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**Trip Report, Marine Mammal Monitoring  
Mine Neutralization Exercise Event, August 2010  
VACAPES Range Complex**

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### **List of Acronyms and Abbreviations**

deg C	degrees Celcius
EST	Eastern Standard Time
ft	feet
kg/m <sup>3</sup>	kilograms per cubic meter
kts	knots (nautical miles per hour)
m	meters
mg/L	milligrams per Liter
MINEX	Mine Neutralization Exercise
MMO	Marine Mammal Observer
nm	nautical miles
NMFS	National Marine Fisheries Service
PMAP	Protective Measures Assessment Protocol
psu	practical salinity units
XO	Executive Officer
yd(s)	yards

## SECTION 1: INTRODUCTION

In order to train with explosives, the Navy must obtain a permit from the National Marine Fisheries Service (NMFS) under the Marine Mammal Protection Act and Endangered Species Act. The Virginia Capes (VACAPES) Range Complex Monitoring Plan (DoN 2009), finalized in June 2009, was developed with NMFS to comply with the requirements under the permits obtained for explosives training (NMFS 2009). The VACAPES Range Complex Monitoring Plan is one component of the overall effort the Navy is undertaking to understand its potential effects and the biological consequences of those effects to protected marine species. The VACAPES Range Complex Monitoring Plan has been designed as a collection of focused “studies” to gather data that will allow us to address the following questions:

1. What are the behavioral responses of marine mammals and sea turtles that are exposed to explosives at specific levels?
2. Is the Navy’s suite of mitigation measures for explosives (e.g., PMAP, major exercise measures agreed to by the Navy through permitting) effective at avoiding TTS, injury, and mortality of marine mammals and sea turtles?

In order to answer these questions, data is to be collected through various means, including contracted vessel and aerial surveys, passive acoustics, and placing marine mammal observers (MMOs) aboard Navy assets.

As part of this data collection effort, vessel surveys were conducted in conjunction with a Mine Neutralization Exercise (MINEX) event during 8-10 August. Two to three U.S. Navy MMOs were stationed aboard the *Annapolis YP668 and YP688* during the event. The primary goal of the monitoring effort was to collect data on marine mammals observed during operations and to answer the follow questions:

1. Are marine mammals and sea turtles exposed to explosives?
2. If so, at what levels?
3. Did exposed marine mammals/sea turtles show a behavioral response?

A secondary goal for the monitoring was to familiarize the MMOs with at-sea Navy operations and to gather information to facilitate future MMO opportunities. This secondary goal is captured as “lessons learned” in Section 5.2.

## SECTION 2: MINE NEUTRALIZATION EXERCISE (MINEX) EVENT DESCRIPTION

During a mine neutralization exercise (MINEX) event, explosive ordnance disposal (EOD) personnel detect, identify, evaluate, and neutralize mines. In this specific case, small boats deployed two EOD divers. The EOD divers searched area to locate the training mine shape. Once found, in order to neutralize the mine, the EOD divers placed a 20 pound (1b) explosive charge on the mine. A timer on the charge was activated (~10 minutes) and then the EOD divers swam over and were picked up by the nearby small boats and taken a specified distance away

from the charge for safety reasons. This event was performed on August 9th and participants were members of the EODTEU-2 group located out of Damneck, VA.

## SECTION 3: METHODS

### 3.1. SHIPBOARD MARINE MAMMAL MONITORING

The vessel surveys were conducted on the bridge wings of the *Annapolis YP668 and YP688* (16 feet [ft] above water's surface), with a minimum of one observer on each wing. On-effort monitoring conducted before and after the events involved line-transect surveys. Observers would use the naked eye and 7X50 powered binoculars to scan the area from dead ahead to just abaft of the beam.

On-effort monitoring conducted during the event involved the ship being approximately 1,775 yds (1,623 m) away from the detonation site, where the MMOs would use the naked eye and 7X50 powered binoculars to scan the detonation site and surrounding mitigation zone. MMO surveys were conducted on a not-to-interfere basis, which means that the MMOs would not replace required Navy lookouts and would not dictate operational requirements/maneuvers. The only exception would be if a marine mammal or sea turtle was sighted by the MMO within the mitigation zone for the specified event (within 700 yds of the detonation site for a MINEX event), and was not sighted by the lookout, the MMO would report the sighting to the lookout for appropriate reporting and action.

When an animal was visually detected, the MMO would collect information on sighting, environmental, and operational parameters (Table 1). When practical, still photography was obtained by the MMOs. In addition to visual monitoring, a hydrophone was put in the water to monitor marine mammal vocal activity before, during, and after the events.

**Table 1. MMO Data Category Descriptions**

Data Category	Description
<b>Sightings Information</b>	
Effort (on/off)	On effort means actively searching for marine mammals.
Date	Format in mm/dd/yy.
Time	Time provided in Eastern Standard Time (EST).
Location	This is the location of the YP686 at the time of the sighting, provided by MMOs.
Detection Sensor	Either visual or aural (if detected passively by the sonar technician).
Species/Group	Determined by the MMO.
Group Size	Estimated by the MMO.
# Calves	Estimated by the MMO.
Behavior	<u>Individual behaviors</u> : breach, porpoise, spin, bowride, feeding, head slap, social, tail slap, pectoral fin slap, other <u>Whale behaviors</u> : blow, no blow rise, fluke up, peduncle arch, unidentified large splash <u>Group behaviors</u> : rest, mill, travel, surface active travel, surface active mill
Animal bearing (true)	Estimated by the MMO.
Animal motion relative to ship	Estimated by the MMO (closing, parallel, opening).
Distance from ship (yds)	Estimated by the MMO using reticled binoculars.
Length of contact	Estimated by the MMO.
<b>Environmental Information</b>	
Wave height (ft)	Estimated by the MMO.
Visibility	Estimated by the MMO.
BSS	Estimated by the MMO.
<b>Operational Information</b>	
Active sonar in use?	Specifically refers to MFAS.
Explosives in use?	Determined by the MMO.
Bearing of ship	Provided by monitors on the bridge.
Mitigation implemented	If explosive exercise underway, the measures implemented, if any, by the Navy Operators.
Comments	Other comments as necessary.

