Deepwater Horizon Oil Spill (DWHOS)

NRDA Plankton Sampling Plan & Fall 2010 Cruise Plan

Specialty Diver 1 – September 2010 SIPPER Cruise

Water Column Technical Working Group

November 15, 2010

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Cruise Dates

Specialty Diver – September 8-18th, 2010

Background/Justification

Conceptual Model – Water Column Organisms

The trustees have developed a preliminary conceptual model of the DWH release, potential pathways and routes of exposure, and potential receptors. This preliminary model has informed the trustees' decision to pursue the studies outlined in the work plan. By signing this work plan and agreeing to fund the work outlined, BP is not endorsing the model articulated in the work plan.

Release and Pathway

Oil released from the broken well head both dispersed at depth and rose through nearly a mile of water column. The composition of the released gas-liquid mixture changed over time and space as the result of dilution, changes in pressure, dissolution, and addition of other constituents such as dispersants, methanol, and anti-foaming additives. Of oil that made it to the water surface, some entrained water forming mousse, was dispersed into the water column naturally and by application of dispersants, and some was removed mechanically or by in situ burning. Floating oil, oil droplets and dissolved components were transported large distances at various levels of the water column. Oil also picked up sediments, and other particulate material, some of which became neutrally or slightly negative buoyant, sinking to various depths. The oil dispersed at the wellhead (both via turbulence or by injection of dispersants) was transported by currents that varied in time and space, yielding a complex pathway of subsurface oil contamination that affected abyssal, bathypelagic, and meso-pelagic waters of the offshore Gulf of Mexico.

Routes of Exposure

Fish and invertebrates in the water column are exposed to contaminants by swimming through the water column, passing contaminated water over respiratory structures, and ingesting water and oil droplets as part of feeding. Additionally, sensitive life stages of pelagic fish and invertebrates come in

direct contact with floating oil that covers and is mixed into the neuston layer (upper ~0.5m) where embryos and larvae develop. Other neustonic organisms exposed to surface oil include many small invertebrates important to the food web. In the water column, organisms are also exposed to suspended oil droplets, which can foul appendages or other body surfaces. Water column organisms have also been exposed to dispersants dissolved in water, on oil droplets and adsorbed to suspended particulate matter. Water column organisms were also exposed to dissolved and water-borne chemical additives such as methanol and anti-foaming agents.

Plankton in the north-eastern Gulf of Mexico, which include early life history stages of fish and invertebrates, as well as smaller invertebrate holo-plankton and gelatinous zooplankton, are among those biota exposed to the released oil and spill-related chemicals. Planktonic organisms in the upper 200m of the water column were potentially exposed both offshore (over deep water) and on the shelf. Figure 1 shows the approximate cumulative extent of oil on the water surface through July 2010, which indicates areas potentially affected.

