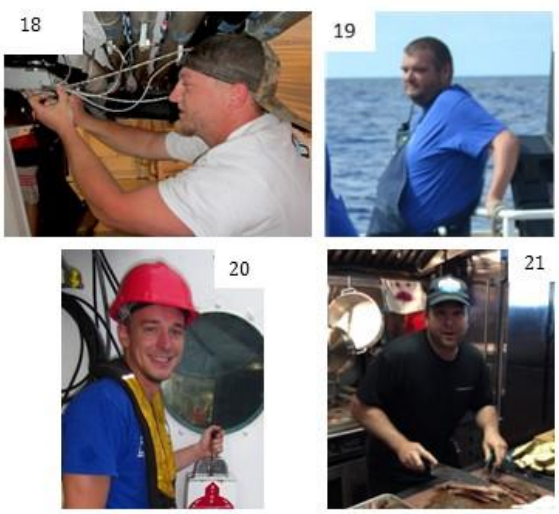
DEEP PELAGIC NEKTON DYNAMICS OF THE GULF OF MEXICO

Cruise Report
R/V *Point Sur* cruise DP03

30 April – 14 May 2016

DEEPEND DP03 Cruise Participants on the R/V *Point Sur*



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3. Max Weber	TAMUG	Fish geneticist
4. Dr. Tamara Frank	NSUOC	Taxonomist
5. Dr. Heather Bracken-Grissom	FIU	Shrimp geneticist
6. Espen Rekdal	SAZ	BBC photographer
7. Dr. Jon Moore	FAU	Taxonomist
8. April Cook	NSUOC	Project manager
9. Dr. Mike Vecchione	SI	Taxonomist
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16. Dr. Danté Fenolio	SAZ	Outreach/filming lead
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21. Alex Forsythe	LUMCON	Chef

DEEPEND
DEEP PELAGIC NEKTON DYNAMICS OF THE GULF OF MEXICO

Report of
DEEPEND Cruise DP03
30 April - 14 May 2016; USM R/V *Point Sur*, Gulfport, MS
Chief Scientist: Tracey Sutton

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A DEEPEND (Deep Pelagic Nekton Dynamics)
Consortium Report

Available online from the DEEPEND website,
www.deependconsortium.org

Acknowledgements

This was the third DEEPEND cruise in the Gulf of Mexico. The success of the cruise was due to the outstanding efforts of the Captain and Crew of the R/V *Point Sur*, LUMCON Marine Operations, the University of Southern Mississippi Department of Marine Science, OKEANUS Science and Technology, Continental Shelf Associates, Sea-Gear Corporation, the San Antonio Zoo, the NSU Oceanic Ecology Lab (R. Milligan, M. Novotny, E. Paulus N. Pruzinsky, K. Ramikssoon, M. Woodstock), and all members of the science party. The cheerfulness, resourcefulness, and hard work of all participants were outstanding. This cruise was supported by the Gulf of Mexico Research Initiative (GOMRI2014-IV-914).

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1 Purpose of the Cruise

The DEEPEND Consortium is an ocean realm field project supported by the Gulf of Mexico Research Initiative (GoMRI). The focus of the DEEPEND Consortium is to develop a quantitative, taxonomically comprehensive assessment of the deep-pelagic faunal assemblages of the northern Gulf of Mexico (GoM hereafter) in the region of the *Deepwater Horizon* oil spill (DWHOS), including examination of longer-term consequences of the DWHOS on these assemblages. The project goals of this third cruise include: 1) quantitative assessment of deep-pelagic nekton (fishes, macrocrustaceans, and cephalopods) and gelatinous zooplankton assemblage structure, abundance, and distribution across a range of biophysical conditions corresponding to the major oceanographic features of the Gulf of Mexico; 2) quantitative acoustic profiling of the fine- and mesoscale distributions of oceanic nekton; 3) collection of nekton, plankton and microbial samples for genomics/genetic analyses to be conducted in five research labs (Nova Southeastern University, Texas A&M University Galveston, Florida International University, Smithsonian Institution/National Museum of Natural History); 4) collection of nekton, and plankton samples for stable isotope, hydrocarbon, otolith microchemistry, parasite, and mercury analyses; 5) collection of particulate organic carbon samples for stable isotope analysis; 6) collection of phytoplankton filtrates (chlorophyll analysis) for remote sensing calibration; 7) collection of *in situ* biophysical oceanographic data for community analyses and assimilation into HYCODE and remote sensing models; 8) collection of fish specimens for genomic fingerprinting of bioluminescent microbial symbionts; and 9) collection of photographic and video content for Outreach & Education efforts. The strategy for DP03 was to sample within three major oceanographic features that occurred in the northern GoM at the time of the cruise: a cyclonic (cold-core) eddy, an anti-cyclonic (warm-core) Loop-Current eddy, and "common" water (Figure 1). Sampling was also conducted to continue a time series of stations sampled from the DWH spill site to DeSoto Canyon.

As with previous DP03 cruises, sampling/sensing was conducted aboard the R/V *Point Sur*. Scientific participants on this cruise (see frontispiece) included expert taxonomists in the major deep-pelagic nekton faunal groups, genetic taxonomists, acousticians, technicians, an Educator-at-Sea, an outreach/imaging specialist, graduate students, and a professional videographer from the BBC Natural History Unit. Specimens were identified at sea using traditional taxonomic approaches. After the cruise, species counts, molecular analyses, and expert taxonomic evaluation and description of any putative new records or undescribed species will be done in association with the DEEPEND Taxonomic Working Groups.

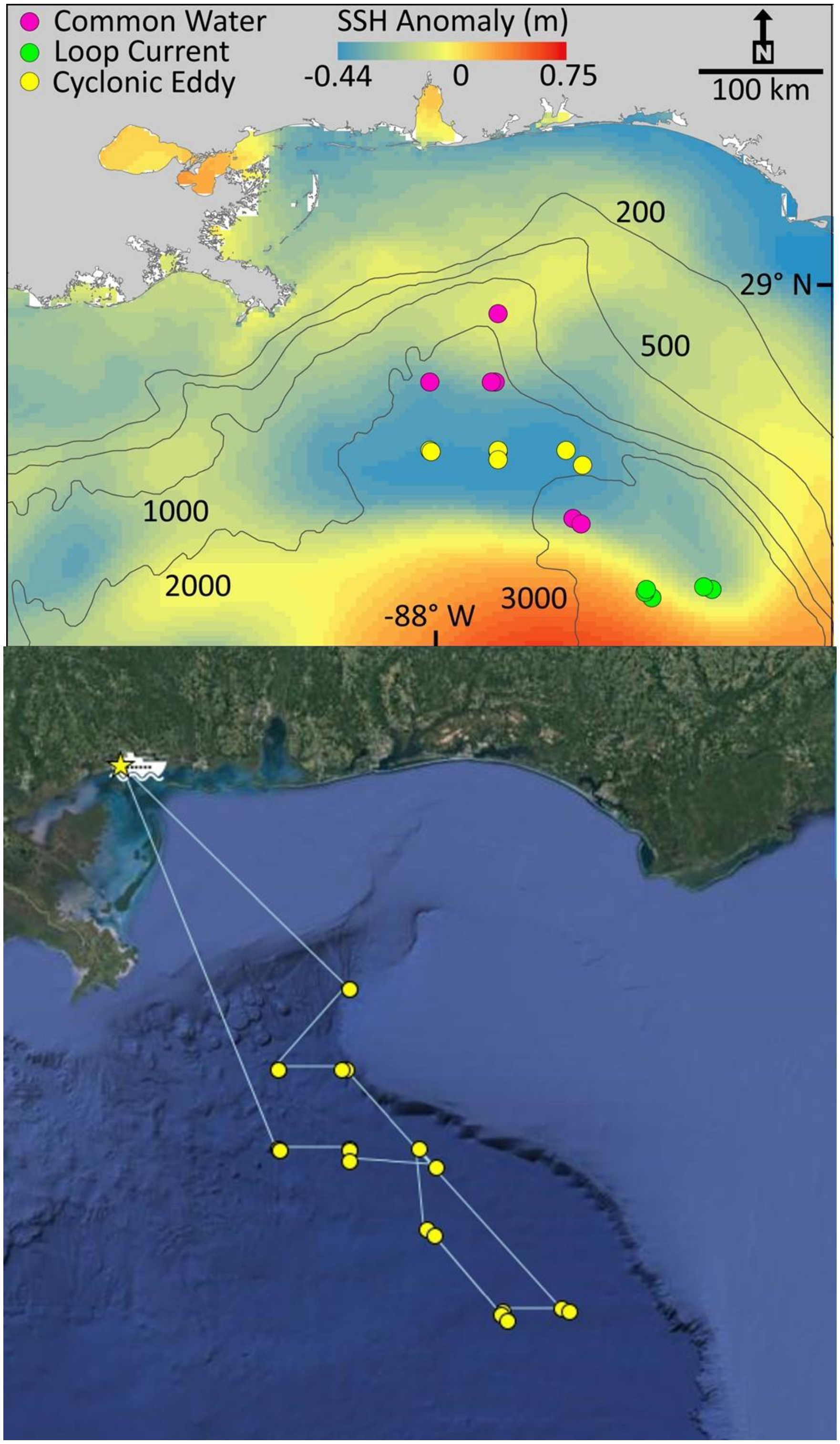


Figure 1. Cruise track of DEEPEND cruise DP03 (30 April – 14 May 2016) relative to mesoscale oceanographic features (top) and seafloor topography (bottom).

2 Narrative

Ship's cruise number: PS_16_22_Sutton
DEEPEND cruise number: DP03

All cruise activity times presented as 24-h clock notation in Central Daylight Time (UTC – 5 h). A map of standardized station names and station order is presented in Figure 2.

30 April 2016: We left Gulfport at 0039 and arrived at Station B082 (28°00N, 88°00W) at 1850. We conducted a CTD rosette cast at 1920, followed by the deployment of the optics profiler at 2027.

1 May 2016: The CTD rosette was deployed at 0738, followed by a deployment of the optics profiler at 0912. The MOC-10 gear was deployed at 1534 (Trawl 036) to target an acoustically-detected scattering layer. Nets 1-5 were fished to a maximum depth of 477.2 m and recovered onto deck at 1736. The samples were unloaded and processing began. The naming conventions for trawl samples remained the same as those used in DP01 and DP02:

Example: DP03-01MAY16-MOC10-B082D-036-N1.
Key: Cruise No. – Date – Gear Type - SEAMAP station code + (N = night, D = day) - Trawl No. - Net No.

Gear Types: MOC10: MOC-10 trawls;
TT: Tucker trawl;
NN: Neuston net;
BN: Bongo net;
CTD: Water sample from CTD rosette

Trawl numbers are cumulatively increased across all sampling years and are not restarted each cruise.

A CTD cast was conducted at 1843. The MOC-10 gear was deployed again at 2200 (Trawl 037). Nets 1-5 were fished to a maximum depth of 1506 m, but the flow meter failed below 650 m.

02 May 2016: Trawl 037 was recovered to deck at 0400. We conducted a CTD cast at 0600 and deployed the optics profiler at 0751. The MOC-10 gear (Trawl 038 was deployed at 1038. Nets 1-5 were fished to a maximum depth of 1504.7 m but the flow meter failed at depths greater than 600 m. The MOC-10 was recovered to deck at 1605. The vessel arrived at station B278 (28°00N, 87°30W) and deployed the CTD rosette at 1833. The CTD was recovered at 1959 and was followed by the deployment of the optics profiler at 2023. The MOC-10 gear (Trawl 039) was deployed at 2200. Nets 1-5 were fished to a maximum depth of 1505.3 m but the flow meter failed at depths greater than 250 m. The MOC-10 was recovered to deck at 0400.

03 May 2016: We began the return journey back to station B278 at 0428. A CTD cast was made at 0715, followed by deployment of the optics profiler at 0832. The MOC-10 gear (Trawl 040) was deployed at 0952. Nets 1-5 were fished to a maximum depth of 900 m but the flow meter failed at depths greater than 400 m and Net 5 was recovered torn. The MOC-10 was recovered to deck at c. 1530. We returned to station B278 and conducted a CTD cast with ADCP at 1717. A standard CTD cast was conducted at 1928. The MOC-10 gear (Trawl 041) was deployed at 2200. Nets 1-5 were fished to a maximum depth of 900 m to target an acoustically-defined layer. The flow meter failed for at least nets 1 and 2.

04 May 2016: The MOC-10 was recovered to deck at 0530. The ship departed for station B003 (28°00, 87°00W) at 0600. A CTD cast was conducted at 0910 followed by deployment of the optics profiler at 1036. Poor weather began during the day. A second CTD cast was conducted at 2022 to 50 m and the MOC-10 (Trawl 042) was deployed at 2215 in rough seas resulting in variable ship's speed during the deployment. Nets 1-5 were fished to a maximum depth of 1500 m. The flow meter worked correctly.

05 May 2016: The MOC-10 was recovered to deck at 0400. We steamed back towards station B003 at 0600, and conducted a CTD case at 0700. The optics profiler was deployed at 0813. The MOC-10 (Trawl 043) was deployed at 1024 to a maximum depth of 2000 m and minimum depth of 1000 m to target the bathypelagic fauna. The gear was recovered to deck at 2310. A CTD cast was conducted at 2328.

06 May 2016: The optics profiler was deployed at 0200. The vessel left station at 0237 and began travelling towards station B079 (27°30N, 87°00W). The MOC-10 gear (Trawl 044) was deployed at station B079 at 1015. Nets 1-5 were fished to a maximum depth of 1500 m before being recovered to deck at 1624. The vessel started the return journey to station B079 at 1712. A CTD cast was conducted at 1905, followed by deployment of the optics profiler at 2035. The MOC-10 gear (trawl 045) was deployed at 2200. Nets 1-5 were fished to a maximum depth of 1500 m.

07 May 2016: The MOC-10 was recovered to deck at 0317. A CTD cast was conducted at station B079 at 0542. A diver conducted a hull inspection of the vessel at 0728, and deployment of the optics profiler was conducted at 0837. At 0901 we attempted to fly the drone but flight was unsuccessful. We left for station SE-4 (27°00, 86°30W) at 0931, arriving on station at c. 1545. The optics profiler was deployed at 1545 followed by a CTD cast with calibration ball at 1658. The CTD was recovered at 2035. The MOC-10 (Trawl 046) was deployed at 2200. Nets 1-5 were fished to a maximum depth of 1500 m.

08 May 2016: The MOC-10 was recovered to deck at 0341. A CTD cast was conducted at station SE-4. The drone was deployed but had to be ditched due to high winds. A diver was sent to recover the drone at 0810 and returned at 0825. The optics profiler was deployed at 0835. The MOC-10 (Trawl 47) was deployed at 1015. Nets 1-5 were fished to a maximum depth of 1500 m before being recovered on deck at 1557. The optics profiler was deployed at 1601, followed by a CTD cast with an orb attached that was deployed at 1710. At 2139, the MOC-10 (Trawl 48) was deployed to station SE-4. Nets 1-5 were fished to a maximum depth of 1500 m.

09 May 2016: The MOC-10 was recovered at deck at 0316. We left for station SE-5 (27°00, 86°00W) at 0540 and conducted a CTD cast on arrival at 0720. The optics profiler was deployed at 0844. At 0901 the optics package was lost when it parted the 0.322 cable. A debrief with the crew suggested it got hung up on the boat somewhere due to the light nature of the package and the prevailing wind and current conditions. A mark was taken shortly after the cable parted at approximately 26°58.818'N, 085°57.056'W. The MOC-10 (Trawl 49) was deployed at 1005, it was recovered on deck at 1519. Nets 1-5 were fished to a maximum depth of 1500 m. A CTD cast was deployed at 1721. The MOC-10 was deployed again at 2044 at station SE-5 (Trawl 50). Nets 1-5 were fished to a maximum depth of 1500 m.

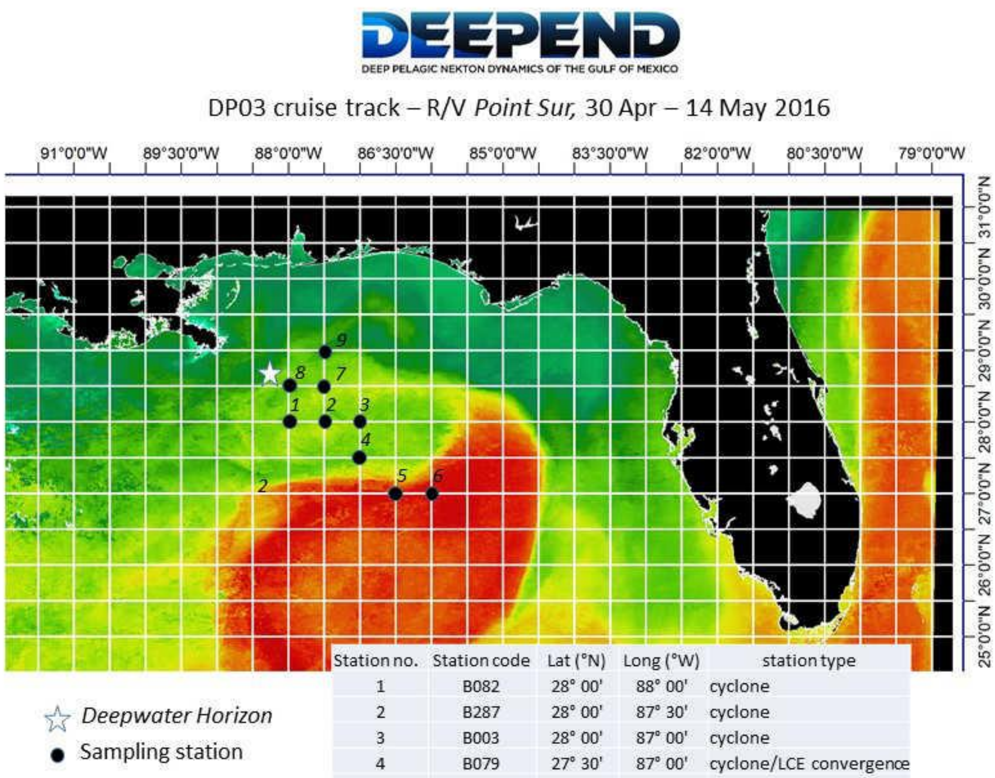
10 May 2016: The MOC-10 was recovered at 0230. We then proceeded to station B255 (27°30, 86°30W) at 0250 and arrived at 0810. Conditions were too rough to deploy the MOC-10, so we relocated to station B252 (28°30, 87°30W) at 1226. At 1900, a CTD cast was deployed, followed by the MOC-10 at 2100 (Trawl 51). Nets 1-5 were fished to a maximum depth of 1500 m.

11 May 2016: At 0245, the MOC-10 was recovered. At 0545, a CTD cast was conducted at the station and at 1033, the MOC-10 was deployed (Trawl 52). Nets 1-5 were fished to a maximum depth of 1600 m. At 1119, a small derelict boat was spotted with an outboard. MOC-10 was recovered on deck at 1619. At 1624, we left for station B081 (28°30N 88°00) and upon arrival deployed a CTD cast at 2017. At 2200, the MOC-10 was deployed (Trawl 53).

