Final Report: Deepwater ROV Sampling to Assess Potential Impacts to Hardbottom Coral Communities and Associates from the Deepwater Horizon Oil Spill

Results from the Cruise Effort Conducted on the Holiday Chouest

October 2nd – 25th, 2011

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Chapter 1: Introduction

This report presents results of data collection efforts undertaken on the Holiday Chouest Cruise (HC3), a cruise undertaken from October 2nd through October 25th, 2011, as part of the Natural Resource Damage Assessment of the Deepwater Horizon Oil Spill. The cruise was conducted pursuant to the cooperative work plan entitled "Deepwater ROV Sampling to Assess Potential Impacts to Hardbottom Coral Communities and Associates from the Deepwater Horizon Oil Spill".[1] Information presented herein is considered supplementary to data and information presented in the preliminary cruise report and does not repeat all of the information contained in that previous report.

The remainder of the report is organized as follows:

- Chapter 2: Description of Sites and Coral Communities Visited and Imagery Collection Summaries, presents a narrative of assessment activities conducted on board the HC3, makes notes of any observed abnormalities, and presents data on the number of images collected at each sampling site.
- Chapter 3: Coral and Coral Associate Species Identification, presents the results of coral and coral associate identification efforts.
- Chapter 4: Time Lapse Camera Recoveries and Deployments, discusses the deployment and retrieval of the time-lapse camera system used on the HC3, as well as a summary of observations from, and transient fauna visible in, images using that system.
- Chapter 5: Meiofauna and Macrofauna, presents the results of infauna enumeration and identification in sediment cores collected on the HC3 cruise.
- Appendix A presents a data summary of the coral associates imaged at 10 sites visited on the HC3 cruise.
- Appendix B presents the results of coral species identification efforts using genetic techniques.
- Appendix C presents the results of coral associate identification efforts using genetic techniques.
- Appendix D presents the technical details related to the deployment of the time-lapse camera.
- Appendix E presents the results of observations of coral associates from time-lapse camera images.
- Appendix F presents the results of mobile fauna observations from time-lapse camera images.

[1] Pursuant to the work plan, coral histology was undertaken; however this work was not completed. A preliminary report of the partially-completed coral histology work is provided under separate cover.

Chapter 2: Description of Sites and Coral Communities Visited and Imagery Collection Summaries

This Chapter presents short descriptions of findings at each of the hardground coral sites visited during the cruise. In addition, data are presented on the numbers of images captured at each site. Any observed abnormalities are noted. Figures 1 through 3 present representative examples of notable features observed on corals.

As a general rule, efforts were made to document all of the coral colonies at each site visited. However, the distribution of corals on carbonates, and of the carbonates around the corals, sometimes prevented the remotely operated vehicle (ROV) from approaching to an optimal position for lighting and imaging of individual corals. Due to these technical constraints, not all the individual coral colonies at all sites were imaged, not all pictures are of equal resolution, and it is unlikely all of the individual coral colonies at a given site were imaged, let alone discovered.

The exception to the general rule above was how we treated image collection at four of the hardground sites: at AT 375, VK 826, VK 906, and MC 118. Due to the large number of coral colonies present at AT 357, not all corals were imaged throughout the dive. Rather, an emphasis was placed on identifying corals with abnormalities (although no significant abnormalities were observed at this site). At AT 357, images of approximately 61 corals suitable for impact assessment were collected initially in areas with markers. Then, approximately 30 additional corals were imaged at other locations around the site to survey associates and to document collections of both associate and coral samples. Similar to AT 357, the previously studied VK 826 and VK 906 sites harbor thousands of individual colonies. As a result, we limited our imaging to video documentation of the dives and re-survey of previously mosaicked area at these sites. The MC 118 site has also been surveyed rather extensively on previous visits and corals at this site are spread over a very large area, so we only attempted to survey corals at a few representative parts of this site. More detailed findings for each of these sites, as well as for the rest of the sites visited, are provided below.

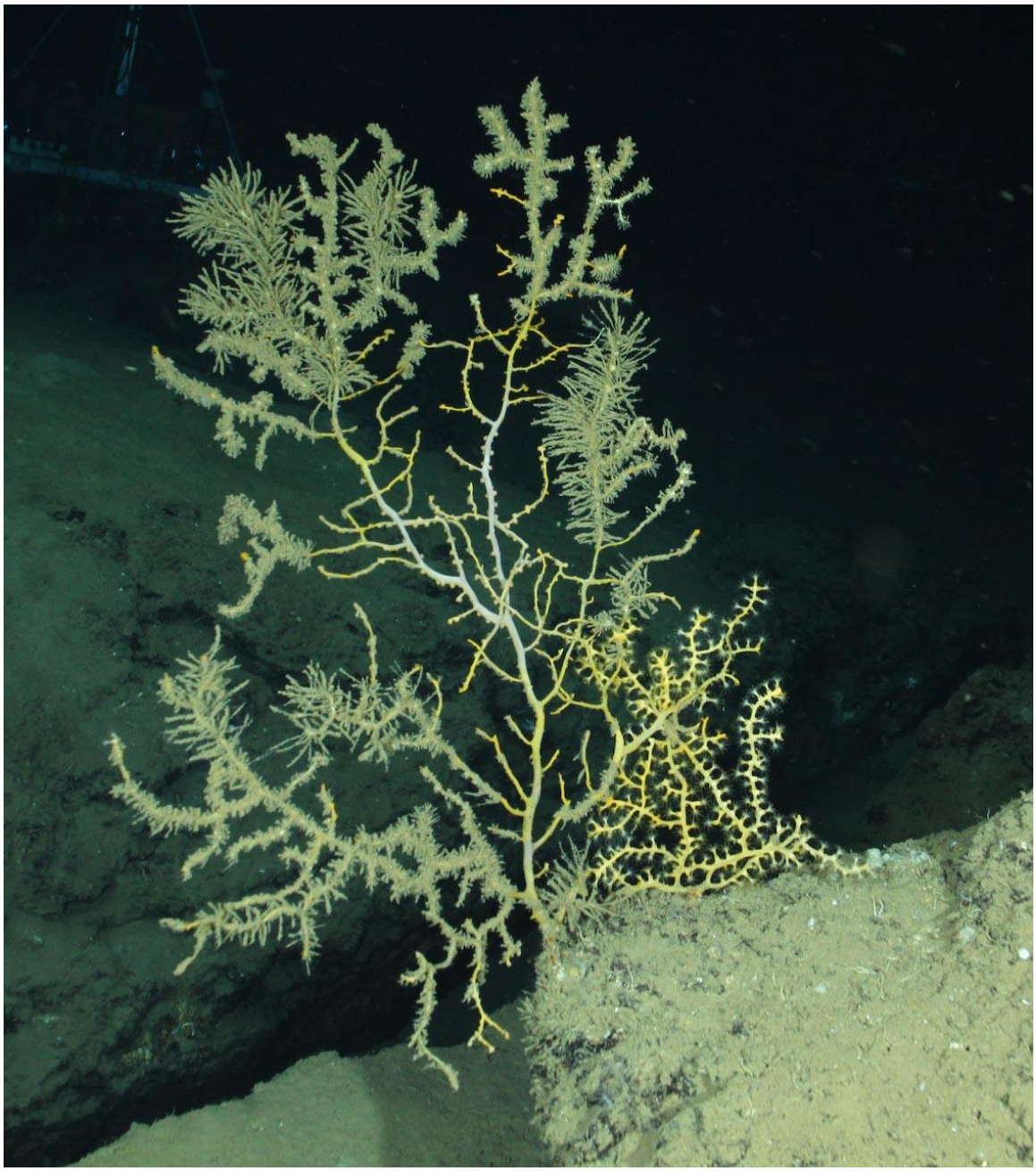

Figure 1. On this *Paramuricea biscaya* coral (A10) from MC 294 there are areas covered by hydroid colonization (2 morphotypes), a central area with discolored tissue, and several portions of branches with no tissue on the skeleton. Polyps are not extended on the portions of the coral that still have tissue on them (little bumps on the skeleton), as is evident by contrasting the coral in the foreground with the colony behind it with most polyps extended.

Figure 2. The *Swiftia pallid*a in this image from MC 294 (B3) has floc covering parts of the colony.

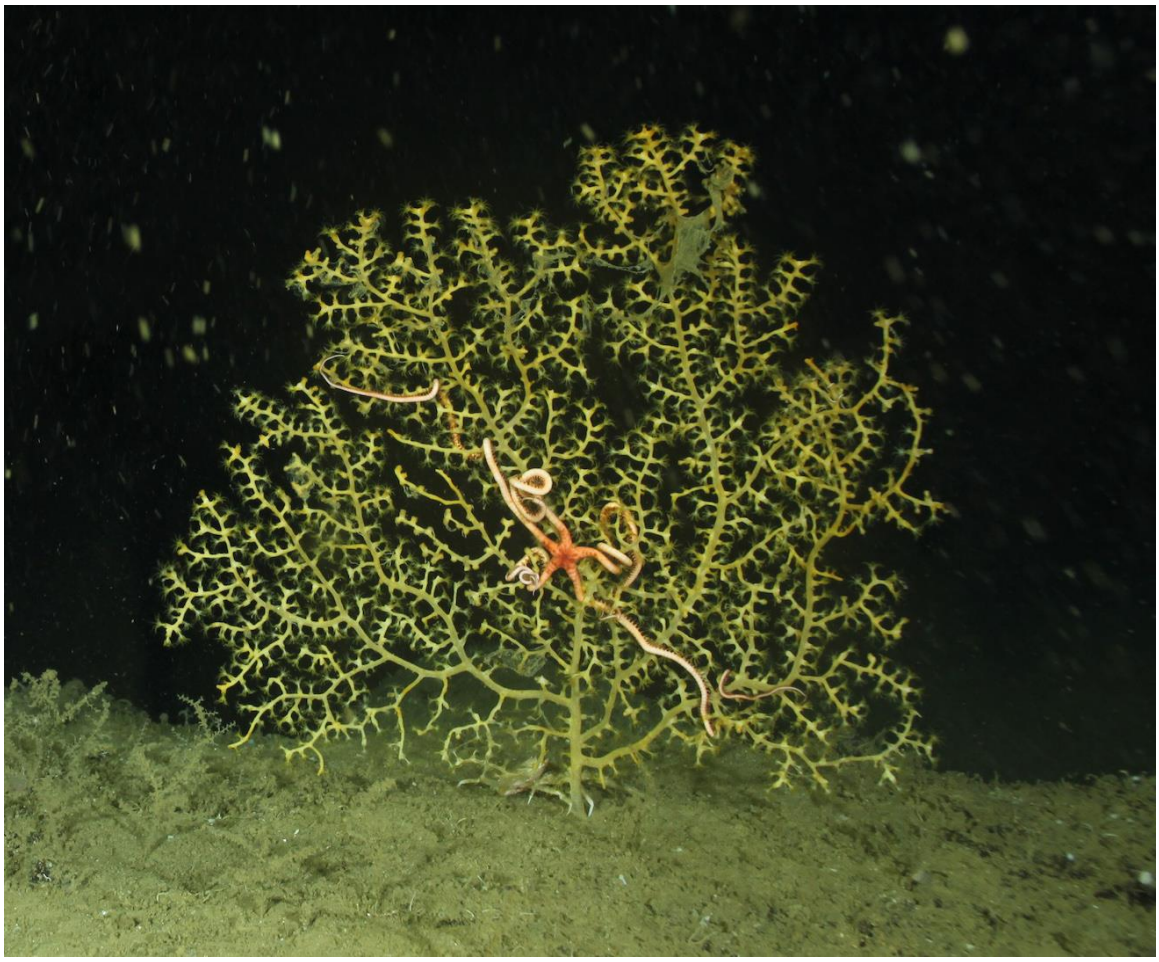

Figure 3. The *Paramuricea biscaya* (MM1-7) in this image from MC 297 has areas with excessive mucous production and adherent floc in the upper portion of the colony.

The MC 338/294 site is the site discovered during the Ronald Brown cruise in 2010. The central portion of the area colonized by corals and the area most intensively studied is limited to the area with corals present on two large carbonate slabs covering an area of about 10 by 12 m. An updated mosaic of this area from images collected in 2010 can be found in Figure 4. A few (about 10) other coral colonies were present on carbonate boulders scattered within about 30 meters of this central area when the site was originally discovered. Many of these have been sampled for genetic identifications and we made no attempt to further study these corals in order to concentrate our efforts on the more densely populated area of the site. This site had been visited during three previous expeditions: by the ROV Jason II cruise in November 2010 (supported by the Bureau of Ocean Energy Management (BOEM) and NOAA OER), the HOV Alvin cruise in December 2010 (supported by the NSF), and by the HOS Sweetwater NRDA cruise in March 2011 (as part of the NRDA Time Lapse Camera Recovery and Redeployment plan). A total of seven dives were made to this site as part of this cruise effort on the Holiday Chouest. At this site, we recovered and then twice redeployed the time-lapse camera system. A description

of these deployments and the images obtained is given in Chapter 4 below.

During the dives from the Holiday Chouest a total of 52 corals were imaged at sufficient quality to determine the presence or absence of associates (ophiuroids or anemones) on the corals, and 41 corals were imaged in sufficient resolution for digitization of all branches (the 41 corals do not include corals that had been impacted on a previous dive by slurping floc or sub-sampling branches for genetic or pathological analyses). Based on our accumulated knowledge of this site, there were at least 56 colonial corals present on the two large carbonate slabs when the site was first visited (some were either not seen or not identified as unique individuals until subsequent visits and some were collected during subsequent visits). This included 51 *Paramuricea biscaya* colonies, two *Swiftia pallida* colonies, one *Acanthogorgia aspera* colony, one *Paragorgia regalis* colony, and one area colonized by the encrusting octocoral, *Clavularia rudis*. During this cruise there was still floc evident on many of the corals and hydroids had grown over the skeleton of portions of many corals that were covered by floc during previous visits (Figure 5). A total of 101 physical samples were acquired from this site along with 481 magic cam and 24 Imenco images. Four samples from *Paramuricea sp*. corals were taken for histopathology. Another dive to another area in MC 338/294 found only a single *Bathypathes* sp. on a carbonate boulder. It was adjacent to the marker M23 deployed at 88.47069°W, 28.66448°N and 1395 m depth. Twenty-one magic cam images were taken of this coral between 20:49 and 20:56 on 13 October, 2011.

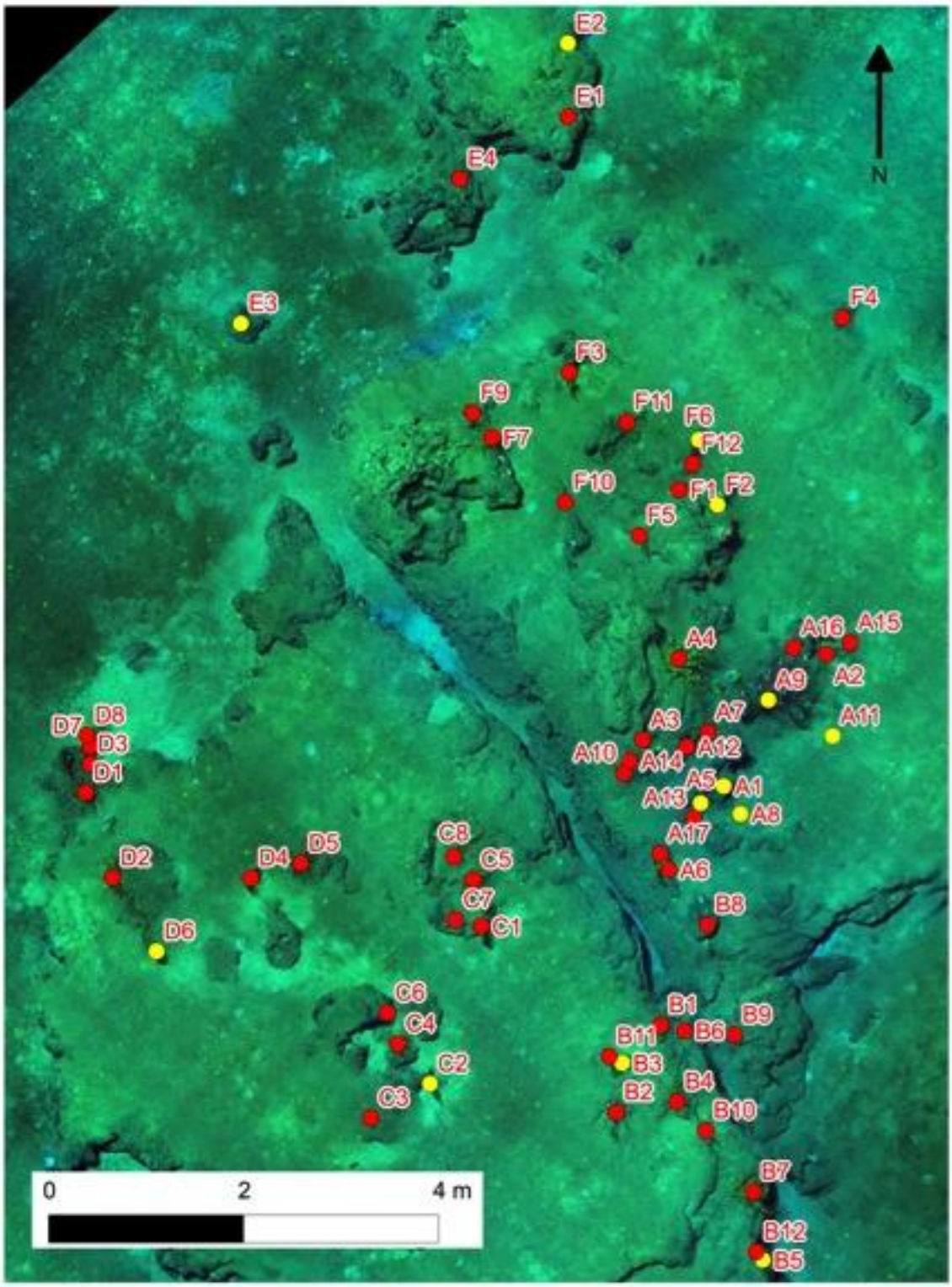

Figure 4. Mosaic of the central area of the coral community at MC 294 with individual corals identified.