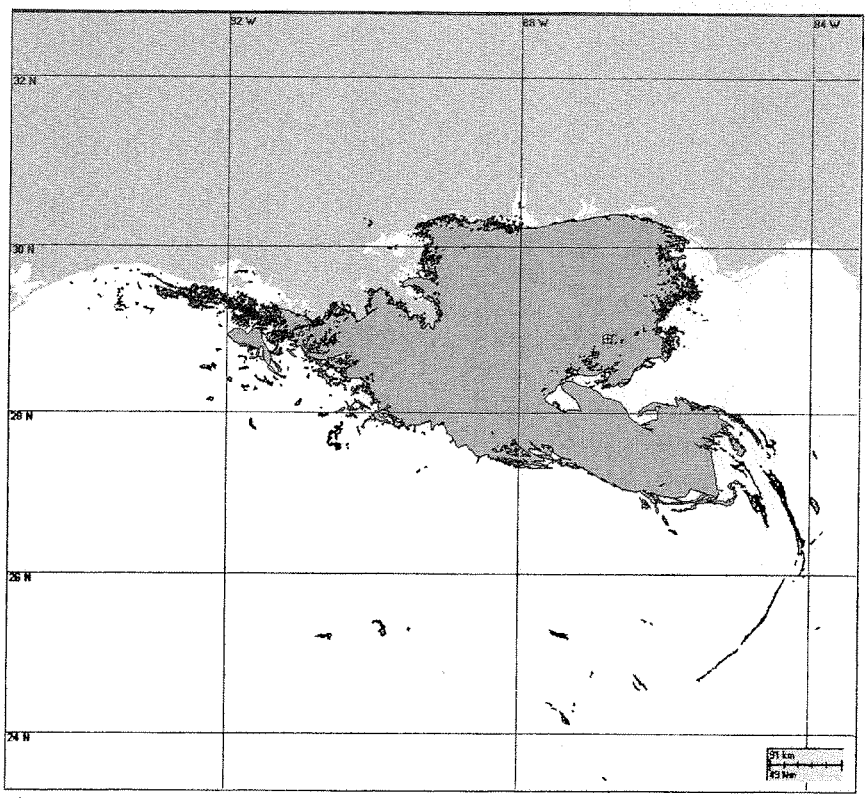

Figure 1. Cumulative potential surface floating oil extent of the DWHOS. (Figure derived from compositing April, May, June, and July 2010 radar shape files available on the NOAA ERMA website. Note that radar images with noted anomalies were not included in composite.)
Summary of Historical Shelf and Offshore Plankton Data

Objectives and Approach: Plankton Sampling Plan

This plan is part of a series of cruises to be conducted to evaluate the distribution and densities of ichthyoplankton and other zooplankton in Gulf of Mexico waters potentially affected by the Deepwater Horizon Oil Spill (DWHOS) and in surrounding areas. Plankton in the upper 200m of the water column of the Gulf of Mexico off of Texas to Florida have been sampled by the NMFS/NOAA SEAMAP program over the past 25 years (Attachment 1). The overall NRDA plankton sampling plan takes advantage of this historical data set and plans for continuation and extension of the NMFS Southeast Fisheries Science Center (SEFSC) SEAMAP program into deep water areas where the spill took place. In order to maximize the use of the existing data, additional sampling will be completed to determine the background state of plankton in the Gulf of Mexico. This can be completed outside the area of impact and be compared to the 25-year dataset to generate an estimate of pre-spill densities. Once the areas and water depth ranges exposed to DWHOS-related releases are delineated (by water sampling combined with fate and exposure modeling), we will identify areas suitably-representative of baseline conditions but sampled after the spill began. Baseline data (both historical and newly-acquired) will be used as injury model inputs, whereas the plankton conditions and distributions in the exposed areas/volumes will be examined for evidence of impact, as possible given the constraints of feasible sampling efforts in the extensive and naturally variable ocean volume potentially affected.

Regular SEAMAP plankton sampling was conducted this year as well as additional sampling during May (Figure 9-10 in Attachment 1), August, and September (R/V *Gordon Gunter*) in conjunction with other sampling efforts for the MC252 incident site. Additionally, as part of other NRDA sampling plans, other sampling methods (holographic camera, particle profilers) are being used to document the plankton in close proximity to the MC252 incident site where the presence of oil precludes the use of small mesh nets. The particle profilers are also being used in areas further from the well to document distributions and densities of plankton. Comparative studies between these plankton imaging systems and traditional net-based sampling techniques have been carried out by various investigators (i.e. Broughton and Lough, 2006). These studies have shown the advantages and limitations of imaging systems. For example fragile organisms and particles such as small gelatinous organisms and marine snow are easily identified and quantified using imaging systems, where as these delicate groups are destroyed or damaged beyond recognition in net samples. Using both sampling approaches will produce an inclusive time series data set for this incident.

The existing data that describe plankton distributions in potentially affected areas in the deep-water offshore are less extensive than data available for the shelf areas. First, the composition and density of plankton in the vicinity of the MC252 incident and the subsequent areas of impact have not been quantified in detail, especially in the deep-water areas surrounding the release site. Second, vertically stratified sampling in the upper water column is sparse. Other data gaps include the underrepresentation of soft bodied organisms in net based surveys. The *Specialty Diver* 1 sampling plan herein addresses in part these data needs with sampling in the fall of 2010.

Subsequent sampling in other seasons will likely be needed, particularly in spring and summer, to provide additional quantitative information and to document the plankton community in subsequent time periods in order to evaluate degree and rate of recovery over longer time periods. The overall plan is to perform sampling in each of the four seasons over the next several years (extent of the program to be determined). Because plankton are transported over wide areas, and populations are connected across the northern Gulf of Mexico, sampling plans need to be broad in geographic scope.