12 May 2016: At 0330, the MOC-10 was recovered. At 0615, a CTD cast was deployed (2000 m depth) and recovered on deck at 0734. At 1045, the MOC-10 (Trawl 54) was deployed and fished to a maximum depth of 1500 m. It was recovered on deck at 1652. We left for station B175 (29°00N 87°30W) at 1822 and upon arrival conducted a CTD at 2119, but was aborted at 2130. At 2202, the MOC-10 was deployed (Trawl 55). Nets 1-5 were fished to a maximum depth of 1500 m.

13 May 2016: At 0323, the MOC-10 was recovered on deck. At 0955, the MOC-10 (Trawl 56) was deployed at station B175 and recovered at 1532. Nets 1-5 were fished to a maximum depth of 1500 m. A CTD cast was deployed at 1744. At 1950, we were on our way back to Gulf Port.

14 May 2016: At 0515, we entered the Gulfport channel and docked at Gulfport state port at 0711.



Station no.	Station code	Lat (°N)	Long (°W)	station type
1	B082	28° 00'	88° 00'	cyclone
2	B287	28° 00'	87° 30'	cyclone
3	B003	28° 00'	87° 00'	cyclone
4	B079	27° 30'	87° 00'	cyclone/LCE convergence
5	SE-4	27° 00'	86° 30'	LCE (anticyclone)
6	SE-5	27° 30'	86° 00'	LCE (anticyclone)
7	B252	28° 30'	87° 30'	Common Water
8	B081	28° 30'	88° 00'	Common Water
9	B175	29° 00'	87° 30'	Common Water

Figure 2 - Cruise track of DEEPEND cruise DP03 (30 April – 14 May 2016), with station codes and station order.

3 Operations and Protocols

3.1 Midwater Trawling

Midwater trawling was conducted using a 10-m[2] mouth area MOCNESS (MOC-10 hereafter) unit (Figure 3), leased from OKEANUS Science and Technology (Houma, LA), rigged with six 3-mm mesh nets manufactured for DEEPEND by Sea-Gear Corporation (Melbourne, FL). Each net was fitted with a removable PVC cod end (Figure 4), numbered consecutively to correlate with depth sampled. Sampling was conducted to 1500 m, bottom depth allowing. The first net (Net 0) was fished from the surface to 1500 m, Net 1 from 1500 to 1200 m, Net 2 from 1200 to 1000 m, Net 3 from 1000 to 600 m, Net 4 from 600 to 200 m, and Net 5 from 200 m to the surface (Figure 5) This was the same depth scheme used during the NOAA NRDA Offshore Nekton Sampling and Analysis Program.

Each station was sampled twice, with one deployment centered at solar noon (1000 h -1600 h) and one centered at midnight (2200 h – 0400 h). Ship's speed was kept minimal, between 1 and 2.5 kn. Winch deployment and retrieval speeds (non-zero) ranged from 5-25 m min^{-1}, with 15 m min^{-1} typical. The MOCNESS operator stayed in constant radio contact with the winch operator in order to keep the MOCNESS frame at an optimal angle (between 35-50°).

Figure 3 - 10-m2 MOCNESS (MOC-10) unit being retrieved (left) and deployed (right) on the R/V *Point Sur* during DEEPEND cruise DP03.

Figure 4 - MOC-10 cod ends.

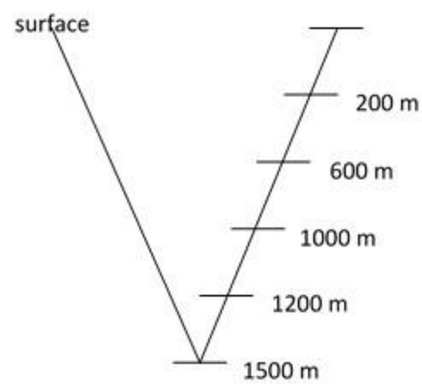


Figure 5 - Depth sampling scheme.

3.2 Near-Surface Sampling

When opportunities arose (e.g., during nighttime CTD casts) neustonic and near-surface organisms were collected via long-handled dipnet for genetic and/or stable isotope analyses.

3.3 IACUC Permit

All field protocols, fish handling and preservation, and removal of fish tissues were conducted in compliance with Florida Atlantic University IACUC protocol (Protocol #A15-06 Trawl surveys of deep-sea fishes) for the study of vertebrates and adhered to the USA legal requirements.

3.4 Hydroacoustics

Multi-frequency acoustic profiling (38, 70, and 120 kHz) was conducted continuously during all MOC-10 deployments, CTD casts, and bio-optical profiler casts via a pole-mounted transducer (Figure 6). Mechanical and electrical noise associated with operating the MOC-10 reduced the effective range of each echosounder. The 38, 70, and 120 kHz echosounders collected meaningful data to depths of approximately 1000 m, 400 m, and 100 m, respectively. An 18 kHz EK80 echosounder was not operational due to an internal conflict to the data acquisition software that could not be rectified at sea. The acoustics were calibrated using a tungsten sphere at sea following well-established procedures (e.g., Foote et al. 1987).

3.5 CTD Profiling

CTD profiles were conducted using the ship's CTD rosette (Figure 7) at nine stations. The majority of stations were profiled twice, once at dawn and once at dusk, with the remainder being sampled either at dawn or dusk. Maximum profile depths depended on bottom depth and ranged from 1000-1600 m.

3.6 Water Collection

Seawater was collected via CTD-mounted Niskin bottles (twelve 12-L bottles) from four depths, with multiple bottles per depth, and distributed according to the plan shown in Figure 8.

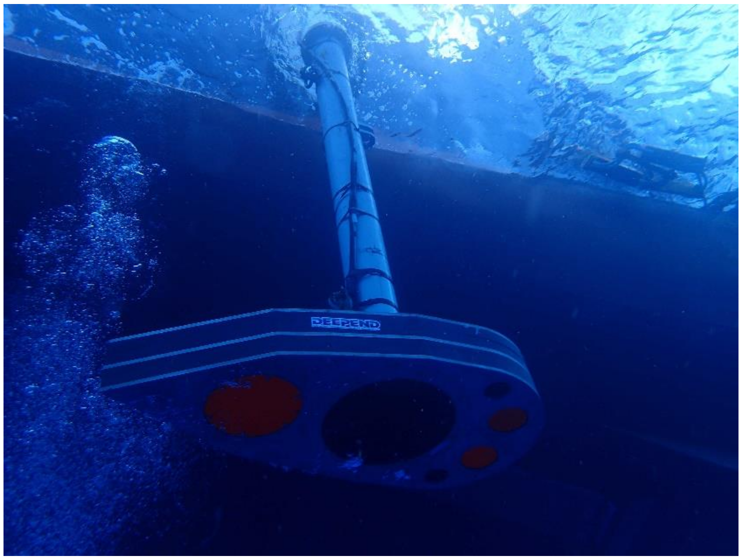


Figure 6 - Hydroacoustics transducer in sensing mode (underwater) on the R/V *Point Sur*.

Figure 7 - R/V *Point Sur* CTD rosette

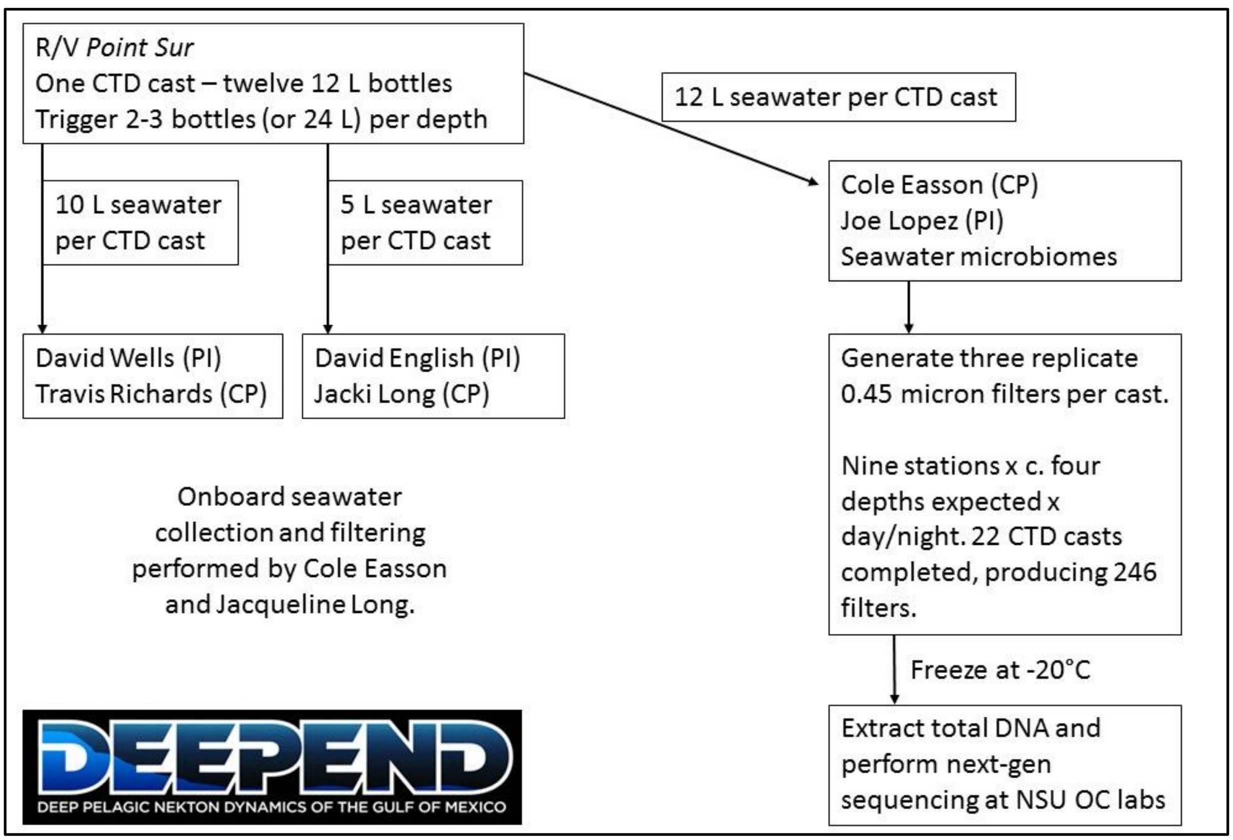


Figure 8 - Distribution and processing of water samples collected during DP03. CP: Cruise Participant; PI: Principle Investigator

3.7 Bio-optical Profiling and Remote Sensing Reflectance Measurement

Water column optical properties were measured with a bio-optical profiler containing a HOBILabs HS6 and 2 WET Labs ECO instruments (Figure 9). Profiles were collected at five stations. The HS6 records depth and the backscattering of light at six wavelengths (420, 442, 470, 532, 590, and 700 nm) at a scattering angle of ~ 140°. The ECO instruments, a WET Labs ECO BBFL2 and an ECO BBSB, were secured to the HS6's instrument cage. The BBFL2 measures backscattering of red light (650 nm) at ~120°, and the stimulated emission of light at wavelengths where chlorophyll_a and dissolved organic material (CDOM) are known to fluoresce. The BBSB measures the backscattering of green light (532 nm), also at ~120°.

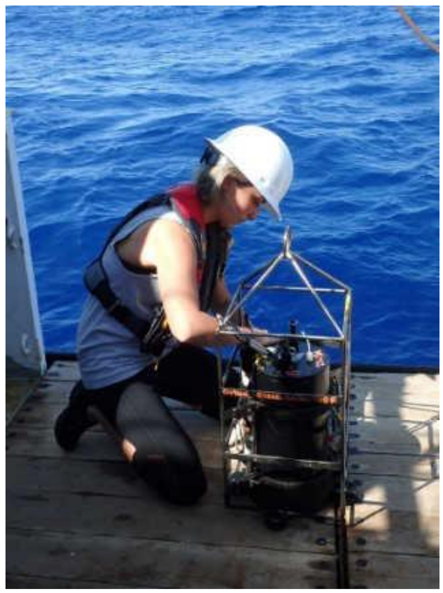


Figure 9 - HS6 bio-optical profiler.

3.8 Sampling on Station

Sampling and sensing operations on station were organized around daytime and nighttime MOC-10 trawling, with these centered on solar noon and midnight, respectively (Table 1). Each MOC-10 deployment took approximately 6 h. MOC-10 sample processing occurred between MOC-10 deployments, as were CTD and bio-optical profiler casts. Transit to the next station generally occurred during the morning interval after day and night MOC-10 deployments at each station. Acoustic profiling was conducted during all hours except during transits, when the transducer boom was raised.

Table 1 - DP03 daily schedule

		1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
		Night MOC; acoustics			CTD		transit				Day MOC; acoustics						CTD		ad hoc (below)				Night MOC; acoustics		
							water filtering												water filtering						
	Institution																								
April Cook	NSUOC				X	X	X	X	X	X							X	X	X	X	X	X			
Christia Hewlett	TAS				X	X	X	X	X	X							X	X	X	X	X	X			
Dante Fenolio	SA Zoo				X	X	X	X	X	X							X	X	X	X	X	X			
Espen Rekdal	SAZ				X	X	X	X	X	X							X	X	X	X	X	X			
Gray Lawson	Okeanus	X	X	X							X	X	X	X	X	X							X	X	X
Heather Bracken-Grissom	FIU				X	X	X	X	X	X							X	X	X	X	X	X			
Jacki Long	USF				X	X	X	X	X	X							X	X	X	X	X	X			
Joe Warren	SBU	X	X	X							X	X	X	X	X	X							X	X	X
Jon Moore	FAU				X	X	X	X	X	X							X	X	X	X	X	X			
Kevin Boswell	FIU	X	X	X							X	X	X	X	X	X							X	X	X
Max Weber	TAMUG				X	X	X	X	X	X							X	X	X	X	X	X			
Mike Vecchione	SI				X	X	X	X	X	X							X	X	X	X	X	X			
Tammy Frank	NSUOC				X	X	X	X	X	X							X	X	X	X	X	X			
Tracey Sutton	NSUOC				X	X	X	X	X	X							X	X	X	X	X	X			
Travis Richards	TAMUG				X	X	X	X	X	X							X	X	X	X	X	X			
Cole Easson	NSUOC				X	X	X	X	X	X							X	X	X	X	X	X			
																			ad hoc sampling						
																			Tucker trawl						
																			acoustic profiling						
																			additional water						
																			optical profiling (done during daylight)						
																			glider pick up at end of cruise						

4 Sample Processing Protocol

4.1 Microbial genomics samples

Carboys were rinsed with Millipore or DOI water and rinsed with the sample water from Niskin bottle. Water from CTD rosette Niskin bottles was then drawn into the clean carboy using a sterilized tube. In the ship's lab, sterilized forceps were used to place PALL GN-6 0.45-um filter onto a filtration rig. Seawater was filtered at each station with a 1.1 cfm/25.5" Hg-60psi/115V vacuum pump at low pressure. Triplicate filters were generated at each depth, and then stored at -20°C for future molecular processing.

4.2 Nekton, micronekton, and macroplankton samples

Upon MOC-10 recovery, individual nets were washed down with seawater to assure all collected organisms were concentrated in the cod ends. Cod ends were disconnected from the net one at a time and the contents were poured/washed into 6-L Nalgene bottles filled with pre-chilled seawater. Each Nalgene was numbered to correspond with the net from which samples were collected.

Nalgene bottles were taken inside the ship's lab as they were washed down and stored cold in a refrigeration unit pending processing. Only one sample was processed at a time to prevent cross-sample mixing. "Net 0" (0-1500 m oblique) samples were generally processed first except in cases where live animals suitable for imaging were collected, in which case these samples were processed first. Afterwards, samples were processed in numerical order.

Processing involved the identification, enumeration, weighing (when possible) and measurement of all fish, macrocrustacean, and cephalopod specimens. Once a sample was completely subsampled, then the entire remaining sample was fixed in 10% buffered formalin (v/v formalin:seawater). A running tally was kept of specimens collected for all analyses. In the individual project reports that follow, only data for those portions of samples that were taken for genetic or biochemical analyses are included. The remaining data will be presented after complete laboratory sample work-up.
Tissues or whole samples were taken of each taxon according to a pre-determined protocol. Sample processing for genetic analyses was as follows:

1) for fishes lateral muscle tissue was dissected from the specimens' right side and then stored in 95% non-denatured alcohol;
2) for macrocrustaceans whole specimens were stored in RNALater and frozen;
3) for pteropods whole specimens were stored in 100% isopropanol; and
4) for cephalopods tissue samples were stored in RNALater.

Fish specimens from which tissue was taken (i.e. vouchers) were individually marked with a paired tag matching that of the tissue sample and fixed in formalin.

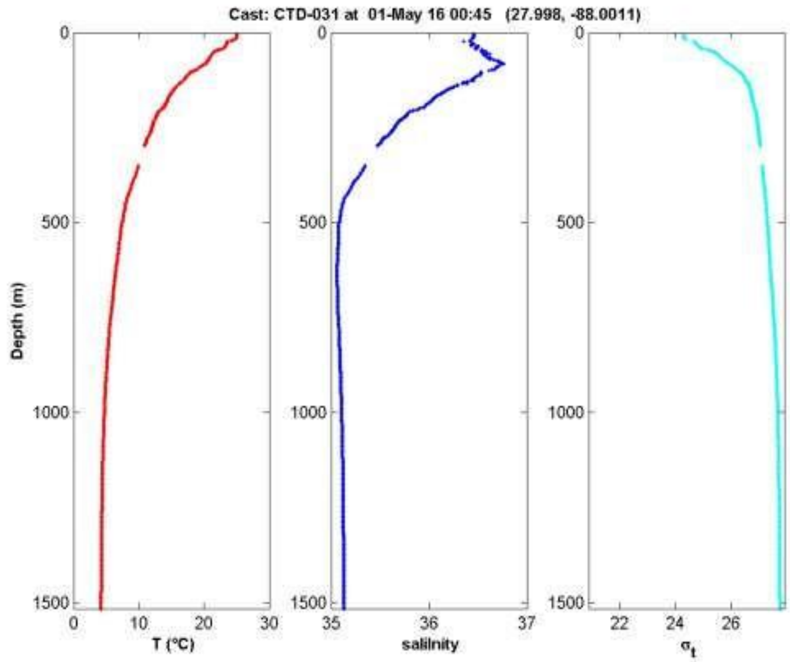
For stable isotope (SIA), otolith microchemistry (OM), mercury (Hg), and polycyclic aromatic hydrocarbon (PAH) analyses whole specimens and/or tissue samples were frozen at -20°C. Prior to PAH sample collection, reusable 20-ml VOA vials were washed with water and detergent, rinsed three times with deionized water then combusted in an oven at 450°C for 4-5 hours. Aluminum foil was combusted as well in an oven at 450°C for 4-5 hours and used to cover the inside of each VOA vial plastic cap. Samples were deposited in each vial and then frozen. Prior to lipid extraction (i.e. PAHs) samples will be freeze-dried. Lipid extraction of freeze-dried samples will be conducted under high temperature (100°C) and pressure (1500 psi) with a solvent mixture 9:1 v:v cyclohexane : dichloromethane using an Accelerated Solvent Extraction system (ASE 2001, Dionex) following modified EPA methods. Specimens for the remaining analyses (SIA, OM, Hg) were individually bagged and frozen with the corresponding sample labels.

4.3 Water Column Structure at the Stations

Detailed hydrographic analyses are currently ongoing, but the predominant mesoscale oceanographic feature during DEEPEND cruise DP03, as in DP01 and DP02, was a large anticyclonic Loop Current eddy (LCE) in the southcentral portion of the DEEPEND sample grid. This feature was manifest in a positive sea-surface height anomaly (Figure 1). An additional, smaller-scale feature was a cyclonic eddy located in the center of the sampling grid, just north of the Loop Current eddy intrusion (Figure 1 and Figure 2). This feature was manifest in a negative sea-surface height anomaly.

