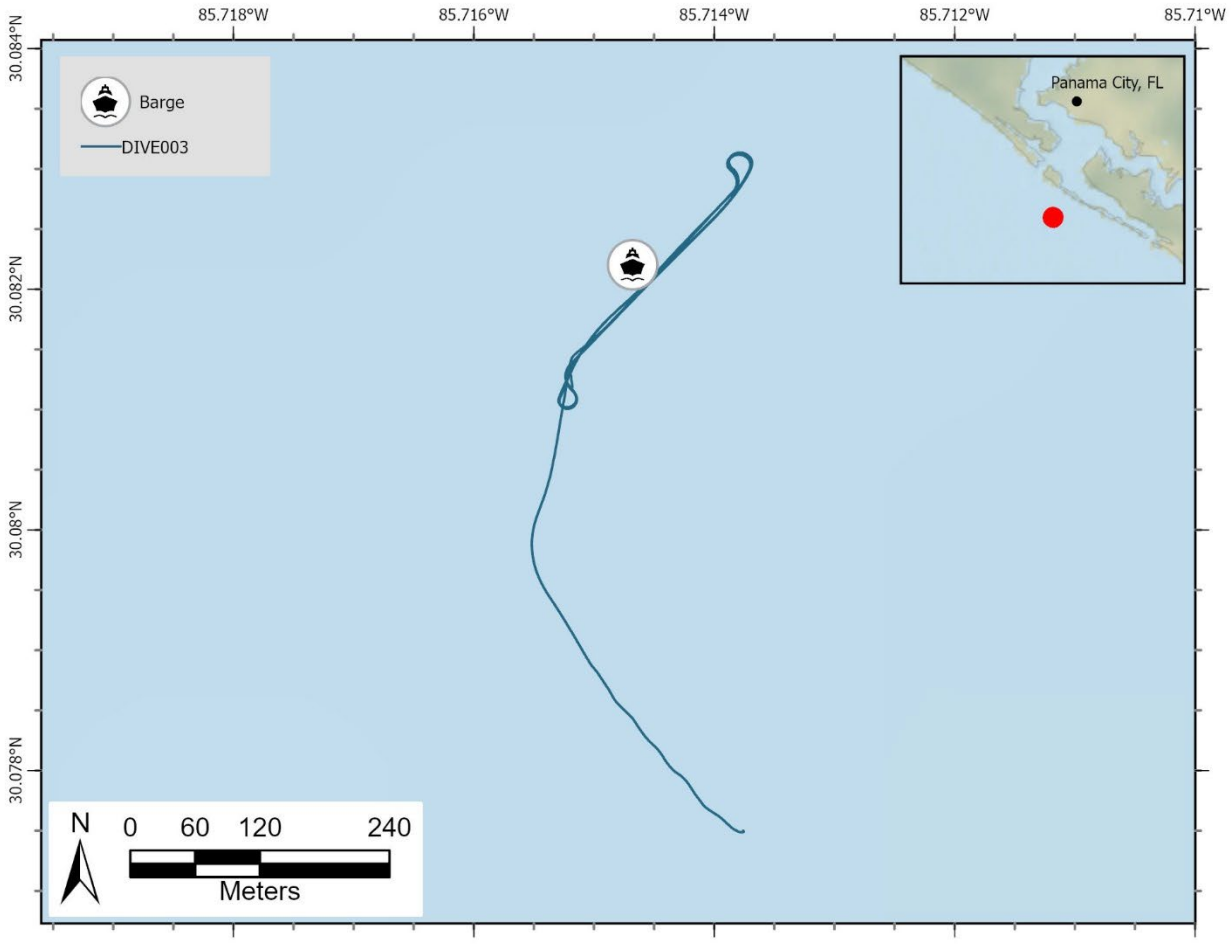

Figure 11. Map of the dive track for DIVE003. Location of the barge is noted.

DIVE004 – Barge. March 11–12, 2024

The AUV started a survey at 04:13 March 12 (UTC) at the barge site. The objective was to do a photogrammetric development on the southeast side of the barge to start to create a workflow for photogrammetry for this AUV. The vehicle made its way back to the survey site after 1 hr 50 min adrift while the NOAA and WHOI teams reviewed data and created a new dive plan. The AUV made passes, gradually stepping down in depth to create overlap of the site (Figure 12). The dive ended at 05:45 March 12 (UTC), the vehicle was recovered, and the team transited back to dock.

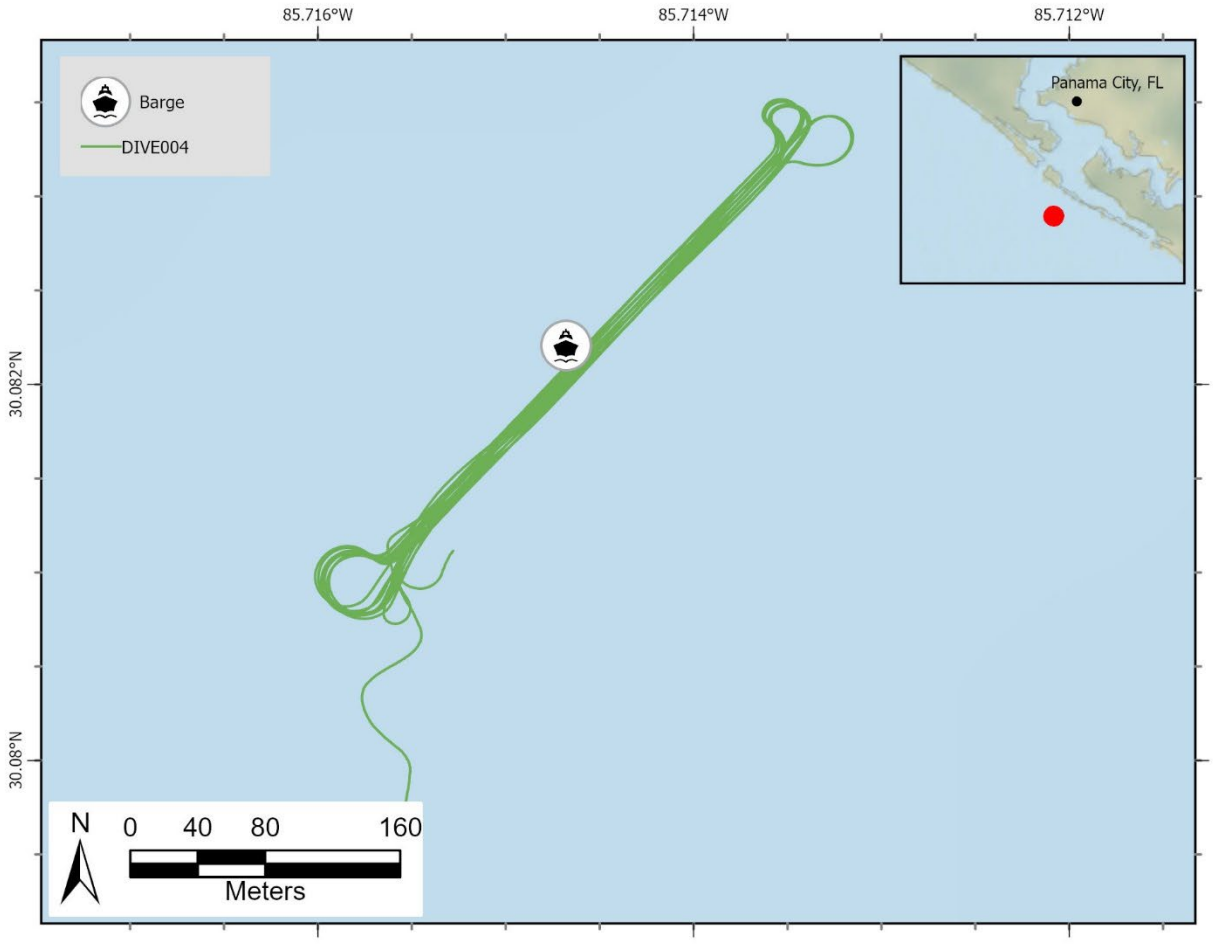

Figure 12. Map of the dive track for DIVE004. Location of the barge is noted.