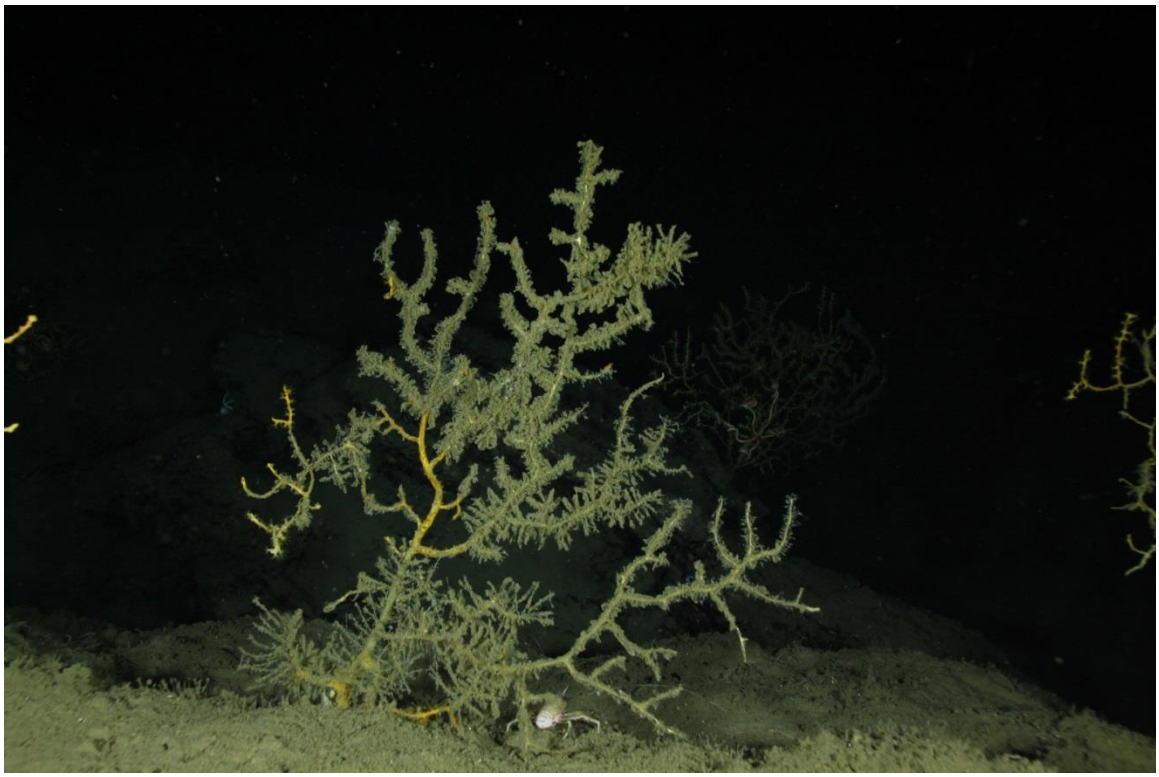

Figure 5. This *Paramuricea biscaya* from 294 (B 10) was almost entirely covered with hydroids and/or floc at the time of the Holiday Chouest visit.

The MC 297 site was identified as hosting hardgrounds from the BP AUV abandonment survey and was surveyed by ROV for the first time (to our knowledge) on this cruise. This site hosted carbonates slabs and boulders scattered over a large area and the most extensive gorgonian coral development within 20 nm of Macondo of any site below 1000m. Seventy-five corals were imaged in the main area of this site, largely localized in two sub-areas separated by about 370 m. Two markers were deployed in one of the sub areas: Marker MM1 was deployed at 88.34487° W, 28.68231°N and 1582 m depth, and M3 was deployed at 88.34491° W, 28.68224° N and 1583 m depth. This subarea area is about 200 square meters in extent and 58 corals were imaged in connection with these markers between 14:40 and 20:37 on October 5, 2011 and between 22:08 and 22:15 on October 22, 2011. The imaged corals included 41 *Paramuricea* sp., two unidentified Octocorallia, one unidentified Isididae (bamboo coral), one *Clavularia rudis*, and three gorgonian skeletons, tentively identified as *Paramuricea* sp.). Three markers were deployed in the second sub area: M2 at 88.34227°W, 28.67989°N and 1569 m depth; M6 at 88.34223°W, 28.67979°N and 1569 m depth; and M5 at 88.34199°W, 28.67994°N and 1568 m depth. This sub area was about 500 square meters in extent and 17 corals were imaged in connection with these markers between 7:49 and 12:58 on October 5, 2011. The imaged corals included: 11 *Paramuricea* sp., three *Bathypathes* sp. (Black corals), one Keratoisidinae sp. I2, one gorgonian covered with an encrusting zoanthid, and one gorgonian skeleton. A total of 87 physical samples were acquired from this main area of MC 297 along with 535 magic cam and 622

Imenco images (for a total of five mosaics; Figure 6). Seven samples from *Paramuricea* sp. corals were taken for histopathology. Numerous corals at this site had visual abnormalities such as presence of floc or hydroids on living colonies (Figure 7).

Another area in the same lease block was investigated on a separate dive. Marker M21 was deployed here at 88.34636°W, 28.69593°N and 1548 m depth. There were two, and possibly three (hard to tell from the images) colonies of *Paramuricea* sp. imaged here for injury assessment between 02:37 and 03:37 on October 14, 2011. These corals were present on the same carbonate outcrop. At this smaller area in the lease block, 41 physical samples were taken along with 27 magic cam images. One sample from *Paramuricea* sp. was taken for histopathology from this area.

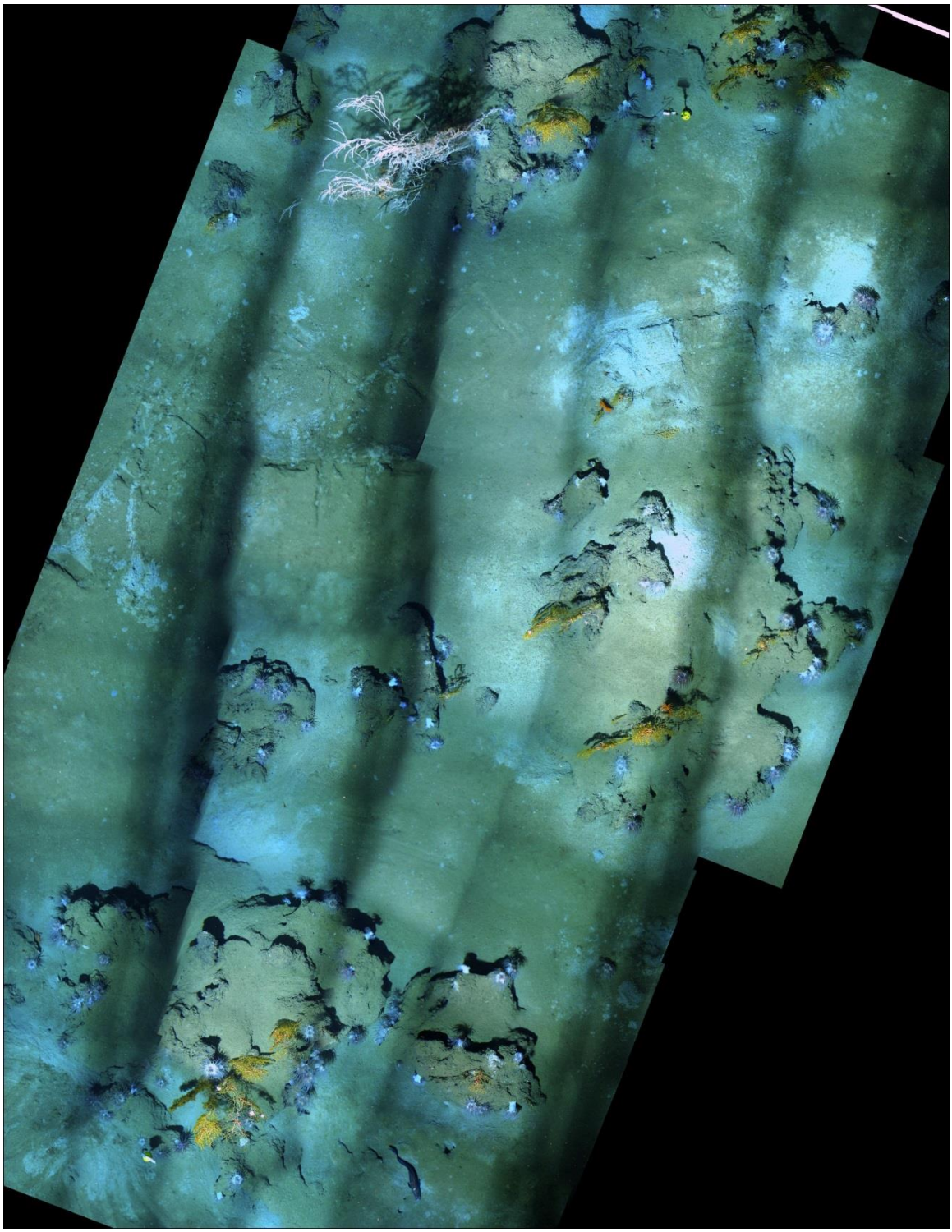

Figure 6: Mosaic of a portion of one of the coral areas in MC 297. This mosaic covers and area of about 40 square meters and includes at least 37 colonial corals and markers M3 (near the bottom of the image) and MM1 (near the top of the image).

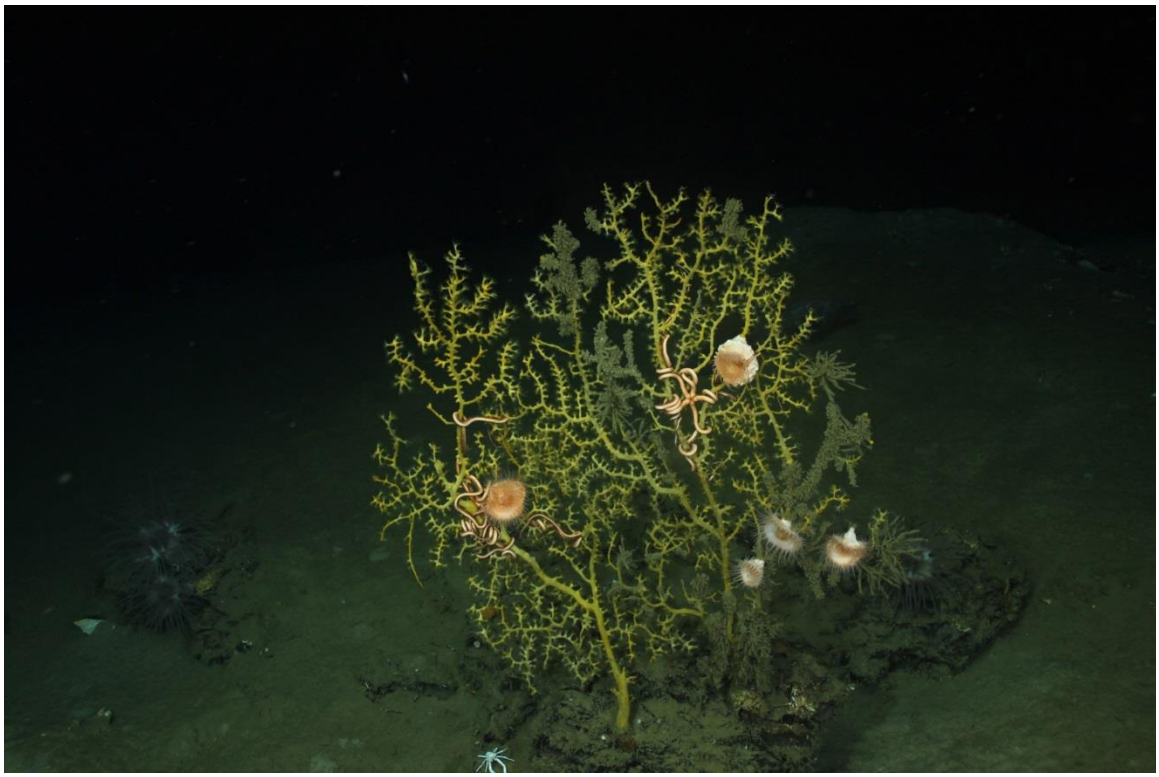

Figure 7: One of the *Paramuricea* sp. corals shown here from MC 297 (M6-9) has extensive areas covered by hydroids and/or flocculent material.

The site in MC 388 was discovered during the NRDA drift camera cruise and first explored by the Alvin submersible on an NSF-funded cruise in Dec 2010. Corals and associates were carefully documented at this site in high resolution for the first time during this Holiday Chouest cruise. Corals here are scattered on carbonate boulders and slabs over an area of about 600 square meters. Four markers were deployed here in the areas with extensive coral development: Marker MM2 at 88.16953°W, 28.63349°N and 1851 m depth; M8 at 88.16956°W, 28.63373°N and 1848 m depth; M9 at 88.16947°W, 28.63349°N and 1851 m depth; and M10 at 88.1696°W, 28.63353°N and 1850 m depth. Corals were imaged in association with these markers on October 6, 2011 between 13:19 and 14:26 and between 16:10 and 18:36. Corals of a wide range of sizes were present at this site and at least 34 living or dead colonies were imaged here. This included at least 26 colonies of *Paramuricea* sp., two colonies of *Bathypathes* sp., one subfamily Keratoisidinae coral (Figure 8), a small unidentified octocoral, a colony of encrusting *Clavularis rudis*, and at least two *Stichopathes* sp. Flocculent material and other notable features were associated with several corals at this site. A total of 93 physical samples were acquired from MC 388 along with 210 magic cam and 29 Imenco images. Six samples from *Paramuricea* sp. corals were taken for histopathology from this site.