### 3.2. SCHEDULE OF EVENTS

*Annapolis YP686* departed out of Little Creek Amphibious Base in Virginia Beach, VA on 8 August and conducted pre-event monitoring from 1232 to 1355 Eastern Standard Time (EST) and deployed four buoys in the area. On 9 August, the *Annapolis YP686* conducted pre-event monitoring from 1106 to 1235 EST. The MINEX training event was conducted from approximately 1100 to 1330 EST, with the detonation occurring at 1254 EST. From 1235 to 1325 EST, the *Annapolis YP686* conducted monitoring during the event from approximately a 1,775 yds (1,623 m) distance from the detonation site. Post-event monitoring was then conducted from 1325 to 1456 EST. On 10 August, the *Annapolis YP686* conducted post-event monitoring from 1240 to 1414 EST. A detailed schedule of events is provided below in Table 2.

**Table 2. Schedule of Events**

8 August	
Time	Notes
~0730	YP686 underway
1143	Buoy deployment begins
1227	Buoy deployment ends
1232	MMOs on effort
1355	MMOs off effort
1405	Buoy retrieval begins
1423	Buoy retrieval ends
~1730	YP686 return to port

9 August	
Time	Notes
~0730	YP686 underway
0930	MINEX event begins
1032	CTD taken
1106	MMOs on effort
1210	Buoy deployment begins
1227	Buoy deployment ends
1254	Detonation occurs
1330	MINEX event ends
1419	Buoy retrieval begins
1442	Buoy retrieval ends
1456	MMO off effort
~1730	YP686 return to port

10 August	
Time	Notes
~0930	YP686 underway
~1200	CTD taken
1220	Buoy deployment begins
1235	Buoy deployment ends
1240	MMOs on effort
1414	MMO off effort
1430	Buoy retrieval begins
1445	Buoy retrieval ends
~1730	YP686 return to port

## SECTION 4: RESULTS

### Visual

Two marine mammal and one schooling jack sightings were recorded by the MMOs (). Both marine mammal sightings were of unidentified dolphins. One marine mammal sighting occurred on 8 August, the day before the event, and is shown in Figure 1 in relation to the planned detonation location. The marine mammal and schooling amberjack sightings on 9 August are shown in Figure 2 in relation to the detonation location.

For sightings that were obtained between 30 minutes pre-detonation and 30 minutes post-detonation, calculations were made to determine whether it was probable the animals could have been exposed to the detonation. Only one sighting fell within this time frame, which was a visual sighting of unidentified dolphins obtained approximately 8 minutes prior to the detonation on 9 August. The group was followed for approximately 2-3 minutes and was last seen heading north. The group was initially sighted approximately 885 yds (810 m) away from the detonation site and then resighted approximately 722 yds (660 m) away from the detonation site, which is outside the 700 yd mitigation zone. The group was passing by the detonation site traveling north and last seen opening their distance away from the site. For a 20 lb charge, the estimated range for temporary threshold shift (TTS) is approximately 552 yds (505 m). If the group stayed in the

area it is possible they could have been exposed to the explosion, but as stated they were headed away from the detonation site when last seen. The sighting was brief, but the individuals seemed to be traveling and no unusual behavior was observed.

**Table 3. Marine Species Sighting Data**

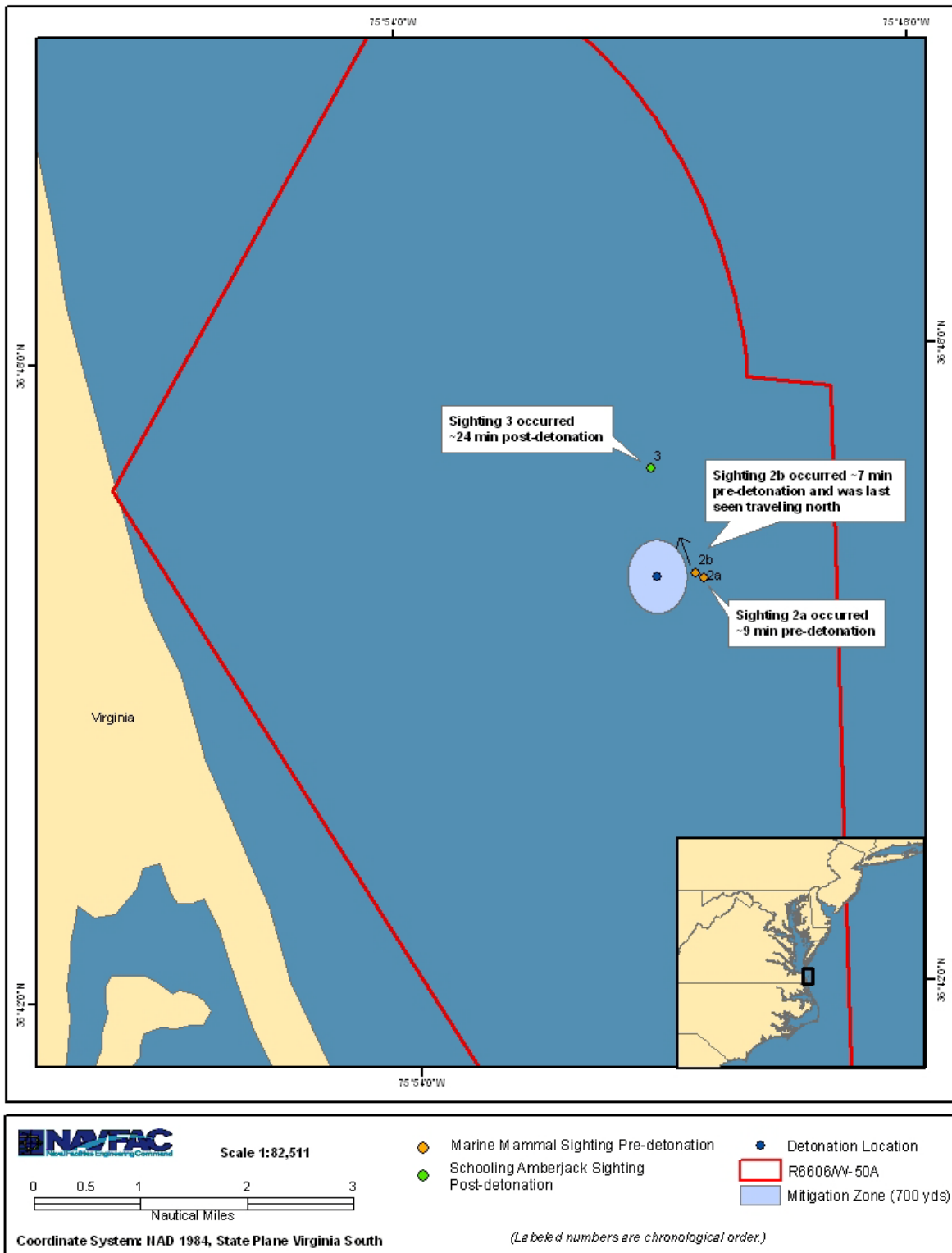
Data Category	Sighting 1	Sighting 2	Sighting 3	Sighting 4
Map ID*	1	2a	2b	3
<b>Sightings Information</b>				
Effort (on/off)	on	on	on	on
Date	08/08/10	08/09/10	08/09/10	08/09/10
Time	?	1246	1248	1320
Ship Location	36°46.287'N 75°49.955'W	36°45.750'N 75°50.365'W	36°45.750'N 75°50.365'W	36°46.876'N 75°51.137'W
Detection Sensor	visual	visual	visual	visual
Species/Group	unidentified dolphin	unidentified dolphin	unidentified dolphin	amberjack
Group Size	?	1-2	1-2	?
# Calves	0	0	0	NA
Behavior	?	traveling	traveling	splashing at surface
Animal bearing (true)	310°	300°	300°	300°
Animal motion relative to ship	?	closing	opening	
Distance from ship (yds)	?	358	536	
Distance of animal to detonation location (yds)	NA	885	722	NA
Length of contact	?	?	?	10 min
<b>Environmental Information</b>				
Wave height (ft)	4-6	4-6	4-6	4-6
Visibility	1.5 -10 km	1.5 -10 km	1.5 -10 km	1.5 -10 km
BSS	2	2	2	2
<b>Operational Information</b>				
Active sonar in use?	no	no	no	no
Explosives in use?	no	yes	yes	no
Bearing of ship	330°	180°	034°	022°
Mitigation implemented	N/A	No	No	N/A
Comments	Possible spotted dolphin; sighted by crew member on bow	Pre-detonation sighting outside of mitigation zone	Resighting of group, still outside mitigation zone	Broke track to investigate splashing; turned out to be large bait ball (~100 ft wide)