DIVE005 – Barge. March 12–13, 2024

The AUV started a survey at 23:17 March 12 (UTC) at the barge site. The objective was to cover the entire barge area and assess further low-altitude work at the site. The AUV made a couple of passes at the previously determined altitude of 4 m to cover the barge and surrounding areas (Figure 13). The dive ended at 23:42 March 12 (UTC), and the vehicle was sent on a subsequent dive without being recovered first.

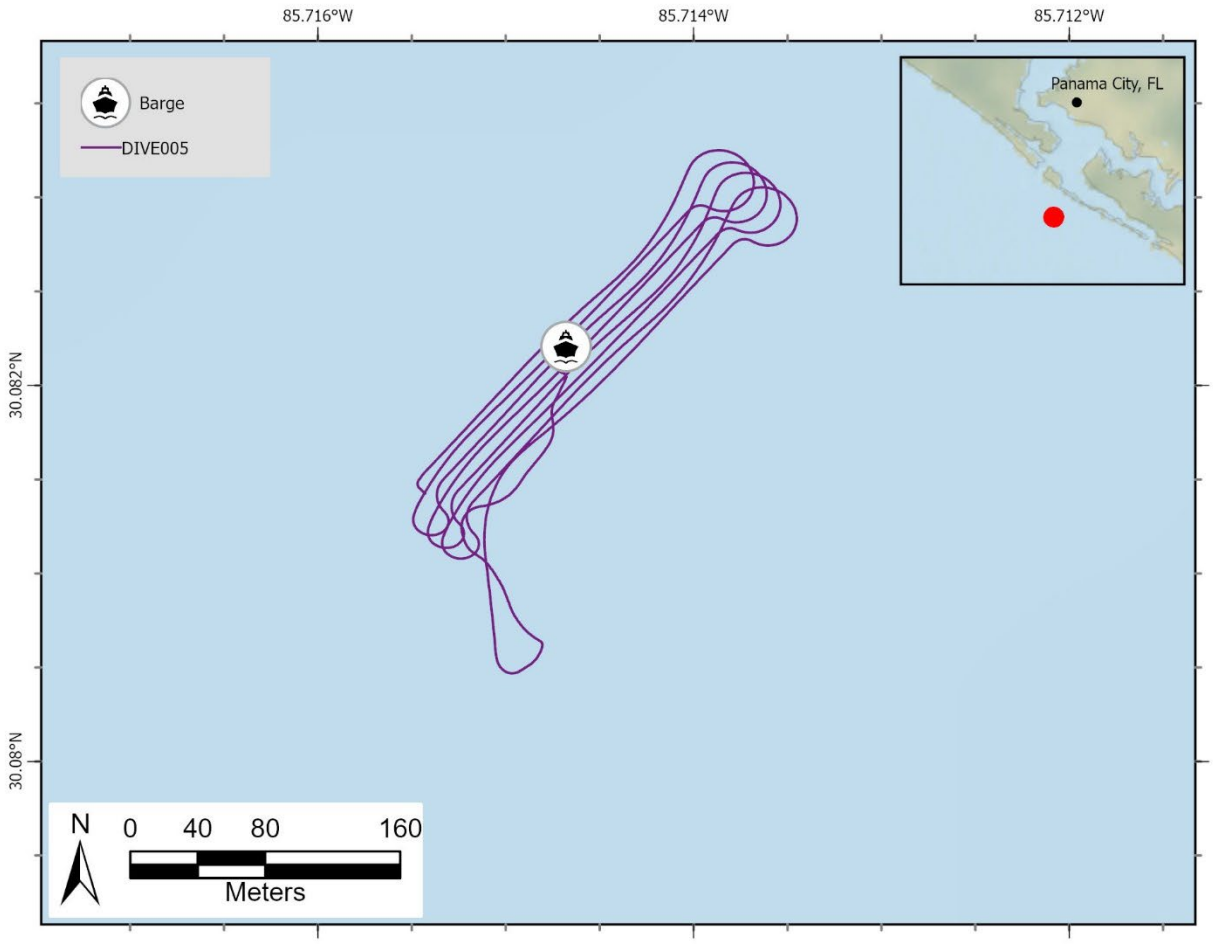

Figure 13. Map of the dive track for DIVE005. Location of the barge is noted.

DIVE006 – Barge. March 12–13, 2024

The AUV started a survey at 00:22 March 13 (UTC) at the barge site. The objective was to do a patch test right over the barge to determine lever arm offsets. The AUV made a pinwheel pattern crisscrossing the barge at an altitude of 4 m (Figure 14). The dive ended at 01:19 March 13 (UTC), and the vehicle was sent on a subsequent dive without being recovered first. On download, the hard drive storing images and LLS was corrupted, resulting in a partial data set for this dive.