Hydrographic structure at depth via analysis of CTD and MOC-10 sensor data for each station is presented in Figure 10 - Figure 18. Depths of the chlorophyll maximum varied from 50 m to 100 m.

(a)



(b)

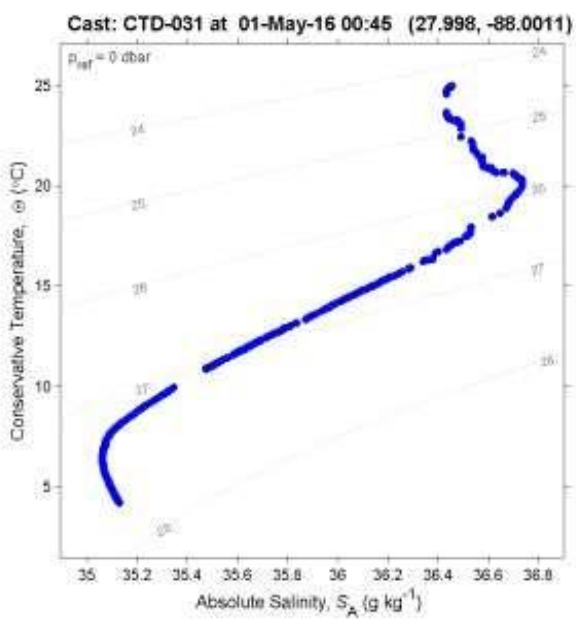
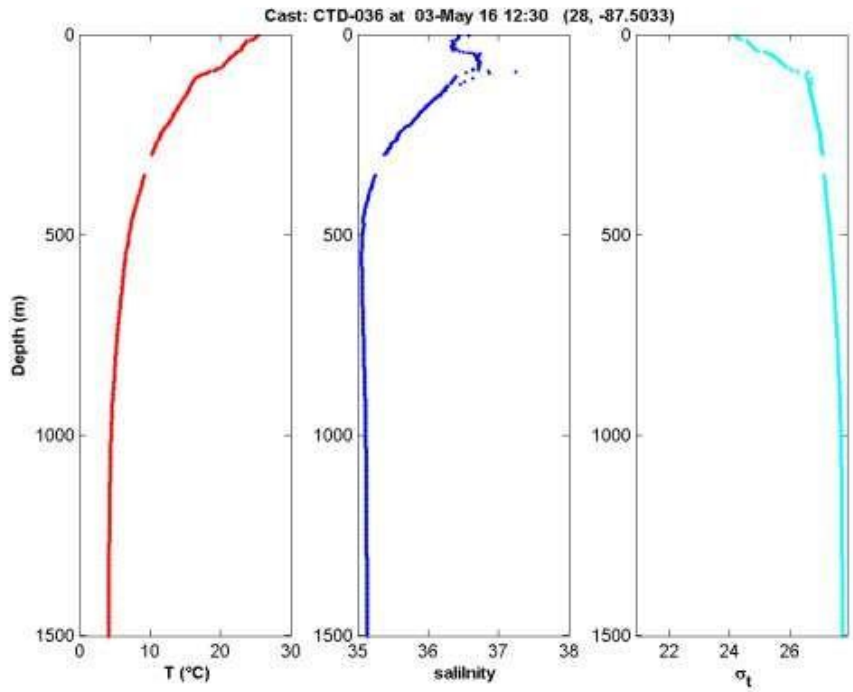


Figure 10 - CTD temperature and salinity data from cast CTD-031 at Station 1 (B082, morning). a) Full-depth CTD temperature, salinity, and density profiles; b) temperature vs. salinity plot. The measured values at some depths were removed due to inconsistent values or excessive instrument noise.

(a)



(b)

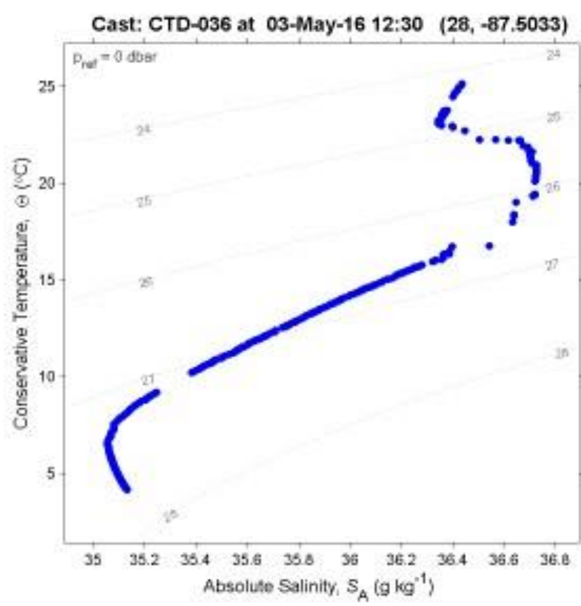
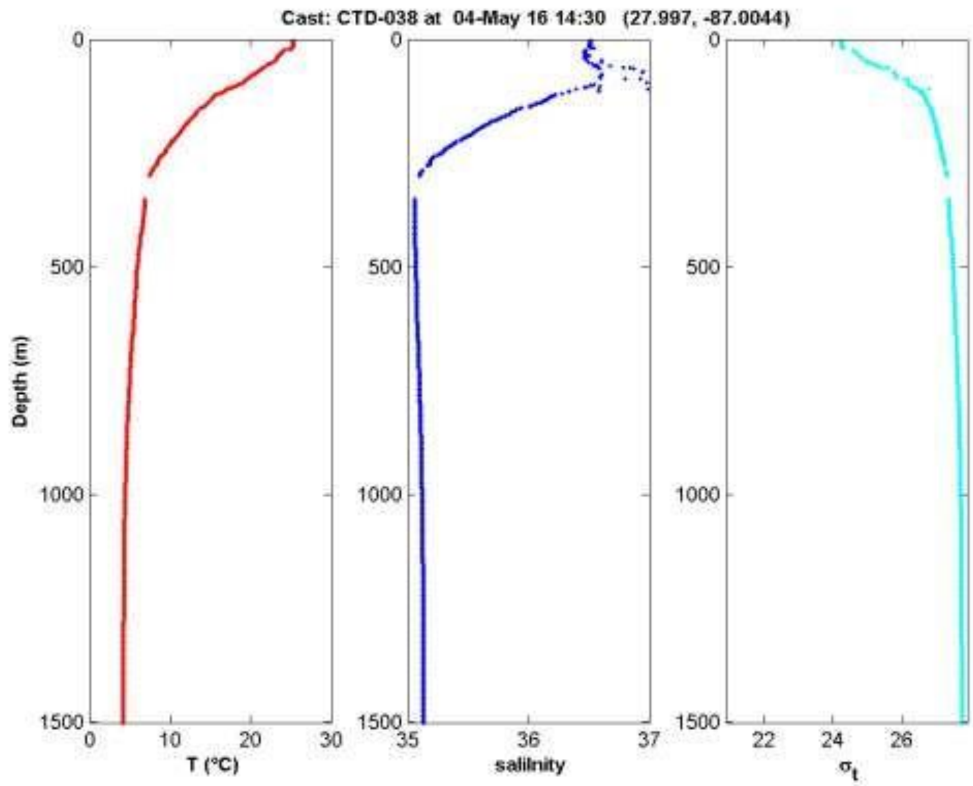


Figure 11 - CTD temperature and salinity data from cast CTD-035 at Station 2 (B287, morning). a) Full-depth CTD temperature, salinity, and density profiles; b) temperature vs. salinity plot.

(a)



(b)

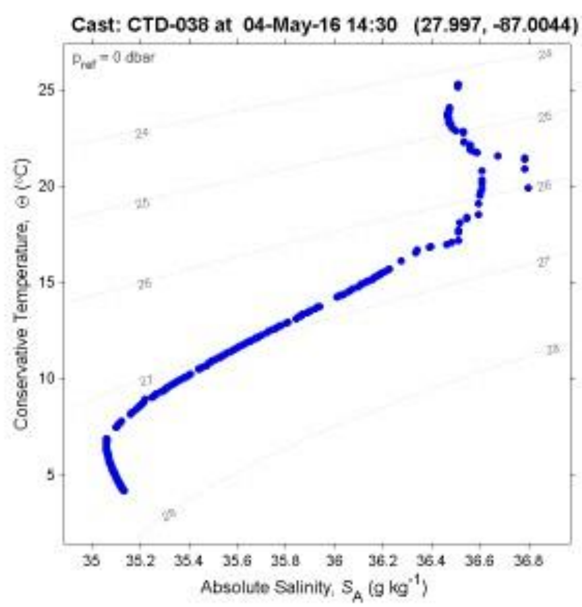
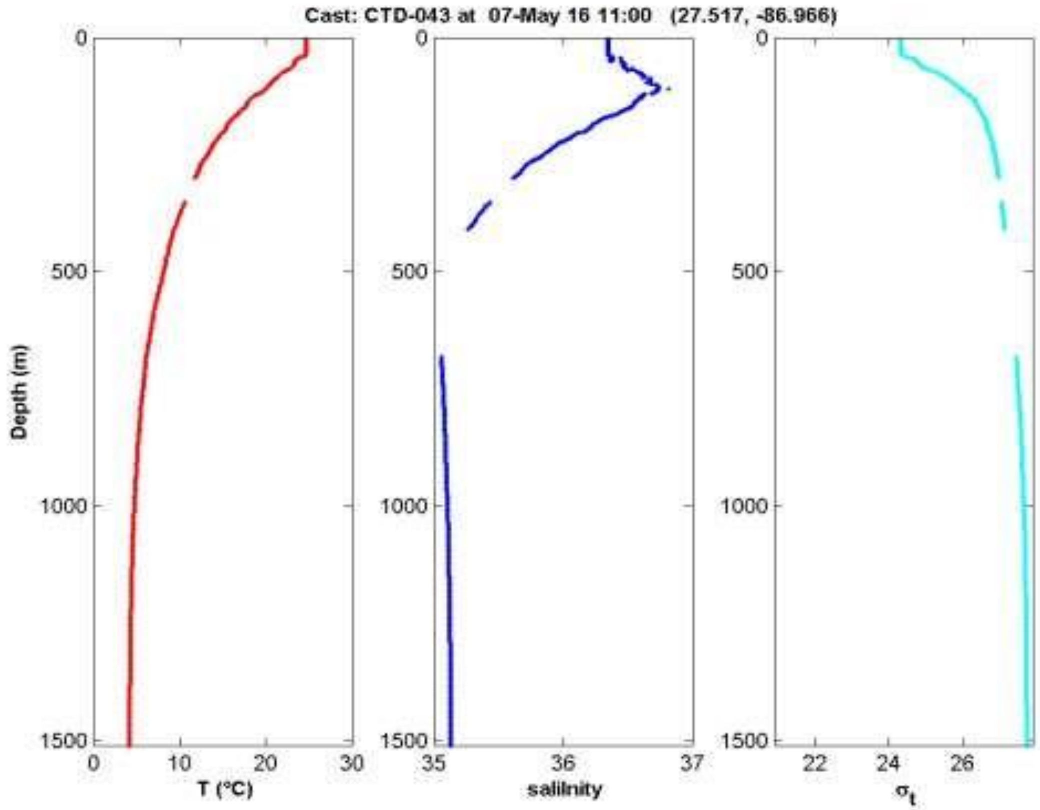


Figure 12 - CTD temperature and salinity data from cast CTD-038 at Station 3 (B003, morning). a) Full-depth CTD temperature, salinity, and density profiles; b) temperature vs. salinity plot.

(a)



(b)

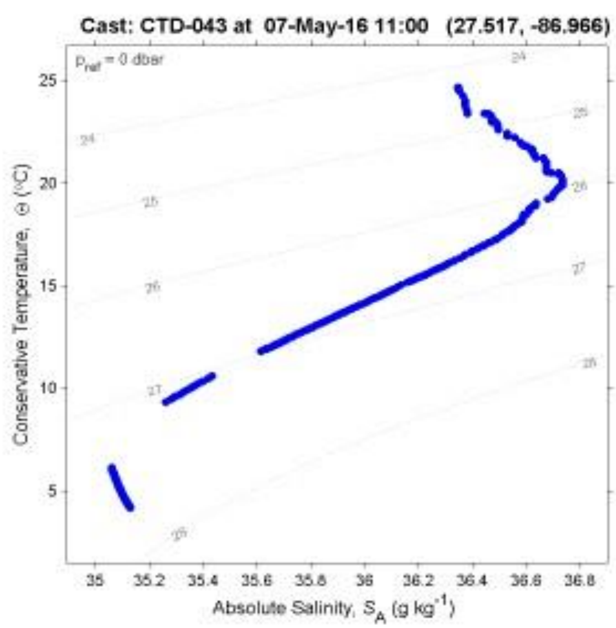
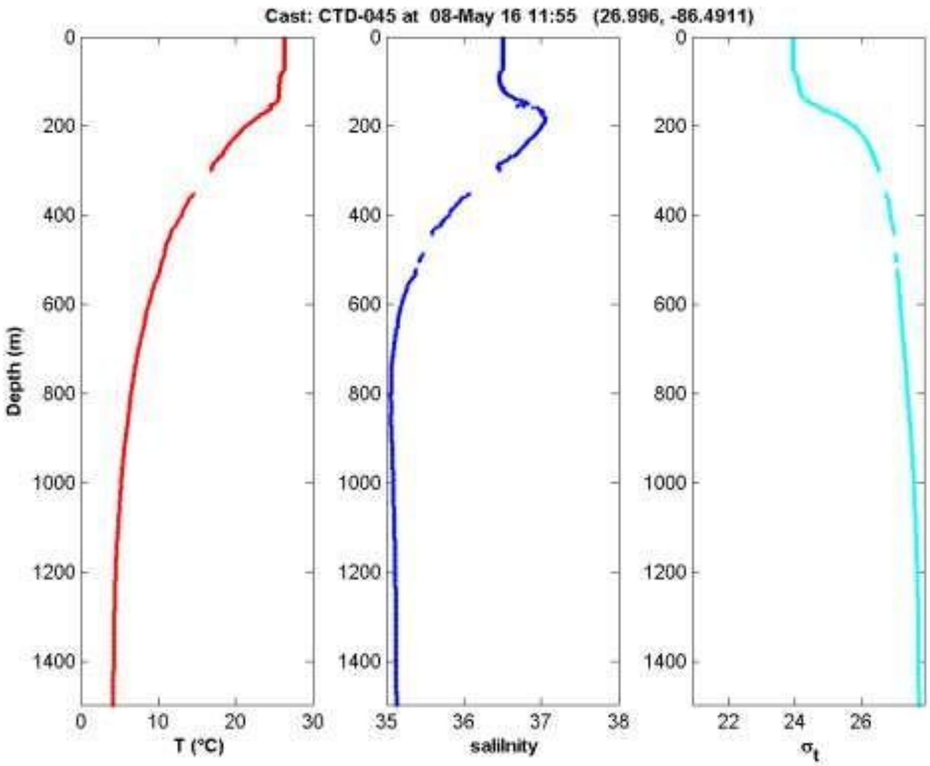


Figure 13 - CTD temperature and salinity data from cast CTD-040 at Station 4 (B079, morning). a) Full-depth CTD temperature, salinity, and density profiles; b) temperature vs. salinity plot.

(a)



(b)

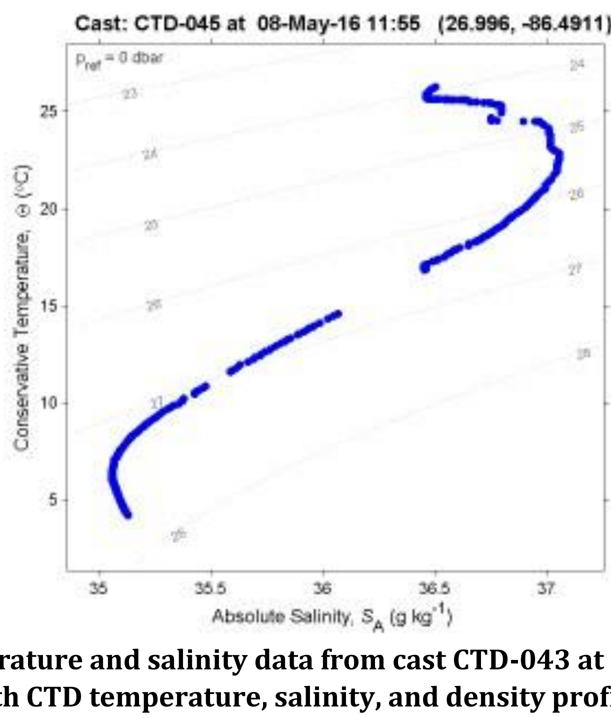
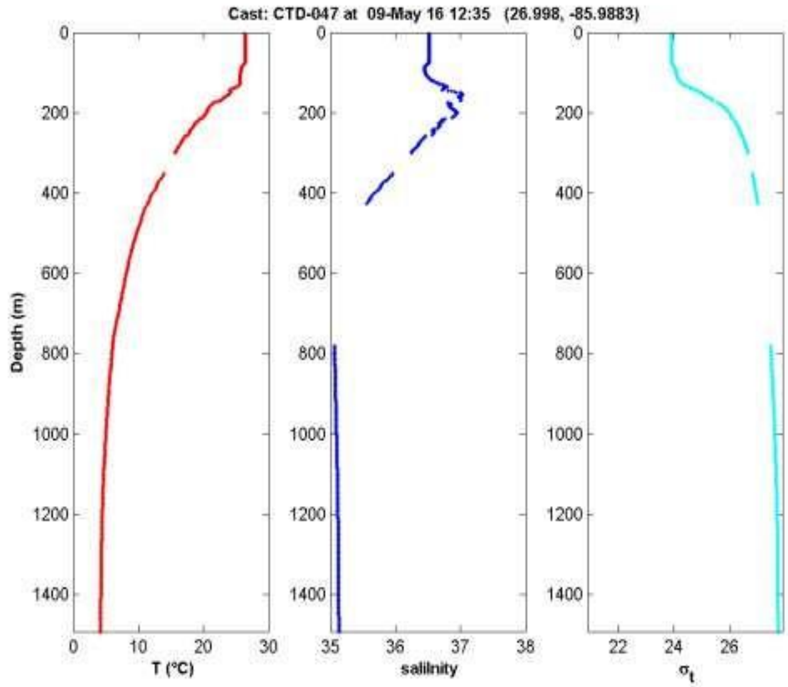


Figure 14 - CTD temperature and salinity data from cast CTD-043 at Station 5 (SE-4, morning). a) Full-depth CTD temperature, salinity, and density profiles; b) temperature vs. salinity plot.