\* Map ID related to the labeled numbers in Figures 1 and 2.





**Figure 1. Ship position at time of sighting on 8 August 2010.**



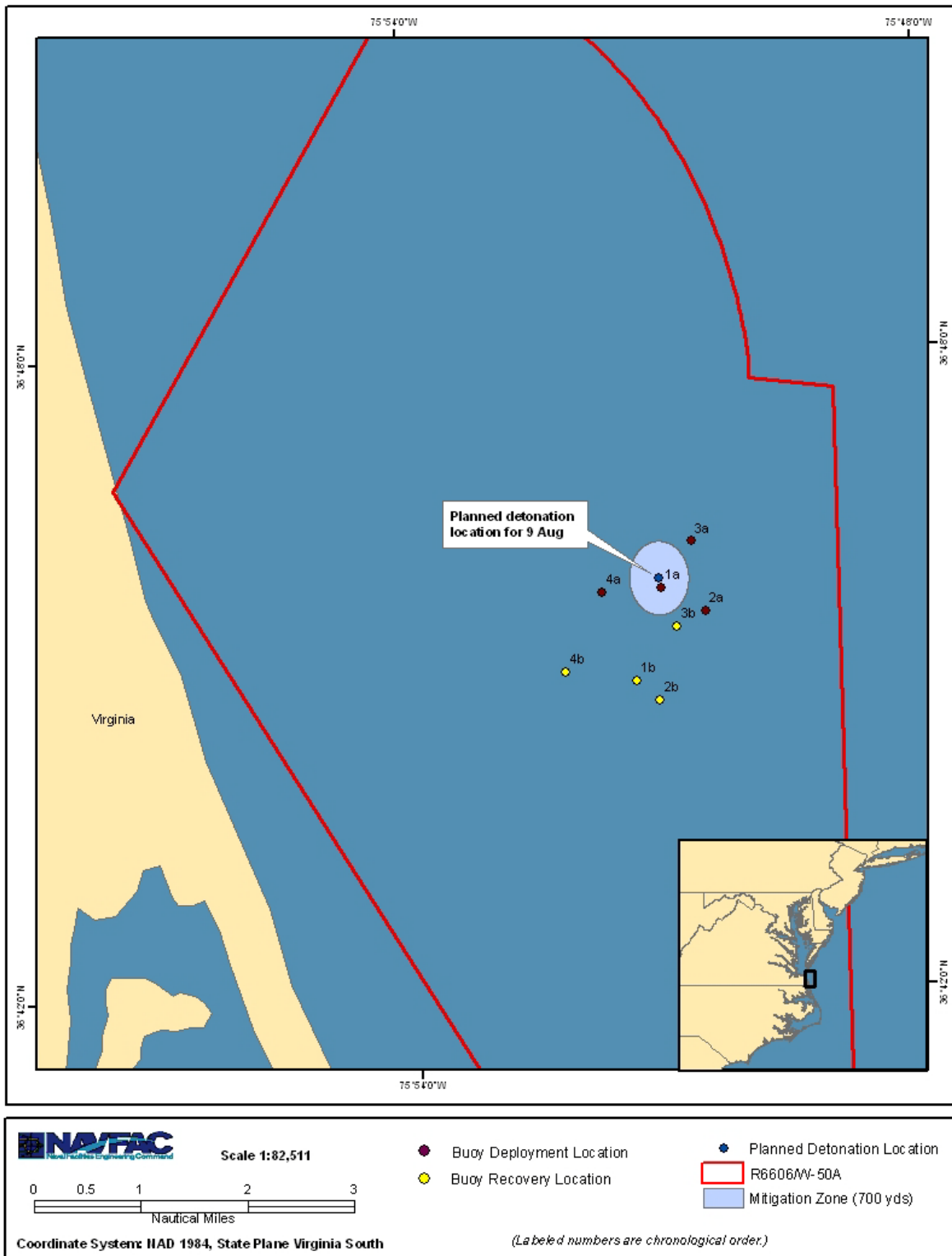
**Figure 2. Location of sightings and approximate detonation location on 9 August 2010.**