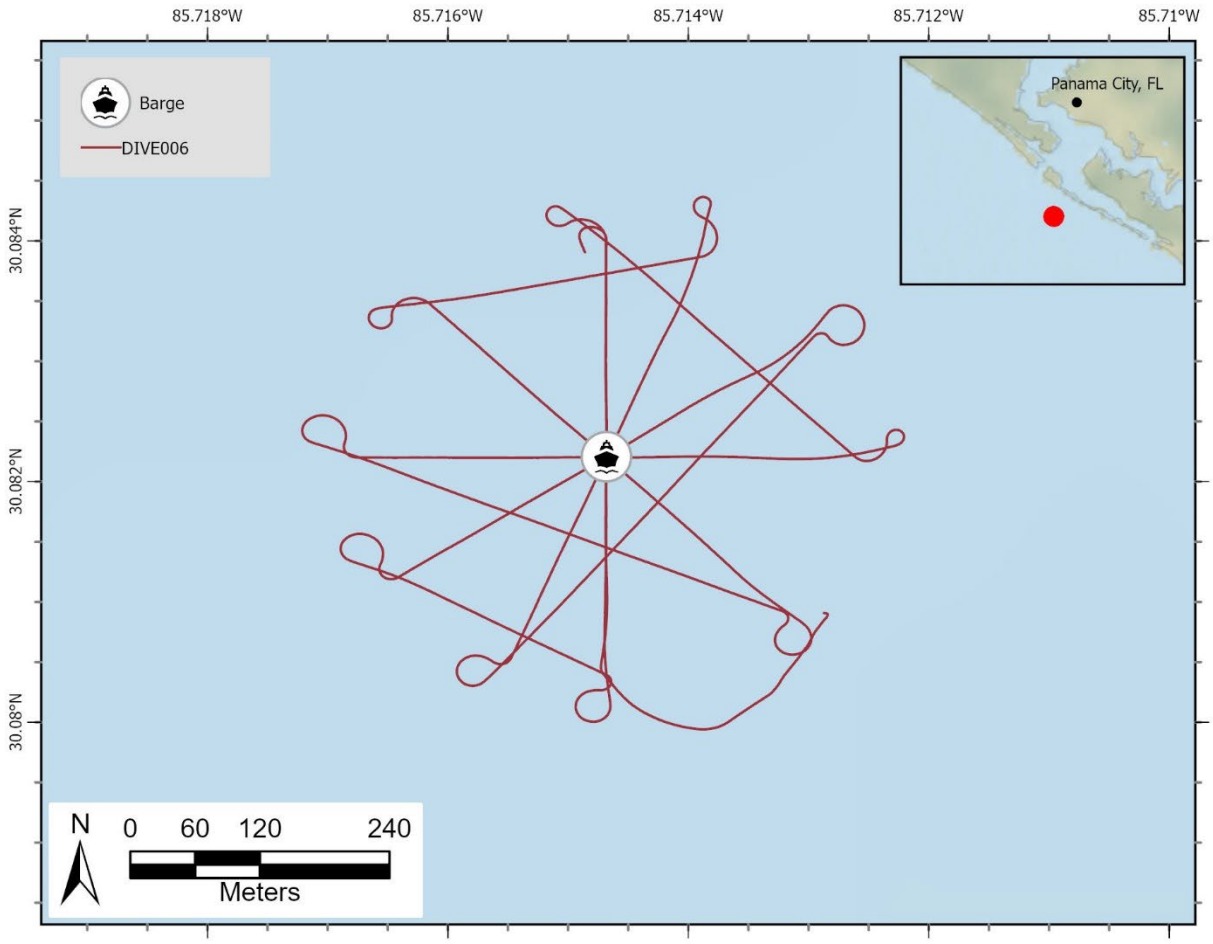

Figure 14. Map of the dive track for DIVE006. Location of the barge is noted.

DIVE007 – Barge. March 12–13, 2024

The AUV started a survey at 02:10 March 13 (UTC) at the barge site. The objective was to do some photogrammetric development right over the barge. The AUV made narrow line spacing passes of the barge at an altitude of 4 m (Figure 15). The dive ended at 02:50 March 13 (UTC), and the vehicle was sent on a subsequent dive without being recovered first. On download, the hard drive storing images and LLS was corrupted resulting in a data loss for this dive.

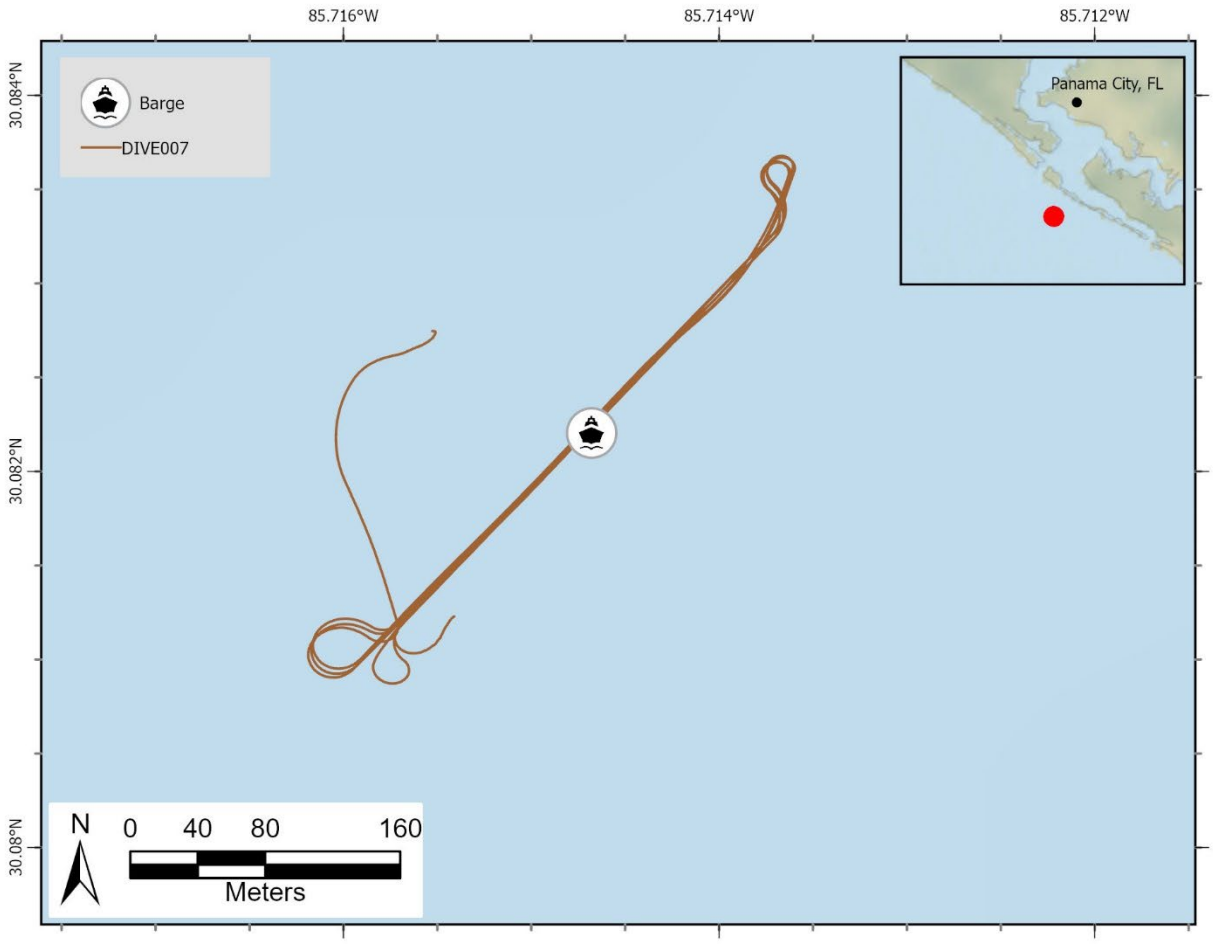

Figure 15. Map of the dive track for DIVE007. Location of the barge is noted.

DIVE008 – Barge. March 12–13, 2024

The AUV started a survey at 04:38 March 13 (UTC) at the barge site. The objective was to do some photogrammetric development right over the barge. The AUV made narrow line spacing passes of the barge at an altitude of 4 m (Figure 16). The dive ended at 06:13 March 13 (UTC), and the vehicle was recovered. On download, the hard drive storing images and LLS was corrupted resulting in a data loss for this dive.