(a)



(b)

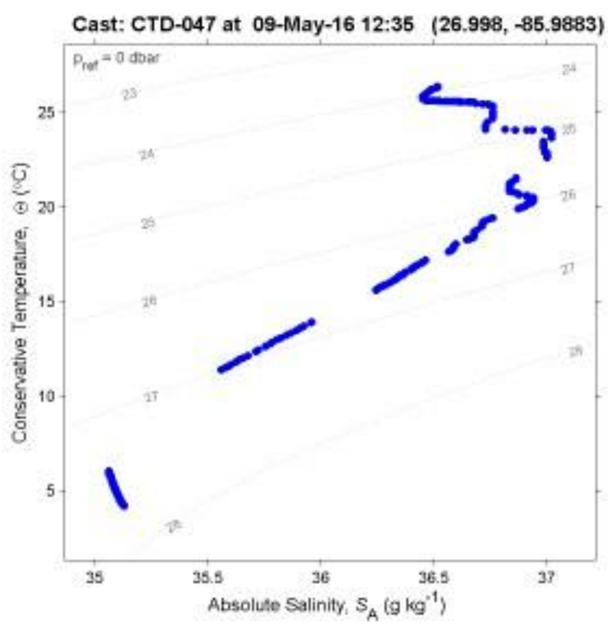
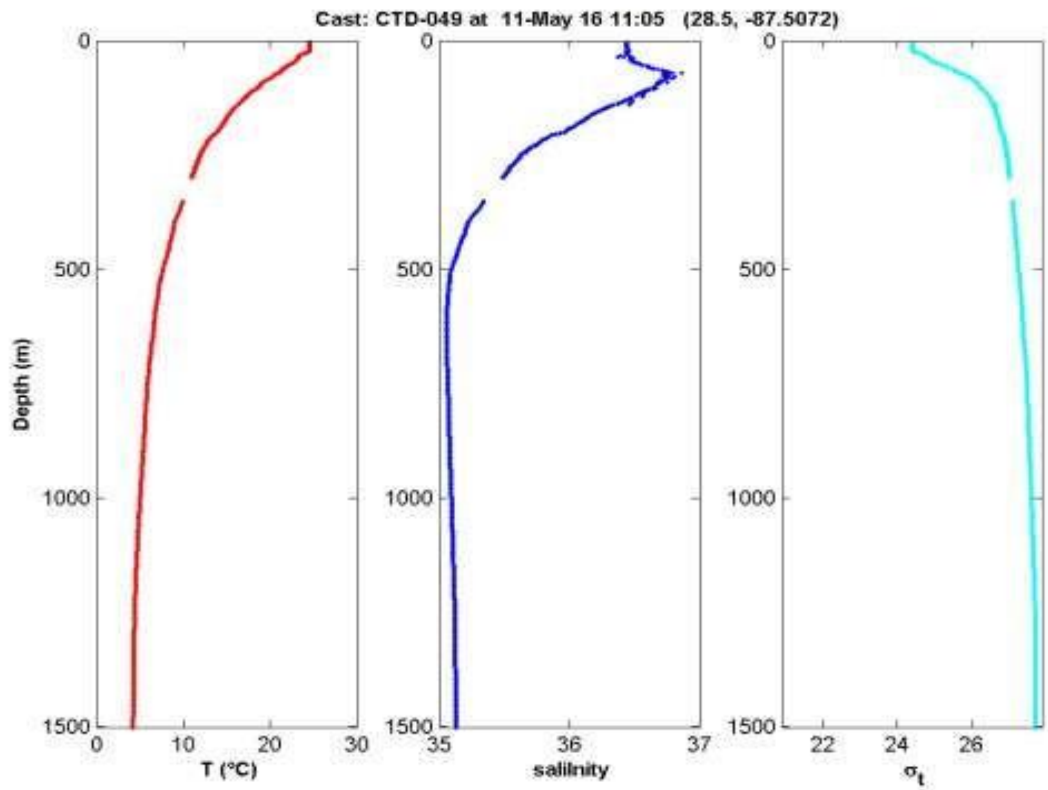


Figure 15 - CTD temperature and salinity data from cast CTD-045 at Station 6 (SE-5, morning). a) Full-depth CTD temperature, salinity, and density profiles; b) temperature vs. salinity plot.

(a)



(b)

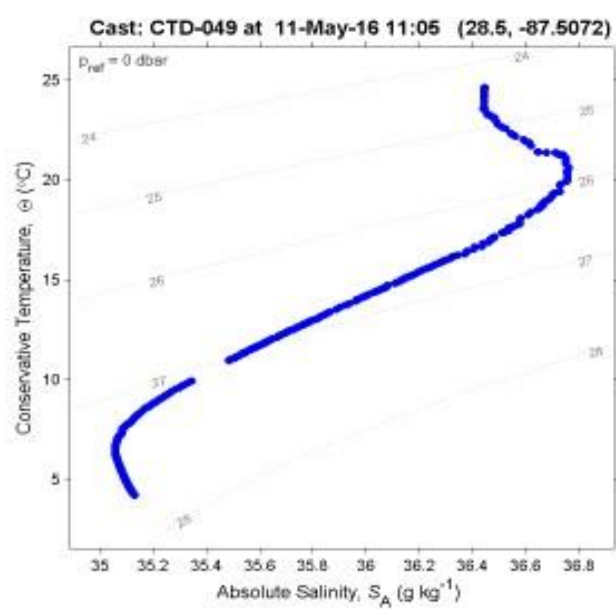
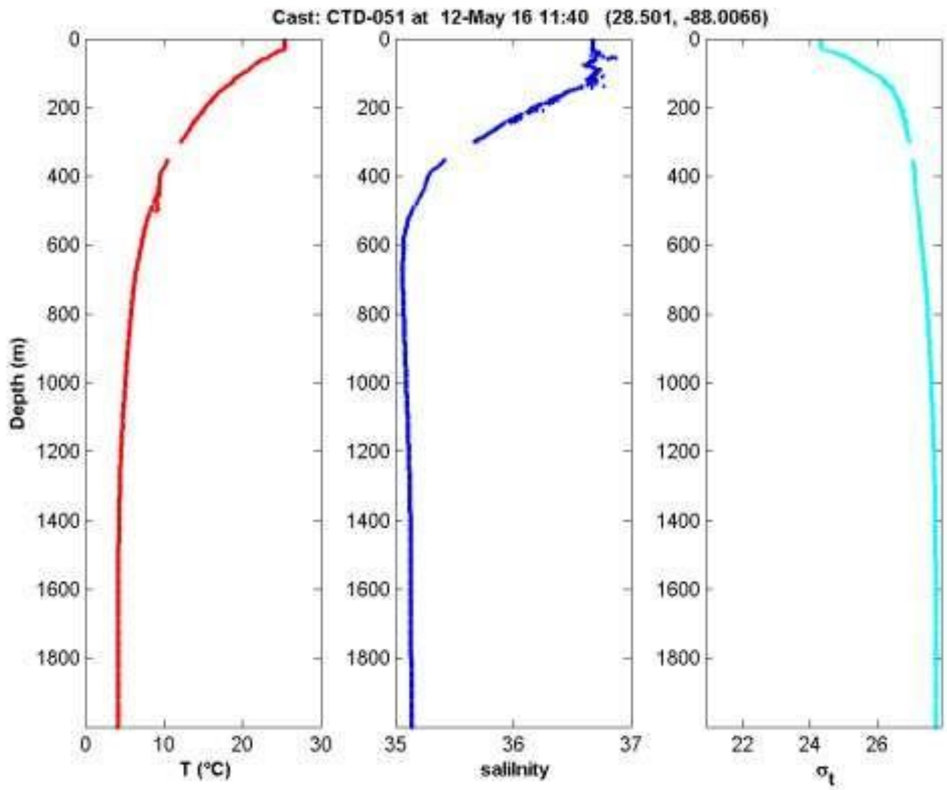


Figure 16 - CTD temperature and salinity data from cast CTD-047 at Station 7 (B252, morning). a) Full-depth CTD temperature, salinity, and density profiles; b) temperature vs. salinity plot.

(a)



(b)

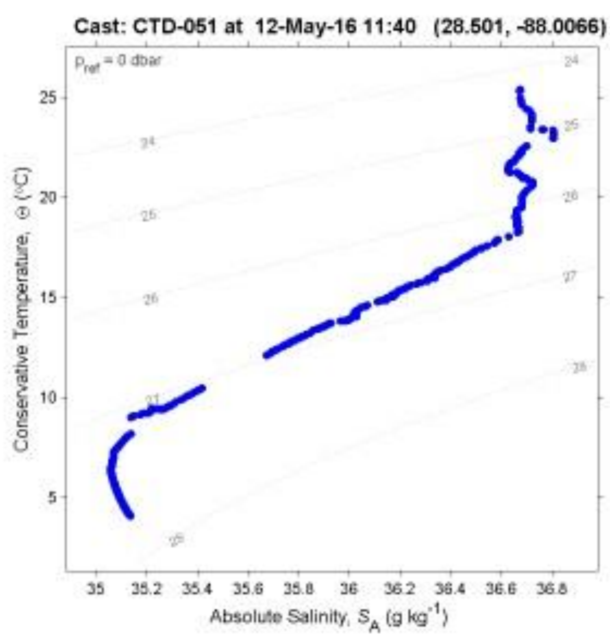
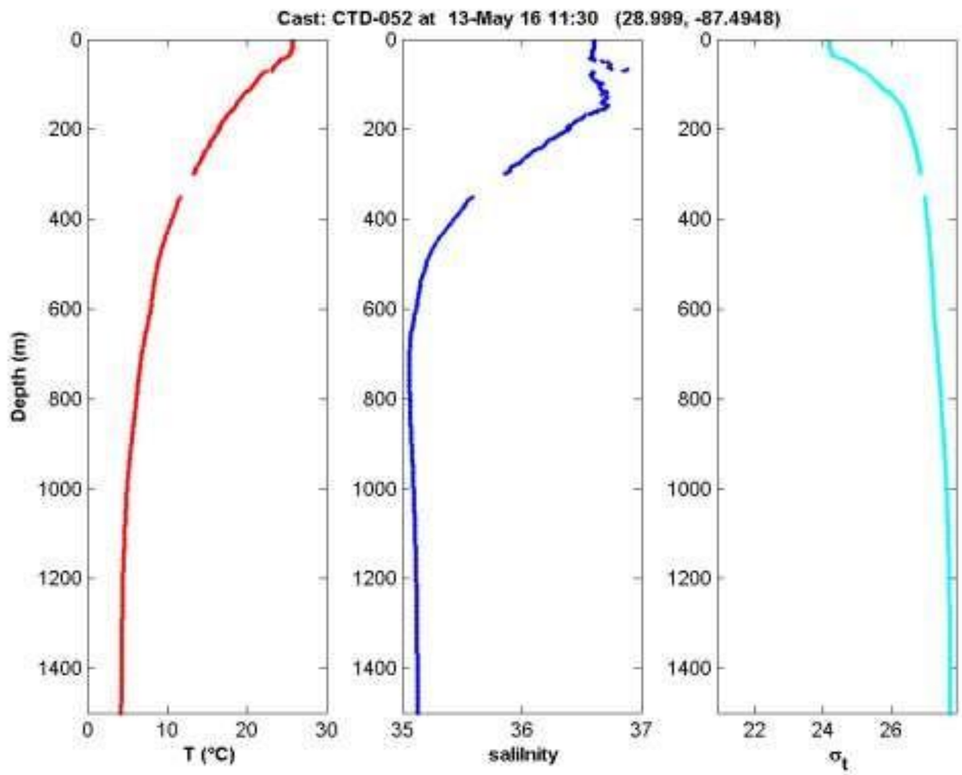


Figure 17 - CTD temperature and salinity data from cast CTD-049 at Station 8 (B081, morning). a) Full-depth CTD temperature, salinity, and density profiles; b) temperature vs. salinity plot.

(a)



(b)

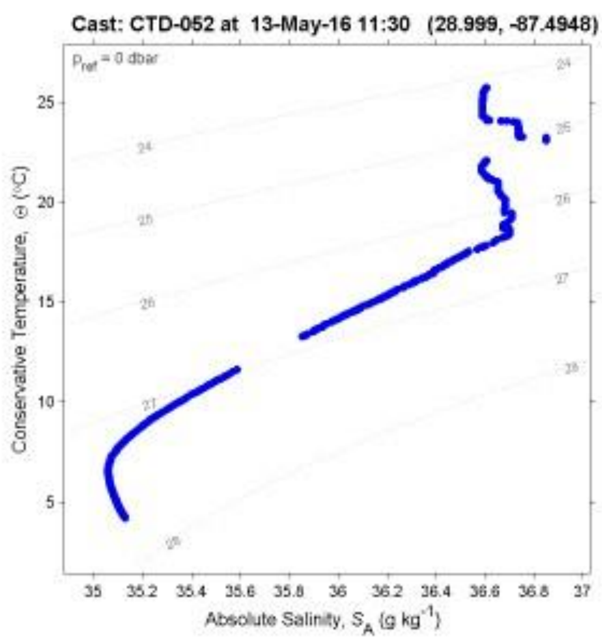


Figure 18 - CTD temperature and salinity data from cast CTD-051 at Station 9 (B175, morning). a) Full-depth CTD temperature, salinity, and density profiles; b) temperature vs. salinity plot.

5 Individual Project Reports

5.1 MOCNESS Sampling

A total of 126 trawl samples were collected during 21 deployments (Table 2; Figure 19). Of these, 75 samples were considered 'quantitative,' having met the criteria of: 1) proper opening and closing at prescribed depths; 2) proper flowmeter (volume) readings; 3) proper net behavior (mouth angle, net speed) during deployment; and 4) no signs of mechanical failure (tears, holes). These samples combined for a cumulative total of ~4.5 million cubic meters of water filtered. There were 21 "Net 0" samples that fished from the surface to max depth, which we classified as "non-standard," though flow data were taken. The remaining samples fished non-standard depth strata, had flow meter validation errors, or suffered mechanical problems. Specimens for genetic and biochemical analyses (see below) were taken from all trawls.

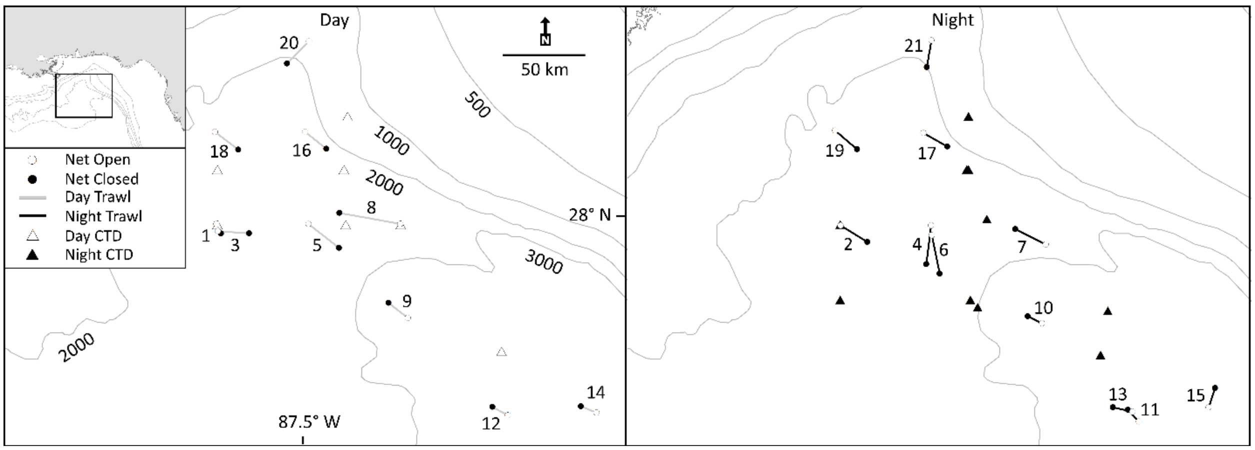


Figure 19 - DEEPEND cruise DP03 MOC-10 trawl locations and trajectories.

5.2 Faunal Accounts

3.2.1. Crustacea

Approximately 6000 nektonic crustaceans were sampled, sorted and preserved from nets 1-5 in various fixatives (e.g. Figure 20). A total of 473 crustaceans (including samples collected from net 0) were identified to species and preserved in RNA later for studies of population connectivity and barcoding. These included one odd oplophorid that shared characteristics of both *Ephyrina* and *Meningodora*, and several *Sergia* with photophore patterns that do not match any key.

Approximately 5500 crustaceans were identified to genus and stored in 10% formalin for species identification back in the laboratory. The remaining crustaceans were kept for genetic, stable isotope, and PAH analyses.

Table 2. MOC-10 trawl deployment times and locations during DP03

Station No.	Station ID	Start Date	Tow Start Time (CDT)	Start Lat.	Start Lon.	End Date	Tow End Time (CDT)	End Lat.	End Lon.
36	B082	05/01/2016	15:20	28.00	-88.01	05/01/2016	17:31	27.95	-87.98
37	B082	05/01/2016	22:13	27.99	-88.00	05/02/2016	03:57	27.91	-87.85
38	B082	05/02/2016	10:34	27.96	-88.00	05/02/2016	16:04	27.95	-87.83
39	B287	05/02/2016	21:49	27.99	-87.50	05/03/2016	04:01	27.78	-87.53
40	B287	05/03/2016	9:54	28.00	-87.50	05/03/2016	15:25	27.87	-87.34
41	B287	05/03/2016	22:26	27.94	-87.50	05/04/2016	05:45	27.73	-87.46
42	B003	05/04/2016	22:11	27.89	-86.88	05/05/2016	03:49	27.98	-87.05
43	B003	05/05/2016	10:22	28.00	-87.00	05/05/2016	23:10	28.06	-87.34
44	B079	05/06/2016	10:45	27.49	-86.96	05/06/2016	16:25	27.57	-87.07
45	B079	05/06/2016	21:31	27.46	-86.90	05/07/2016	02:53	27.50	-86.98
46	SE-4	05/07/2016	22:05	26.93	-86.37	05/08/2016	03:26	26.99	-86.43
47	SE-4	05/08/2016	10:17	26.96	-86.42	05/08/2016	15:36	27.01	-86.50
48	SE-4	05/08/2016	21:43	26.98	-86.41	05/09/2016	03:05	27.00	-86.51
49	SE-5	05/09/2016	10:05	26.98	-85.93	05/09/2016	14:56	27.01	-86.02
50	SE-5	05/09/2016	20:44	27.00	-85.99	05/10/2016	02:04	27.11	-85.96
51	B252	05/10/2016	21:00	28.50	-87.55	05/11/2016	01:55	28.42	-87.42
52	B252	05/11/2016	10:31	28.51	-87.52	05/11/2016	16:07	28.41	-87.41
53	B081	05/11/2016	22:10	28.51	-88.03	05/12/2016	03:37	28.41	-87.91
54	B081	05/12/2016	10:49	28.51	-88.01	05/12/2016	16:23	28.41	-87.89
55	B175	05/12/2016	22:02	29.00	-87.50	05/13/2016	03:25	28.86	-87.53
56	B175	05/13/2016	9:58	29.00	-87.50	05/13/2016	15:23	28.88	-87.62

Figure 20 - *Notostomus* sp. collected during DEEPEND cruise DP03. Photo by: Tamara Frank

5.2.1 Mollusca

A total of 128 cephalopod specimens, representing at least 34 species in 17 families, were collected, along with numerous pteropod and heteropod specimens, whose analysis is ongoing.

5.2.2 Fishes

A total of 6083 fish specimens were collected from a minimum of 204 species. Analysis is currently ongoing.

5.2.3 Other Invertebrates

Tissue and specimens of several invertebrates were collected for research or exhibit at the National Museum of Natural History, Smithsonian Institution. These included pelagic polychaetes and nemerteans, the nudibranch *Phylliroe*, the jellyfish *Periphylla*, and a large shelled pteropod snail, *Clio recurve* (Table 3 and Table 4).