## **Acoustic**

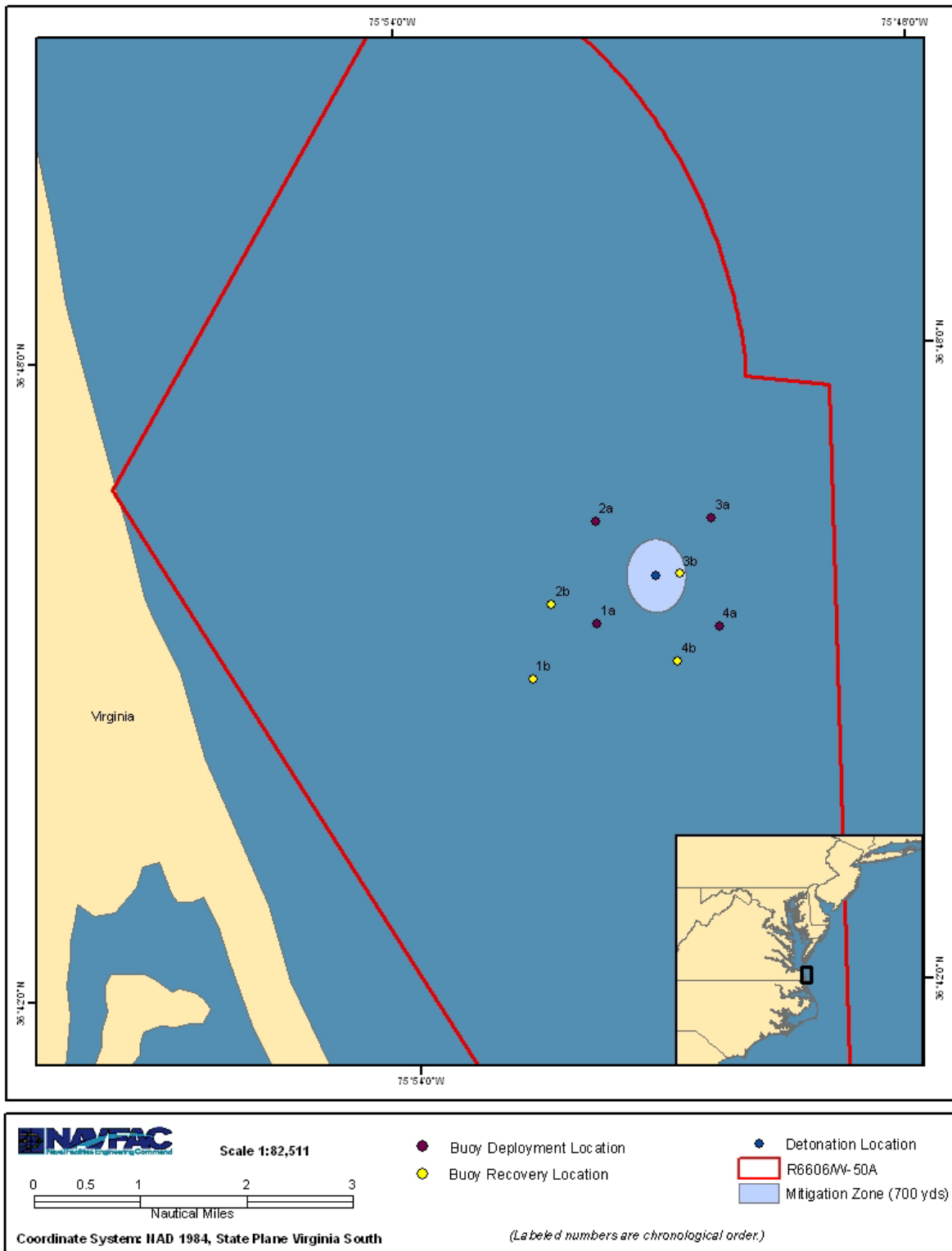
Acoustic buoys were deployed on the 8<sup>th</sup>, 9<sup>th</sup>, and 10<sup>th</sup> of August to monitor marine mammal vocalization activity before, during, and after the MINEX event (see Figures 3-5). On 8 August, 4 buoys were deployed, but only 2 of them recorded properly (buoys #1 and #2 failed). On 9 August, 4 buoys were deployed, but only 3 of them recorded properly (buoy #3 failed). On 10 August, 2 buoys were deployed and both of them recorded properly. Total successful recording time was approximately 14.5 hours, which includes 4 hours on 8 August, 7 hours on 9 August and 3.5 hours on 10 August.

A preliminary look was performed on the 9 August data using 1 minute windows. Results showed marine mammal detections on all 3 of the buoys. It does not look as though there were detections that occurred before the detonation, but there were detections found as early as 15 minutes following the detonation. As an example, Figures 6 and 7 show some whistles from buoy #1 that occurred 15 min 27 sec and 19 min 21 sec after the detonation, respectively. There were no visual sightings after the detonation to correspond with any of the acoustic data gathered.

At this time, no detailed analysis has been completed on the acoustic data set, except a quick visualization of the data; however, plans are in place and any additional results that are found will be presented in the 2011 Monitoring Report.