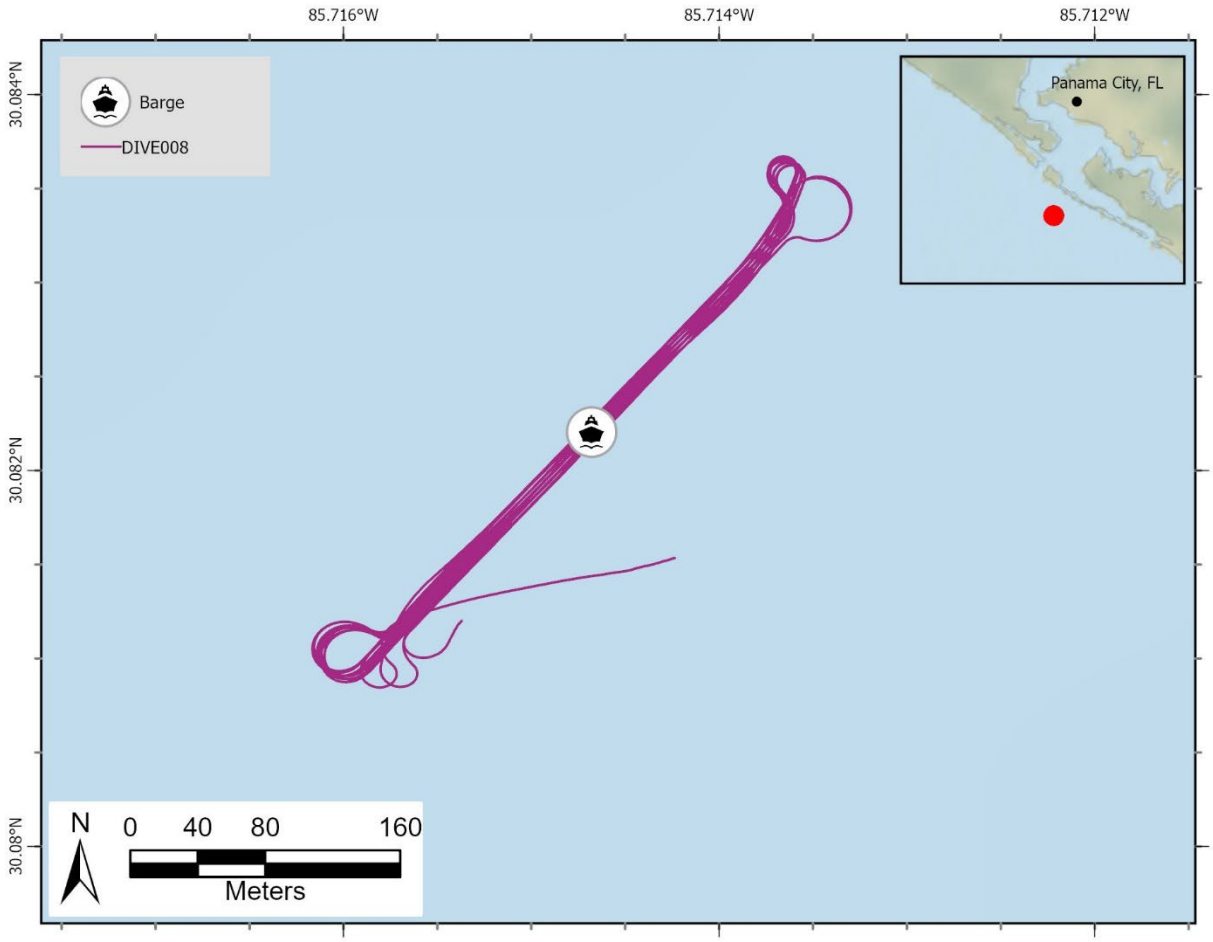

Figure 16. Map of the dive track for DIVE008. Location of the barge is noted.

DIVE009 – PC2302L3_ROV29-47. March 13–14, 2024

The AUV started a survey at 22:57 March 13 (UTC) at a site associated with MDBC ROV Dive PC2302L3_ROV29-47. The objective was to do an exploratory dive to see how the micro terrain varied from the multibeam bathymetry. The AUV made a couple of passes and was able to verify relatively flat terrain (Figure 17). The dive ended at 00:15 March 14 (UTC), and the vehicle was sent on a subsequent dive without being recovered first.

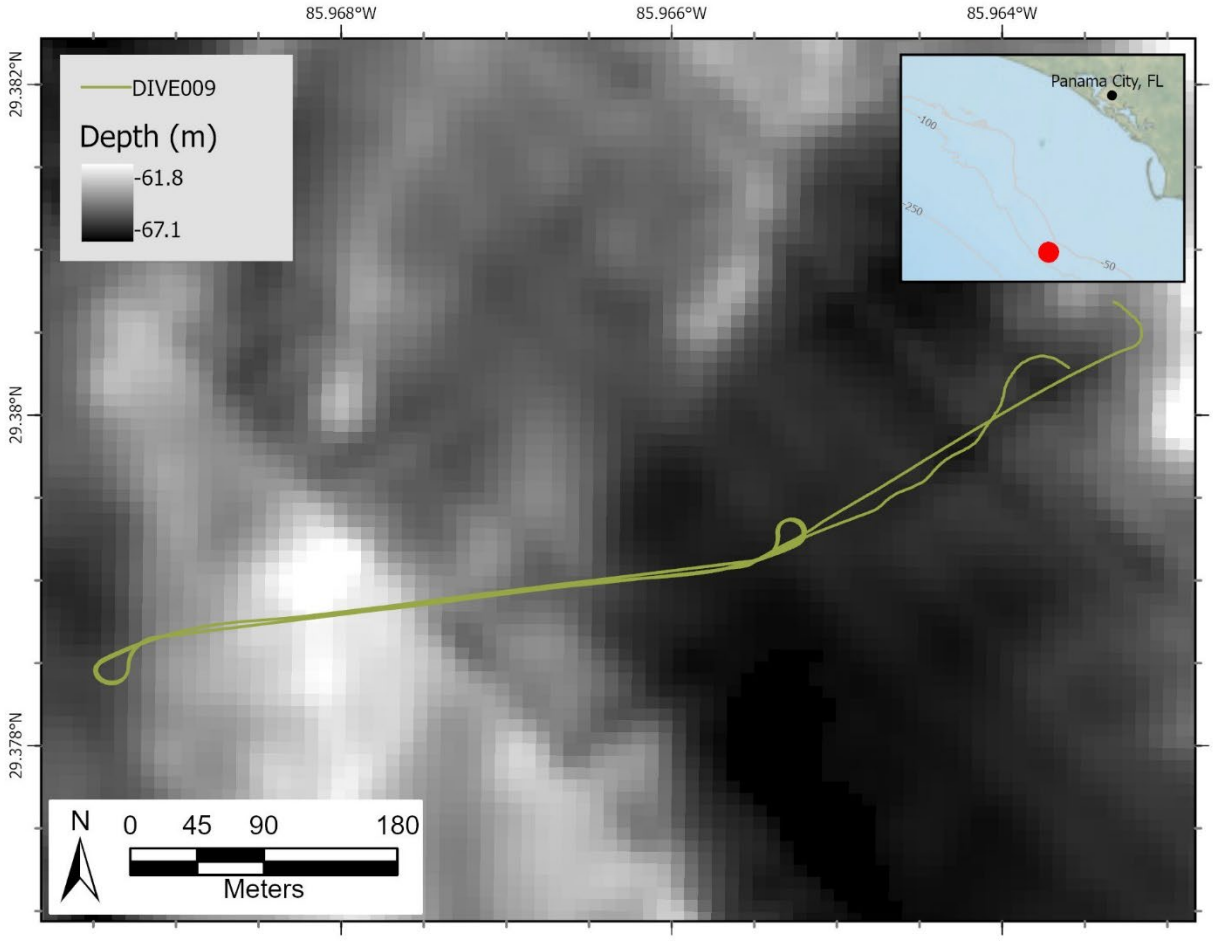

Figure 17. Map of the dive track for DIVE009. Bathymetry source: USGS, 2002.