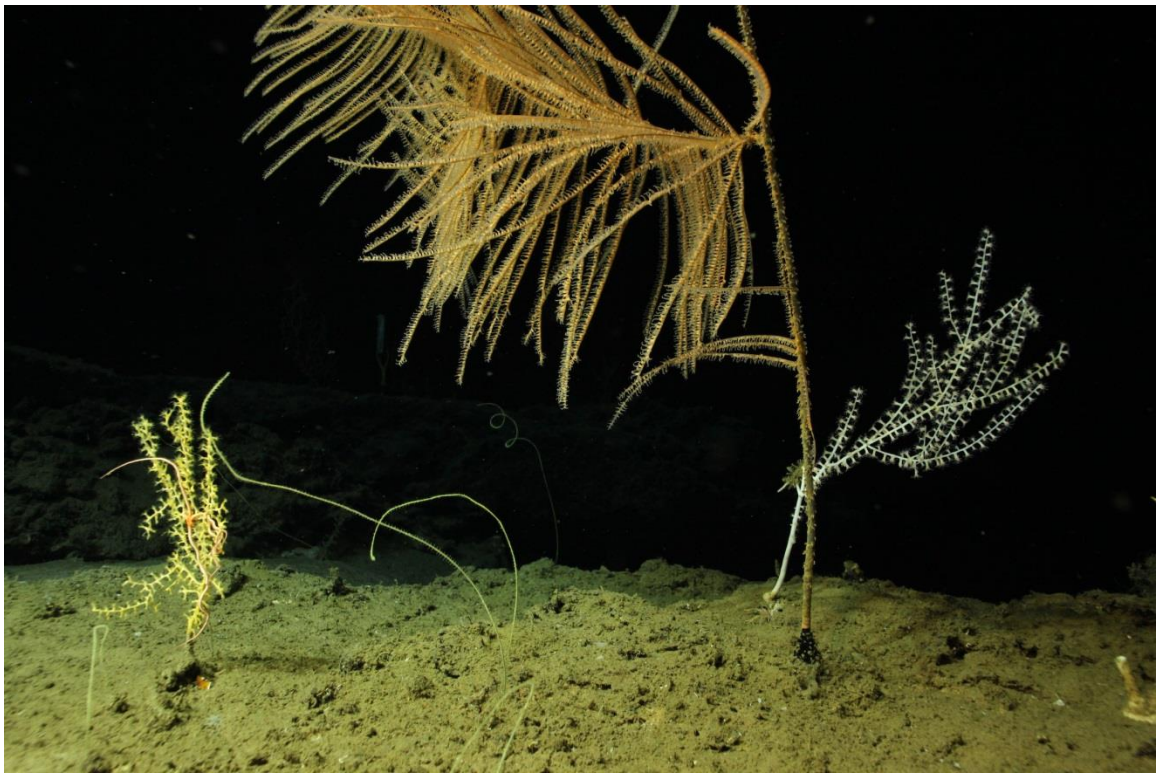

Figure 8. This image from MC 388 includes a specimen of *Paramuricea* sp. on the left, a large black coral, *Bathypathes* sp., in front of a white bamboo coral in the subfamily Keratoisidinae, and *Stichopathes* sp. whip corals.

AT 357is a coral site in that was originally identified during the NRDA HOS Davis 3 cruise in September 2010. This is the largest coral community identified to date in the Gulf of Mexico, in the >1000 m depth range and hosts diverse arrays of corals, coral-associated fauna (e.g., ophiuroids, crabs, shrimp, and polychaetes), and seep fauna (Figure 9). There is a large *Madrepora* sp. reef structure in the northern, central part of the site, surrounded by gorgonian communities, primarily of the genus *Paramuricea* but also including a variety of other gorgonian and black coral species as well as other small *Madrepora* sp. colonies. The full extent of the area of this site colonized by corals has not been determined but covers an area of at least 10,000 m^2. A total of five dives were made to this site. Eleven markers were deployed to aid in navigation and potential revisits to this site and corals were imaged for assessment in association with seven of these markers. Eight corals (four *Madrepora* sp. and four *Paramuricea* sp.) were imaged in association with Marker M13 at 89.70465°W, 27.58674°N and 1047 m depth on October 10, 2011 between 08:20 and 09:32. Two *Paramuricea* sp. were imaged in association with marker M14 at 89.70462°W, 27.58693°N and 1048 m depth on October 10, 2011 between 13:31 and 13:37. One other *Paramuricea* sp. was imaged in association with Marker M12 at 89.70479°W, 27.58669°N and 1046 m depth at about noon on October 11, 2011. Fourteen *Paramuricea* sp. corals were imaged in association with marker M19 at 89.70518°W, 27.58576°N and 1057 m depth between 11:58 and 13:33 on October 12, 2011. Nine corals (three *Madrepora* sp. and six *Paramuricea*

sp.) were imaged in association with marker M17 at 89.70495°W, 29.58576°N and 1055m depth between 15:47 and 16:54 on October 12, 2011. Ten *Paramuricea* sp. were imaged in association with marker M15 at 89.70321°W, 29.58624°N and 1052 m depth between 18:42 and 19:07 on Octctober 12, 2011. Six colonies of *Paramuricea* sp., three of which were colonized by encrusting zoanthids, were imaged in association with marker M16 at 89.70388°W, 29.58654°N and 1047m depth between 10:08 and 20:56 on October 12, 2011. An additional eleven colonies of *Paramuricea* sp., including one colony covered with encrusting zoanthids were imaged in association with marker M20 at 89.70476°W, 27.58633°N and 1051 m depth between 15:04 and 15:56 on October 24, 2011. Downlooking images for a large mosaic including both seep mussels and corals were acquired at this site. Navigational limitations precluded construction of a mosaic with full coverage over the entire area but the track lines (using over 600 photographs) show the proximity of the active seep area and assorted corals (Figure 10). A total of 136 physical samples were taken from here along with 885 magic cam and 2,121 Imenco images. Five samples from *Paramuricea* sp., one from a *Chrysogorgia* sp., and one from a *Madrepora* sp. coral were taken for histopathology from this site.

Figure 9: Area with a high density of *Paramuricea* sp. corals near marker M21 at AT 357. Note the numerous crabs and ophiuroids associated with the gorgonians.

Figure 10: Downlooking images mosaiced together to show relations between area of active seepage (in upper right of image) and assorted boulders with attached colonial corals. This image covers an area of approximately 80 by 150 m.

The area of MC 036 that was originally identified from 3D seismic data as potentially hosting hardgrounds and hardground communities was considerably larger than could be completely surveyed by Sentry during the Macarthur II AUV hardground cruise (Sentry). One area with coral colonization was identified near the southeast corner of the block surveyed by Sentry. In this area a total of at least 17 corals were present on scattered carbonates and imaged. Two markers were deployed at this site. At least six corals (five *Paramuricea* sp. and one *Chrysogorgia* sp.) were imaged in the vicinity of marker M11 at 88.20264°W, 28.93592°N and 1093 m depth between 00:41 and 2:17 on October 15, 2011 (Figure 11). Eleven additional corals were imaged in the vicinity of marker M18 at 88.20142°W, 28.93538°N and 1094 m depth between 03:48 and 05:36 on October 15, 2011 (Figure 12). Two of these corals were mostly bare skeleton devoid of coral tissue with small areas of living tissue present. These markers are about 100 m apart and the corals associated with each marker are within 10 m of the markers. There was no significant accumulation of floc on the corals imaged. A total of 88 physical samples were acquired from MC 036 along with 142 magic cam images. Two samples from *Paramuricea* sp. corals and one from a *Chrysogorgia* sp. coral were taken for histopathology from this site.

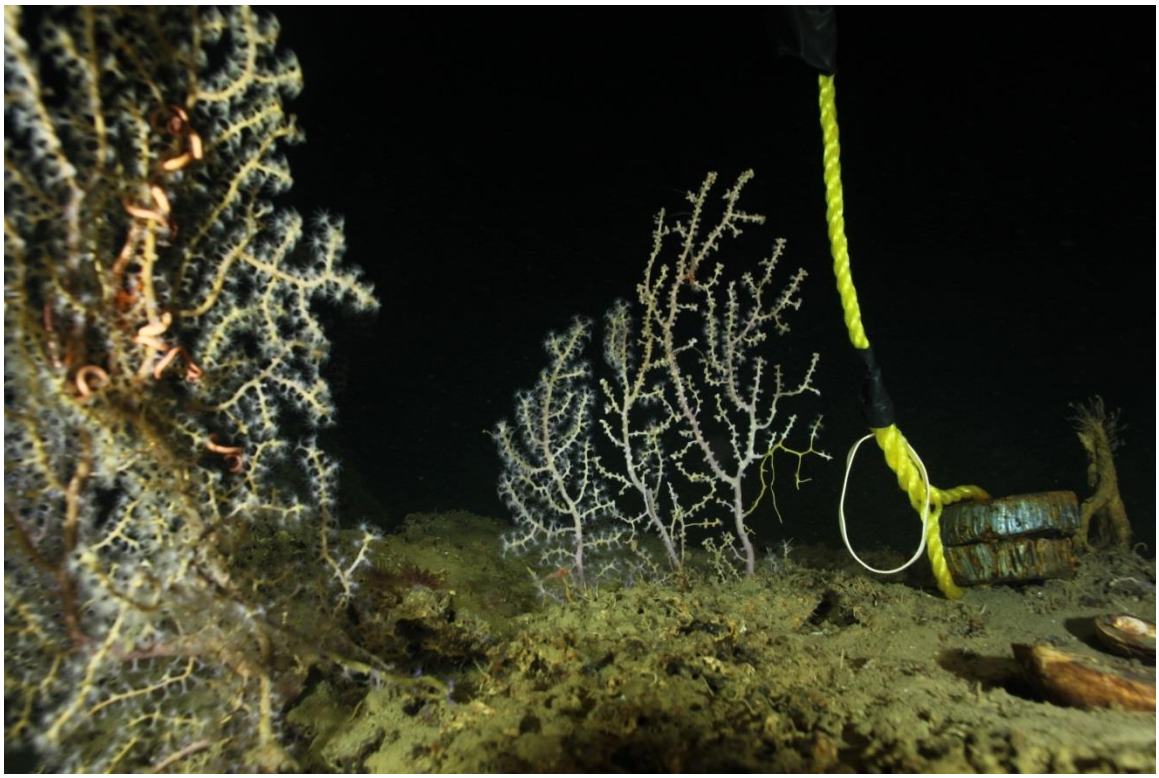

Figure 11. This group of at least three small *Paramuricea* sp. colonies (M11-2) in the center of this image was treated as a single coral for the assessment because the bases could not be clearly seen. What appear to be several very small corals can also be seen from this angle. A small area of dead coral (skeleton without tissue) can be seen on the right side of the right-most coral.

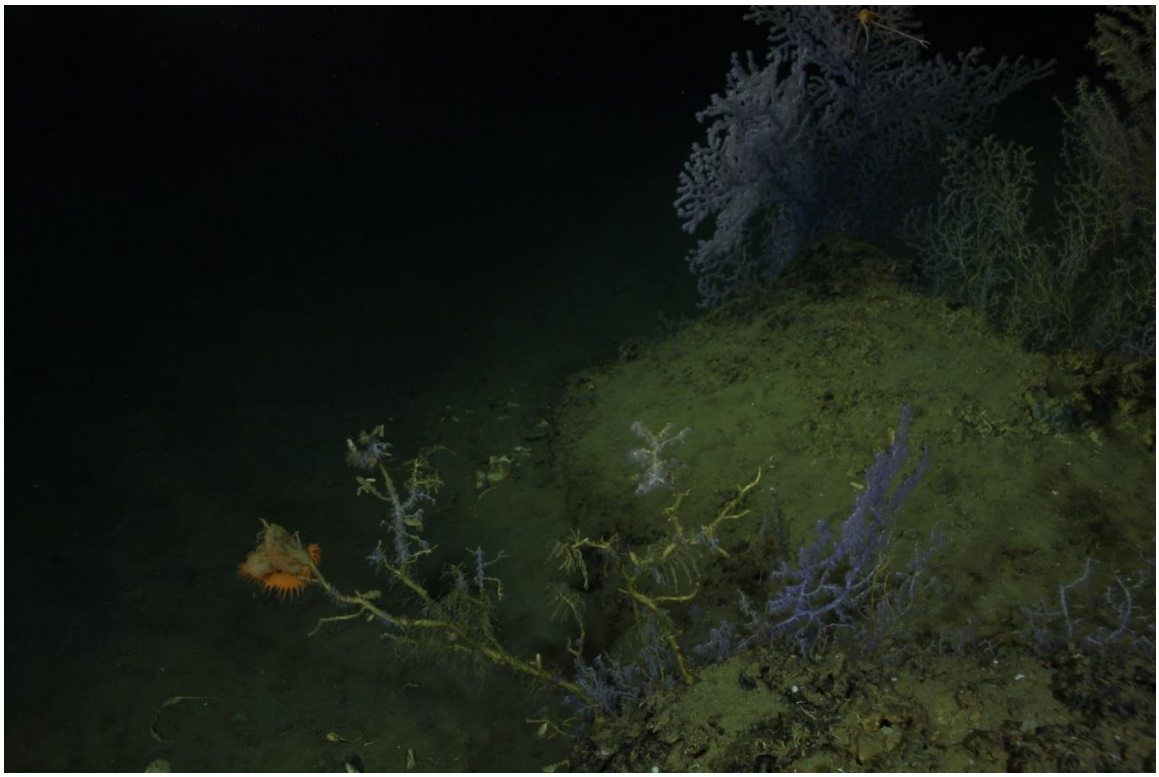

Fig 12. The mostly dead coral on the left foreground of this image (M18-3) still has small amounts of living tissue present.

The MC 506/507 coral community is limited to two large carbonates that are both in the same small area originally identified from Sentry photographs. It is about 35 nm to the southwest of the Macondo well. A single marker, M27, was deployed for this site at 88.85084°W, 28.48567°N at a depth of 1040m (Figures 13 and 14). All corals are within 10 m of this marker so the total size of the area colonized by corals is less than 300 m^2. No Imenco cam images were obtained from this site and no mosaics were constructed from this site. Ten large corals were imaged at this site (nine individuals of *Paramuricea* sp. B3 and one *Crysogorgia* sp.). No smaller corals were seen and no signs of recent recruitment of corals were noted. The corals were imaged between 23:38 on October 15, 2011 and 02:09 on October 16, 2012. One of the *Paramuricea* sp. corals appeared to be tangled in long-line and had signs of tissue damage. Two of the colonies of *Paramuricea* had extensive areas that had been dead for a long time (based on the lack of dead branches of small diameter) and had growing areas on the tip ends of some branches. There was no visual evidence of floc on any of the corals. A total of 65 physical samples were acquired from MC 506/507 along with 158 magic cam images. Three samples from *Paramuricea* sp. corals were taken for histopathology from this site.

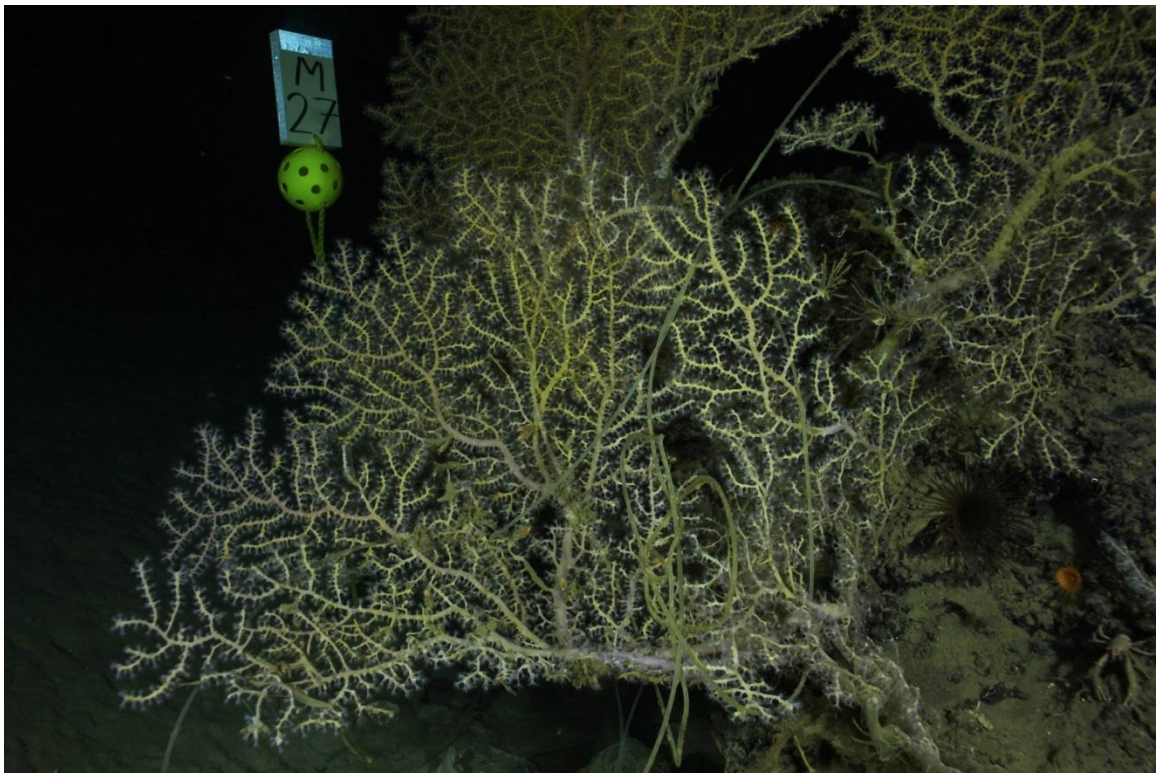

Figure 13. A *Paramuricea* sp. colony from MC 506/507 (M27-2) tangled in long-line fishing line.