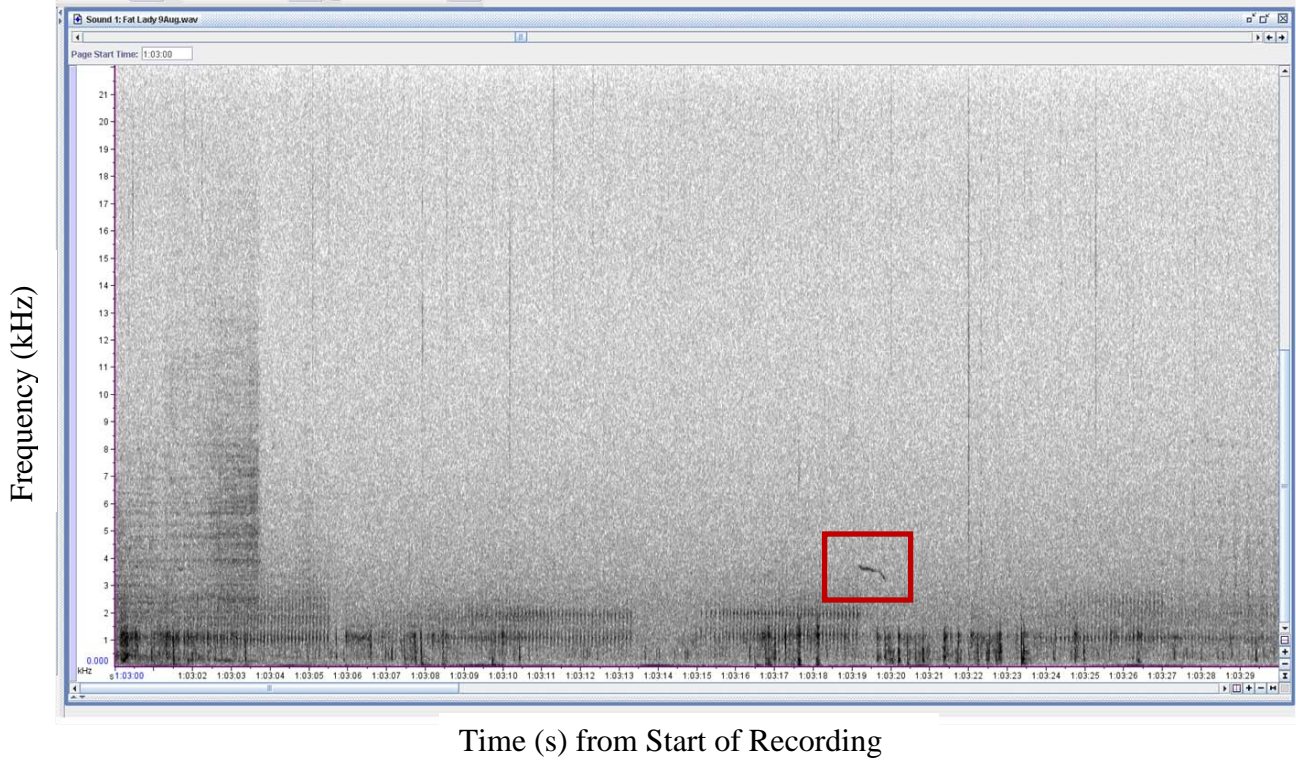
**Figure 3. Location of Buoy Deployment and Recovery on 8 August 2010.**



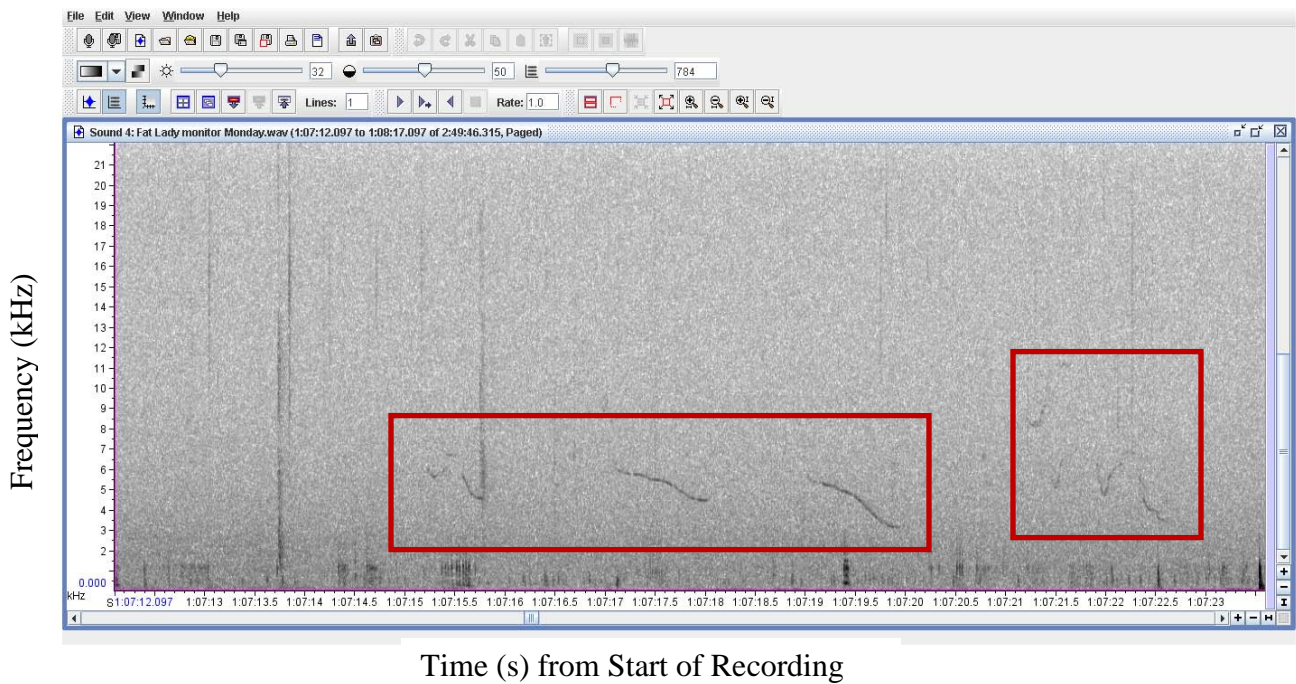
**Figure 4. Location of Buoy Deployment and Recovery on 9 August 2010.**



**Figure 5. Location of Buoy Deployment on 10 August 2010.**



**Figure 6. Spectrogram of Vocal Detection from Buoy #1 on 9 August 2010.**



**Figure 7. Spectrogram of Additional Vocal Detections from Buoy #1 on 9 August 2010.**

## **Oceanographic Sampling**

On 9 and 10 August, Conductivity, Temperature and Depth (CTD) recorders were deployed to gather oceanographic data samples for the monitoring area. On 9 August the CTD was taken at around 10:30 am and on 10 August the CTD was taken around noon. Results are shown in Figures 8 and 9. For temperature, the mixed layer occurred from the surface to approximately 6 m, where the temperature was mainly constant and ranged from only 24-25 degrees celcius (deg C). Then the temperature decreased rapidly with depth (also known as the thermocline) from 25 degrees celcius (deg C) at a depth of 6 m to about 14 deg C at a depth of 9 m, and then remained at 14 deg C through 12 m in depth. Salinity increased with depth (also known as the halocline) from 27.5 practical salinity units (psu) at the surface to about 32 psu at a depth of 9 m, and then remained at 32 psu through 12 m in depth. Density of the water increased from 17 kilograms per cubic meter ( $\text{kg/m}^3$ ) at the surface to 24  $\text{kg/m}^3$  at a depth of 9 m, and then remained at 24  $\text{kg/m}^3$  through 12 m in depth. Dissolved oxygen was measured at 7.8 milligrams per liter (mg/L) from the surface to a depth of 7 m and then again from 10.5 m to 12 m in depth. There was a spike in dissolved oxygen from 7 to 10.5 m, with a maximum level of 8.7 mg/L at 9 m in depth.