DIVE010 – PC2302L3_ROV29-47. March 13–14, 2024

The AUV started a survey at 01:06 March 14 (UTC) at a site associated with MDBC ROV Dive PC2302L3_ROV29-47. The objective was to do an exploratory dive to see how the micro terrain varied from the multibeam bathymetry. The AUV made a couple of passes and was able to verify relatively flat terrain (Figure 18). The dive ended at 08:12 March 14 (UTC), and the vehicle was recovered before steaming to a different location. This dive is slated to be annotated to further assess the substrate and biologic cover.

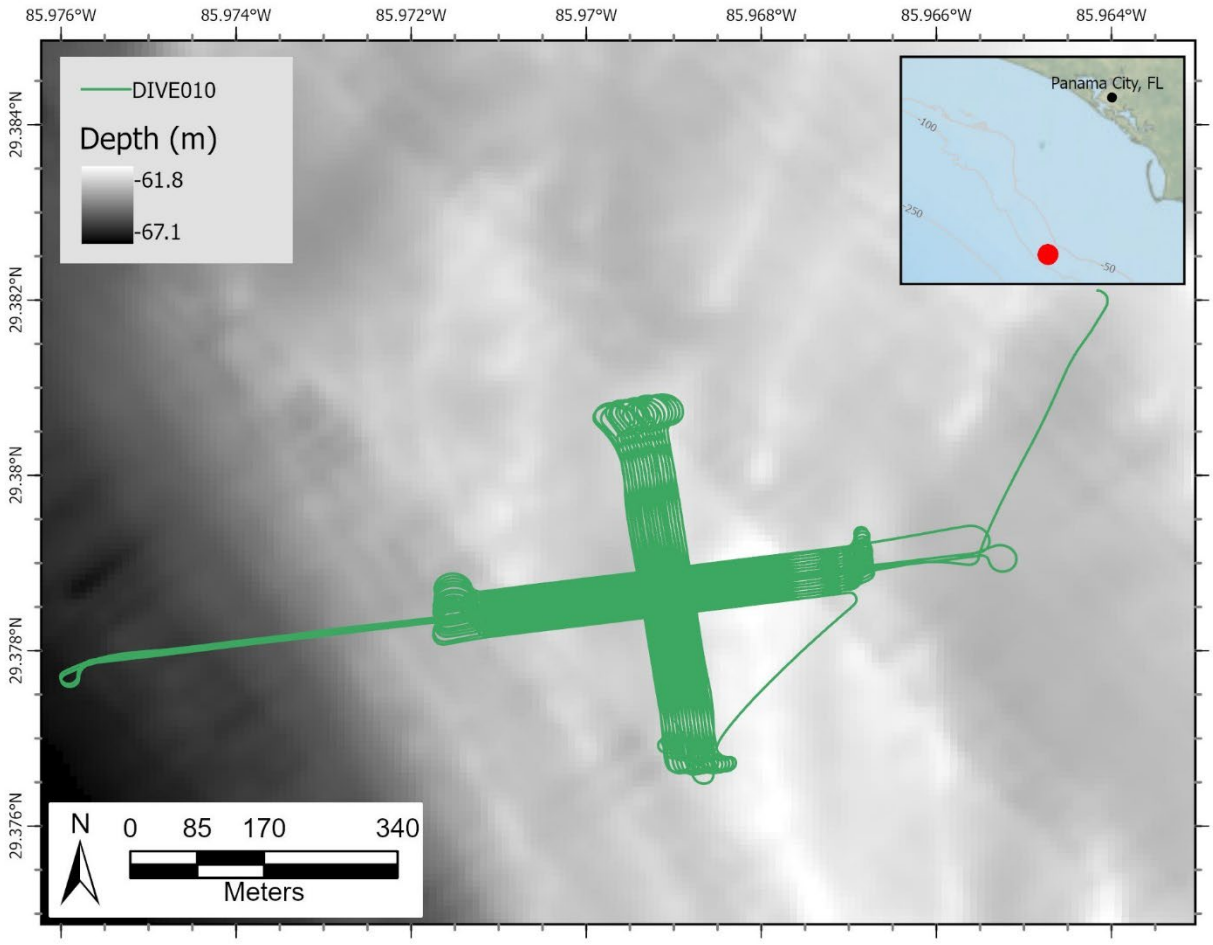

Figure 18. Map of the dive track for DIVE010. Bathymetry source: USGS, 2002.

DIVE011 – PC2302L3_ROV12-30. March 14–15, 2024

The AUV started a survey at 22:55 March 14 (UTC) at a site on Destin Dome associated with MDBC ROV Dive PC2302L3_ROV12-30. The objective was to do an exploratory dive to see how the micro terrain varied from the multibeam bathymetry. The AUV made a couple of passes in opposing directions and verified a significant high-relief hard bottom seafloor ledge structure with an east–west orientation (Figure 19). The vehicle came close to hitting the seafloor on the northbound legs. Pilots decided a more complex transect involving higher-altitude turnarounds was needed to avoid potential seafloor obstacles. The dive ended at 01:26 March 15 (UTC), and the vehicle was sent on a subsequent dive without being recovered first. This dive is slated to be annotated to further assess the substrate and biologic cover.