Herein, the fall 2010 *Specialty Diver 1* upper-water column (200m) plankton sampling plan is described. Sampling and analysis protocols have been developed for offshore stations for the upper 200m of the water column. The primary objective of the cruise is to collect plankton image data using the Shadowed Image Particle Profiling and Evaluation Recorder (SIPPER). The occurrence, abundance, biomass, vertical distribution, and daily vertical migration of zooplankton species of the Gulf of Mexico will be assessed.

In other efforts, water sampling has and will document in part concentrations of dissolved and particulate oil, as well as droplet size distributions. These sampling plans are described in the Jack Fitz 1 to 3, American Diver 1, Hos Davis 1 to 3, and subsequent water sampling cruise plans.

Methodology

Cruise Plan and Sampling Stations

The *Specialty Diver* 1 will depart from Houma, LA on September 7, 2010 to primarily conduct SIPPER plankton image sampling at offshore stations in the upper water column (200m). The 11-day cruise is scheduled to come back into port on September 17, 2010. Other sampling activities are planned in conjunction with the SIPPER, as time allows, including vertical profiles of water column properties (Conductivity, Temperature, Depth or CDT casts) using the winch and cable or the DTS6000 (Attachment 3), plus fluorometry profiles with the Chelsea Aquatracka (Attachment 4). These casts will generally cover the upper water column (to a maximum of 200m), unless sufficient time allows for casts to the seafloor.

Eight transects, each 18NM (nautical miles) in length, will be sampled by the SIPPER system in the vicinity of the spill site. Eighteen NM was selected because it is the approximate length that corresponds to 6 hours of towing the SIPPER at 3.5 knots. Transects SI-1 through SI-6 run from the southwest to the northeast of the well head. These transects run from deeper areas, up the slope, and onto the shelf. SI -7 (slope) and SI - 8 (deeper area) run from the northwest to the southeast of the well head. This transect configuration samples across the offshore depth gradient where much of the surface oiling occurred. Transect SI – 1 is to the east of the well site located on the slope. This area was previously sampled by the SIPPER device during the USF cruise in May 2010.

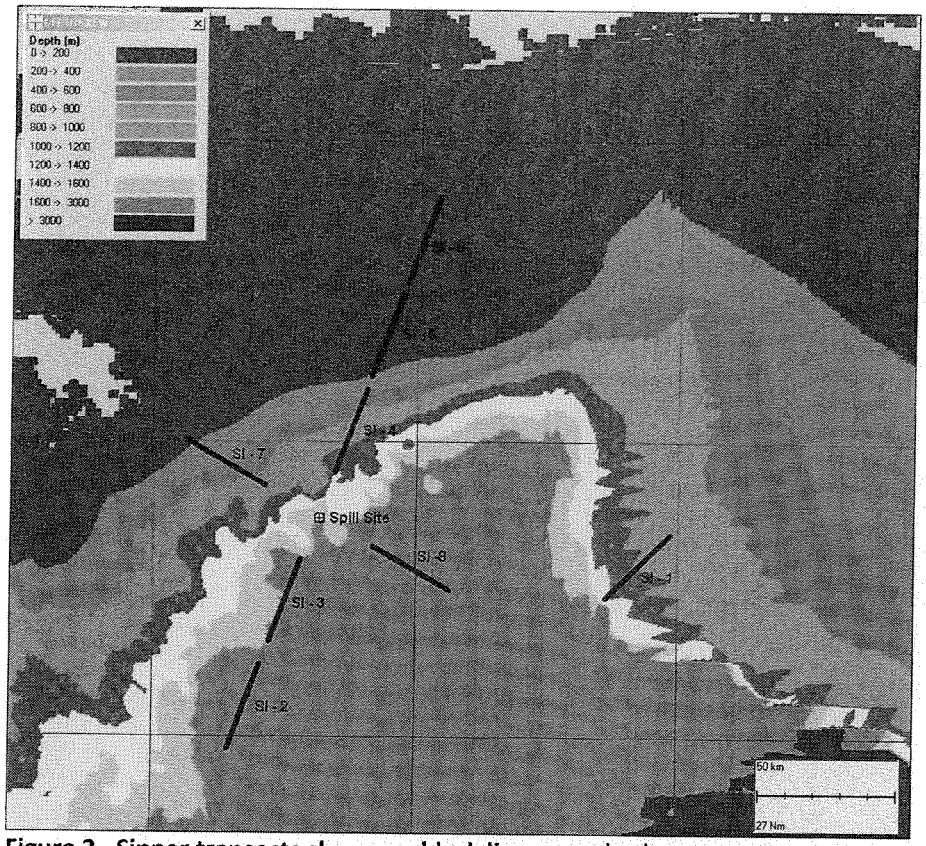

Figure 2. Sipper transects shown as black lines over bathymetry. Transects are 18 NM each.