Table 3 - Tissue samples preserved in RNA Later for the National Museum of Natural History, Smithsonian Institution

Tissue No.	Lowest Taxonomic Identification	Disposition
040M5-018	*Phylliroe*	Allen Collins
041P2-022	Tomopterid	Karen Osborn
043N2-033	Nemertean	Jon Norenberg
051P5-060	Polychaete	Karen Osborn
052M5-063	*Phylliroe*	Allen Collins

Table 4 - Specimens collected for the National Museum of Natural History, Smithsonian Institution

Sample ID	Lowest Taxonomic Identification	Disposition	Comments
DP03-01MAY16-MOC10-B082D-036-N2	*Clio*	Exhibit	1/2 in RNA later, 1/2 in EtOH
DP03-02MAY16-MOC10-B287N-039-N0	*Periphylla*	Allen Collins	
DP03-02MAY16-MOC10-B287D-040-N0	*Periphylla*	Allen Collins	1 in RNA later, 1 in formalin
DP03-03MAY16-MOC10-B287N-041-N2	Tomopterid Polychaete	Karen Osborn	
DP03-05MAY16-MOC10-B003D-043-N1	Nemertean	Jon Norenberg	
DP03-06MAY16-MOC10-B079D-044-N1	Nemertean	Jon Norenberg	
DP03-10MAY16-MOC10-B252N-051-N5	Unid. polychaete	Karen Osborne	
DP03-11MAY16-MOC10-B252D-052-N5	*Phylliroe*	Allen Collins	

The remaining invertebrates other than macrocrustacea (gelantinous zooplankton, chaetognaths, nemerteans, polychaetes, gastropods, etc.) were kept with the original sample and fixed in 10% formalin. These will be processed in detail in lab.

5.3 Genetic/Genomic Analyses

5.3.1 *Pelagic Microbial Assemblages.*

A total of 276 pelagic microbial communities were sampled over the course of the cruise. Four discreet depths were sampled at each station (n=3), and all stations except SE-5 had at least two CTD deployments (Table 5). In addition, seawater microbial samples were collected on four occasions where the CTD was used for targeted acoustic sampling with the "WBAT" sensor. The goal was to sample microbial communities during the daily vertical migration and determine if these migrating organisms have a detectable microbial "signature" or are altering ambient microbial communities via other ecological mechanisms. Nine seawater samples were collected from surface water (~3 meters depth) at 1 hour intervals during the initial transit to station B082. The purpose of these samples was to sample coastal microbial communities to compare with pelagic communities and collect preliminary data on coastal-pelagic connectivity. A total of seven samples of anglerfish esca were obtained from three species for analysis of symbiotic microbial communities that inhabit the esca and are a source of bioluminescence for these host fish. Two species had not previously been collected (*Melanocetus murrayi* and *Ceratias uranoscopus*) but *Cryptopsaras couesii* was collected on previous cruises. Analysis from previously collected samples indicated different primary esca symbionts between the hosts *Cryptopsaras couesii* and a *Melanocetus murrayi* congener, *Melanocetus johnsonii*. The additional host specimens collected during DP03 will help further elucidate the ecology and evolution of this unique symbiotic relationship.

5.3.2 *Crustaceans*

A total of 443 crustacean individuals were collected and preserved in RNAlater for barcoding or population genetic studies (Table 6). Nine species were collected for population genetics (*Acanthephyra purpurea, Acanthephyra stylorostratis, Eucopia sculpticauda, Sergia grandis, Sergia* *robusta, Sergia splendens, Sergia tenuiremis, Stylopandalus richardi, and Systellaspis debilis*) while all others will be used in barcoding studies. A list of all these species and total counts can be found in Table 6.

5.3.3 Miscellaneous Crustacean Larvae

A total of 30 larval crustacean samples were preserved in RNA-later for barcoding, hopefully leading to the identification of the (currently unknown) adults.

5.3.4 Cephalopoda and other Pelagic Mollusca

A total of 33 species of Mollusca were collected for genetic studies, 25 of which were Cephalopoda (Table 7).

5.3.5 Gastropoda (pteropods)

After manual micronekton and nekton sorting, pteropods and heteropods were removed and preserved in ethanol for identification and genetic sequencing. Pteropods were not counted at sea, but total numbers exceeded 1000.

5.3.6 Fishes

A total of 929 fish tissue samples were collected for genetic analysis from 304 species (Table 8). All tissues and voucher specimens were individually matched with paired tissue tags. Those specimens not identified to species level were primarily larval forms (e.g., leptocephalus stage) or males for which no key currently exists (e.g., ceratioid anglerfishes). From the total list of fish species, adequate sample size for barcoding (n = 15) was achieved for four species, which included: *Ceratoscopelus warmingii* (n = 21), *Chauliodus sloani* (n = 31), *Hygophum taaningi* (n =18), and *Sternoptyx pseuduobscura* (n = 20). Esca (lures) were also taken from *Cryptopsaras couesii* (n=3), *Melanocetus murrayi* (n=1), and *Ceratias uranoscopus* (n=2). Following the cruise fish tissue samples were parsed between Eytan's (TAMUG) and Shivji's (NSU OC) labs.

Table 5. Pelagic microbial assemblage samples collected during DEEPEND cruise DP03

Date	Day / Night	Site	Identifier	Depths (m)	Bottle	Replicates
4/30/2016	Night	On-offshore 1	On-offshore 1	0	SW SYS	3
		On-offshore 2	On-offshore 2	0	SW SYS	3
		On-offshore 3	On-offshore 3	0	SW SYS	3
	Night	B082	CTD_031	0	SW SYS	3
				80	12	3
				450	5	3
				1600	1	3
5/1/2016	Day	B082	CTD_032	0	11	3
				450	7	3
				80	10	3
				1600	2	3
	Night	B082	CTD_033	0	12	3
				68	10	3
				377	7	3
				1600	2	3
5/2/2016	Day	B082	CTD_034	1600	1	3

				375	7	3
				50	10	3
				0	12	3
	Night	B287	CTD_035	0	12	3
				56	8	3
				303	5	3
				1500	1	3
5/3/2016	Day	B287	CTD_036	0	11	3
				52	9	3
				283	5	3
				1500	1	3
	Night	B287	CTD_037	274	1	3
				245	2	3
				50	3	3
5/4/2016	Day	B003	CTD_038	0	11	3
				59	8	3
				244	5	3
				1500	4	3
	Night	B003	CTD_039	300	4	3
				300	5	3
				50	6	3
5/5/2016	Day	B003	CTD_040	0	10	3
				64	7	3
				252	4	3
				1500	1	3
	Night	B079	CTD_041	0	10	3
				70	7	3
				237	4	3
				1500	3	3
5/6/2016	Day	B079	CTD_042	0	10	3
				94	7	3
				347	4	3
				1500	2	3
5/7/2016	Day	B079	CTD_043	0	10	3
				86	8	3
				360	5	3
				1500	2	3
	Night	B079	CTD_044	300	4	3
				300	5	3
				50	6	3
5/8/2016	Day	SE4	CTD_045	0	12	3
				105	9	3
				145	7	3

				533	4	3
				1500	1	3
	Night	SE4	CTD_046	300	4	3
				300	5	3
				50	9	3
5/9/2016	Day	SE5	CTD_047	0	12	3
				106	8	3
				511	4	3
				1500	1	3
5/10/2016	-	B252	CTD_048	0	10	3
				64	7	3
				376	4	3
				1500	1	3
5/11/2016	Day	B252	CTD_049	0	10	3
				65	7	3
				360	4	3
				1500	1	3
	Night	B081	CTD_050	0	10	3
				49	7	3
				467	4	3
				1500	1	3
5/12/2016	Day	B081	CTD_051	0	10	3
				53	7	3
				480	4	3
				1500	2	3
5/13/2016	Day	B175	CTD_052	0	10	3
				64	7	3
				485	4	3
				1500	2	3
	Night	B175	CTD_053	0	10	3
				59	7	3
				507	4	3
				1500	1	3

Table 6 - Crustaceans collected on DP03 with total numbers

Species	N
Acanthephyra acutifrons	3
Acanthephyra brevirostris	1
Acanthephyra curtirostris	3
Acanthephyra purpurea	40
Acanthephyra stylorostratis	41
Achelata	1
Amphipoda	9
Bentheogennema intermedia	1
Caridea sp.	1
Cystisoma sp.	2
Decapod spp.	14
Ephyrina benedicti	3
Ephyrina ombango	2
Eucopia sculpticauda	41
Funchalia villosa	2
Gennadas valens	1
Gnathophausia gracilis	1
Gnathophausia ingens	2
Gnathophausia zoea	2
Heterocarpus ensifer	1
Hymenodora	6
Isopoda	2
Janicella spinicauda	1
Lucaya bigelowi	4
Meningodora mollis	1
Meningodora vesca	5
Notostomus elegans	5
Oplophorus gracilirostris	1
Oplophorus spinosus	2
Oplophorus spinosus	1
Oxycephalus clausi	3
Parapasiphae sulcatifrons	3
Pasiphaea merriami	2
Phronima	5
Sergia	2
Sergia grandis	31
Sergia hansjacobi	10
Sergia regalis	5
Sergia robusta	9
Sergia splendens	53

Sergia talismani	3
Sergia tenuiremis	33
Stomatopoda	3
Stylopandalus richardi	40
Systellaspis cristata	2
Systellaspis debilis	36

Table 7. Mollusca collected for genetics studies during DEEPEND cruise DP03

Species	N	Notes
Abralia redfieldi	1	
Abraliopsis atlantica	2	
Bathyteuthis sp.	1	
Bolitaena pygmaea	2	
Cardiapoda placenta	1	
Carinaria lamarcki	2	
Carinarioidea	1	
Chiroteuthis mega	1	
Cranchia scabra	6	
Clio recurva	1	
Corolla spectabilis	1	
Echinoteuthis atlantica	1	
Galiteuthis armata	1	
Grimalditeuthis bonplandi	1	
Helicocranchia pfefferi	2	
Heteroteuthis sp.	1	
Histioteuthis corona	1	
Japetella diaphana	14	
Joubiniteuthis portieri	1	
Mastigoteuthis agassizii	1	
Mastigoteuthis atlantica	1	
Octopoteuthis megaptera	1	
Onychoteuthis cf banksii	1	
Phylliroe sp.	1	
Pteropoda	1	Stored in RNALater
Pterotrachea spp.	6	
Pterygioteuthis gemmata	3	
Pyroteuthis margaritifera	7	
Selenoteuthis scintillans	1	
Spirula spirula	1	
Sthenoteuthis pteropus	1	
Stigmatoteuthis arcturi	1	
Vampyroteuthis infernalis	5	
Walvisteuthis jeremiahi	1	

Table 8 - Fish taxa collected for genetics studies during DEEPEND cruise DP03 with taxon comments

Species/Taxon	N	Comments
Acanthurus sp. (juvenile)	2	
Ahlia egmontis	1	
Alepisaurus ferox	2	
Anoplogaster cornuta	2	
Anthias nicholsi	2	
Anthiinae	1	
Antigonia capros	1	
Antigonia combatia	2	
Apogon sp. juvenile	1	
Argyropelecus aculeatus	10	
Argyropelecus affinis	2	
Argyropelecus gigas	5	
Argyropelecus hemigymnus	1	
Argyropelecus sladeni	1	
Ariosoma anale	1	
Ariosoma balearicum	1	
Aristostomias tittmanni	1	
Aristostomias xenostoma	2	
Astronesthes sp. juvenile	1	
Astronesthes atlanticus	1	
Astronesthes macropogon	1	
Astronesthes micropogon	2	
Astronesthes niger	5	
Astronesthes oligoa	1	
Astronesthes richardsoni	1	
Astronesthes similus	1	
Ataxolepis apus	3	
Avocettina infans	6	
Avocettina infans	1	Damaged
Bathophilus longipinnis	1	
Bathophilus pawneei	1	
Bathophilus proximus	1	
Bathygadus sp. juvenile	1	
Bathylaco nigricans	3	
Bathylagidae	1	
Benthodesmus simonyi	1	
Benthosema suborbitale	2	
Bolinichthys photothorax	8	
Bolinichthys supralateralis	6	
Bonapartia pedaliota	3	

Borostomias sp. juvenile	1	
Borostomias mononema	2	
Brama sp. (juvenile)	8	
Bregmaceros sp. (juvenile)	7	
Bregmaceros atlanticus	5	
Bregmaceros undescribed TS1	7	
Canthigaster sp. (juvenile)	4	
Caranx sp. (juvenile)	1	
Caranx ruber	2	
Caulolatilus sp. (juvenile)	2	
Caulolatilus sp. (juvenile)	1	Jon took a photo with microscope
Centrobranchus nigroocellatus	1	
Centropyge sp. (juvenile)	1	
Centropyge argi	1	
Ceratias uranoscopus	1	Esca was sampled
Ceratias uranoscopus	1	Esca and tissue sampled for Lopez
Ceratoscopelus warmingii	21	
Cetomimidae	1	
Cetomimus sp. TBD	3	
Cetostoma regani	5	
Chauliodus sloani	31	
Cheilopogon exsiliens	1	
Cheilopogon melanurus	1	
Chiasmodon niger complex	6	
Chilorhinus suensonii	3	
Chlorophthalmus agassizi	11	
Coccorella atlantica	4	
Coelorinchus sp. (juvenile)	2	
Conger esculentus	3	
Conger oceanicus	1	
Congridae sp. C	1	
Congridae sp. E	1	
Congridae sp. G	1	
Cryptopsaras couesii	5	
Cryptopsaras couesii	1	Esca sampled for Lopez
Cubiceps pauciradiatus	2	
Cyclothone acclinidens	6	
Cyclothone alba	7	
Cyclothone braueri	4	
Cyclothone obscura	5	
Cyclothone pallida	1	
Cyclothone pseudopallida	5	
Desmodema polystictum	2	

Diaphus anderseni	1	
Diaphus brachycephalus	1	
Diaphus dumerilii	6	
Diaphus effulgens	1	
Diaphus lucidus	8	
Diaphus mollis	4	
Diaphus perspicillatus	3	
Diaphus rafinesquii	3	
Diaphus roei	3	
Diaphus splendidus	11	
Diaphus subtilis	1	
Diaphus taaningi	9	
Diaphus termophilus	4	
Diceratiidae	1	
Dicrolene sp. (juvenile)	3	
Diogenichthys atlanticus	3	
Diplospinus multistriatus	7	
Ditropichthys storeri	3	
Dolicholagus longirostris	6	
Dolichopteryx sp. (juvenile)	1	
Dolichopteryx longipes	2	
Dysalotus alcocki	1	
Dysomma anguillare	1	
Echiostoma barbatum	3	
Echiostoma barbatum	1	BBC video, photo
Eustomias brevibarbatus	1	
Eustomias fissibarbis	1	
Facciolella sp. (juvenile)	1	*Faciolella* sp. Jam3
Fistularia sp. (juvenile)	1	
Foetorepus sp. (juvenile)	2	
Gadella imberbis	2	
Gigantactis gargantua	1	*G. gargantua* group
Gigantactis gracilicauda	1	
Gigantura sp. (juvenile)	5	
Gigantura indica	1	
Gnathophis sp. (juvenile)	1	
Gnathophis sp. (juvenile)	1	*Midlateral melanophore* image
Gnathophis sp. (juvenile)	5	No pigment
Gnathophis sp. (juvenile)	1	Has pigment spots
Gnathophis sp. (juvenile)	1	Is pigmented
Gonichthys cocco	3	
Gonostoma atlanticum	1	
Gymnothorax sp. juvenile	1	*G. conspersus* or *G. kolpos*

Gymnothorax ocellatus	4	
Gymnothorax sp. C FWNA	1	
Helicolenus dactylopterus	2	
Hemanthias aureorubens	4	
Himantolophus spp. (male)	1	
Holocentridae	1	
Holtbyrnia innesi	1	
Hoplunnis macrura	7	
Hoplunnis tenuis	8	
Howella sp. juvenile	2	
Howella atlantica	2	
Hygophum benoiti	1	
Hygophum hygomii	4	
Hygophum macrochir	7	
Hygophum reinhardtii	2	
Hygophum taaningi	18	
Ichthyococcus ovatus	2	
Kaupichthys hyoproroides	4	
Laemonema sp. (juvenile)	1	
Lampadena luminosa	2	
Lampanyctus alatus	1	
Lampanyctus alatus	7	parasite study (Woodstock)
Lampridiformes juvenile	1	
Lepidophanes guentheri	3	
Lepidophanes guentheri	1	parasite study (Woodstock)
Leptochilichthys sp. TBD	2	
Leptostomias bilobatus	2	
Lestidiops affinis	3	
Lestidiops affinis	1	Damaged
Lestrolepis intermedia	1	
Linophrynidae males	11	
Lobianchia dofleini	2	
Lobianchia gemellarii	8	
Luciobrotula corethromycter	1	
Magnisudis atlantica	1	
Malacosteus niger	5	
Margrethia obtusirostra	2	
Maurolicus weitzmani	3	
Melamphaes polylepis	2	
Melamphaes pumilus	1	
Melamphaes simus	12	
Melanocetus spp.	2	
Melanocetus murrayi	2	

Melanolagus bericoides	1	
Melanonus zugmayeri	6	
Mentodus facilis	1	
Moringua edwardsi	7	
Muraenidae	1	Muraenidae sp. 2 JAM
Myctophum affine	9	
Myctophum asperum	1	
Myctophum nitidulum	1	
Myrichthys breviceps	2	
Myrophis punctatus	5	
Nannobrachium achirus	1	
Nannobrachium cuprarium	3	
Nannobrachium lineatum	7	
Nealotus tripes	1	
Nemichthys curvirostris	7	
Neoconger mucronatus	1	
Nettenchelys pygmaea	7	
Nezumia sp. (juvenile)	3	
Notolychnus valdiviae	5	
Notoscopelus caudispinosus	2	
Notoscopelus resplendens	6	
Octopoteuthis megaptera	1	
Omosudis lowii	4	
Omosudis lowii	1	full stomach containing squid
Oneirodes sp. juvenile	1	
Oneirodes carlsbergi	3	
Oneirodes eschrichtii	1	
Oneirodes macrosteus	1	
Ophidiidae	1	
Parabathymyrus oregoni	2	
Paraconger sp. juvenile	4	
Parasudis truculenta	3	
Photocorynus spiniceps	1	
Photonectes dinema	1	
Photonectes margarita	3	
Photostomias goodyeari	1	
Photostomias guernei	9	
Photostylus pycnopterus	1	
Physiculus sp. juvenile	1	
Physiculus fulvus	1	
Platytroctes apus	1	
Pleuronectiformes	1	
Poecilopsetta sp. juvenile	1	

Pollichthys mauli	5	
Polyipnus clarus	5	
Polymixia lowei	8	
Poromitra "Gibbsi" Keene undescribed JM1	4	
Poromitra crassiceps	1	
Poromitra megalops	1	
Promethichthys prometheus	1	
Psenes sp. (juvenile)	2	
Pseudomyrophis frio	1	
Pseudoscopelus scutatus	2	
Rhynchactis sp. TBD	1	
Rhynchactis leptonema	1	
Rhynchoconger flavus	4	
Rhynchoconger gracilior	7	
Rinoctes nasutus	1	
Scombridae	4	
Scopelarchoides danae	1	
Scopelarchus analis	4	
Scopeloberyx opercularis	10	
Scopeloberyx opisthopterus	14	
Scopeloberyx robustus	12	
Scopelogadus mizolepis	3	
Scopelosaurus sp. juvenile	1	
Scopelosaurus mauli	1	
Scorpaenidae	1	
Searsia koefoedi	1	
Serraninae	1	
Serrivomer beanii	1	
Sigmops elongatus	6	
Sphoeroides sp. (juvenile)	1	
Spiniphryne gladisfenae	2	
Stemonosudis bullisi	1	
Stemonosudis intermedia	1	
Stemonosudis rothschildi	1	
Sternoptyx diaphana	14	
Sternoptyx pseudobscura	20	
Sternoptyx pseudobscura	1	material properties analysis (Warren)
Stictorhinus potamius	1	
Stomias affinis	7	
Stomias affinis	1	Had a full stomach
Stomiidae	1	
Stylephorus chordatus	4	

Stylephorus chordatus	1	Espen
Sudis atrox	1	
Synagrops spinosus	6	
Taaningichthys sp. TBD	1	
Taaningichthys bathyphilus	6	
Talismania antillarum	2	
Trachinocephalus myops	1	
Trachipteridae	1	
Trachurus lathami	1	
Uncisudis advena	1	
Uroconger syringinus	7	
Valenciennellus tripunctulatus	3	
Vinciguerria attenuata	2	
Vinciguerria nimbaria	6	
Vinciguerria poweriae	4	
Xenodermichthys copei	1	
Xenolepidichthys dalgleishi	7	
Xenomystax congroides	8	
Zenion hololepis	1	

5.4 Polycyclic Aromatic Hydrocarbon Analysis

A total of 171 samples were collected for PAH analysis. Large fish specimens were dissected at sea and organs/tissues kept separate (guts, liver, muscle, skin, ovaries). Other fish, cephalopod and invertebrate specimens were frozen as whole bodies (Table 9).