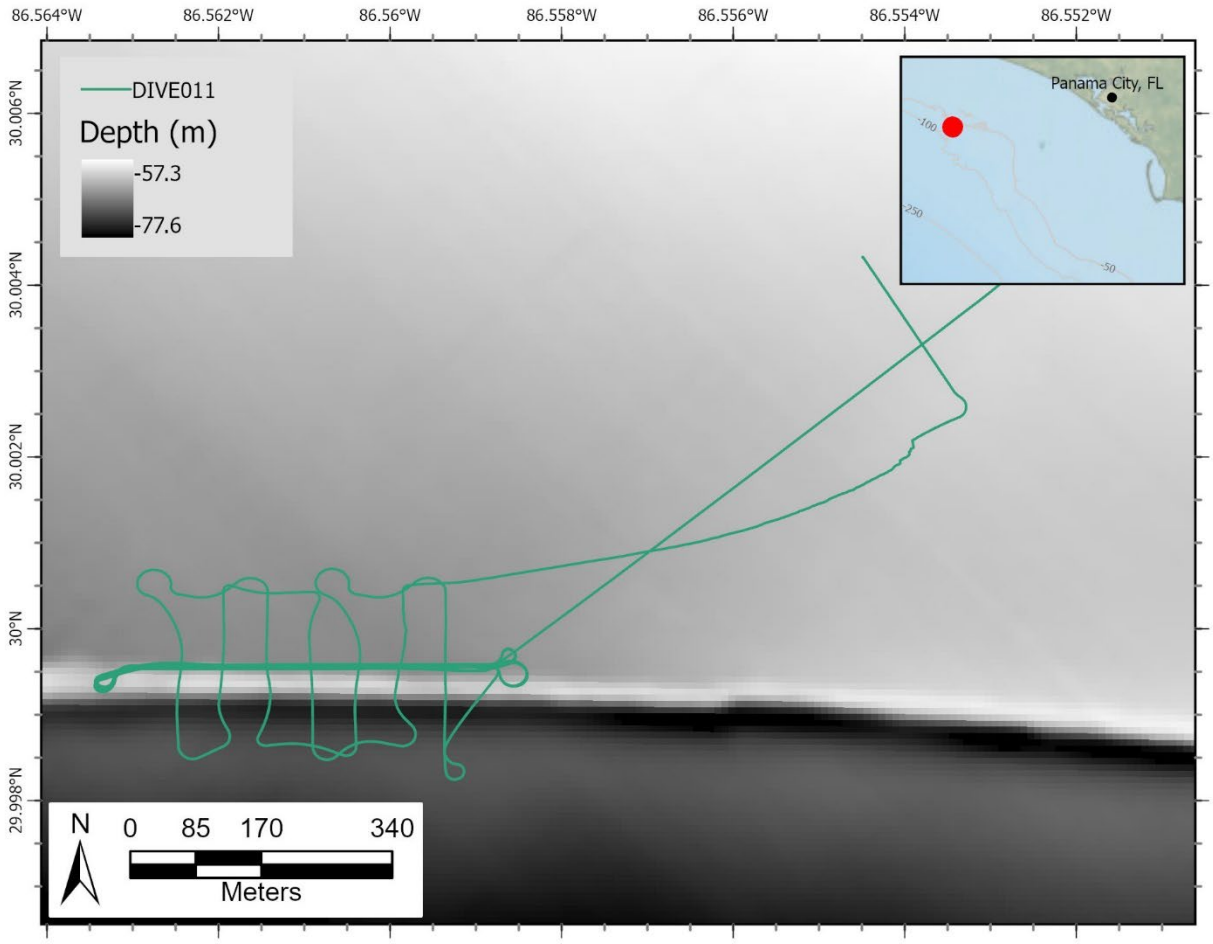

Figure 19. Map of the dive track for DIVE011. Bathymetry source: USGS, 2002.

DIVE012 – PC2302L3_ROV12-30. March 14–15, 2024

The AUV started a survey at 02:45 March 15 (UTC) at a site on Destin Dome associated with MDBC ROV Dive PC2302L3_ROV12-30. The objective was to do a dive to explore more of the high-relief, hard bottom seafloor ledge feature and to give the pilot more time to plan a more complicated mission for DIVE013. The AUV made a single pass, ran down the feature, and returned to the ship (Figure 20). The dive ended at 03:08 March 15 (UTC), and the vehicle was sent on a subsequent dive without being recovered first.

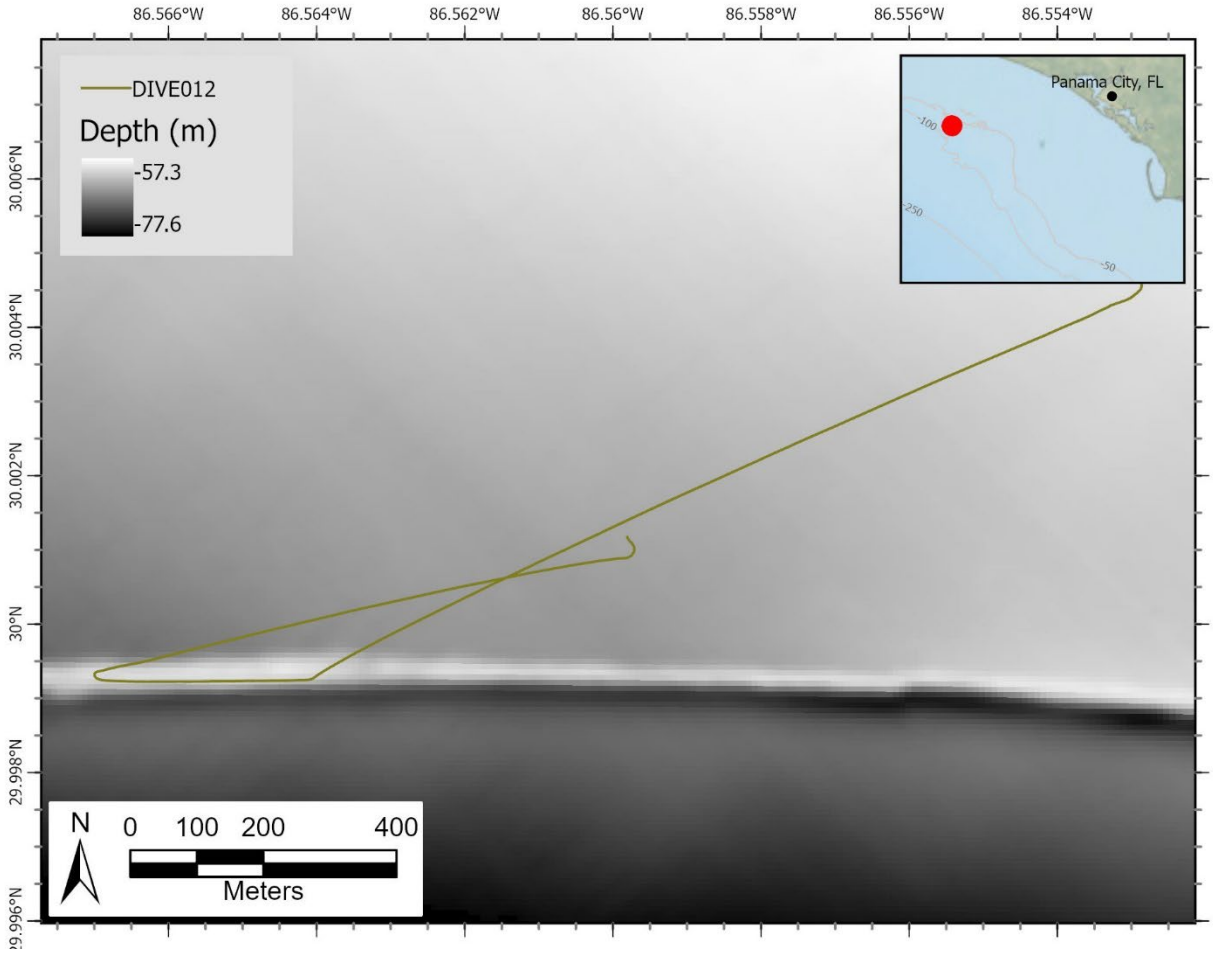

Figure 20. Map of the dive track for DIVE012. Bathymetry source: USGS, 2002.