Table 1. Approximate start and end positions of each SIPPER transect.

Transect	Start Position		End Position	
	Latitude (N)	Longitude (W)	Latitude (N)	Longitude (W)
SI - 1	[redacted]	[redacted]	[redacted]	[redacted]
SI - 2	[redacted]	[redacted]	[redacted]	[redacted]
SI - 3	[redacted]	[redacted]	[redacted]	[redacted]
SI - 4	[redacted]	[redacted]	[redacted]	[redacted]
SI - 5	[redacted]	[redacted]	[redacted]	[redacted]
SI - 6	[redacted]	[redacted]	[redacted]	[redacted]
SI - 7	[redacted]	[redacted]	[redacted]	[redacted]
SI - 8	[redacted]	[redacted]	[redacted]	[redacted]

Each transect will be sampled with the SIPPER device twice (1 day, 1 night) for total of 16 deployments. Day transects will be run from 9am to 3pm, and night transects from 9pm to 3am. Day and night sampling will capture diel vertical migration of plankton in the epipelagic zone (<200m). The SIPPER will be towed up and down profiling the upper water column in a "tow-yo" pattern. Throughout each transect two depth ranges will be targeted for sawtooth shape profiles (<200m and <25m, at approximately 50% effort for each). The higher effort for sampling the upper 25m reflects the higher likelihood that upper mixed-layer plankton were most affected by re-entrained floating oil (because most exposure to re-entrained previously-floating oil would be in the upper mixed layer). In addition to

the profiles, a portion of the transect will be run right at, or close to, the sea surface if sea conditions allow (<5m). This will provide data on plankton in the immediate surface layer. The other sampling devices (CTD, Aquatracka, DTS6000) will be deployed before and after each SIPPER transect.

Sampling Procedures

SIPPER : The Shadowed Image Particle Profiling and Evaluation Recorder (SIPPER) is an in-situ suspended particle imaging system capable of collecting high resolution information on the distribution of zooplankton, phytoplankton, larval fish and detritus. The SIPPER measures depth, time and flow rate through the system, determines volume sampled and uses combined manual and automated classification methods to provide vertical and horizontal estimates of zooplankton (and other particulate) densities. The tow body is deployed from a conducting cable, winch, and A-Frame system off the side or stern of the vessel and towed at approximately 3.5 knots (sea state and depth dependant). Real time environmental and SIPPER diagnostic data is transmitted back to a ship board computer for monitoring while image data is stored in a pressure housing on the tow body. For more detail on SIPPER, deployment, and analysis approaches, see Attachment 2.

CTD: We will deploy to full ocean depth a Seabird CTD profiling package (which can be deployed to a depth of 6000 meters) to collect dissolved oxygen, and salinity, temperature, and depth information.

Aquatracka: The Chelsea Aquatracka (to be attached to CTD array, Attachment 4) will be used in profiling mode (to full ocean depth), to detect fluorescence from submerged oil and/or dissolved components. These measurements will complement similar profiling activities performed on other cruises (e.g., Hos Davis 1 &2), as described elsewhere.

SEAtronics Digital Video Data Telemetry System (DTS6000): The DTS 6000, described in Attachment 3, provides an alternate means for performing CTD and other sensor profiles, as well as for water sampling. It has a SeaBird 19+V2 CTD, and 6 2.5L water sampling bottles. The video camera system on the DTS 6000 will be used to photograph plankton and other subsurface materials (e.g., suspended particulate matter) as a test of the system.

Personnel for Specialty Diver 1 (30 Berths available):
Dr. Andrew Remsen (Chief Scientist, SIPPER operator)
Dr. Jason Lenes (SIPPER operator assistant)
Robert Nelson (NRDA water sampler, WHOI)
Mason Foret (NOAA Data Manager)
Jude Stelly (Seatronics Technician, DTS operator))
Kristian Rogers (ENTRIX employee)
18 Specialty Offshore Boat Crew (captain, mates, deck hands, plus 2 subcontractors from Cochrane Technologies as Navigation Technicians)

Vessel
Operations will be completed on the NOAA contracted vessel of opportunity Specialty Diver.