Table 9. Specimens collected for PAH analysis on DEEPEND cruise DP03.

Vial No.	Sample	Species	Sample_Type	N
320	DP03-01MAY16-MOC10-B082N-037-N0	*Lampanyctus alatus*	wholebody	12
321	DP03-01MAY16-MOC10-B082N-037-N3	*Cyclothone pallida*	wholebody	1
328	DP03-01MAY16-MOC10-B082N-037-N4	*Argyropelecus hemigymnus*	wholebody	2
327	DP03-01MAY16-MOC10-B082N-037-N4	*Lampanyctus alatus*	wholebody	1
331	DP03-01MAY16-MOC10-B082N-037-N5	*Abralia redfieldi*	wholebody	2
332	DP03-01MAY16-MOC10-B082N-037-N5	*Lampanyctus alatus*	wholebody	5
330	DP03-01MAY16-MOC10-B082N-037-N5	*Lepidophanes guentheri*	wholebody	2
333	DP03-02MAY16-MOC10-B082D-038-N0	*Lepidophanes guentheri*	wholebody	2
334	DP03-02MAY16-MOC10-B082D-038-N0	*Sternoptyx pseudobscura*	gills	1
337	DP03-02MAY16-MOC10-B082D-038-N1	*Notoscopelus resplendens*	wholebody	2
338	DP03-02MAY16-MOC10-B082D-038-N2	*Notoscopelus resplendens*	wholebody	2
339	DP03-02MAY16-MOC10-B082D-038-N3	*Lampanyctus alatus*	wholebody	3
340	DP03-02MAY16-MOC10-B082D-038-N4	*Argyropelecus hemigymnus*	wholebody	5
341	DP03-02MAY16-MOC10-B082D-038-N4	*Lampanyctus alatus*	wholebody	2
342	DP03-02MAY16-MOC10-B287N-039-N2	*Cyclothone obscura*	wholebody	4
343	DP03-02MAY16-MOC10-B287N-039-N4	*Argyropelecus hemigymnus*	wholebody	4
344	DP03-02MAY16-MOC10-B287N-039-N4	*Sternoptyx diaphana*	heart	1
349	DP03-03MAY16-MOC10-B287D-040-N0	*Lepidophanes guentheri*	wholebody	5
350	DP03-03MAY16-MOC10-B287D-040-N0	*Notoscopelus resplendens*	wholebody	3
348	DP03-03MAY16-MOC10-B287D-040-N0	*Pyrosoma atlanticum*	wholebody	5
359	DP03-03MAY16-MOC10-B287D-040-N2	*Cyclothone obscura*	wholebody	3
360	DP03-03MAY16-MOC10-B287D-040-N2	*Cyclothone pallida*	wholebody	2
365	DP03-03MAY16-MOC10-B287D-040-N3	*Lampanyctus alatus*	wholebody	1
364	DP03-03MAY16-MOC10-B287D-040-N3	*Lepidophanes guentheri*	wholebody	1
363	DP03-03MAY16-MOC10-B287D-040-N3	*Notoscopelus resplendens*	wholebody	5
362	DP03-03MAY16-MOC10-B287D-040-N3	*Pyrosoma atlanticum*	wholebody	1
356	DP03-03MAY16-MOC10-B287D-040-N3	*Sigmops elongatus*	heart	1
368	DP03-03MAY16-MOC10-B287N-041-N0	*Argyropelecus hemigymnus*	wholebody	2
369	DP03-03MAY16-MOC10-B287N-041-N0	*Lampanyctus alatus*	wholebody	4
380	DP03-03MAY16-MOC10-B287N-041-N0	*Sternoptyx diaphana*	wholebody	4
370	DP03-03MAY16-MOC10-B287N-041-N0	*Sternoptyx pseudobscura*	wholebody	2
379	DP03-03MAY16-MOC10-B287N-041-N1	*Sternoptyx diaphana*	wholebody	3
382	DP03-03MAY16-MOC10-B287N-041-N4	*Sigmops elongatus*	gills	1
389	DP03-03MAY16-MOC10-B287N-041-N5	*Ceratoscopelus warmingii*	wholebody	3
390	DP03-03MAY16-MOC10-B287N-041-N5	*Lepidophanes guentheri*	wholebody	2
395	DP03-04MAY16-MOC10-B003N-042-N5	*Lampanyctus alatus*	wholebody	10
394	DP03-04MAY16-MOC10-B003N-042-N5	*Notoscopelus resplendens*	wholebody	1
bag	DP03-05MAY16-MOC10-B003D-043-N0	*Histioteuthis corona*		1
398	DP03-06MAY16-MOC10-B079D-044-N0	*Argyropelecus aculeatus*	wholebody	7
481	DP03-06MAY16-MOC10-B079N-045-N0	*Argyropelecus aculeatus*	wholebody	2

451	DP03-06MAY16-MOC10-B079N-045-N0	*Sternoptyx diaphana*	gills	1
431	DP03-06MAY16-MOC10-B079N-045-N0	*Sternoptyx pseudobscura*	wholebody	3
492	DP03-06MAY16-MOC10-B079N-045-N4	*Argyropelecus aculeatus*	wholebody	3
411	DP03-06MAY16-MOC10-B079N-045-N4	*Histioteuthis corona*	wholebody	1
401	DP03-06MAY16-MOC10-B079N-045-N5	*Diaphus dumerilii*	wholebody	3
412	DP03-07MAY16-MOC10-SE-4N-046-N0	*Chauliodus sloani*	gills	1
322	DP03-01MAY16-MOC10-B082N-037-N3	*Cyclothone pallida*	wholebody	1
323	DP03-01MAY16-MOC10-B082N-037-N3	*Cyclothone pallida*	wholebody	1
324	DP03-01MAY16-MOC10-B082N-037-N3	*Cyclothone pallida*	wholebody	1
325	DP03-01MAY16-MOC10-B082N-037-N3	*Cyclothone pallida*	wholebody	1
326	DP03-01MAY16-MOC10-B082N-037-N3	*Cyclothone pallida*	wholebody	1
329	DP03-01MAY16-MOC10-B082N-037-N4	*Argyropelecus hemigymnus*	wholebody	2
335	DP03-02MAY16-MOC10-B082D-038-N0	*Sternoptyx pseudobscura*	heart	1
336	DP03-02MAY16-MOC10-B082D-038-N0	*Sternoptyx pseudobscura*	liver	1
bag	DP03-02MAY16-MOC10-B082D-038-N0	*Sternoptyx pseudobscura*	wholebody	1
345	DP03-02MAY16-MOC10-B287N-039-N4	*Sternoptyx diaphana*	liver	1
355	DP03-02MAY16-MOC10-B287N-039-N4	*Sternoptyx diaphana*	gills	1
356	DP03-02MAY16-MOC10-B287N-039-N4	*Sternoptyx diaphana*	ovary	1
bag	DP03-02MAY16-MOC10-B287N-039-N4	*Sternoptyx diaphana*	wholebody	1
347	DP03-03MAY16-MOC10-B287D-040-N0	*Acanthephyra stylorostrata*	wholebody	8
407	DP03-07MAY16-MOC10-SE-4N-046-N4	*Cyclothone pallida*	wholebody	1
403	DP03-07MAY16-MOC10-SE-4N-046-N4	*Sigmops elongatus*	gills	1
408	DP03-07MAY16-MOC10-SE-4N-046-N5	*Pyrosoma atlanticum*	wholebody	1
413	DP03-08MAY16-MOC10-SE-4D-047-N0	*Histioteuthis corona*	wholebody	1
409	DP03-08MAY16-MOC10-SE-4D-047-N2	*Sternoptyx pseudobscura*	gills	1
414	DP03-08MAY16-MOC10-SE-4D-047-N3	*Cyclothone pallida*	wholebody	8
bag	DP03-08MAY16-MOC10-SE-4D-047-N3	*Sigmops elongatus*		1
417	DP03-09MAY16-MOC10-SE-5D-049-N3	*Japetella diaphana*	wholebody	1
418	DP03-09MAY16-MOC10-SE-5D-049-N4	*Histioteuthis corona*	wholebody	1
463	DP03-09MAY16-MOC10-SE-5N-050-N0	*Onychoteuthis banksii*	wholebody	1
450	DP03-10MAY16-MOC10-B252D-052-N0	*Japetella diaphana*	wholebody	1
420	DP03-10MAY16-MOC10-B252D-052-N0	*Sternoptyx pseudobscura*	gills	1
426	DP03-10MAY16-MOC10-B252D-052-N4	*Benthosema suborbitale*	wholebody	2
445	DP03-10MAY16-MOC10-B252N-051-N0	*Japetella diaphana*	wholebody	1
446	DP03-10MAY16-MOC10-B252N-051-N5	*Argyropelecus hemigymnus*	wholebody	6
434	DP03-10MAY16-MOC10-B252N-051-N5	*Benthosema suborbitale*	wholebody	6
424	DP03-10MAY16-MOC10-B252N-051-N5	*Ceratoscopelus warmingii*	wholebody	9
435	DP03-10MAY16-MOC10-B252N-051-N5	*Lampanyctus alatus*	wholebody	9
436	DP03-10MAY16-MOC10-B252N-051-N5	*Nannobrachium lineatum*	wholebody	1
425	DP03-10MAY16-MOC10-B252N-051-N5	*Notoscopelus resplendens*	wholebody	1
429	DP03-11MAY16-MOC10-B081N-053-N4	*Anoplogaster cornuta*	gills	1
449	DP03-11MAY16-MOC10-B081N-053-N4	*Cyclothone pallida*	wholebody	1
419	DP03-11MAY16-MOC10-B081N-053-N4	*Histioteuthis corona*	wholebody	1
427	DP03-11MAY16-MOC10-B081N-053-N5	*Onychoteuthis banksii*	organs	1
600	DP03-12MAY16-MOC10-B175N-055-N2	*Cyclothone obscura*	wholebody	5
595	DP03-12MAY16-MOC10-B175N-055-N3	*Cyclothone pallida*	wholebody	7
599	DP03-12MAY16-MOC10-B175N-055-N3	*Sternoptyx diaphana*	gills	1
591	DP03-12MAY16-MOC10-B175N-055-N5	*Benthosema suborbitale*	wholebody	5

bag	DP03-12MAY16-MOC10-B175N-055-N5	*Diaphus dumerilii*	wholebody	1
581	DP03-13MAY16-MOC10-B175D-056-N3	*Japetella diaphana*	wholebody	3
357	DP03-03MAY16-MOC10-B287D-040-N3	*Sigmops elongatus*	liver	1
358	DP03-03MAY16-MOC10-B287D-040-N3	*Sigmops elongatus*	gills	1
bag	DP03-03MAY16-MOC10-B287D-040-N3	*Sigmops elongatus*	wholebody	1
354	DP03-03MAY16-MOC10-B287D-040-N3	*Sigmops elongatus*	ovary	1
352	DP03-03MAY16-MOC10-B287D-040-N3	*Sigmops elongatus*	heart	1
353	DP03-03MAY16-MOC10-B287D-040-N3	*Sigmops elongatus*	liver	1
351	DP03-03MAY16-MOC10-B287D-040-N3	*Sigmops elongatus*	gills	1
361	DP03-03MAY16-MOC10-B287D-040-N3	*Sigmops elongatus*	ovary	1
bag	DP03-03MAY16-MOC10-B287D-040-N3	*Sigmops elongatus*	wholebody	1
366	DP03-03MAY16-MOC10-B287N-041-N0	*Acanthephyra curtirostris*	wholebody	2
367	DP03-03MAY16-MOC10-B287N-041-N0	*Acanthephyra stylorostrata*	wholebody	2
378	DP03-03MAY16-MOC10-B287N-041-N2	*Sternoptyx pseudobscura*	wholebody	1
375	DP03-03MAY16-MOC10-B287N-041-N2	*Sternoptyx pseudobscura*	heart	1
376	DP03-03MAY16-MOC10-B287N-041-N2	*Sternoptyx pseudobscura*	liver	1
377	DP03-03MAY16-MOC10-B287N-041-N2	*Sternoptyx pseudobscura*	gills	1
378	DP03-03MAY16-MOC10-B287N-041-N2	*Sternoptyx pseudobscura*	wholebody	1
374	DP03-03MAY16-MOC10-B287N-041-N2	*Sternoptyx pseudobscura*	ovary	1
371	DP03-03MAY16-MOC10-B287N-041-N1	*Sternoptyx diaphana*	gills	1
372	DP03-03MAY16-MOC10-B287N-041-N1	*Sternoptyx diaphana*	heart	1
373	DP03-03MAY16-MOC10-B287N-041-N1	*Sternoptyx diaphana*	liver	1
bag	DP03-03MAY16-MOC10-B287N-041-N1	*Sternoptyx diaphana*	wholebody	1
381	DP03-03MAY16-MOC10-B287N-041-N1	*Sternoptyx diaphana*	ovary	1
383	DP03-03MAY16-MOC10-B287N-041-N4	*Sigmops elongatus*	heart	1
384	DP03-03MAY16-MOC10-B287N-041-N4	*Sigmops elongatus*	liver	1
bag	DP03-03MAY16-MOC10-B287N-041-N4	*Sigmops elongatus*	wholebody	1
385	DP03-03MAY16-MOC10-B287N-041-N4	*Sigmops elongatus*	gills	1
386	DP03-03MAY16-MOC10-B287N-041-N4	*Sigmops elongatus*	heart	1
387	DP03-03MAY16-MOC10-B287N-041-N4	*Sigmops elongatus*	liver	1
bag	DP03-03MAY16-MOC10-B287N-041-N4	*Sigmops elongatus*	wholebody	1
388	DP03-03MAY16-MOC10-B287N-041-N4	*Sigmops elongatus*	ovary	1
391	DP03-03MAY16-MOC10-B287N-041-N5	*Lepidophanes guentheri*	wholebody	2
392	DP03-04MAY16-MOC10-B003N-042-N0	*Acanthephyra curtirostris*	wholebody	1
393	DP03-04MAY16-MOC10-B003N-042-N0	*Acanthephyra stylorostrata*	wholebody	5
396	DP03-04MAY16-MOC10-B003N-042-N5	*Lampanyctus alatus*	wholebody	13
397	DP03-05MAY16-MOC10-B003D-043-N1	*Sigmops elongatus*	wholebody	1
399	DP03-06MAY16-MOC10-B079D-044-N0	*Acanthephyra curtirostris*	wholebody	3
400	DP03-06MAY16-MOC10-B079D-044-N0	*Sergia splendens*	wholebody	8
491	DP03-06MAY16-MOC10-B079N-045-N0	*Acanthephyra curtirostris*	wholebody	2
461	DP03-06MAY16-MOC10-B079N-045-N0	*Sternoptyx diaphana*	liver	1
371	DP03-06MAY16-MOC10-B079N-045-N0	*Sternoptyx diaphana*	heart	1
bag	DP03-06MAY16-MOC10-B079N-045-N0	*Sternoptyx diaphana*	wholebody	1
441	DP03-06MAY16-MOC10-B079N-045-N0	*Sternoptyx diaphana*	ovary	1
482	DP03-06MAY16-MOC10-B079N-045-N0	*Sternoptyx pseudobscura*	wholebody	2
421	DP03-06MAY16-MOC10-B079N-045-N4	*Argyropelecus aculeatus*	gills	1
472	DP03-06MAY16-MOC10-B079N-045-N4	*Argyropelecus aculeatus*	liver	1
462	DP03-06MAY16-MOC10-B079N-045-N4	*Argyropelecus aculeatus*	ovary	1

bag	DP03-06MAY16-MOC10-B079N-045-N4	*Argyropelecus aculeatus*	wholebody	1
452	DP03-06MAY16-MOC10-B079N-045-N5	*Sthenoteuthis pteropus*	mantle	1
402	DP03-07MAY16-MOC10-SE-4N-046-N0	*Acanthephyra acutifrons*	wholebody	3
422	DP03-07MAY16-MOC10-SE-4N-046-N0	*Chauliodus sloani*	heart	1
432	DP03-07MAY16-MOC10-SE-4N-046-N0	*Chauliodus sloani*	liver	1
442	DP03-07MAY16-MOC10-SE-4N-046-N0	*Chauliodus sloani*	muscle	1
404	DP03-07MAY16-MOC10-SE-4N-046-N4	*Sigmops elongatus*	heart	1
405	DP03-07MAY16-MOC10-SE-4N-046-N4	*Sigmops elongatus*	liver	1
bag	DP03-07MAY16-MOC10-SE-4N-046-N4	*Sigmops elongatus*	wholebody	1
406	DP03-07MAY16-MOC10-SE-4N-046-N4	*Sigmops elongatus*	ovary	1
410	DP03-08MAY16-MOC10-SE-4D-047-N2	*Sternoptyx pseudobscura*	heart	1
415	DP03-08MAY16-MOC10-SE-4D-047-N2	*Sternoptyx pseudobscura*	liver	1
bag	DP03-08MAY16-MOC10-SE-4D-047-N2	*Sternoptyx pseudobscura*	wholebody	1
416	DP03-08MAY16-MOC10-SE-4D-047-N2	*Sternoptyx pseudobscura*	ovary	1
423	DP03-09MAY16-MOC10-SE-5D-049-N0	*Acanthephyra purpurea*	wholebody	2
433	DP03-09MAY16-MOC10-SE-5D-049-N0	*Acanthephyra purpurea*	wholebody	1
453	DP03-09MAY16-MOC10-SE-5D-049-N0	*Acanthephyra curtirostris*	wholebody	2
443	DP03-09MAY16-MOC10-SE-5N-050-N0	*Sergia splendens*	wholebody	8
444	DP03-10MAY16-MOC10-B252N-051-N0	*Acanthephyra curtirostris*	wholebody	2
430	DP03-10MAY16-MOC10-B252D-052-N0	*Sternoptyx pseudobscura*	heart	1
440	DP03-10MAY16-MOC10-B252D-052-N0	*Sternoptyx pseudobscura*	liver	1
439	DP03-10MAY16-MOC10-B252D-052-N0	*Sternoptyx pseudobscura*	ovary	1
428	DP03-11MAY16-MOC10-B081N-053-N5	*Onychoteuthis banksii*	head	1
437	DP03-11MAY16-MOC10-B081N-053-N0	*Acanthephyra acutifrons*	head	1
447	DP03-11MAY16-MOC10-B081N-053-N0	*Acanthephyra acutifrons*	tail	1
448	DP03-11MAY16-MOC10-B081N-053-N4	*Anoplogaster cornuta*	heart	1
438	DP03-11MAY16-MOC10-B081N-053-N4	*Anoplogaster cornuta*	liver	1
598	DP03-12MAY16-MOC10-B175N-055-N3	*Sternoptyx diaphana*	heart	1
597	DP03-12MAY16-MOC10-B175N-055-N3	*Sternoptyx diaphana*	liver	1
596	DP03-12MAY16-MOC10-B175N-055-N3	*Sternoptyx diaphana*	ovary	1
bag	DP03-12MAY16-MOC10-B175N-055-N3	*Sternoptyx diaphana*	wholebody	1
bag	DP03-12MAY16-MOC10-B175N-055-N3	*Sternoptyx diaphana*	wholebody	1
592	DP03-12MAY16-MOC10-B175N-055-N5	*Diaphus dumerilii*	gills	1
593	DP03-12MAY16-MOC10-B175N-055-N5	*Diaphus dumerilii*	heart	1
594	DP03-12MAY16-MOC10-B175N-055-N5	*Diaphus dumerilii*	liver	1

5.5 Mercury Analysis

5.5.1 Fishes

A total of 33 species were collected for mercury analysis from 12 families (Table 10).