DIVE013 – PC2302L3_ROV12-30. March 14–15, 2024

The AUV started a survey at 03:34 March 15 (UTC) at a site on Destin Dome associated with MDBC ROV Dive PC2302L3_ROV12-30. The objective was to do photogrammetric development with a more complex vehicle behavior to avoid impacting the seabed. The AUV made multiple parallel passes at a survey altitude of 5 m above the seabed (Figure 21). At the end of each pass, the vehicle increased its altitude and turned around for the next pass. After the turn, the vehicle descended back to survey altitude and finish the pass before repeating the process (Figure 8). The dive ended at 04:32 March 15 (UTC), and the vehicle was sent on a subsequent dive without being recovered first. In post-processing, the vehicle data revealed that the depth was not recorded correctly by the doppler velocity logger in the AUV. The images were clear and highly resolved but not correctly depth referenced.

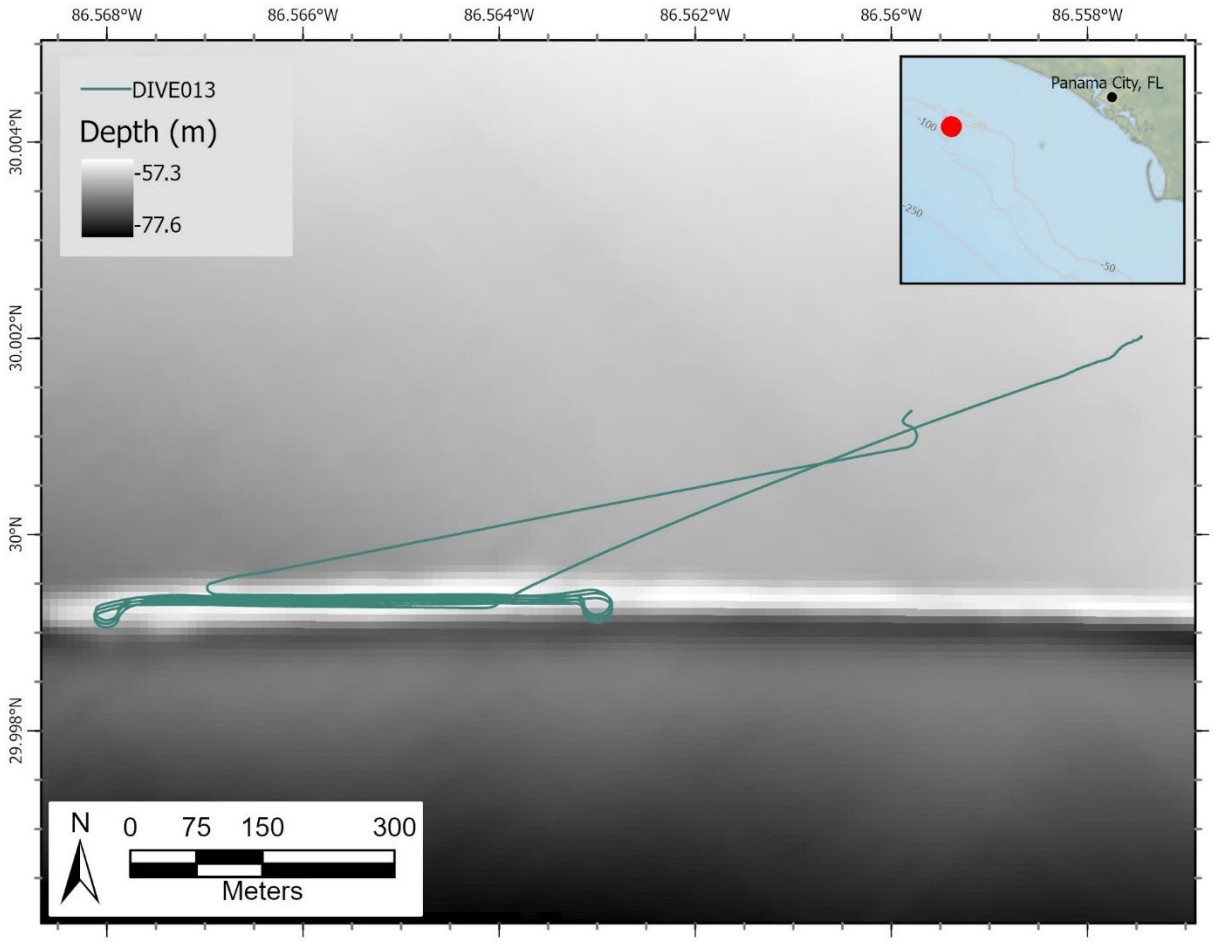

Figure 21. Map of the dive track for DIVE013. Bathymetry source: USGS, 2002.

DIVE014 – PC2302L3_ROV12-30. March 14–15, 2024

The AUV started a survey at 05:11 March 15 (UTC) at a site on Destin Dome associated with MDBC ROV Dive PC2302L3_ROV12-30. The objective was to do photogrammetric development with more complex vehicle behavior to avoid impacting the seabed adjacent to DIVE013. The AUV followed the same behavior as DIVE013 but extended the parallel passes to the south and off the ridgeline of the ledge feature (Figure 22). The dive ended at 06:33 March 15 (UTC), and the vehicle was sent on a subsequent dive without being recovered first. In post-processing, the vehicle data revealed that depth was properly recorded during this dive as opposed to the previous dive. This dive is slated to be annotated to further assess the substrate and biologic cover.