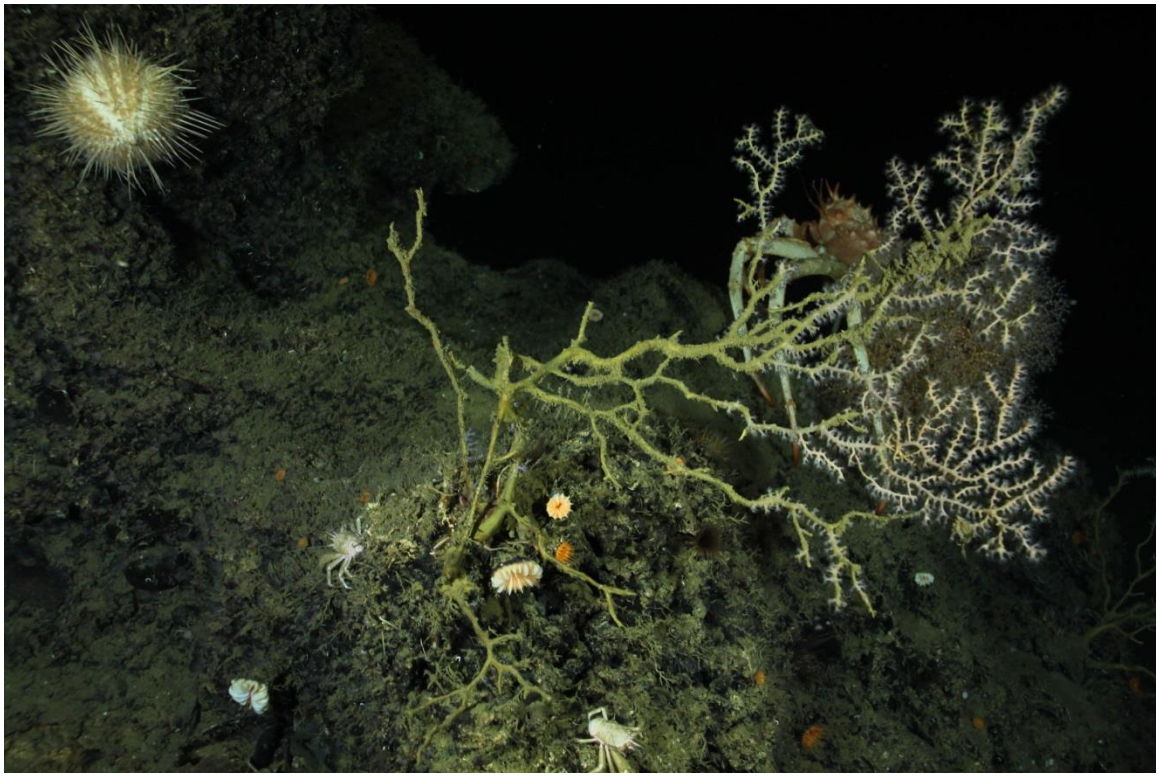
Figure 14. A *Paramuricea* sp. colony from MC 506-507 (M27-9) with basal portions that are dead, and with living portions on the ends of some branches.

The MC 159/203 coral community is limited to a single small area of carbonate boulders identified from the Sentry survey. It is about 17 nm west-northwest of the Macondo wellhead. A single marker, M24, was deployed for this site at 88.63472°W, 28.78724°N at a depth of 917 m (Figure 15). All corals are within 10 m of this marker so the total size of the area colonized by corals is less than 300 m^2. Twenty corals were imaged at this site between 08:31 and 10:45 on October 16, 2012. This included 11 *Paramuricea* sp., two *Acanthogorgia aspera* and seven *Swiftia* cf. *koreni* (Figure 16). The corals here are mostly larger, presumably older colonies and there was long-line present and tangled among six of the coral colonies imaged. Also notable at this site was the presence of shark egg cases attached to many of the corals. There was no visual evidence of significant floc on the corals. A total of 50 physical samples were acquired from MC 159/203 along with 163 magic cam images. Two samples from *Paramuricea* sp., one from an *Acanthagorgia aspera*, and one from a *Swiftia* sp. coral were taken for histopathology from this site.

Figure 15. A portion of a healthy colony of *Paramuricea* sp. (M24-4) from MC 159/203 with attached ophiuroids and shark egg cases.

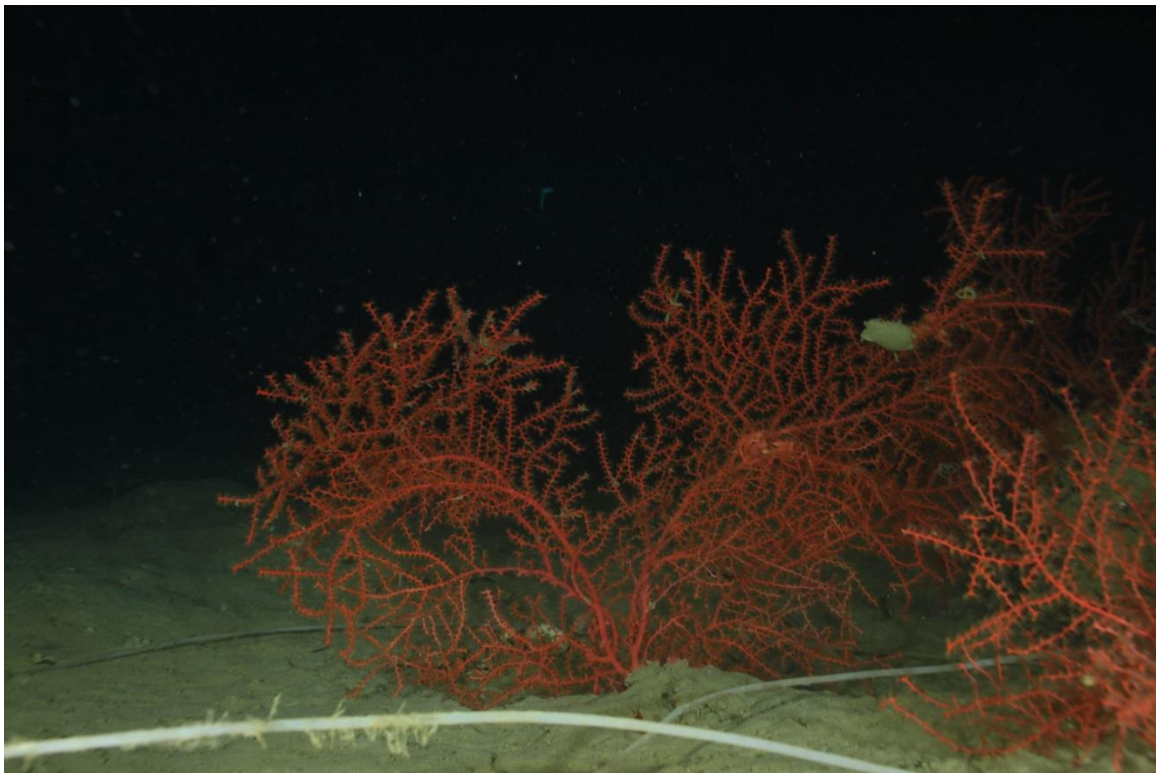

Figure 16. *Swiftia* sp. (M24-7) from MC 159/203 with attached shark egg case and long-line fishing line.

MC 118 is a site that has been well studied by microbiologists and geochemists, and is referred to as the "hydrate observatory site". It is a very large site with corals located in several different areas separated by hundreds of meters and extensive areas of seepage with both buried and exposed hydrates. Parts of this site were visited by the Ronald Brown cruise in December, 2010 and again by the Hos Sweetwater cruise in March, 2011. Three dives were made to this site during this Holiday Chouest cruise. Not all of the corals present at the site were imaged; however the gorgonians encountered were imaged as fully as possible. Areas with previous imagery of colonies of the hard coral *Madrepora* sp. were revisited and new images were collected near the previously deployed marker T1 both vertically and for down looking mosaics. At least 13 individuals of the gorgonian *Paramuricea* sp. were imaged sufficiently well for injury assessment (in some cases it is possible that groups of more than one colony were treated as a single individual). Two colonies were imaged in association with marker M22 at 88.49381°W, 28.85573°N and 886 m depth between 03:56 and 05:06 on October 21, 2011. Two colonies were imaged in association with marker M26 at 88.49383°W, 28.85564°N and 886 m depth between 02:57 and 03:39 on October 20, 2011 (Figure 17). One colony was imaged in association with marker M28 at 88.49184°W, 28.85264°N and 883 m depth at about 21:17 on October 20, 2011 and one colony was imaged in association with marker M29 at 88.49198°W, 28.85269°N and 884 m depth on about 20:59 on the same day. The *Paramuricea* sp. colonies occurred in an area of about 225 square meters. Five colonies of *Madrepora* sp. were imaged from a vertical perspective for

injury assessment near Marker T1 at 88.4927°W, 28.8527°N and 884 m depth between 23:48 on October 20, 2011 and 00:31 on Oct 21, 2011 (Figure 18). *Madrepora* sp. in this area cover approximately 100 square meters of the sea floor. In addition, one individual of *Paramuricea* sp. colony and one *Madrepora* sp. colony were imaged for associate documentation only. A total of 101 physical samples were acquired from MC 118; along with 358 magic cam and 220 Imenco images. One sample from a *Paramuricea* sp. coral was taken for histopathology from this site.

Figure 17. A *Paramuricea* sp. colony (M26-1) at MC 118 with attached ophiouroids, anemones, shark egg cases, and *Acesta* sp. bivalves at its base.

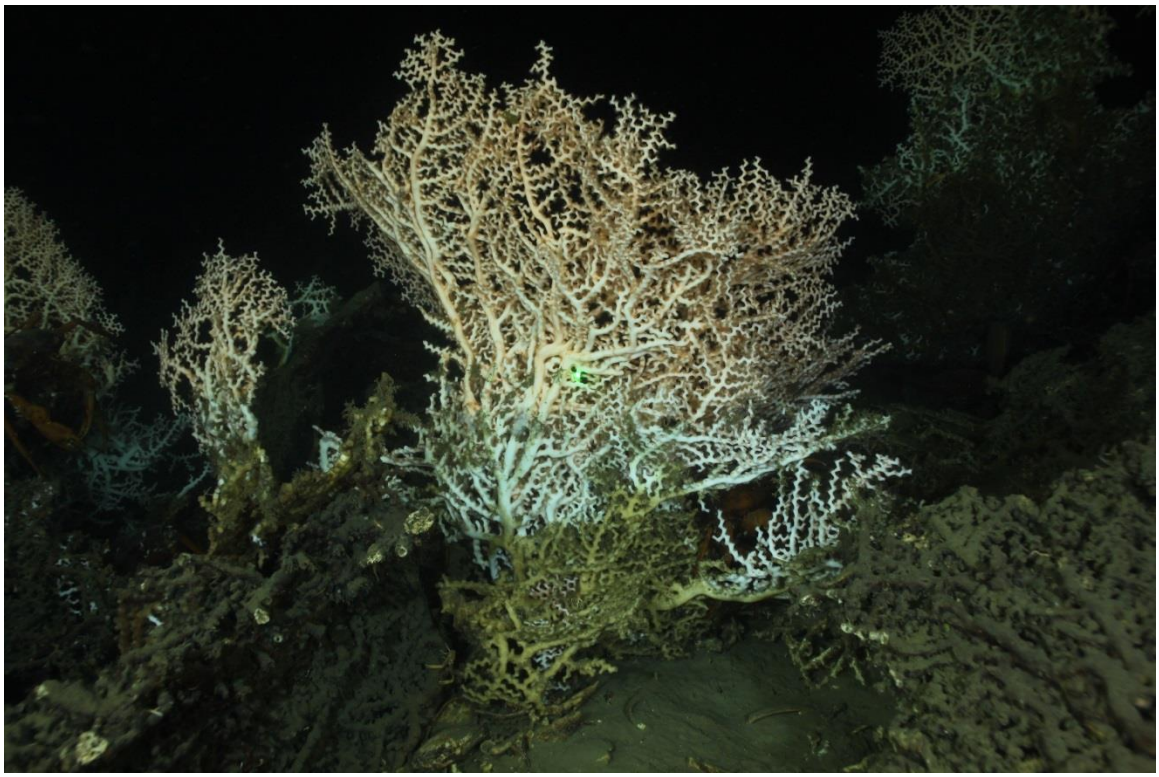

Figure 18. The scleractinian coral *Madrepora* sp. at MC 118 (near marker T1) with living and dead portions visible.

One dive was made at each of the two somewhat shallower coral sites **VK 826 and VK 906** to the north of the Macondo wellhead established as part of the BOEM "Lophelia II" project and also visited during the NRDA Nancy Foster hardground cruise in 2010. These are sites with extensive development of the hard coral *Lophelia pertusa* that also harbor numerous colonies of black corals and gorgonians. Images were acquired for mosaics over the established down looking monitoring stations (Figure 19). Eleven images were acquired from VK 826 and 15 from VK 906 using the magic cam. Six-hundred and ninety-five images were acquired from VK 826 and 729 from VK 906 using the Imenco camera. No floc was evident on any of the live corals. A total of 79 physical samples were acquired from VK 826 and 78 from VK 906. One sample from the hard coral *Lophelia pertusa* was taken from each VK site for histopathology.

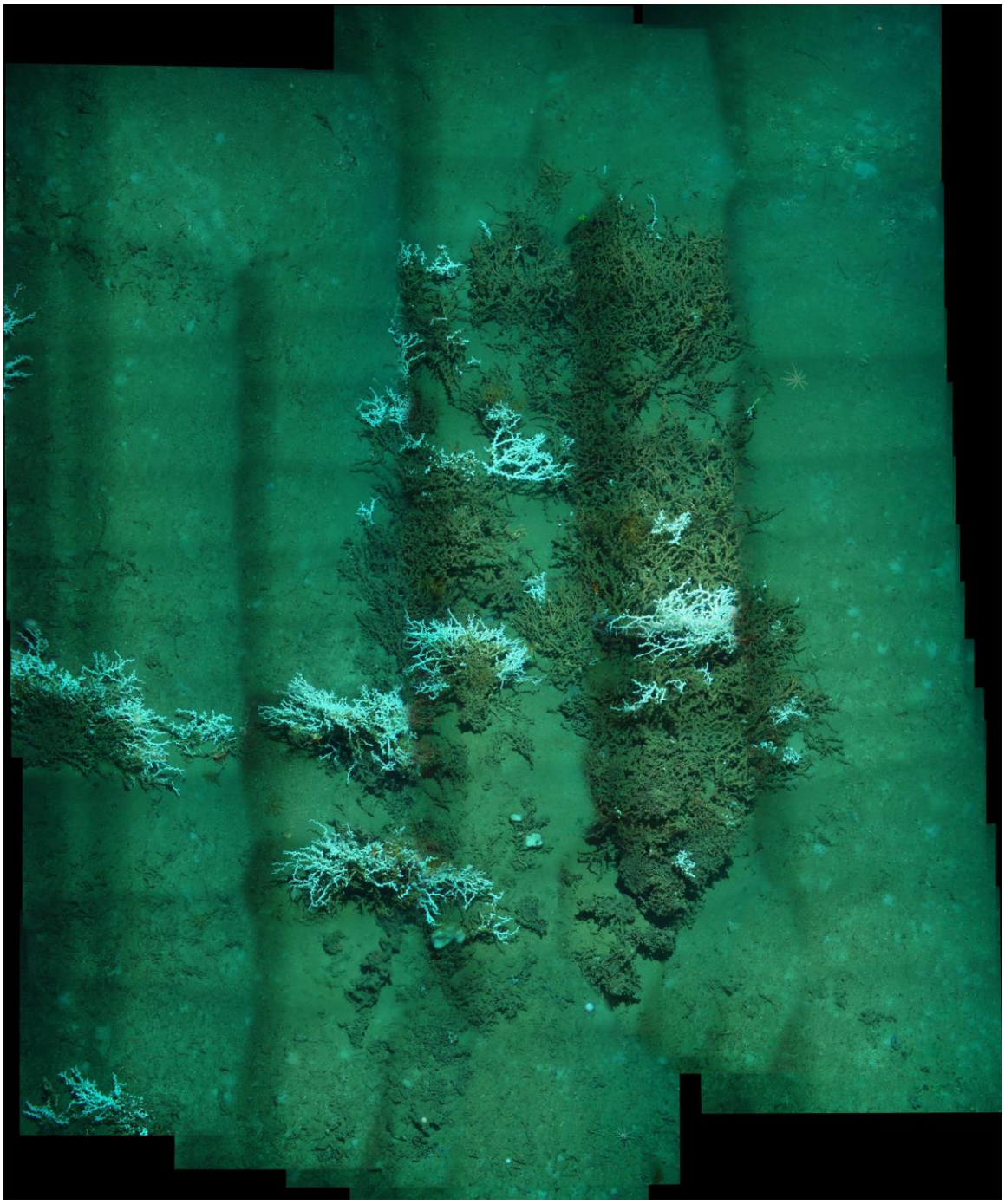

Figure 19: Photo mosaic of a L*ophelia pertusa* based aggregation in VK 826.