Table 10. Fish species/taxa collected for mercury studies during DEEPEND cruise DP03.

Species	N
Acanthurus sp. juvenile	3
Argyropelecus aculeatus	5
Argyropelecus hemigymnus	4
Benthosema suborbitale	64
Bothus sp. juvenile	2
Bregmaceros atlanticus	1
Centrobranchus nigroocellatus	1
Ceratoscopelus warmingii	6
Chlorophthalmus agassizi	2
Cyclothone obscura	44
Cyclothone pallida	15
Cyclothone pseudopallida	4
Diaphus dumerilii	26
Diaphus mollis	5
Diogenichthys atlanticus	8
Gonichthys cocco	1
Hygophum macrochir	2
Hygophum taaningi	5
Lampadena luminosa	4
Lampanyctus alatus	17
Lepidophanes guentheri	8
Notolychnus valdiviae	9
Notoscopelus resplendens	5
Scopeloberyx opercularis	2
Sigmops elongatus	15
Stephanolepis hispidus	1
Stephanolepis setifer	7
Sternoptyx diaphana	6
Trachurus lathami	1
Valenciennellus tripunctulatus	14
Vinciguerria nimbaria	10
Vinciguerria poweriae	12
Xenolepidichthys dalgleishi	3

5.6 Stable Isotope Analysis

5.6.1 Crustacea

A total of 229 individuals from families Oplophoridae (*Acanthephyra acutifrons, A. curtirostris, A. purpurea, A. stylorostratis* and *Systellaspis debilis*, Lophogastridae (*Eucopia sculpticauda)*, Euphausiidae (monolobed and bilobed), Sergestidae (*Sergia splendens),* and Pandalidae (*Stylopandalus richardi*) were taken from net 0 and frozen for stable isotope and PAH analyses.

5.6.2 Cephalopoda

Six cephalopod species were frozen for stable isotope analysis, including *Octopoteuthis megaptera* (n =1), *Octopoteuthis* cf. *banksii* (n = 1), *Japatella diaphana* (n = 3), *Sthenoteuthis pteropus* (n=1), *Mastigoteuthis agassizii* (n = 1), and *Stigmatoteuthis arcturi* (n = 1).

5.6.3 Fishes

A total of 44 fish species were collected for stable isotope analysis (Table 11). These species encompass a range of trophic levels, vertical distributions, and vertical migration habits.

Table 11. Fishes collected for stable isotope analysis. N = sample number; VM = vertical migrator or non-migrator; E = epipelagic, M = mesopelagic, B = bathypelagic

Species	N	VM?	Primary habitat
Argyropelecus aculeatus	51	Y	M
Argyropelecus hemigymnus	47	N	M
Avocettina infans	14	Y	M/B
Bathylaco nigricans	1	N	B
Benthosema suborbitale	35	Y	M
Centrobranchus nigroocellatus	2	Y	M
Ceratoscopelus warmingii	9	Y	M/B
Cetostoma regani	1	N	M/B
Chauliodus sloani	2	Y	M/B
Chlorophthalmus agassizi	1	N	E/M
Coccorella atlantica	1	Y	M
Cyclothone alba	3	N	M
Cyclothone obscura	85	N	B
Cyclothone pallida	76	N	M/B
Cyclothone pseudopallida	1	N	M/B
Diaphus dumerilii	22	Y	M
Diaphus lucidus	5	Y	M
Dolicholagus longirostris	4	Y	M
Hoplunnis tenuis	4	N	E (larva)
Hygophum taaningi	4	Y	M
Lampadena luminosa	1	Y	M
Lampanyctus alatus	7	Y	M
Lepidophanes guentheri	12	Y	M
Melamphaes simus	29	Y	M

Melanonus zugmayeri	1	N	M/B
Myctophum affine	9	Y	M
Nannobrachium lineatum	1	Weak	M/B
Nemichthys curvirostris	4	Y	M/B
Notolychnus valdiviae	1	Y	M
Notoscopelus resplendens	1	Y	M/B
Parasudis truculenta	1	N	E (larva)
Pollichthys mauli	13	Y	M
Rhynchoconger flavus	18	N	E (larva)
Scopeloberyx opercularis	6	Y	M/B
Sigmops elongatus	39	Y	M/B
Stephanolepis hispidus	1	N	E (juvenile)
Sternoptyx diaphana	40	Y	M/B
Sternoptyx pseudobscura	9	N	M/B
Stomias affinis	1	Y	M/B
Synagrops spinosus	1	N	E (juvenile)
Uroconger syringinus	1	N	E (larva)
Valenciennellus tripunctulatus	47	Y	M
Vinciguerria nimbaria	1	Y	M
Xenolepidichthys dalgleishi	3	Y	M

5.6.4 Gelatinous Zooplankton.
Two species of gelatinous zooplankton were collected for stable isotope analysis, including the colonial tunicate *Pyrosoma atlanticum* (n = 35) and the coronate cnidarian *Periphylla periphylla* (n = 22).

5.7 Otolith Microchemistry Analysis
5.7.1 Fishes
All fishes frozen for stable isotope analysis (Section 3.6, Table 11) are available for otolith microchemistry analysis.

5.8 Leptocephalus Identification Key
Samples and high-resolution photographs were taken of eel leptocephali (e.g. Figure 21) in support of an ongoing taxonomic identification key revision.

Figure 21 - Image of eel leptocephalus taken during the DEEPEND Leptocephalus Identification Key project.

5.9 Hydroacoustic Data

Over 300 GB of acoustic backscatter data were collected during the DP03 cruise. Four frequency (18, 38, 70, and 120 kHz) Simrad WBT echosounders collected data covering 1500 m (18 kHz), 1000 m (38 kHz) and ~ 400 m (70 and 120 kHz) of the water column (Figure 6). Both narrowband and broadband (at 18 and 70 kHz) data were collected. Data were collected during day and night time MOC10 tows at 10 different stations (B003, B079, B081, B082, B175, B252, B255, B287, SE04, SE05) and during transits between three station pairs (B255 to B252, B079 to SE04, and B003 to B079). Additionally, all four echosounders were calibrated using standard tungsten carbide and copper spheres in both narrowband and broadband (18 and 70 kHz) modes. Data have undergone preliminary quality control inspection. In addition to the echo sounders described above, data were collected with a wideband autonomous echo sounder (Simrad "WBAT") that was deployed on a CTD and descended into the migrating layers at 300 m depth at the following stations (SE04, B003, B287). The autonomous echo sounder was equipped with a 120 and 200 kHz transducer. This system was calibrated continuously with a tungsten carbide sphere suspended below the CTD rosette. Finally, during the WBAT deployment, we also mounted an autonomous downward looking 300kHz acoustic doppler current profiler (ADCP). The ADCP was configured to collect data to measure the velocity of both the water column at depth and also the vertically migrating animals. These two systems provided an incredible view of the targets in the water column at depth, which was not possible from the shipboard echo sounders (Figure 22). During this cruise, we refined the algorithms and display of the acoustic classification approach recently published (D'Elia et al. 2016) and were applied to the data in real time during DP03 (Figure 23).

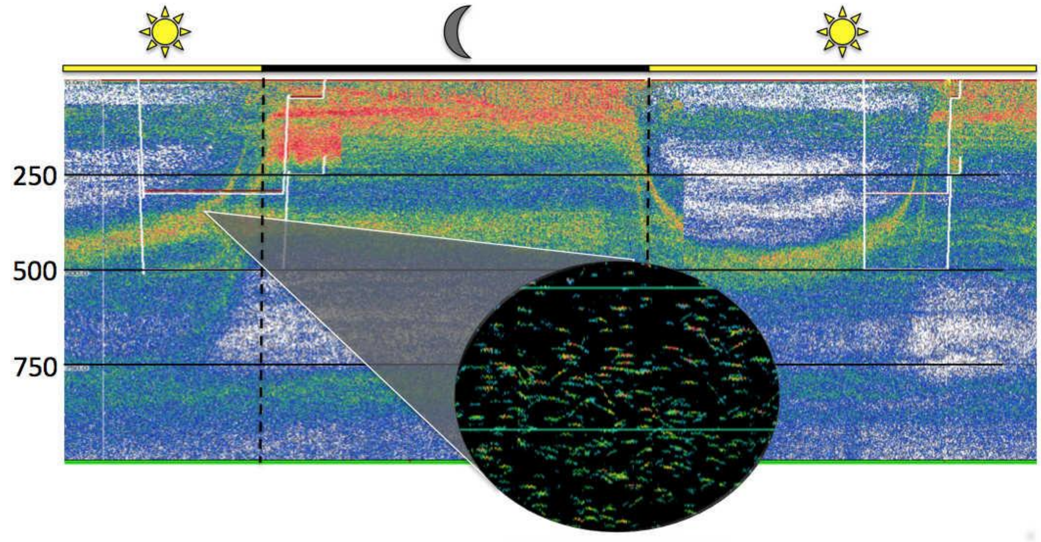


Figure 22 - Example of the mesopelagic layers that move between day and night. The highest density of animals is displayed in red and the lowest density is shown in dark blue. The microscopic view from the SONAR on the CTD shows the individuals that live in these migrating layers.

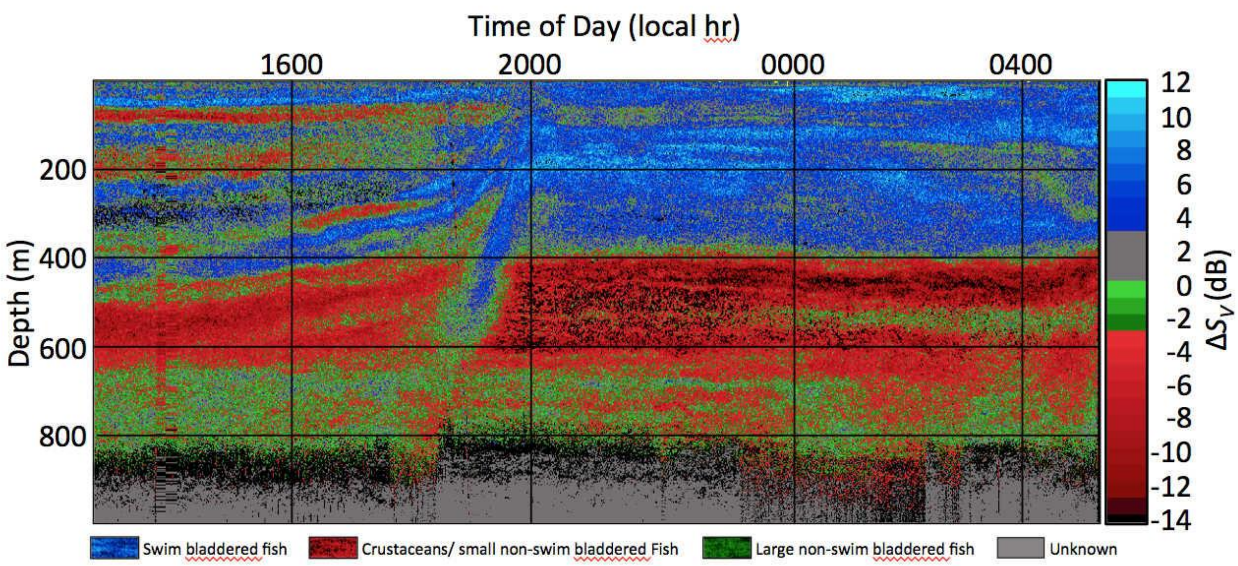


Figure 23 - Echogram illustrating the acoustically derived taxonomic categories used in the analysis.

5.10 Physical Oceanographic Data Collected

Several different types of *in situ* physical oceanographic data were collected during DP03. These data are summarized in Table 12. The data collected from each instrument are described individually in the following sections.

Table 12 - Physical oceanographic sampling efforts during the DEEPEND DP03 cruise. CTD = Conductivity-Temperature-Density rosette casts; HS6 = Fluorometer; Rrs = Remote-Sensing Reflectance

Station	Date & Times near station	CTD	HS6	Rrs
B082	01 May 0200 to 02 May 1400	4	3	2
B087	03 May 0100 to 04 May 0100	3	2	-
B003	04 May 1500 to 06 May 0800	4	3	2
B079	07 May 0100 to 07 May 1400	2	2	1
SE-4	07 May 2000 to 08 May 2200	3	2	1
SE-5	09 May 1200 to 09 May 1400	1	*	-
B252	10 May 2300 to 11 May 1500	2	-	-
B081	12 May 0100 to 12 May 1300	2	-	1
B175	13 May 1200 to 14 May 0500	2	-	1

5.10.1 CTD and Water Samples

The CTD and water sampling rosette was deployed 23 times at nine stations during the DEEPEND DP03 cruise (Table 13).

From these deployments, 43 water samples (Table 14) were collected by the USF-Optical Oceanography Laboratory for determining chlorophyll-a concentration and the spectral absorption due to total particulate material, $a_p(\lambda)$, detrital material, $a_d(\lambda)$, and colored dissolved organic matter, $a_{CDOM}(\lambda)$. Water samples from several sample depths were collected using Niskin bottles on the CTD rosette, or from the ship's flow-through (FT) system. Duplicate samples were collected at select stations (see Table 14).

Both particulate (ap(λ)) and detrital (ad(λ)) absorption spectra were determined following the cruise at a shore-based laboratory using the quantitative filter technique. A custom-built spectroradiometer (~330-880nm, <2 nm resolution) was used for measuring the spectral transmission of total particulate material collected on a glass fiber filter (Whatman's GF/F) relative to a wetted blank. The subsequent extraction of the pigments from the particles captured by the filter followed by re-measurement of both filters allows for the separation between the living (phytoplankton) and non-living (detrital) components of the total particulate material. This pigment extraction technique also allows chlorophyll a to be determined fluorometrically. Thus the same water sample is used for the determination of the ap(λ) and ad(λ) absorption spectra, as well as the chlorophyll a concentration.

Seawater samples, filtered first through a GF/F filter and then through a 0.2-µm polycarbonate filter, were used to determine aCDOM(λ). These filtered samples were stored at 5°C for less than two weeks prior to being measured using a Hitachi U3900H UV/Vis spectrophotometer equipped with 10-cm path length cells and using Milli Q water as a reference. Absorption was measured from 200-800 nm at 0.5nm increments.

Table 13 - CTD rosette deployments during the DEEPEND DP03 cruise

Station	Identifier	Date	Time (UTC)	Latitude (decimal degrees)	Longitude (decimal degrees)	Bottom Depth (m)	Water Sample Depths (m)
B082	CTD_031	30-Apr-16	19:23	27.598	-88.000	2416	1; 53; 363; 1520
B082	CTD_032	01-May-16	08:06	28.005	-88.003	2376	2; 63; 357; 1508
B082	CTD_033	01-May-16	18:42	28.000	-88.001	2383	5; 68; 377; 1500
B082	CTD_034	02-May-16	06:23	28.001	-88.001	2397	2; 50; 370; 1514
B287	CTD_035	02-May-16	18:23	27.597	-87.299	2749	2; 56; 303; 1500
B287	CTD_037	03-May-16	17:09	27.559	-87.251	2824	50; 245; 275
B003	CTD_038	04-May-16	09:10	28.000	-87.000	2855	2; 59; 244;1500
B003	CTD_039	04-May-16	17:27	27.535	-86.541	2853	50; 300
B003	CTD_040	05-May-16	07:00	28.000	-87.000	2852	2; 64; 252; 1503
B003	CTD_041	05-May-16	23:30	28.034	-87.200	2757	2; 70; 1500
B079	CTD_042	06-May-16	18:22	27.296	-86.587	2995	2; 94;347; 1500
B079	CTD_043	07-May-16	05:39	27.311	-86.455	3008	2; 86; 360; 1500
SE-4	CTD_044	07-May-16	17:25	26.590	-86.308	3100	311
SE-4	CTD_045	08-May-16	06:40	26.594	-86.284	3140	2; 145; 533; 1500
SE-4	CTD_046	08-May-16	17:10	26.590	-86.252	3197	2; 111; 300
SE-5	CTD_047	09-May-16	07:17	26.598	-85.594	3282	2; 106; 511; 1500
B252	CTD_048	10-May-16	18:58	28.300	-87.303	2580	2; 64; 376; 1500
B252	CTD_049	11-May-16	05:49	28.303	-87.314	2580	2; 83; 362; 1500
B081	CTD_050	11-May-16	20:19	28.305	-87.313	2268	2; 49; 467; 1500
B081	CTD_051	12-May-16	06:20	28.300	-88.003	2277	2; 53; 480; 1500
B175	CTD_052	13-May-16	06:00	28.590	-87.290	1730	2; 64; 485; 1500
B175	CTD_053	13-May-16	17:30	28.599	-87.301	1744	2; 59; 507; 1500

Table 14 - Summary of chlorophyll and absorption samples collected during DP03

Date & Time (UTC)	Identifier	Station	Latitude (decimal degrees)	Longitude (decimal degrees)	Surface (<5 m)	Deep chlorophyll maxima (~50-110m)	Base of photic zone (~160m)
01-May-16 00:23	CTD_031	B082	27.998	-88.001	X	X	-
01-May-16 13:06	CTD_032	B082	28.009	-88.006	X	X	-
01-May-16 23:42	CTD_033	B082	28.001	-88.002	X	X	-
02-May-16 11:23	CTD_034	B082	28.002	-88.003	X	X	-
02-May-16 23:23	CTD_035	B287	27.996	-87.499	X	X[D]	- X
03-May-16 12:14	CTD_036	B287	28.001	-87.502	X	X	
03-May-16 22:15	CTD_038	B003	28.001	-87.002	X	X	-
04-May-16 14:10	CTD_040	B003	28.000	-87.000	X	X	-
04-May-16 22:27	CTD_041	Between B003 and B287	28.058	-87.334	X[D]	X	-
05-May-16 12:00	CTD_042		27.494	-86.979	X	X[D]	-
06-May-16 04:30	CTD_043	B079	27.519	-86.935	X	X	-
06-May-16 23:23	CTD_045	SE-4	26.991	-86.474	X	- X	-
07-May-16 10:39	CTD_046	SE-4	26.984	-86.421	X		-
07-May-16 22:17	CTD_047	SE-5	26.998	-85.991	X[D]	-	-
08-May-16 11:40	CTD_048	B252	28.500	-87.506	X	X -	-
08-May-16 22:10	CTD_049	B252	28.505	-87.525	X[D]		-
09-May-16 12:17	CTD_050	B081	28.510	-88.024	X	X	-
10-May-16 23:58	CTD_051	B081	28.501	-88.005	X[D]	-	-
11-May-16 10:49	CTD_052	B175	28.983	-87.483	X	X	-
12-May-16 01:20	CTD_053	B175	29.000	-87.503	X	X	-

[D]: duplicates

5.10.2 Bio-optical (HS6) Data

HOBILabs HS6 and two WETlabs scattering/fluorescence instruments were used to vertically-profile the water column to a depth of c. 200 m during 13 deployments at seven stations (Table 15).