It is useful for the analysis to understand the environmental variables in which the sightings and acoustic data were collected. For example, the speed of sound in water increases with increasing water temperature, increasing salinity, and increasing pressure (depth). From this data, it was possible to calculate the sound velocity profile for each day; results are shown in Figures 10 and 11. The sound velocity profiles show an environment where sound is downward refracted. This means that in order to maximize the detection range of the buoys, it is necessary to place them at depth because sound is being directed away from the surface. The hydrophones of the acoustic buoys were suspended at approximately 3 m depth, which was right in the middle of the mixed layer. Since the area was shallow (10-20 m depth), this was a compromise between suspending the hydrophones at depth and avoiding having them too deep where they could have hit the bottom.



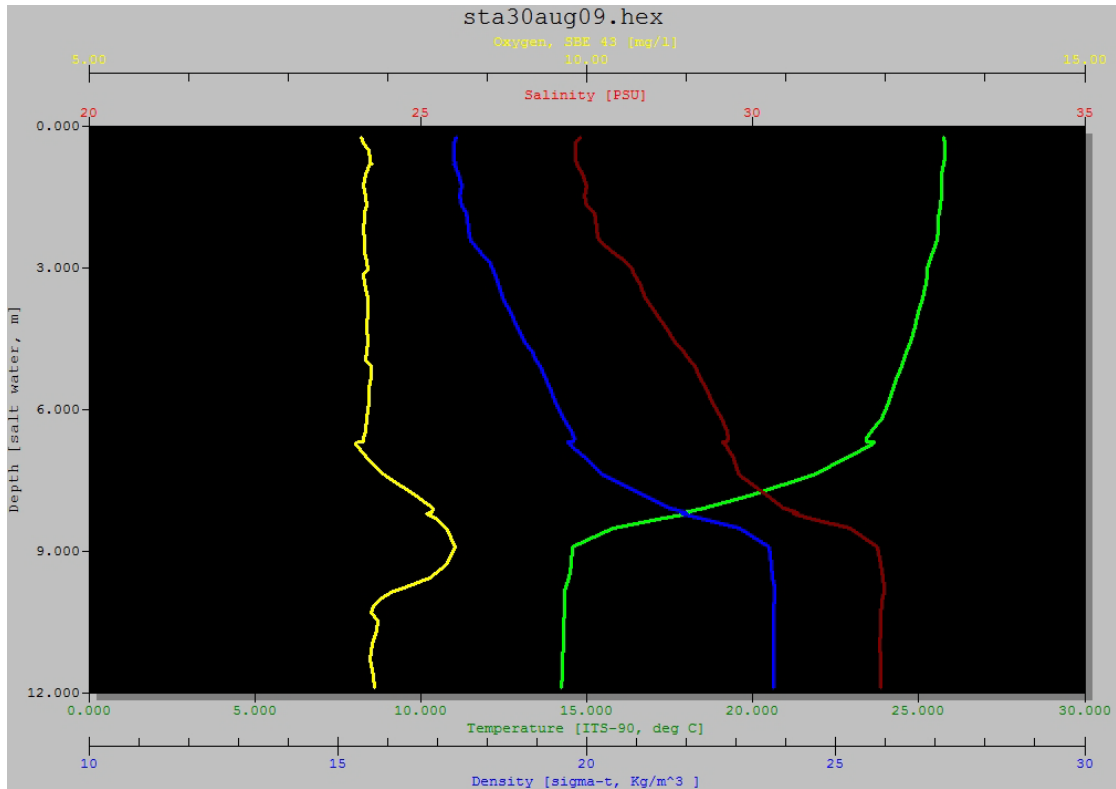


Figure 8. CTD Graph for 9 August 2010.