Chapter 3: Coral and Coral Associate Species Identification

Individual coral colonies and all macrofauna large enough to be identified to major taxon were enumerated on a total of 319 images collected at 10 sites. An examples image showing a coral and a number of coral associates is shown in Figure 20. The results of coral and coral associate identification efforts are presented in Appendix A. In addition, coral and coral associate tissue samples were analyzed using genetic techniques in order to identify species.

Attempts were made to collect at least one individual of each coral morphotype identified at each site and at least one of each morphotype of all fauna directly or indirectly associated with colonial corals at each site. Back in the laboratory at Woods Hole Oceanographic Institute (WHOI) and Temple University, DNA was extracted from all samples and attempts were made to amplify the standard genes used for identification of the faunal group being assessed.

In the case of the corals, 850 bp from the 5' end of the mitochondrial MutS gene and ~1000 bp of the mitochondrial COI+igr1 region were used for molecular barcoding. When possible, scanning electron microscopy (SEM) was used to identify morphological differences between haplotypes identified by molecular barcoding. *Paramuricea biscaya* was the most common species of octocoral collected from 882 to 1858 m depth and had three different barcode haplotypes (B1, B1a, and B2), all of which co-occurred at some sites below approximately 1300 m. Another haplotype (B3), was commonly found at sites shallower than 1300 m, and exhibited consistent morphological differences from *P. biscaya* and therefore very likely represents a different, as yet undescribed species. Appendix B contains the coral genetic identifications conducted by the Cordes Laboratory at Temple University. No identifications are given for the samples that failed to amplify.

For associates, mitochondrial COI, and 16S genes were used. Appendix C contains the results from these analyses. The ophiuroid, *Asteroschema clavigerum*, collected from 1040 to 1852 m depth, and the hydrozoan, *Campanulina panicula*, collected from 886 to 1852 m depth were the two taxa associated with corals most often collected and identified. The genetic identifications of associated fauna shown in Appendix C were conducted by the Shank laboratory at WHOI. No identifications are given for the samples that failed to amplify.

Coral Associate Representative Examples
Site AT 357

ophiuroid *Asteroschema clavigerum*
on purple *Paramuricea*

ophiuroid *Asteroschema clavigerum*
on yellow *Paramuricea*

ophiuroid *Asteroschema clavigerum*
and galatheid associate *Munida congesta*
on yellow *Paramuricea*

ophiuroid *Asteroschema clavigerum*
on yellow *Paramuricea*

multiple ophiuroids on yellow *Paramuricea*

galatheid *Munida congesta* on *Madrepora*

Figure 20: Examples of coral associates from Site AT 357.

Chapter 4: Preliminary Analysis of Time Lapse Camera Recoveries and Deployments

Two camera deployments are discussed herein. The first was deployed in March 2011 [6.7 days collecting 149 images] on the HOS Sweetwater 1 cruise and recovered during Dive 1 of HC3 and the second was deployed and retrieved during HC3 in October 2011 [5.7 days 510 images]). In both deployments, the time lapse camera was focused on the same corals in the field of view. Appendix D presents the details of the October 2011 deployment. Each of these deployments is discussed in greater detail below.

Specifically, the time-lapse camera system was deployed at MC294 during the HOS Sweetwater 1 cruise in March 2011. On that cruise, the system was collected from the sea floor, reconfigured, and deployed in a location almost identical to the previous deployment: camera settings, field of view, and coral subjects were maintained, with the system redeployed at Latitude: 28.672°N Longitude: -88.476°W and at a depth of 1371 m. Within the foreground of the frame of view were four coral colonies, identified as D1, D3, D7, and D8 (Figure 21). The photo interval was set at one hour, with the first image taken on March 13, 2011. This camera system/deployment was recovered on October 3rd, 2011 during the first dive, Dive 1, of the HC3 cruise, and its images downloaded**.** The last image was recorded on March 18, 2011. A total of 149 images were recorded over a 6.2 day period.

Two pairs of Vemco (internally-recording) temperature loggers (Vemco Ltd.) were also deployed on the time-lapse camera frame (30 cm to either side of the camera lens) during the HOS Sweetwater 1 cruise to record temperature variability at the MC 294/388 site during time-lapse imaging.[2] More than 65,000 measurements (65,407) were recorded on each logger, with a measurement taken every four minutes between March 1, 2011 to September 10, 2011. Bottom temperature did not vary on any of the temperature probes; the temperature was consistently approximately 4.23 °C throughout the deployment.

For the camera system's redeployment on the HC3 cruise, seafloor recovery, transit, and positioning with the ROV were all highly efficient. The camera was set in front of the Marker 44/corals at a heading of 090 as in the previous deployment. Following the placement of the camera, at least six flashes were confirmed – the firing of the strobes every 20 minutes. The camera was then re-recovered on HC3 dive 28, and 547 total images were downloaded. The camera recorded an image every 15 minutes for 5.7 days at the sea floor, resulting in the capture of approximately 510 images of the corals at Marker 44.

[2] Paired temperature probe S/N ID: 1129, 1128 and 8653, 8652.

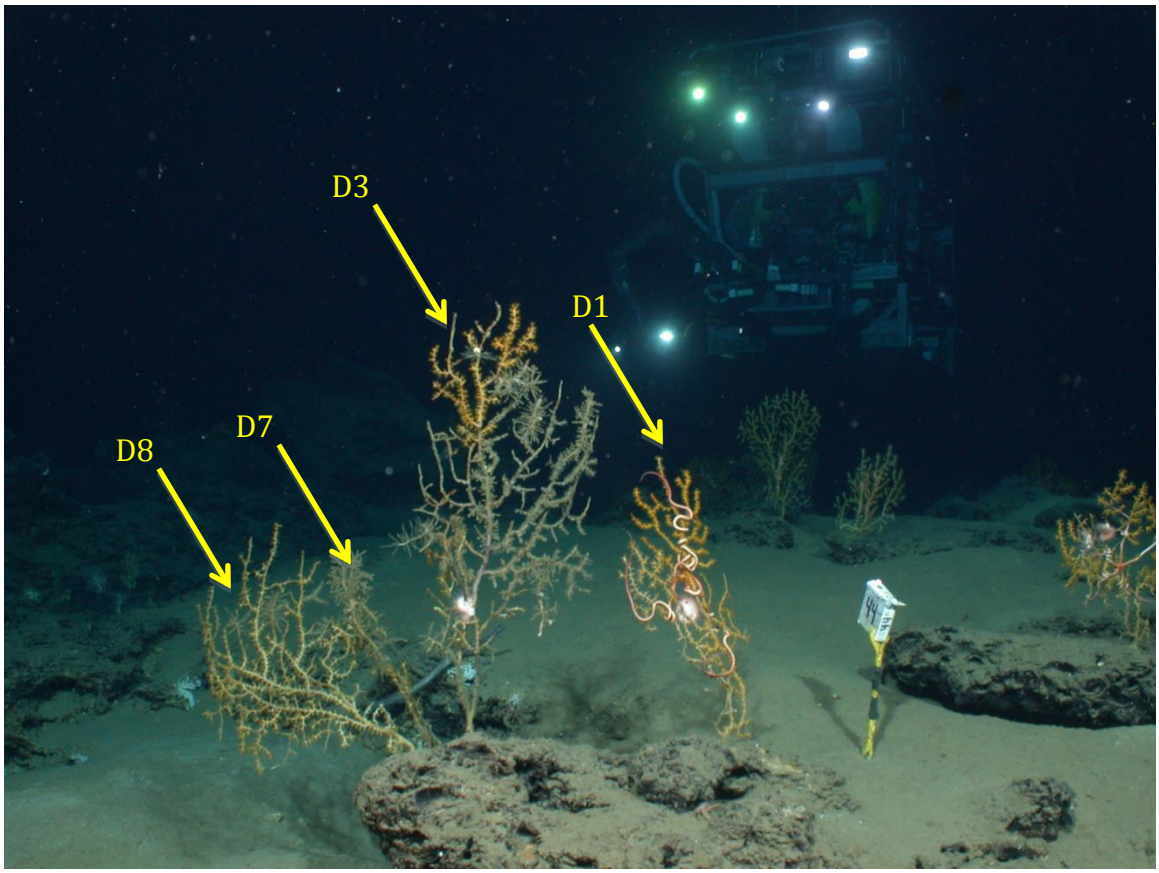

Figure 21: Digital image recorded by the Time-Lapse Camera deployed on October 13, 2011 and recovered October 23, 2011. The UHD-34 is visible in the background.

Image Analysis

Specifically, from each image, the following was recorded:

- Coral associate presence/absence.
- Associate behavior:
    - Anemone extended/retracted, possible indications of feeding.
    - Ophiuroid arms, number extended/retracted.
- Coral behavior: polyps extended/retracted.
- Total number of mobile fauna not directly associated with the coral and substrate upon which the mobile fauna was observed.

Examples of acquired images are provided in Figures 22 and 23.

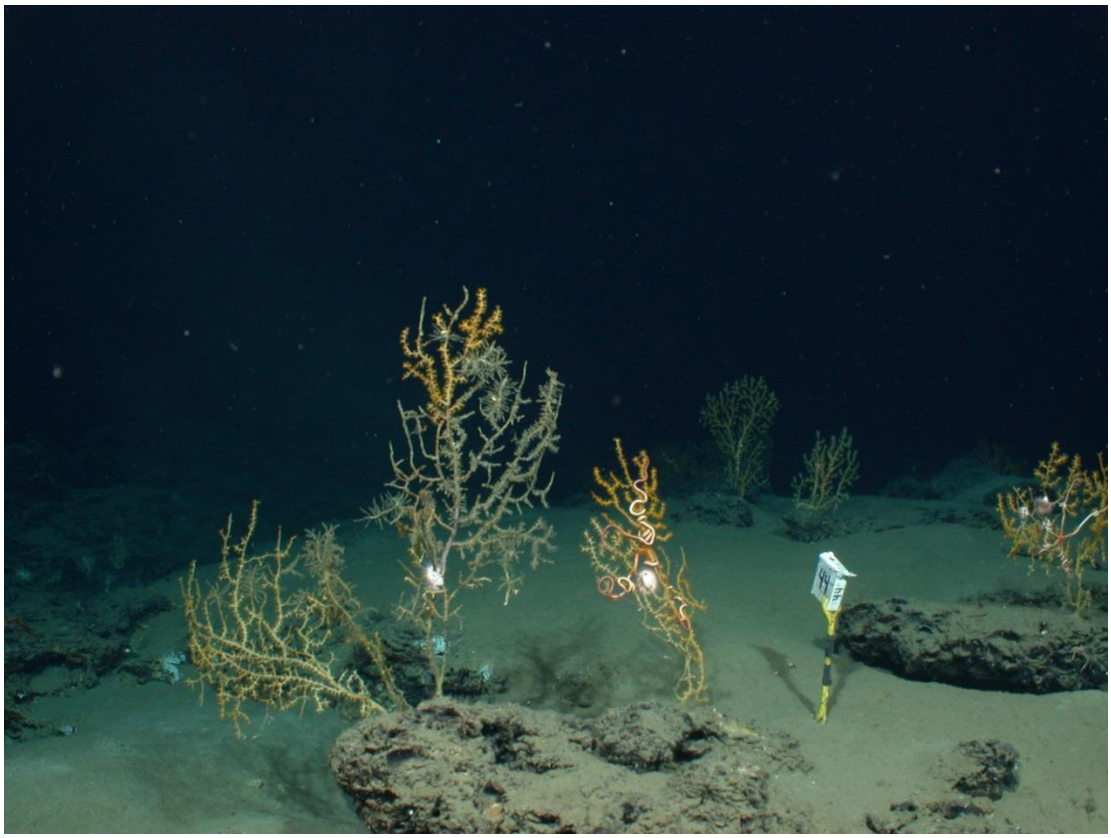
Figure 22: Example of extended anemones on coral colonies D1 and D3 (2011_10_14_13_02_50.jpg).

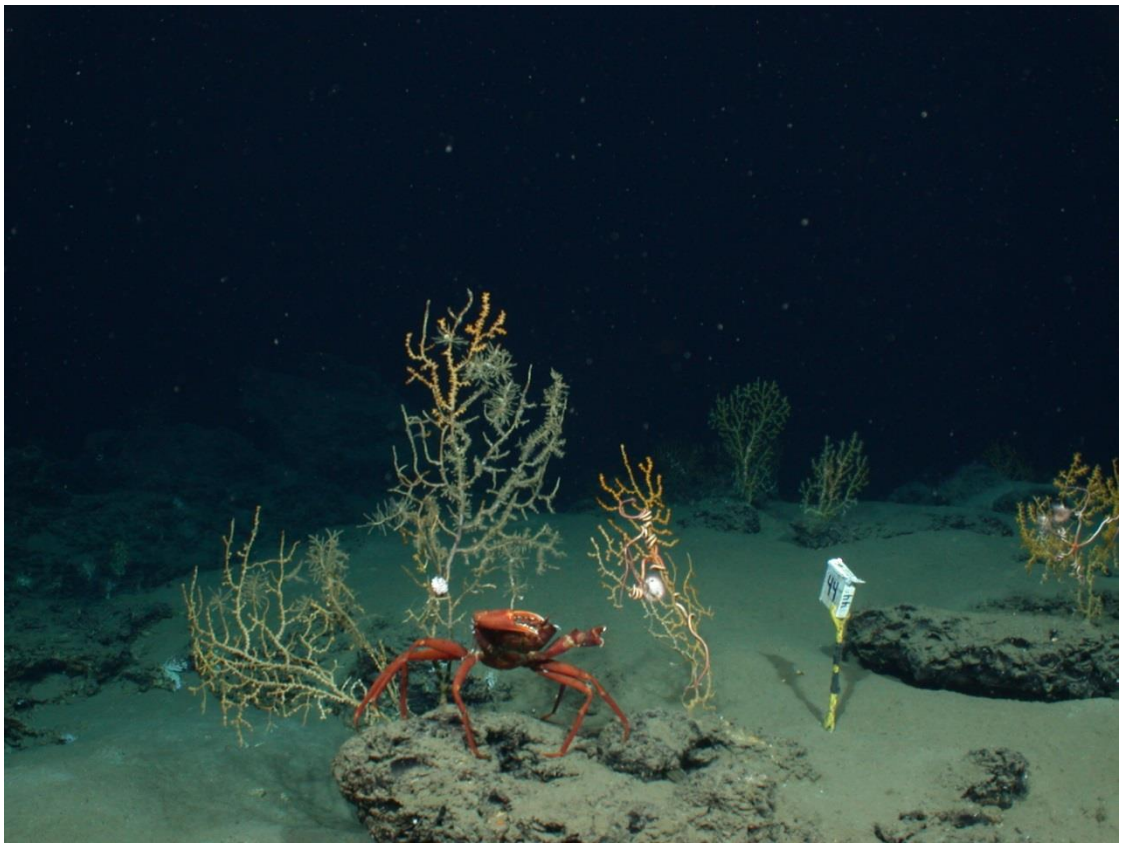

Figure 23: Example of retracted anemones (D3, D1) and coral polyps (D1) in the presence of a red crab (2011_10_14_21_47_51.jpg).

Attached fauna

Observational results of coral and associate fauna are contained in Appendix E. These include presence and absence of ophiuroids, the position on live and dead portions of the host coral, number of ophiuroid arms extended and tightly coiled, position of ophiuroids relative to host, anemone tentacles extended or retracted, coral polyps extended or retracted, and whether or not galatheid crabs are present on corals. Through the course of the deployment, the D1 ophiuroid did not move its central disk from a position near the top of coral D1, although minor arm movement was observed. Repositioning of the ophiuroid associate was not observed. Different ophiuroid arms were extended for short periods of time. A galatheid crab observed during ROV and in the time-lapse imaging as inhabiting rock and sediment habitats was transiently observed on a coral host.