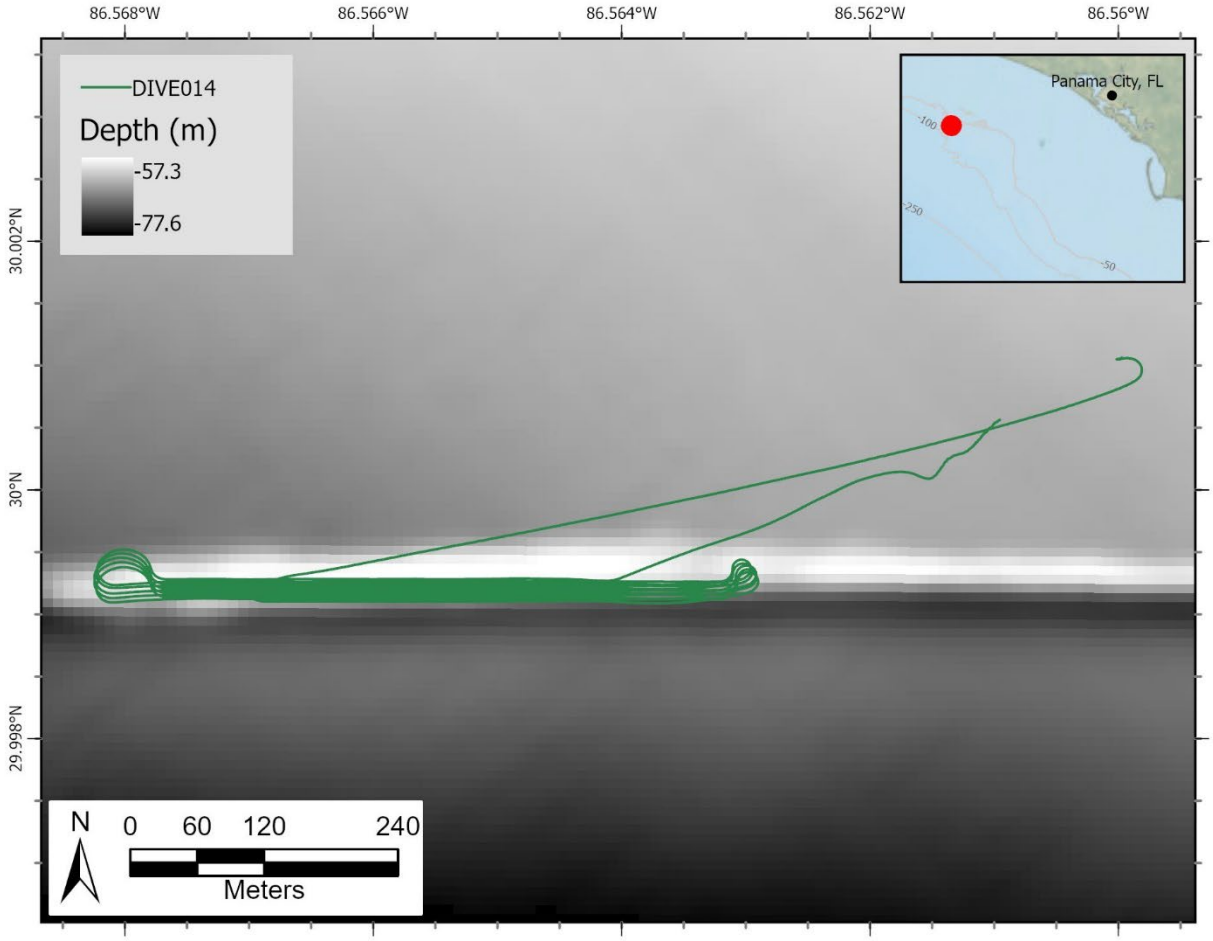

Figure 22. Map of the dive track for DIVE014. Bathymetry source: USGS, 2002.

DIVE015 – PC2302L3_ROV12-30. March 14–15, 2024

The AUV started a survey at 07:40 March 15 (UTC) at a site on Destin Dome associated with MDBC ROV Dive PC2302L3_ROV12-30. The objective was to do a patch test over the top of the ledge structure and further explore how to handle complex terrain like this feature. The AUV followed a pinwheel pattern, but when approaching the ledge from the south, it increased its altitude to clear the relief of the ledge (Figure 23). Approaching the feature from the north, the AUV was able to maintain a steady altitude over the full length of the survey lines. The dive ended at 08:51 March 15 (UTC), and the vehicle was recovered before transit back to port. This dive is slated to be annotated to further assess the substrate and biologic cover.

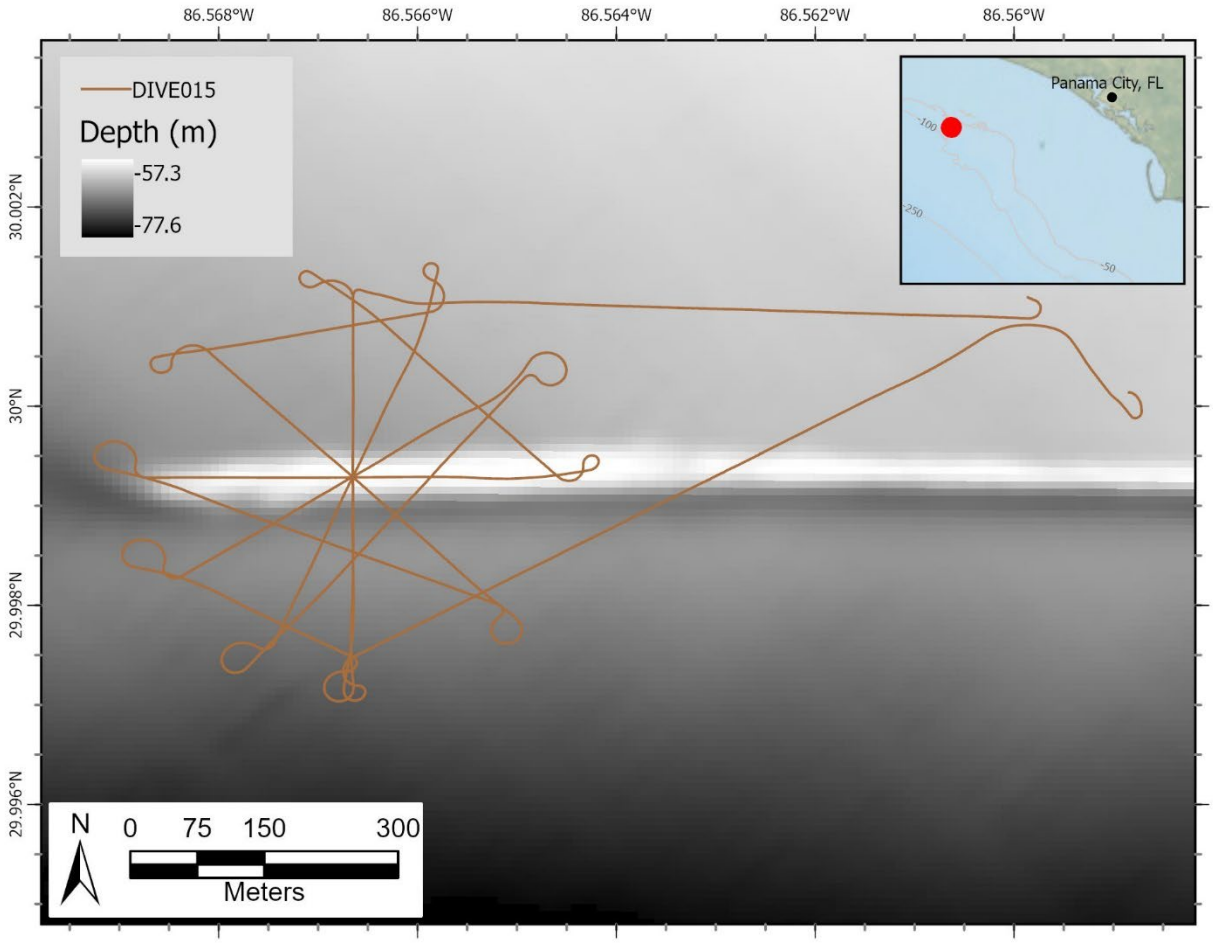

Figure 23. Map of the dive track for DIVE015. Bathymetry source: USGS, 2002.

Data Accessibility

The data, maps, and samples from this field mission will be held by NOAA, WHOI, and Voyis participants. Imagery (both digital stills and video) was uploaded to TATOR Cloud, a web platform from CVision AI, Inc. for video and imagery management and annotation. All other data and corresponding metadata (raw imagery, raw point clouds, navigation files, and bathymetry) will be archived with NOAA National Centers for Environmental Information within one year of completion of quality assurance procedures and be made publicly available through their data dissemination portal at that time.

Processed, detailed, and quality-controlled information on coral occurrences will be reported to NOAA's National Database of Deep-Sea Corals and Sponges.

Information about accessing data and other products from this field mission can also be found on the Data Integration Visualization Exploration and Reporting (DIVER) web page: https://www.diver.orr.noaa.gov/web/guest/dwh-mdbc-portfolio

References

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