Table 15 - The locations and times of HS6 (optical scattering and fluorescence) casts during the DP03 DEEPEND cruise

Station	Data File Identifier	Date & Time (UTC)	Latitude (decimal degrees)	Longitude (decimal degrees)
B082	DP03_HS6001	01-May-16 02:26	28.003	-88.020
B082	DP03_HS6002	01-May-16 14:09	28.027	-88.019
B082	DP03_HS6003	02-May-16 12:49	28.047	-88.046
B287	DP03_HS6004	03-May-16 01:15	27.981	-87.500
B287	DP03_HS6005	03-May-16 13:32	28.001	-87.506
B003	DP03_HS6006	04-May-16 15:38	27.993	-87.004
B003	DP03_HS6007	05-May-16 13:12	28.000	-87.001
Near B003	DP03_HS6008	06-May-16 07:02	28.008	-87.331
B079	DP03_HS6009	07-May-16 01:48	27.463	-86.908
B079	DP03_HS6010	07-May-16 13:23	27.498	-86.874
SE-4	DP03_HS6011	07-May-16 20:41	27.014	-86.567
SE-4	DP03_HS6012	08-May-16 13:38	26.969	-86.430
SE-5	N/A	09-May-16 14:15	26.978	-85.944

Since the optical scattering and fluorescence instruments were powered by internal batteries, each could operate and record its measurements independently, allowing the instrument cage to be profiled without the need for power and communication cables between the instruments and the ship. Data were processed using a combination of the manufacturer's and custom software. The time stamps of each instrument and distinct surface scattering features were used to synchronize the instruments for each cast. Since fluorescence efficiencies vary, the measurements made by the instruments reflect relative fluorescence. By combining these instrument values with discrete water sample measurements we could estimate *in situ* fluorescence, and thus chlorophyll a and CDOM concentrations at depths where discrete water samples were not collected (Figure 24).

Changes in the spectral backscattering shape and slope measured by the HS6 (Figure 24) can be compared to changes in the *in situ* particulates at various depths. Combining the scattering information with the fluorescence measurements allows estimation of the relative amounts of scattering from phytoplankton versus other living and non-living particles. Figure 25 shows vertical profiles of density, chlorophyll a fluorescence and dissolved oxygen from either the HS6 or CTD, from casts made at three DP03 stations.

5.10.3 Remote Sensing Reflectance Data

Remote sensing reflectance (Rrs(λ)) data were collected from the deck of the R/V *Point Sur* 14 times during DP03 (Table 16). These measurements help relate the near surface water samples to the observations made by ocean color satellites. An ASD, Inc. (PANalytical) HandHeld2-Pro spectroradiometer was used to collect Rrs(λ). Figure 24 shows example Rrs(λ) spectra from several DP03 stations. Satellite observations indicate that the surface waters sampled during DP03 had a more limited range of variability compared to the stations sampled during DP02 because, unlike DP02, the DP03 cruise did not encounter a higher chlorophyll plume caused by the Mississippi River.

Table 16 - The locations and times of remote sensing reflectance (RRS(λ)) measurements made during the DP03 DEEPEND cruise

Station	Data file ID	Date & Time (UTC)	Latitude (decimal degrees)	Longitude (decimal degrees)
B082	DP03_Rrs_001	02-May-16 13:21	28.042	-88.041
B082	DP03_Rrs_002	02-May-16 18:50	27.973	-87.906
B003	DP03_Rrs_003	04-May-16 19:10	28.077	-86.998
B003	DP03_Rrs_004	05-May-16 14:20	28.001	-87.012
B079	DP03_Rrs_005	07-May-16 14:36	27.455	-86.825
SE-4	DP03_Rrs_006	08-May-16 18:09	26.983	-86.462
B081	DP03_Rrs_007	12-May-16 16:51	28.492	-87.988
B175	DP03_Rrs_008	13-May-16 13:33	29.018	-87.464

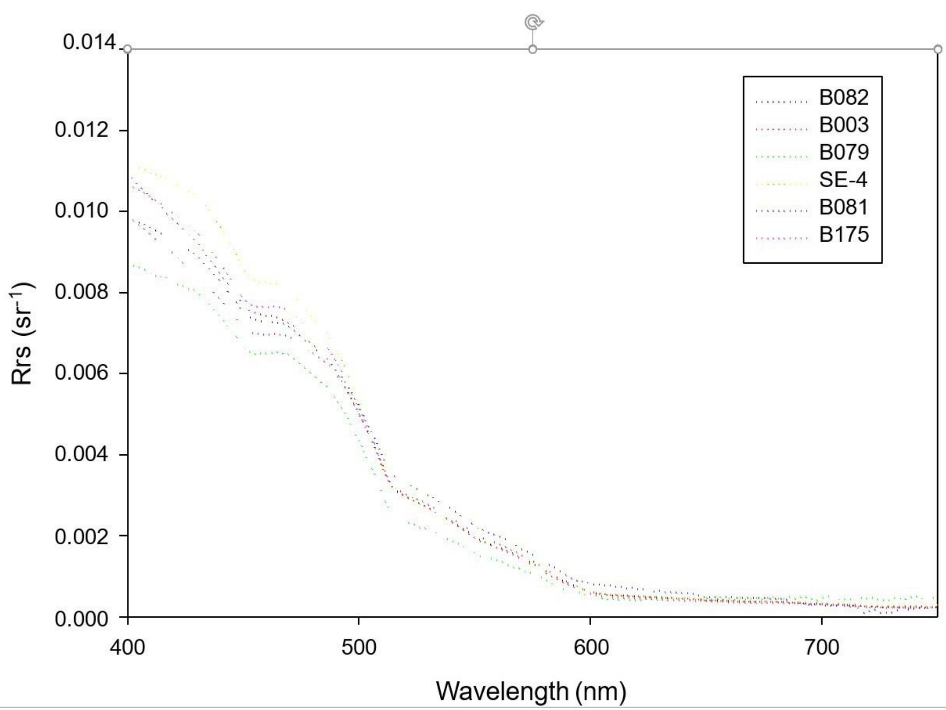
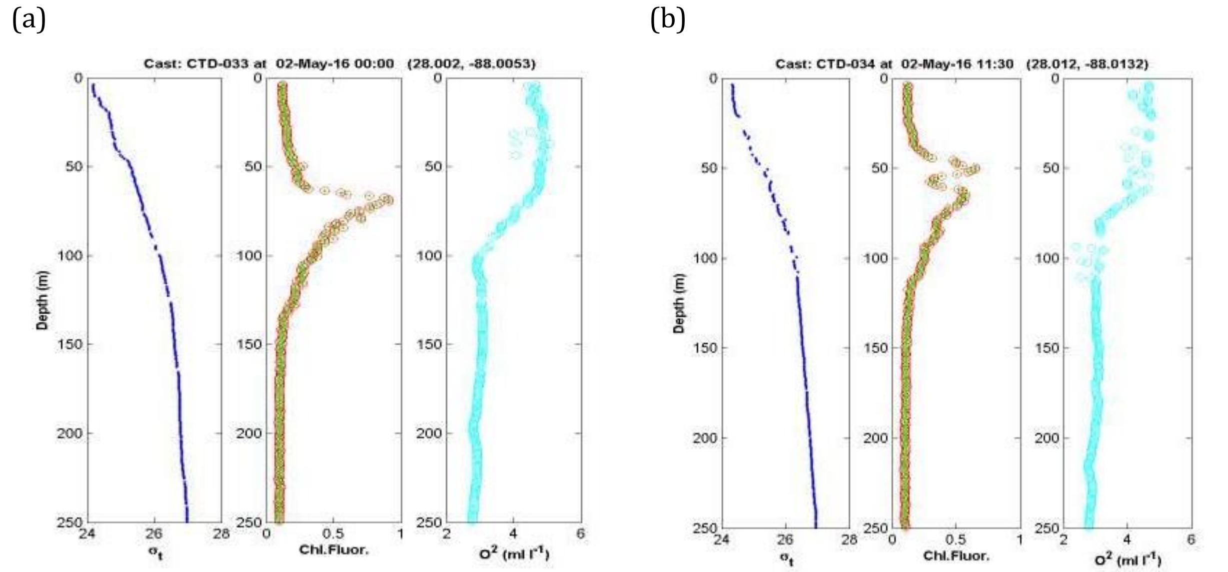


Figure 24 - Remote sensing reflectance (Rrs(λ)) derived from measurements made at eight stations between 02 May and 13 May 2016.



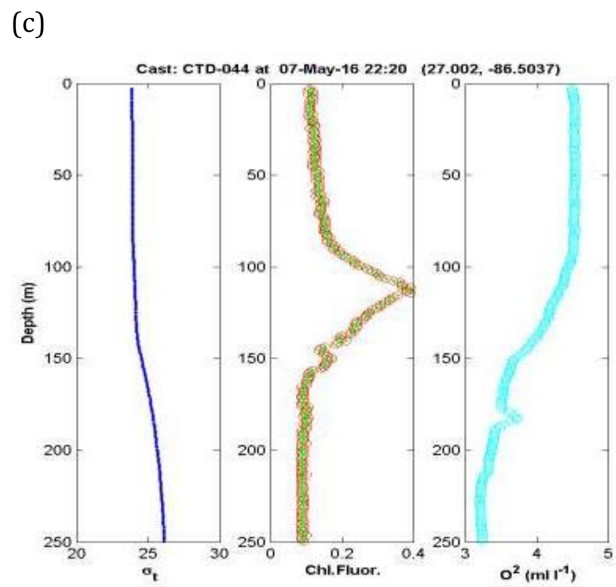


Figure 25 - CTD density, chlorophyll fluorescence, and dissolve oxygen concentration for the upper 250m of cast CTD-033 at (a) Station 3; (b) Station 4; (c) Station 5. These stations correspond to an apparent cold-core eddy, common water and warm-core eddy respectively

6 Outreach Activities

Dr. Danté Fenolio, Lead of DEEPEND's imaging program, continued gathering content for education and outreach. All of the images in this report were generated by this project, as was video of live animals and MOC-10 sampling methods. Figure 26 shows a sample of Dante's photography; he focused in on the scales of the *Myctophum asperum*. Figure 27 demonstrates how Danté photographs the organisms aboard the R/V *Point Sur*.

The public outreach component continued focusing on the Kids blog with "*Squirt*" (Figure 28). Additionally, Flat Stanley (http://www.flatstanleybooks.com/) was added to the DEEPEND team and introduced to the public on the DEEPEND cruise DP03 (Figure 29). *Squirt* continues guiding the kids through the DEEPEND adventures, while Flat Stanley occasionally posted about his exciting adventures at sea. Activities at sea were explained an age-appropriate level. Additionally, the DEEPEND Teacher-At-Sea Program for secondary teachers allowed Christia Hewlett to participate in the DP03 Cruise. She efficiently updated the adult blog each day on the DEEPEND website. She was able to inform DEEPEND's followers and her students about her hands-on experience on the two-week DEEPEND cruise. Blogs were tied to the daily shiptracker, which was updated daily on the DEEPEND home page. Facebook, Twitter, and Instagram accounts were linked to the DEEPEND website. Flat Stanley continuously updated the DEEPEND Instagram account throughout the cruise. Styrofoam cups were also attached to deep CTD deployments and shrunk for students who will be participating 'virtually' on the August DEEPEND cruise through the Creep into the Deep Program (Figure 30).

Outreach efforts included all levels of students as well as the public during the first three DEEPEND cruises. After the cruise, in February, 2017, in St. Petersburg, Florida, twenty grade 6-12 teachers will be participating in a one-day workshop learning about DEEPEND projects (DP03 Cruise), science content and ways to incorporate our program into their classroom activities. They will bring teaching activities and graphics back to classrooms to use. Moreover, new Postcards from the Deep have been added to the E/O page on the DEEPEND site for students in grade K-5 to view and share. Also, new scientist trading cards and mini-posters have been made for students as well.

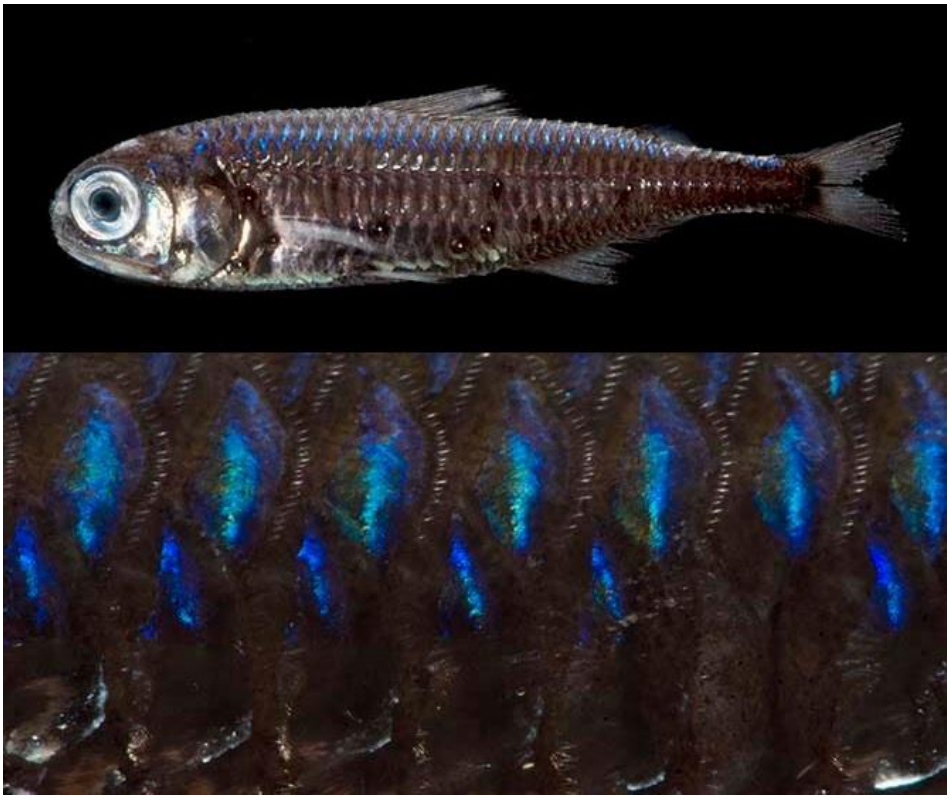


Figure 26. ***Myctophum asperum*** **and a close-up image of its scales. Photo: Danté Fenolio/DEEPEND 2016.**

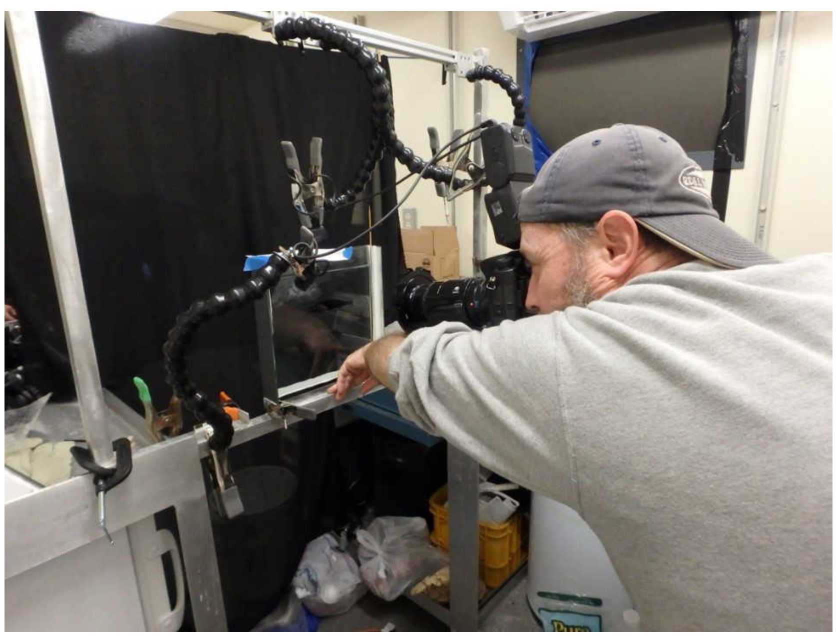


Figure 27 – Dr. Danté Fenolio photographing specimens during the DEEPEND cruise DP03 for the imaging program.

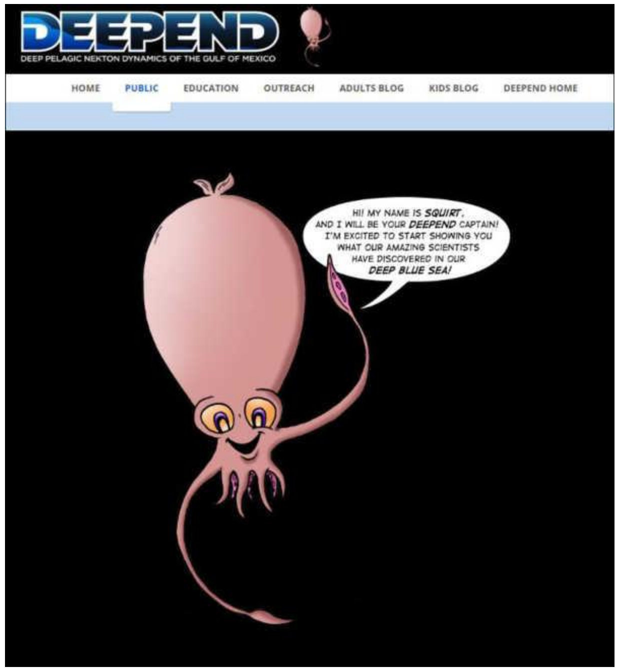


Figure 28 - "Squirt"- cartoon and animated character within the Kids Blog to explain the DEEPEND science to kids.

Figure 29 - Flat Stanley helped blog and Instagram his experiences on the DP03 cruise. Here he has serious reservations about the taxonomic skills of Dr. Sutton, and is helping correct mistakes.

Figure 30 - Education team shrinking cups on CTD for students who will be participating 'virtually' on the August DEEPEND cruise through the Creep into the Deep Program.