Mobile fauna

Observational results of mobile fauna are presented in Appendix F and summarized below. The type of fauna and number of individuals on a particular substrate were logged (see Appendix F). The percentage of occurrence of a particular mobile organism was determined from one or more individuals being present or absent

within the frame of view. Mobile fauna documented include brown and white galatheid crabs, small red crabs, Rat Tail fish, and spider crabs.

In comparing the two camera deployments detailed above, the observational data are very similar. For example, behavioral movement of the ophiuroids on D1 was similar--the central disc did not change position significantly and arms were extended for short periods of time. In addition, each of the mobile species observed over the HC3 deployment were also observed during the previous long-term deployment beginning in March, 2011. However, there were a few exceptions, which are detailed below.

- An asteroschemid ophiuroid was present on Coral D3 during the March, 2011 deployment that was not present at the start of the HC3 deployment.
- There was lack of extensive hydroid colonization in images from the March 2011 deployment, but there was extensive hydroid colonization on two corals during the HC3 deployment.
- Small white particles resembling amphipods were observed during the October, 2011 deployment, which were not observed in the 149 images taken on the previous deployment.
- Flocculent/mucus material was present on the coral colonies during both deployments, but coverage was not as extensive on the HC3 deployment as it was on the previous deployment.
- The coral polyps (of Coral D3 in particular) were mostly, if not always, retracted during the earlier, March, 2011 long-term deployment, but were mostly extended during the HC3 deployment.

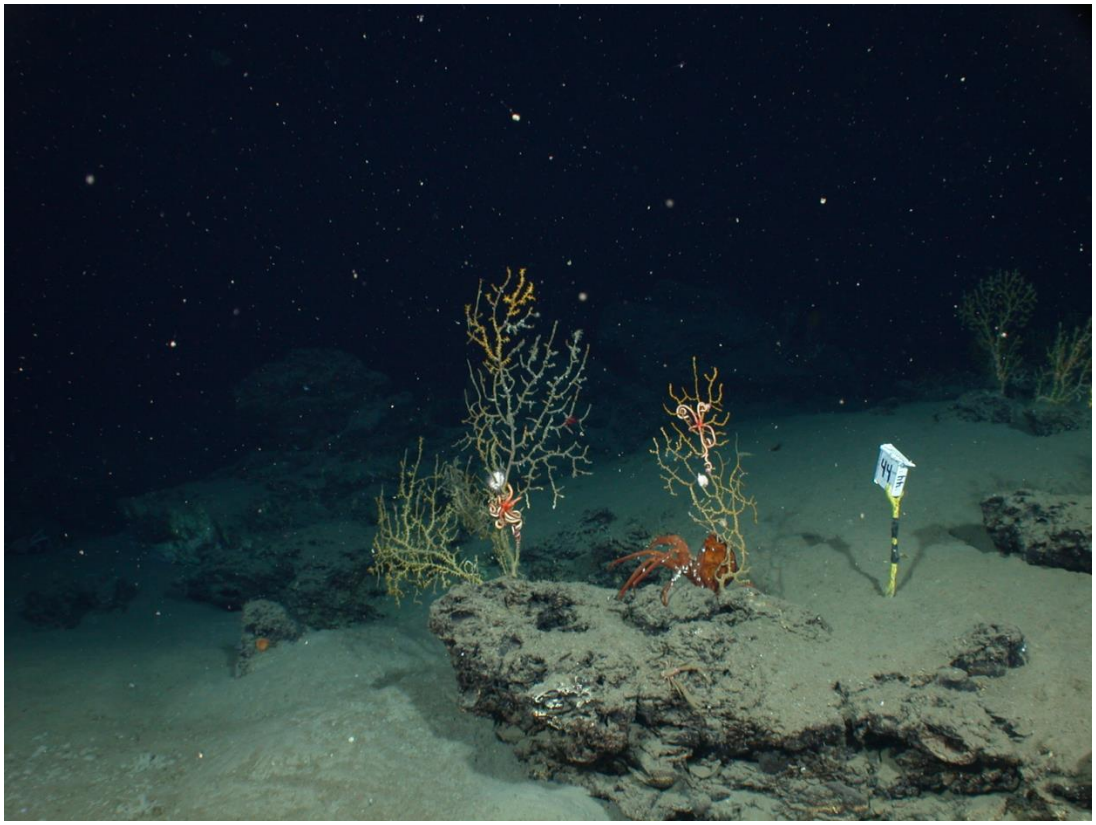

Figure 24: Example of long-term deployment (deployed March, 2011). Note the ophiuroid on Coral D3 at center and notable lack of hydroid colonization (2011_10_14_13_ 02_50.jpg).

Observations of Mobile Fauna during October 2011 HC3 Deployment

The presence/absence of mobile fauna are summarized in Table 1, below. Example images of a white galatheid crab, brown galatheid crab, red crab, "small" red crab, and spider crab are provided in Figures 25 through 29. In addition to the summary of mobile fauna described above, Rat Tail fish were observed in 4.5 percent of images.

Table 1. Summary statistics for presence of mobile fauna observed during the October, 2011 time-lapse camera deployment.

Species Observed	Number of Images with Species Present	Percent of Images where Species Present	Number of Individuals Observed by Substrate		
			Sediment	Rocks	Corals
Galatheid Crabs (white)	262	51.4	1	290	6
Galatheid Crabs (brown)	230	45.0	1	293	0
Red Crabs	32	6.0	20	12	0
"Small" Red Crabs	10	2.0	9	1	0
Spider Crabs	1	0.2	1	0	0
Rat Tail Fish	22	4.5	NA	NA	NA

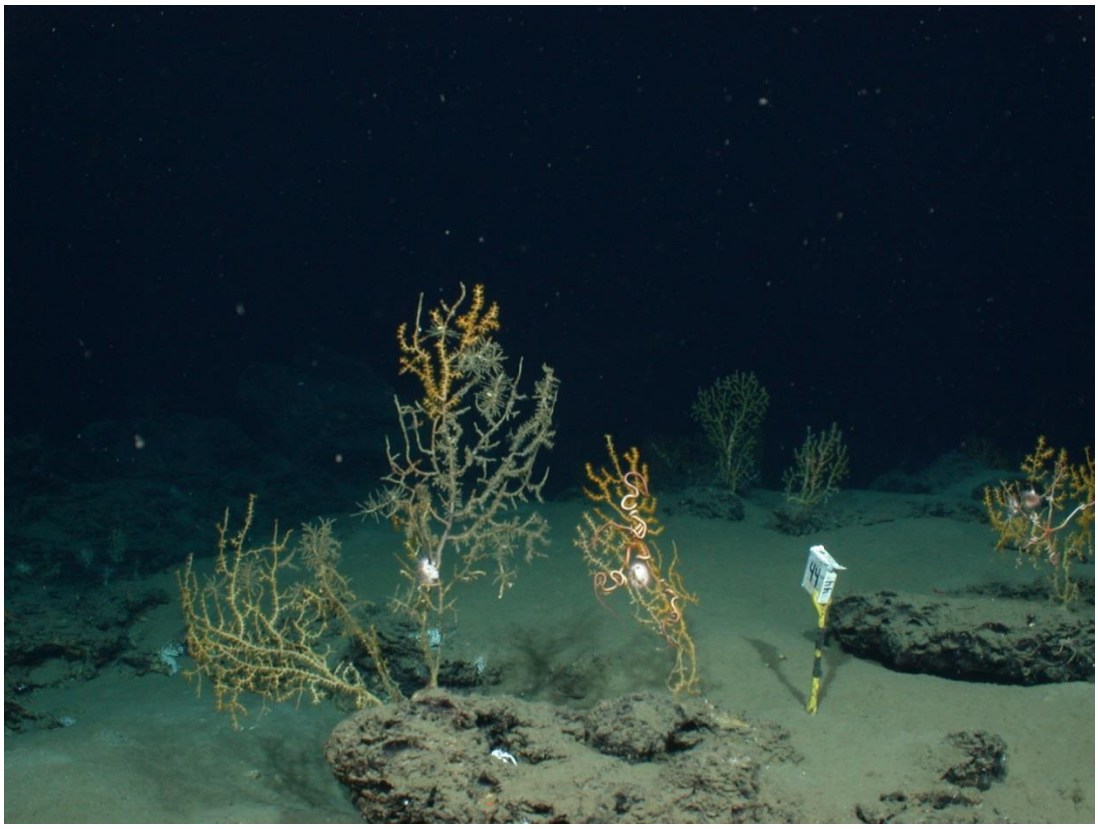

Figure 24. Example of white galatheid crabs (center of image on rock; 2011_10_14_13_32_50.jpg).

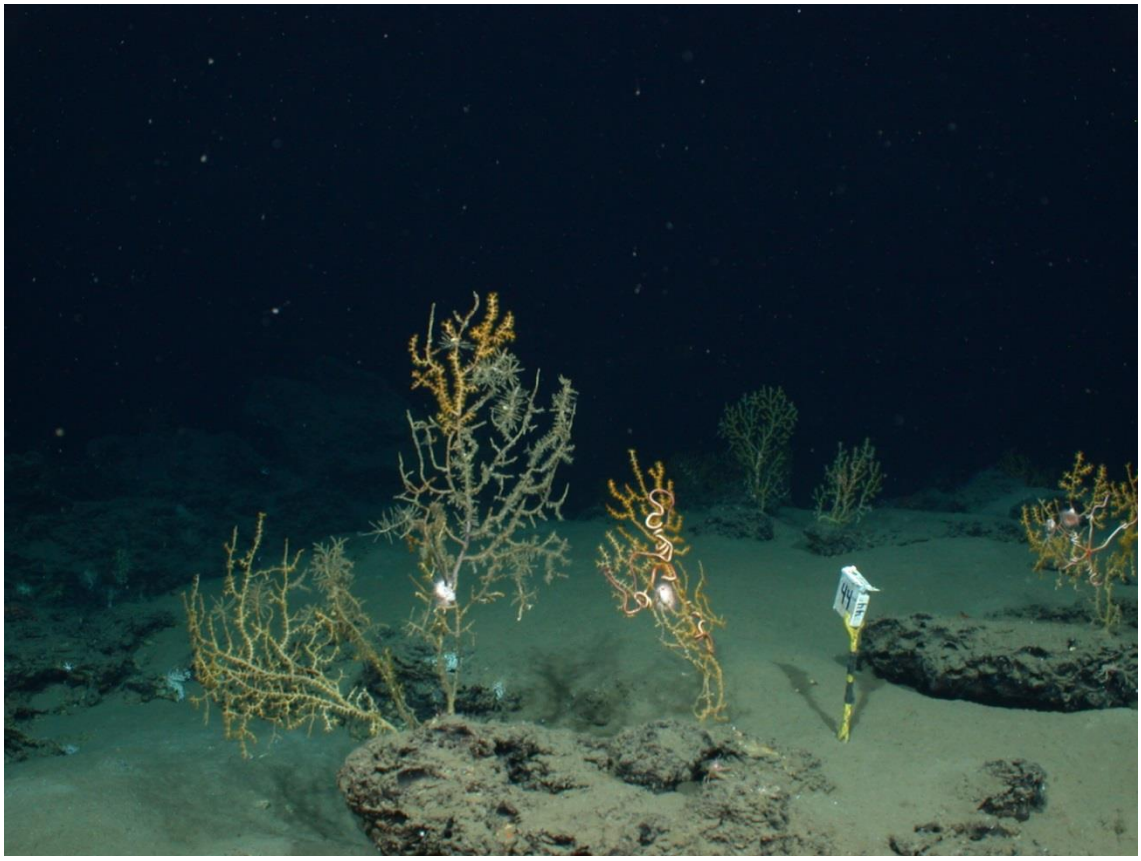

Figure 25. Example of brown galatheid crabs (on rock in image; 2011_10_14_12_02_50.jpg).

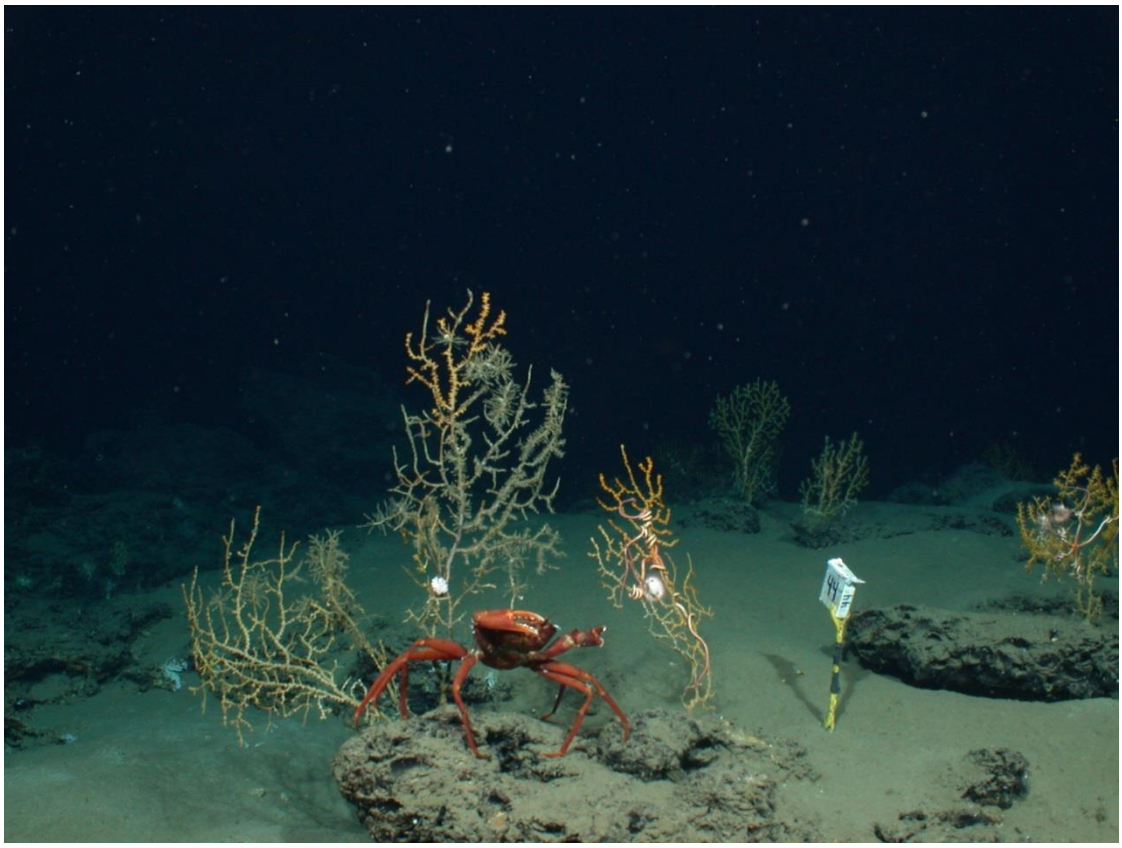

Figure 26. Example of a red crab (*Chaceon quinquedens*; as in 2011_10_14_21_47_51.jpg above).

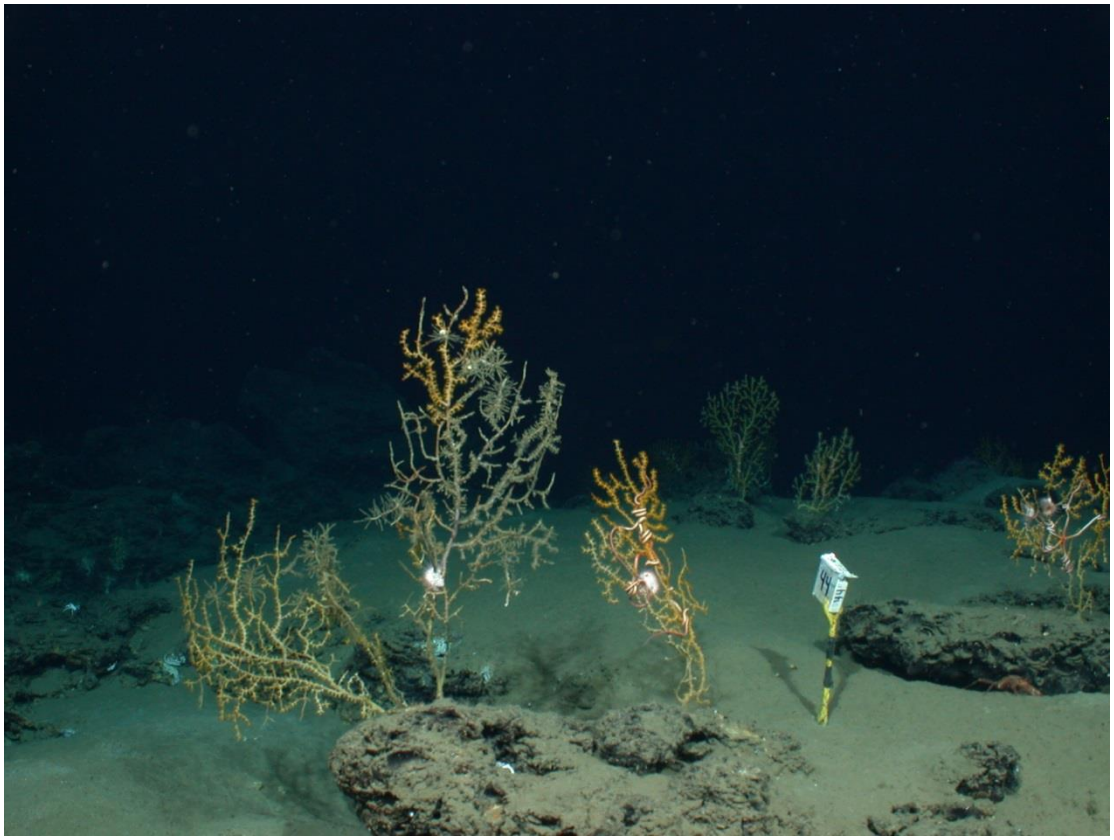

Figure 27. Example of a “small” red crab (back rock, right).