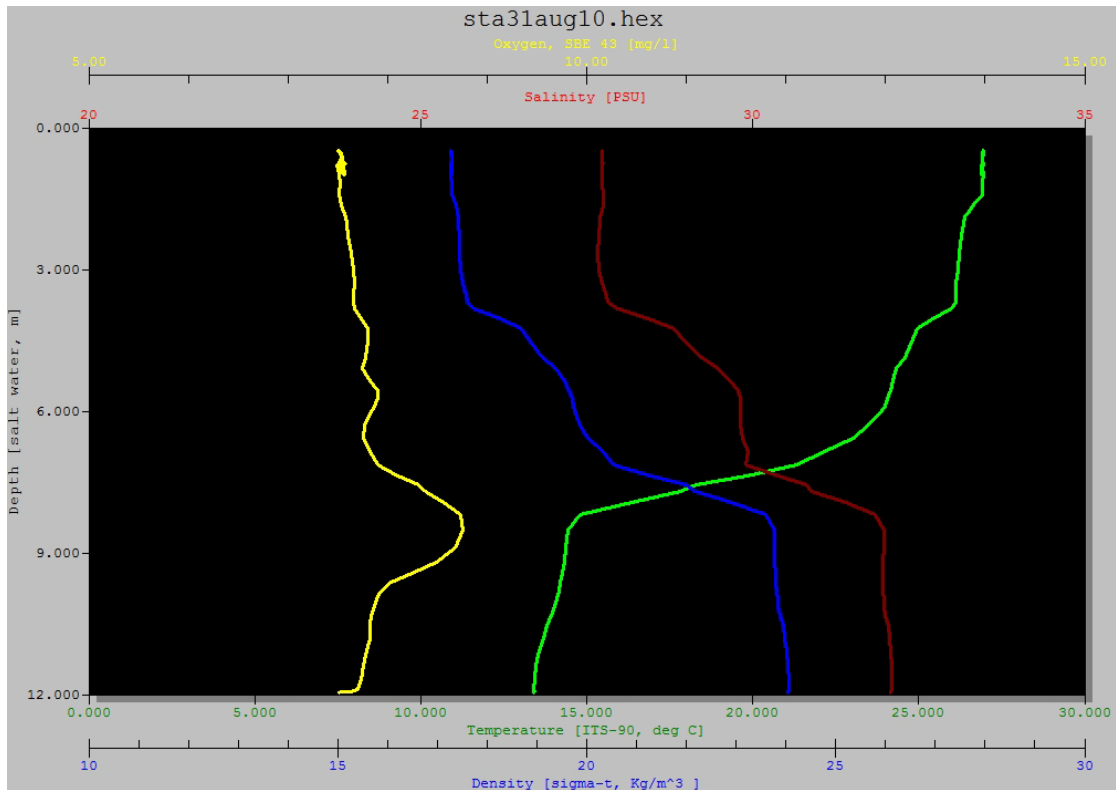
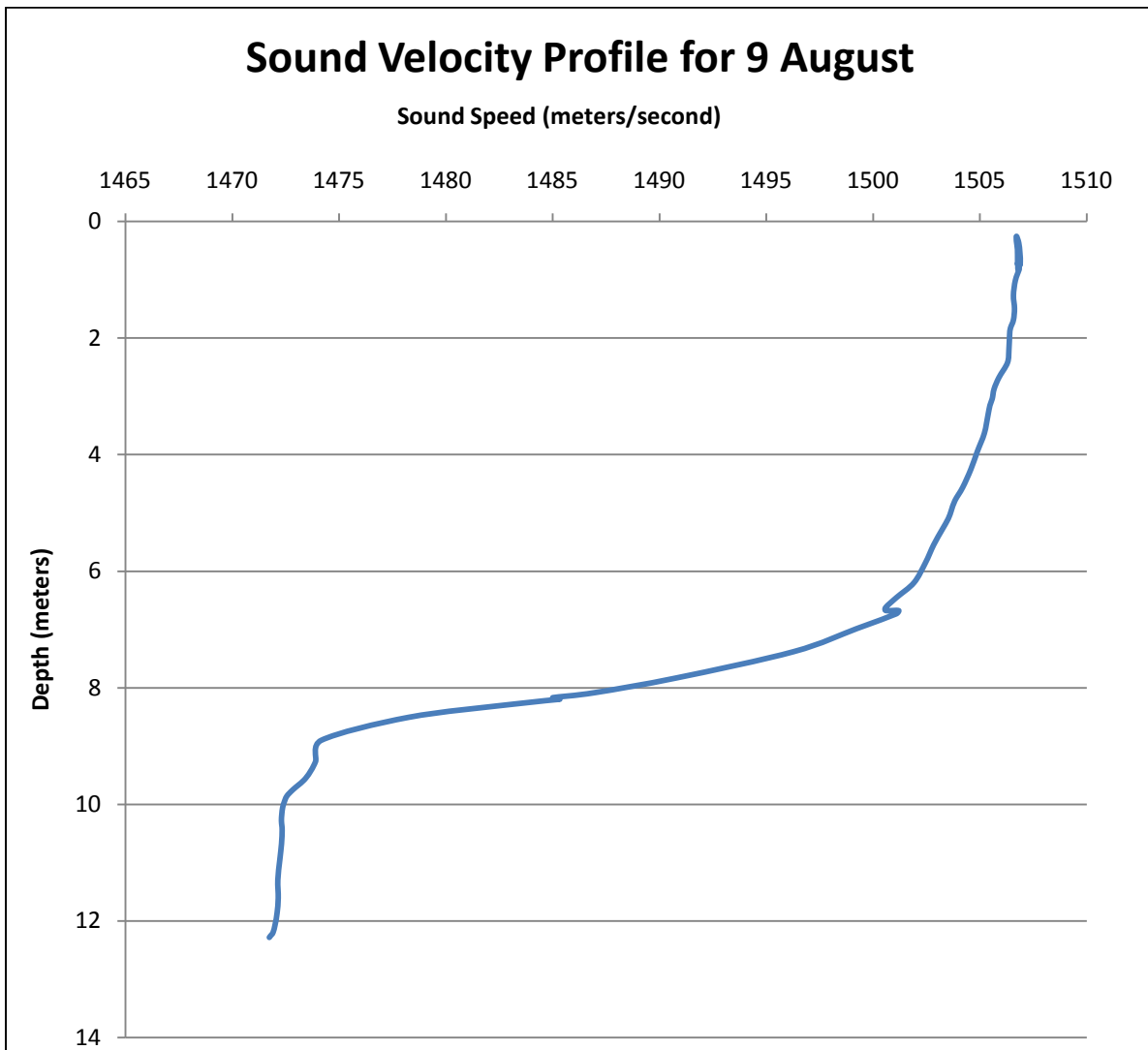
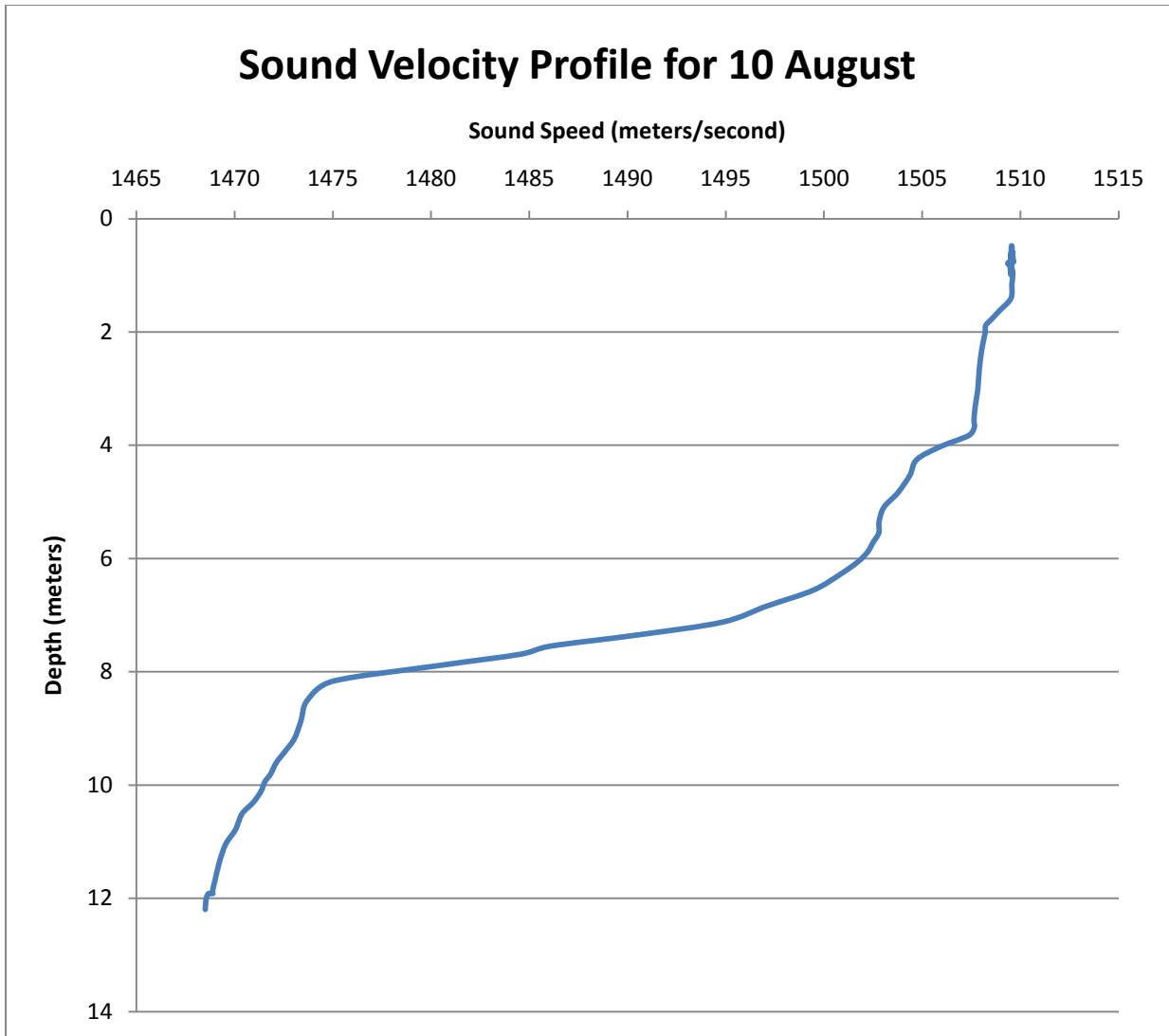