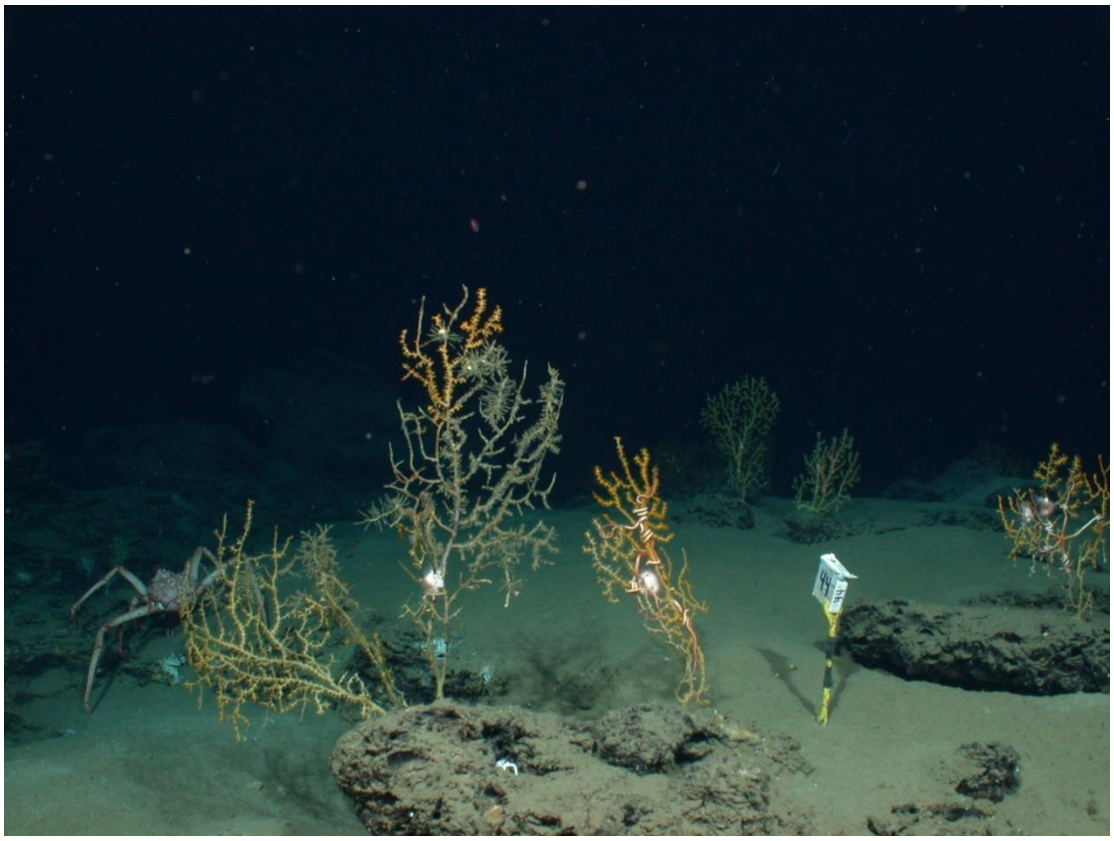

Figure 28. Example of a spider crab (*Rochinia crassa*).

Description of corals, presences of flocculent material, and associates at time of final deployment of the time-lapse camera

Four paramuricid corals with coral identification codes (from left to right in the field of view) D8, D7, D3, and D1, as well as surrounding mobile fauna, were imaged (Figure 21, above):

- Coral D8 exhibited extensive hydroid cover, and no anemones or ophiuroid associates were observed on this coral.
- The adjacent D7 coral comparatively had many fewer branches than D8 and hosted hydroids near the distal ends of the branches.
- Coral D3 had what can be considered the greatest amount of hydroid cover, and no ophiuroid associates were present throughout the deployment (although one was originally present in 2010). However it did have one anemone attached to a branch with live coral tissue. Brown flocculent/mucus material was also observed on coral D3 only, specifically as strands of material, and was evident throughout the deployment. For the majority of the deployment, there were two small white particles observed among the hydroids on two distal branches of coral D3 that resembled and behaved similarly to amphipods. Neither reliable analysis of their presence/absence nor their taxonomic identity on was tenable.
- Coral D1 hosted one ophiuroid and one anemone and had no hydroids.

Sequential time-series images throughout the deployment documented significant swaying movement of corals (in excess of 30 degrees of movement) in local currents that had an apparent southerly to northerly (right and left) and westerly to easterly (toward and away from the camera) movement. As such, the ability to obtain any precise or absolute length measurements of corals and their associates was confounded. Further, the movement of corals between images in combination with the short duration of the deployment of the time-lapse camera did not allow for quantitative analysis of changes in the amount of flocculent/mucus material or in hydroid cover as part of this time-lapse camera component of the effort.

Chapter 5: Meiofauna and Macrofauna

Sample abundance and diversity referenced by location of collection (latitude/longitude) and depth.

Macrofauna abundance and diversity are shown in Table 2. Meiofauna abundance and diversity are shown in Table 3[3]. Overall, 3,025 individual macrofauna and 231,853 meiofauna were identified and quantified. Macrofauna abundance ranged from seven to 127 individuals per core while meiofauna abundance ranged from 1,229 to 10,839 individuals per core. Macrofauna diversity (Shannon Index H'loge) ranged from 1.748 to 3.147 while meiofauna diversity (Shannon Index H'loge) ranged from 0.502 to 1.004.

Indicator Species

Certain macrofauna and meiofauna taxa have been described in the literature as potential indicators of disturbance and pollution (for review see Peterson et al. 1996)[4]. Macrofauna taxa, shown in Table 4, include the polychaete families Capitellidae, Cirratulidae, Dorvilleidae and Spionidae, and amphipod crustaceans. Meiofauna taxa, shown in Table 5, include nematodes, copepods, and additionally the number of individual meiofauna that were colonized with epibionts.

Description and Quantification of Possible Visible Abnormalities

Quantification methodology: Individuals with visible abnormalities were counted and photographs of the abnormality were taken. Only two samples had detectable abnormalities, which are shown in Table 6.

Description/classification system used during the quantification: Visible abnormalities were classified into two types of abnormalities: (1) growths, which included abnormal growths visible on the exterior of an organism and (2) internal abnormalities, which included accumulations of dark substances resembling some type of dark liquid droplets within the organisms.

[3] Meiofauna data presented here are provisional until final QA/QC is complete.

[4] Peterson CH, Kennicutt II MC, Green RH, Montagna P, Harper JDE, Powell EN, Roscigno PF (1996) Ecological consequences of environmental perturbations associated with offshore hydrocarbon production: a perspective on long-term exposures in the Gulf of Mexico. Canadian Journal of Fisheries and Aquatic Sciences 53:2637-2654.

Table 2. Macrofaunal abundance (0-10cm) and density referenced by site location (latitude/longitude) and depth. Values include abundance (N, individuals per core, core area=31.65cm^{-2}), density (individuals m-2), species richness (Margalef's D), evenness (Pielou's Index J'), and Shannon's Index H'(log$_e$).

Site Description				Abundance	Density	Diversity		
Site/Core	**Latitude**	**Longitude**	**Depth (m)**	**N**	**Density (ind m^{-2})**	**D**	**J'**	**H'(log$_e$)**
MC297 PC3	28.68222	-88.34502	1586	18	5687	2.77	0.94	2.06
MC297 PC5	28.68222	-88.34502	1586	44	13902	5.55	0.89	2.75
MC297 PC9	28.68222	-88.34502	1586	65	20537	4.31	0.88	2.60
MC297 PC12	28.68136	-88.34402	1578	127	40126	2.89	0.76	2.06
MC297 PC17	28.68136	-88.34402	1578	65	20537	3.11	0.75	1.97
MC297 PC18	28.68136	-88.34402	1578	52	16430	4.56	0.87	2.56
MC297 PC1	28.69606	-88.34633	1550	21	6635	4.27	0.97	2.56
MC297 PC8	28.69606	-88.34633	1550	44	13902	6.12	0.94	3.00
MC297 PC9(2)	28.69606	-88.34633	1550	70	22117	5.67	0.94	3.02
MC297 PC7	28.69606	-88.34633	1550	40	12638	4.67	0.94	2.73
MC294 PC1	28.67213	-88.47643	1372	11	3476	2.50	0.91	1.77
MC294 PC2	28.67213	-88.47643	1372	7	2212	2.57	0.98	1.75
MC294 PC7	28.67213	-88.47643	1372	42	13270	2.14	0.83	1.83
MC294 PC15	28.67222	-88.47638	1372	51	16114	3.82	0.85	2.34
MC294 PC16	28.67222	-88.47638	1372	59	18641	3.43	0.80	2.17
MC294 PC17	28.67222	-88.47638	1372	32	10111	3.46	0.83	2.13
MC118 PC4	28.85262	-88.49255	887	87	27488	4.04	0.83	2.44
MC118 PC6	28.85262	-88.49255	887	73	23065	4.66	0.92	2.79
MC118 PC8	28.85262	-88.49255	887	81	25592	5.92	0.90	2.95
MC118 PC12	28.85595	-88.49361	888	90	28436	5.33	0.93	3.00
MC118 PC15	28.85595	-88.49361	888	58	18325	5.44	0.94	2.96
MC118 PC17	28.85595	-88.49361	888	83	26224	5.66	0.90	2.93
MC344 PC1	28.63381	-88.16969	1857	21	6635	3.61	0.92	2.29
MC344 PC5	28.63381	-88.16969	1857	30	9479	3.86	0.90	2.37
MC344 PC10	28.63381	-88.16969	1857	22	6951	3.88	0.89	2.29
MC344 PC11	28.63359	-88.16952	1857	50	15798	4.86	0.87	2.61
MC344 PC13	28.63359	-88.16952	1857	46	14534	4.99	0.89	2.67
MC344 PC15	28.63359	-88.16952	1857	48	15166	4.39	0.90	2.59
MC203 PC15	28.78727	-88.63471	919	53	16746	5.57	0.93	2.92
MC203 PC16	28.78727	-88.63471	919	76	24013	5.31	0.91	2.88
MC203 PC17	28.78727	-88.63471	919	52	16430	6.07	0.93	2.99
MC036 PC3	28.93541	-88.20138	1094	56	17694	5.71	0.90	2.85
MC036 PC6	28.93541	-88.20138	1094	38	12006	4.40	0.90	2.55
MC036 PC8	28.93541	-88.20138	1094	57	18009	5.22	0.91	2.80
MC036 PC15	28.93538	-88.20265	1095	48	15166	6.20	0.92	2.96
MC036 PC16	28.93538	-88.20265	1095	54	17062	5.52	0.93	2.92
MC036 PC17	28.93538	-88.20265	1095	68	21485	5.47	0.90	2.85

Table 2 continued.

Site Description				Abundance	Density	Diversity		
Site/Core	**Latitude**	**Longitude**	**Depth (m)**	**N**	**Density (ind m^{-2})**	**D**	**J'**	**H'(log_e)**
VK906 PC4	29.06993	-88.37759	402	63	19905	4.10	0.84	2.42
VK906 PC5	29.06993	-88.37759	402	58	18325	5.42	0.88	2.77
VK906 PC7	29.06993	-88.37759	402	55	17378	3.99	0.85	2.40
VK906 PC13	29.06942	-88.37748	392	90	28436	6.44	0.90	3.05
VK906 PC14	29.06942	-88.37748	392	69	21801	5.67	0.90	2.89
VK906 PC15	29.06942	-88.37748	392	76	24013	4.39	0.82	2.47
MC507 PC3	28.4855	-88.85084	1043	63	19905	4.59	0.90	2.70
MC507 PC4	28.4855	-88.85084	1043	55	17378	4.74	0.88	2.63
MC507 PC8	28.4855	-88.85084	1043	75	23697	3.95	0.78	2.24
VK826 PC2	29.16499	-88.01148	464	75	23697	5.33	0.86	2.72
VK826 PC3	29.16499	-88.01148	464	73	23065	5.36	0.85	2.71
VK826 PC4	29.16499	-88.01148	464	63	19905	6.76	0.93	3.15
VK826 PC14	29.16498	-88.01144	464	58	18325	5.69	0.89	2.82
AT357 PC4	27.5865	-89.70448	1051	27	8531	3.94	0.84	2.22
AT357 PC5	27.5865	-89.70448	1051	29	9163	3.86	0.83	2.20
AT357 PC8	27.5865	-89.70448	1051	27	8531	3.34	0.86	2.14
AT357 PC12	27.58663	-89.70406	1048	38	12006	4.40	0.90	2.56
AT357 PC13	27.58663	-89.70406	1048	47	14850	6.01	0.93	2.95
AT357 PC15	27.58663	-89.70406	1048	45	14218	4.47	0.91	2.62

Table 3. Meiofaunal abundance (0-10cm) and density referenced by site location (latitude/longitude) and depth. Values include abundance (N, individuals per core, core area=31.65cm^{-2}), density (individuals m^{-2}), species richness (Margalef's D), evenness (Pielou's Index J'), and Shannon's Index H'(log$_e$).

Site Description				Abundance	Density	Diversity		
Site/Core	**Latitude**	**Longitude**	**Depth (m)**	**N**	**Density (ind m^{-2})**	**D**	**J'**	**H'(log$_e$)**
MC297 PC3	28.68222	-88.34502	1586	4394	1388310	1.19	0.27	0.64
MC297 PC5	28.68222	-88.34502	1586	5766	1821801	1.27	0.24	0.60
MC297 PC9	28.68222	-88.34502	1586	8604	2718483	1.44	0.21	0.57
MC297 PC12[a]	28.68136	-88.34402	1578	10839	3424645	0.97	0.35	0.80
MC297 PC17	28.68136	-88.34402	1578	6644	2099210	1.36	0.28	0.71
MC297 PC18	28.68136	-88.34402	1578	6009	1898578	1.38	0.28	0.71
MC297 PC1	28.69606	-88.34633	1550	2804	885940	1.39	0.27	0.68
MC297 PC8	28.69606	-88.34633	1550	6520	2060032	1.14	0.30	0.73
MC297 PC9(2)	28.69606	-88.34633	1550	9037	2855292	1.32	0.21	0.55
MC297 PC7[b]	28.69606	-88.34633	1550	-	-	-	-	-
MC294 PC1	28.67213	-88.47643	1372	4731	1494787	1.30	0.23	0.57
MC294 PC2	28.67213	-88.47643	1372	5851	1848657	1.27	0.24	0.61
MC294 PC7	28.67213	-88.47643	1372	6283	1985150	1.37	0.25	0.63
MC294 PC15[c]	28.67222	-88.47638	1372	3721	1175671	1.46	0.30	0.76
MC294 PC16	28.67222	-88.47638	1372	5599	1769036	1.39	0.30	0.78
MC294 PC17	28.67222	-88.47638	1372	6772	2139652	1.36	0.30	0.78
MC118 PC4[d]	28.85262	-88.49255	887	-	-	-	-	-
MC118 PC6	28.85262	-88.49255	887	4740	1497630	1.30	0.29	0.73
MC118 PC8	28.85262	-88.49255	887	5929	1873302	1.15	0.24	0.58
MC118 PC12[c]	28.85595	-88.49361	888	4284	1353555	1.32	0.25	0.61
MC118 PC15	28.85595	-88.49361	888	4018	1269510	1.45	0.29	0.74
MC118 PC17	28.85595	-88.49361	888	7712	2436651	1.56	0.19	0.52
MC344 PC1	28.63381	-88.16969	1857	1595	503949	1.49	0.40	0.99
MC344 PC5	28.63381	-88.16969	1857	2761	872354	1.52	0.39	1.00
MC344 PC10	28.63381	-88.16969	1857	2583	816114	1.02	0.41	0.91
MC344 PC11[e]	28.63359	-88.16952	1857	3580	1131122	1.47	0.26	0.65
MC344 PC13[e]	28.63359	-88.16952	1857	2947	931122	1.13	0.36	0.82
MC344 PC15[e]	28.63359	-88.16952	1857	3153	996209	1.37	0.31	0.77
MC203 PC15[a]	28.78727	-88.63471	919	3215	1015798	1.37	0.24	0.59
MC203 PC16[e]	28.78727	-88.63471	919	4635	1464455	1.30	0.26	0.66
MC203 PC17[e]	28.78727	-88.63471	919	3651	1153555	1.34	0.26	0.65
MC036 PC3	28.93541	-88.20138	1094	4891	1545340	1.06	0.28	0.64
MC036 PC6	28.93541	-88.20138	1094	3688	1165245	1.10	0.26	0.61
MC036 PC8[f]	28.93541	-88.20138	1094	5134	1622117	1.41	0.31	0.79
MC036 PC15	28.93538	-88.20265	1095	3151	995577	1.49	0.34	0.88
MC036 PC16	28.93538	-88.20265	1095	5653	1786098	1.39	0.34	0.88
MC036 PC17	28.93538	-88.20265	1095	5510	1740916	1.63	0.28	0.77

Table 3 continued.

Site Description				Abundance	Density	Diversity		
Site/Core	**Latitude**	**Longitude**	**Depth (m)**	**N**	**Density (ind m^{-2})**	**D**	**J'**	**H'(log$_e$)**
VK906 PC4[g]	29.06993	-88.37759	402	-	-	-	-	-
VK906 PC5[g]	29.06993	-88.37759	402	-	-	-	-	-
VK906 PC7[a]	29.06993	-88.37759	402	1495	472354	1.78	0.30	0.78
VK906 PC13	29.06942	-88.37748	392	1229	388310	1.27	0.34	0.79
VK906 PC14	29.06942	-88.37748	392	2440	770932	1.28	0.30	0.71
VK906 PC15	29.06942	-88.37748	392	2098	662875	1.18	0.37	0.86
MC507 PC3[h]	28.4855	-88.85084	1043	-	-	-	-	-
MC507 PC4	28.4855	-88.85084	1043	8190	2587678	1.00	0.38	0.87
MC507 PC8[e]	28.4855	-88.85084	1043	7109	2246130	1.35	0.20	0.50
VK826 PC2[e]	29.16499	-88.01148	464	2303	727646	1.29	0.34	0.82
VK826 PC3[e]	29.16499	-88.01148	464	1871	591153	1.33	0.33	0.79
VK826 PC4	29.16499	-88.01148	464	1518	479621	1.23	0.35	0.81
VK826 PC14	29.16498	-88.01144	464	2793	882464	1.51	0.38	0.97
AT357 PC4[h]	27.5865	-89.70448	1051	-	-	-	-	-
AT357 PC5	27.5865	-89.70448	1051	3538	1117852	0.98	0.31	0.69
AT357 PC8	27.5865	-89.70448	1051	2907	918483	1.38	0.37	0.92
AT357 PC12	27.58663	-89.70406	1048	6140	1939968	1.38	0.27	0.69
AT357 PC13	27.58663	-89.70406	1048	6104	1928594	1.26	0.21	0.52
AT357 PC15	27.58663	-89.70406	1048	5714	1805371	1.16	0.23	0.54

[a] 3-5 cm fraction may have been sieved through a 63-µm screen.
[b] Sample sieved on 300 µm at sea (>45 µm not collected).
[c] 3-5 cm and 5-10 cm fractions sieved through a 63-µm screen.
[d] Sample not processed due to accidental laboratory spill.
[e] 3-5 cm and 5-10 cm fractions may have been sieved through a 63-µm screen.
[f] 5-10 cm fraction sieved through a 63-µm screen.
[g] HC3-B1023-S-E8-VK906029-MF-002 not processed due to accidental combination with HC3-B1023-S-E8-VK906029-MF-007.
[h] HC3-B1016-S-E8-MC506/507020-MF-002 not processed due to accidental combination with HC3-B1012-S-E8-AT357010-MF-002.

Table 4. Abundance of macrofauna (0-10cm) indicator taxa (N, individuals per core, core area=31.65cm^{-2}) referenced by site location (latitude/longitude) and depth.

Site Description				Indicator Taxa				
Site/Core	**Latitude**	**Longitude**	**Depth (m)**	**Capitellidae**	**Cirratulidae**	**Dorvilleidae**	**Spionidae**	**Amphipoda**
MC297 PC3	28.68222	-88.34502	1586	0	0	0	0	1
MC297 PC5	28.68222	-88.34502	1586	0	0	0	1	7
MC297 PC9	28.68222	-88.34502	1586	0	1	5	1	0
MC297 PC12	28.68136	-88.34402	1578	41	4	12	0	0
MC297 PC17	28.68136	-88.34402	1578	5	0	3	1	1
MC297 PC18	28.68136	-88.34402	1578	6	0	8	0	2
MC297 PC1	28.69606	-88.34633	1550	0	0	1	1	1
MC297 PC8	28.69606	-88.34633	1550	0	1	0	2	1
MC297 PC9(2)	28.69606	-88.34633	1550	0	2	0	4	2
MC297 PC7	28.69606	-88.34633	1550	0	0	0	1	3
MC294 PC1	28.67213	-88.47643	1372	0	0	0	0	0
MC294 PC2	28.67213	-88.47643	1372	0	0	0	0	0
MC294 PC7	28.67213	-88.47643	1372	0	1	0	0	0
MC294 PC15	28.67222	-88.47638	1372	1	4	3	1	0
MC294 PC16	28.67222	-88.47638	1372	0	1	2	0	0
MC294 PC17	28.67222	-88.47638	1372	0	1	0	1	0
MC118 PC4	28.85262	-88.49255	887	18	2	10	1	1
MC118 PC6	28.85262	-88.49255	887	3	3	1	3	2
MC118 PC8	28.85262	-88.49255	887	0	0	7	4	0
MC118 PC12	28.85595	-88.49361	888	0	2	6	6	0
MC118 PC15	28.85595	-88.49361	888	0	4	0	3	4
MC118 PC17	28.85595	-88.49361	888	1	2	1	2	1
MC344 PC1	28.63381	-88.16969	1857	0	0	0	1	2
MC344 PC5	28.63381	-88.16969	1857	0	1	0	0	4
MC344 PC10	28.63381	-88.16969	1857	0	0	0	1	1
MC344 PC11	28.63359	-88.16952	1857	0	0	0	1	0
MC344 PC13	28.63359	-88.16952	1857	0	0	0	1	1
MC344 PC15	28.63359	-88.16952	1857	0	1	0	0	0
MC203 PC15	28.78727	-88.63471	919	0	2	0	5	2
MC203 PC16	28.78727	-88.63471	919	0	2	0	1	8
MC203 PC17	28.78727	-88.63471	919	1	2	0	3	1
MC036 PC3	28.93541	-88.20138	1094	0	0	2	1	4
MC036 PC6	28.93541	-88.20138	1094	0	3	1	0	1
MC036 PC8	28.93541	-88.20138	1094	0	0	3	3	2
MC036 PC15	28.93538	-88.20265	1095	1	3	0	1	3
MC036 PC16	28.93538	-88.20265	1095	0	2	0	4	2
MC036 PC17	28.93538	-88.20265	1095	0	1	0	2	2

Table 4 continued.

Site Description				Indicator Taxa				
Site/Core	**Latitude**	**Longitude**	**Depth (m)**	**Capitellidae**	**Cirratulidae**	**Dorvilleidae**	**Spionidae**	**Amphipoda**
VK906 PC4	29.06993	-88.37759	402	0	0	0	1	0
VK906 PC5	29.06993	-88.37759	402	0	0	1	4	2
VK906 PC7	29.06993	-88.37759	402	0	0	0	2	1
VK906 PC13	29.06942	-88.37748	392	1	0	0	2	4
VK906 PC14	29.06942	-88.37748	392	0	0	0	2	2
VK906 PC15	29.06942	-88.37748	392	0	0	1	3	0
MC507 PC3	28.4855	-88.85084	1043	0	5	5	1	0
MC507 PC4	28.4855	-88.85084	1043	1	1	2	4	1
MC507 PC8	28.4855	-88.85084	1043	2	0	13	0	2
VK826 PC2	29.16499	-88.01148	464	0	3	0	2	1
VK826 PC3	29.16499	-88.01148	464	0	3	0	10	3
VK826 PC4	29.16499	-88.01148	464	2	1	0	1	7
VK826 PC14	29.16498	-88.01144	464	0	4	0	4	7
AT357 PC4	27.5865	-89.70448	1051	0	0	1	0	0
AT357 PC5	27.5865	-89.70448	1051	0	0	1	0	0
AT357 PC8	27.5865	-89.70448	1051	0	0	0	0	0
AT357 PC12	27.58663	-89.70406	1048	0	0	2	0	2
AT357 PC13	27.58663	-89.70406	1048	0	1	3	1	1
AT357 PC15	27.58663	-89.70406	1048	0	0	5	3	3

Table 5. Abundance of meiofauna indicator taxa (0-10cm, N, individuals per core, core area=31.65cm^{-2}) referenced by site location (latitude/longitude) and depth.

Site Description				Indicator Species					
Site/Core	**Latitude**	**Longitude**	**Depth (m)**	**Copepod**	**Nematode**	**Nematodes with epibionts**	**Copepods with epibionts**	**Annelids with Epibionts**	**Ostracods with Epibionts**
MC297 PC3	28.68222	-88.34502	1586	461	3663	0	0	0	0
MC297 PC5	28.68222	-88.34502	1586	667	4844	0	0	0	0
MC297 PC9	28.68222	-88.34502	1586	827	7402	0	0	0	0
MC297 PC12[a]	28.68136	-88.34402	1578	2358	7886	2	56	3	1
MC297 PC17	28.68136	-88.34402	1578	920	5329	2	17	0	0
MC297 PC18	28.68136	-88.34402	1578	879	4773	5	18	0	0
MC297 PC1	28.69606	-88.34633	1550	358	2274	0	1	0	0
MC297 PC8	28.69606	-88.34633	1550	933	5171	0	0	0	0
MC297 PC9(2)	28.69606	-88.34633	1550	905	7778	8	6	0	0
MC297 PC7[b]	28.69606	-88.34633	1550	-	-	-	-	-	-
MC294 PC1	28.67213	-88.47643	1372	474	4026	7	5	0	0
MC294 PC2	28.67213	-88.47643	1372	756	4829	2	5	0	0
MC294 PC7	28.67213	-88.47643	1372	985	5056	13	7	0	0
MC294 PC15[c]	28.67222	-88.47638	1372	622	2861	3	3	0	0
MC294 PC16	28.67222	-88.47638	1372	913	4252	0	2	0	0
MC294 PC17	28.67222	-88.47638	1372	1064	5179	16	5	0	0
MC118 PC4[d]	28.85262	-88.49255	887	-	-	-	-	-	-
MC118 PC6	28.85262	-88.49255	887	697	3705	12	9	0	0
MC118 PC8	28.85262	-88.49255	887	670	5003	15	11	0	0
MC118 PC12[c]	28.85595	-88.49361	888	380	3587	5	3	0	0
MC118 PC15	28.85595	-88.49361	888	521	3151	1	2	0	0
MC118 PC17	28.85595	-88.49361	888	740	6693	14	8	0	0
MC344 PC1	28.63381	-88.16969	1857	429	1016	0	6	0	0
MC344 PC5	28.63381	-88.16969	1857	670	1820	0	8	3	0
MC344 PC10	28.63381	-88.16969	1857	536	1791	0	0	0	0
MC344 PC11[e]	28.63359	-88.16952	1857	488	2927	0	2	0	0
MC344 PC13[e]	28.63359	-88.16952	1857	537	2175	0	3	2	0
MC344 PC15[e]	28.63359	-88.16952	1857	689	2321	1	5	1	0
MC203 PC15[a]	28.78727	-88.63471	919	290	2673	5	0	0	0
MC203 PC16[e]	28.78727	-88.63471	919	522	3810	1	0	0	0
MC203 PC17[e]	28.78727	-88.63471	919	476	3006	3	3	0	0
MC036 PC3	28.93541	-88.20138	1094	763	3950	5	5	0	1
MC036 PC6	28.93541	-88.20138	1094	397	3076	2	0	0	0
MC036 PC8[f]	28.93541	-88.20138	1094	930	3876	4	0	0	0
MC036 PC15	28.93538	-88.20265	1095	715	2159	1	1	0	1
MC036 PC16	28.93538	-88.20265	1095	1065	4080	0	0	0	0
MC036 PC17	28.93538	-88.20265	1095	924	4154	2	2	0	1

Table 5 continued.

Site Description				Indicator Species					
Site/Core	**Latitude**	**Longitude**	**Depth (m)**	**Copepod**	**Nematode**	**Copepods with epibionts**	**Nematodes with epibionts**	**Annelids with Epibionts**	**Ostracods with Epibionts**
VK906 PC4[g]	29.06993	-88.37759	402	-	-	-	-	-	-
VK906 PC5[g]	29.06993	-88.37759	402	-	-	-	-	-	-
VK906 PC7[a]	29.06993	-88.37759	402	229	1161	1	0	0	0
VK906 PC13	29.06942	-88.37748	392	178	935	0	0	0	0
VK906 PC14	29.06942	-88.37748	392	392	1915	0	1	0	0
VK906 PC15	29.06942	-88.37748	392	364	1556	0	2	0	0
MC507 PC3[h]	28.4855	-88.85084	1043	-	-	-	-	-	-
MC507 PC4	28.4855	-88.85084	1043	1703	5888	7	7	0	1
MC507 PC8[e]	28.4855	-88.85084	1043	611	6235	1	9	0	0
VK826 PC2[e]	29.16499	-88.01148	464	330	1766	0	0	1	0
VK826 PC3[e]	29.16499	-88.01148	464	285	1435	0	0	0	0
VK826 PC4	29.16499	-88.01148	464	182	1189	0	0	0	0
VK826 PC14	29.16498	-88.01144	464	572	1947	0	0	0	0
AT357 PC4[h]	27.5865	-89.70448	1051	-	-	-	-	-	-
AT357 PC5	27.5865	-89.70448	1051	437	2870	0	3	0	0
AT357 PC8	27.5865	-89.70448	1051	576	2061	0	1	0	0
AT357 PC12	27.58663	-89.70406	1048	714	5016	1	16	1	0
AT357 PC13	27.58663	-89.70406	1048	570	5317	0	1	0	0
AT357 PC15	27.58663	-89.70406	1048	476	4958	1	5	0	0

[a] 3-5 cm fraction may have been sieved through a 63-µm screen.
[b] Sample sieved on 300 µm at sea (>45 µm not collected).
[c] 3-5 cm and 5-10 cm fractions sieved through a 63-µm screen.
[d] Sample not processed due to accidental laboratory spill.
[e] 3-5 cm and 5-10 cm fractions may have been sieved through a 63-µm screen.
[f] 5-10 cm fraction sieved through a 63-µm screen.
[g] HC3-B1023-S-E8-VK906029-MF-002 not processed due to accidental combination with HC3-B1023-S-E8-VK906029-MF-007.
[h] HC3-B1016-S-E8-MC506/507020-MF-002 not processed due to accidental combination with HC3-B1012-S-E8-AT357010-MF-002.

Table 6. Visible abnormalities detected for sampled infauna (0-10cm, N, individuals per core, core area=31.65cm^{-2}) referenced by site location (latitude/longitude) and depth.

Site Description				Visible Abnormalities		
Site/Core	**Latitude**	**Longitude**	**Depth (m)**	**N**	**Type**	**Description**
MC297 PC3	28.68222	-88.34502	1586	1	Growth	Sigalionidae with growth on ventral surface
MC297 PC5	28.68222	-88.34502	1586	1	Internal	Paraonidae with dark material inside digestive tract