Figure 9. CTD Graph for 10 August 2010.



**Figure 10. Sound Velocity Profile for 9 August 2010.**



**Figure 11. Sound Velocity Profile for 10 August 2010.**

## SECTION 5: CONCLUSION

### 5.1. MARINE MAMMAL MONITORING

The goal of the VACAPES MINEX monitoring effort is provided below, with a conclusion regarding each of the specific questions that were asked:

1. Are marine mammals and sea turtles exposed to explosives?

On 9 August, a sighting of bottlenose dolphins was made approximately 8 minutes pre-detonation. The sighting did not occur within the mitigation zone and the animals were last seen traveling away from the detonation site (see Results Section). Based on the sighting information, it is assumed that the animals were not exposed to the detonation.

On 9 August, approximately 15 minutes following the detonation, delphinid vocalizations (presumed to be bottlenose dolphins) were captured on one of the buoys. At this time it is unclear whether the delphinids were close enough to the detonation to be exposed. Plans are in place for further analysis to be completed, and results will be included in the 2011 Monitoring Report.

2. If so, at what levels?

For a 20 lb charge, the estimated range for temporary threshold shift (TTS) is approximately 552 yds (505 m). It is unlikely that the bottlenose dolphins sighted on 9 August, (last seen at 722 yds (660 m) and traveling away from the detonation site) would have been exposed at levels that could have caused TTS. For single detonations, such as this case, there is no criterion for behavioral disturbance.

For the delphinid vocalizations that were obtained on 9 August, at this time it is unclear how far away the individuals were from the detonation site. If this information can be obtained, estimations can be made regarding whether the individuals were exposed and at what levels. Plans are in place for further analysis to be completed, and results will be included in the 2011 Monitoring Report.

3. Did exposed marine mammals/sea turtles show a behavioral response?

No unusual behavior was observed during any of the sightings, and based on visual sighting data it does not look as though any marine mammal or sea turtles were exposed during the explosive event.

Based on the acoustic data, it is unclear at this point whether the vocalizing delphinids were exposed during the explosive event. No behavioral data can be drawn from the acoustic data at this time, but any

results that can be drawn in the future will be included in the 2011 Monitoring Report.

## 5.2. LESSONS LEARNED

A few lessons learned were noted for the VACAPES MINEX event monitoring effort, and are separated into those for shipboard monitoring and operational information below.

### 5.2.1. Shipboard Marine Mammal Monitoring

- Continue to ensure that a detailed log (leave port, begin on-effort, begin event, end event, off-effort, and return to port) is kept for each day of monitoring.
- Recommend that improvements continue to be made to ensure consistency among MMOs regarding filling out the sighting forms. For example, use same format for coordinates, distance, etc. Future priority will be to look into upgrading to a computer-based format for logging information.
- Methods are needed to continue to improve the close aboard distance estimation by MMOs. Reticled binoculars were used for longer distance sightings, but this method was not useful for close aboard sightings. Suggest that MMOs practice close aboard distance estimation if possible.
- Significant improvements were made to the passive acoustic monitoring capabilities so that more detailed information could be obtained. It is recommended that this continue to be a priority in order to supplement the visual monitoring.

### 5.2.2. Operational Information

- Future monitoring efforts should continue to make every attempt possible to organize a pre-event brief. This allows the environmental staff to present the goals of the monitoring and explain what information is needed for their planning efforts, as well as the opportunity to learn more about the event(s) that will be taking place.
- A field communication plan is extremely vital for successful monitoring on Navy ranges. It is imperative to have multiple forms of potential communication in case the preferred method does not work. Communication needs to take place in the event range schedulers need to confirm that MMOs have permission to be on the range, as well as to get updates regarding schedule of event(s).
- Need to continue to improve pre-planning coordination between operators and MMOs to ensure that monitoring opportunities and data gathering is maximized.

## SECTION 6: ACKNOWLEDGEMENTS

We thank the officers and crew of the *EODTEU-2* unit for their outstanding support and cooperation with our monitoring efforts. We thank the US Naval Academy Annapolis for

supplying the monitoring boats and crews to support the MMO work. We also thank USFF's environmental staff for pre-planning coordination.

## SECTION 7: REFERENCES

- DoN. 2009. Virginia Capes (VACAPES) Range Complex Monitoring Plan-Final 15 June 2009. Department of the Navy, Commander. U.S. Fleet Forces Command.
- NMFS. 2009. Taking and Importing Marine Mammals; U.S. Navy Training in the Virginia Capes (VACAPES) Range Complex; Final Rule. June 15, 2009. 74FR28328.