Estimated Costs:

Costs	Hrs/Days/Trips	Day/Hr Rate	Total
Ship Mobilization / Preparation	1		$30,000
CSA Labor			
Leased Equipment: SIPPER	1	$	$7000
Total			**$37,000**

Field Survey Costs	Hrs/Days/Trips	Day/Hr Rate	Total
Specialty Diver			(VOA)
NOAA Labor (days):			
Andrew Remsen	[redacted]	[redacted]	$ 28,000
Jason Lenes	[redacted]	[redacted]	$ 28,000
Data analysis	1		$ 10,000
NOAA technician ("Water Sampler")	[redacted]	[redacted]	$ 12,000
Seatronics Technician, DTS operator	[redacted]	[redacted]	$ 24,000
Data Manager	[redacted]	[redacted]	$ 21,000
Data Processing	1	$11,000	$ 11,000
Travel (for [redacted])	[redacted]		$ 2,500
Total			**$136,500**
TOTAL			**$173,500**

Days/Trips based on [redacted]
Labor is estimated cost and hours
Ship, Crew, Food, & Fuel included elsewhere

Budgeting

The Parties acknowledge that this budget is an estimate, and that actual costs may prove to be higher due to a number of potential factors. As soon as factors are identified that may increase the estimated cost, BP will be notified and a change order describing the nature and cause for the increase cost in addition to a revised budget for BP's consideration and review.

Safety Plans

BP's full operations and safety plan is attached along with incident reporting form, SIMOPS protocols, and transfer protocols. In addition, the NOAA incident site safety plan (which all NOAA employees and contractors must sign prior to the cruise) is attached (Attachment 1).

Transfer of the shared electronic media in the onboard equipment to each of the party's hardware for retention and use.

Upon return to port, the vessel Operations Manager shall produce identical copies of the raw and processed electronic media generated during the cruise and deliver one of those copies each to NOAA (or its QA contractor) and to ENTRIX.

Laboratory

Official NRDA chain of custody procedures will be followed for transfer of all data products.

Distribution of Laboratory Results

Each laboratory shall simultaneously deliver raw data, including all necessary metadata, generated as part of this work plan as a Laboratory Analytical Data Package (LADP) to the trustee Data Management Team (DMT), the Louisiana Oil Spill Coordinator's Office (LOSCO) on behalf of the State of Louisiana and to BP (or ENTRIX behalf of BP). The electronic data deliverable (EDD) spreadsheet with pre-validated analytical results, which is a component of the complete LADP, will also be delivered to the secure FTP drop box maintained by the trustees' Data Management Team (DMT). Any preliminary data distributed to the DMT shall also be distributed to LOSCO and to BP (or ENTRIX on behalf of BP). Thereafter, the DMT will validate and perform quality assurance/quality control (QA/QC) procedures on the LADP consistent with the authorized Quality Assurance Project Plan, after which time the validated/QA/QC'd data shall be made available simultaneously to all trustees and BP (or ENTRIX on behalf of BP). Any questions raised on the validated/QA/QC results shall be handled per the procedures in the Quality Assurance Project Plan and the issue and results shall be distributed to all parties. In the interest of maintaining one consistent data set for use by all parties, only the validated/QA/QC'd data set released by the DMT shall be considered the consensus data set. In order to assure reliability of the consensus data and full review by the parties, no party shall publish consensus data until 7 days after such data has been made available to the parties. Also, the LADP shall not be released by the DMT, LOSCO, BP or ENTRIX prior to validation/QA/QC absent a showing of critical operational need. Should any party show a critical operational need for data prior to validation/QA/QC, any released data will be clearly marked "preliminary/unvalidated" and will be made available equally to all trustees and to BP (or ENTRIX on behalf of BP).

References

Broughton EA, Lough RG. 2006. A direct comparison of MOCNESS and Video Plankton Recorder zooplankton abundance estimates: Possible applications for augmenting net sampling with video systems. Deep Sea Research Part II: Topical Studies in Oceanography, 53, 2789–2807

Attachments:

Attachment 1. Summary of Historical Shelf and Offshore Plankton Data
Attachment 2. SIPPER_Specifications
Attachment 3. DTS 6000 Specifications
Attachment 4. Chelsea Aquatracka Fluorometer
Attachment 5. NOAA-NRDA_MC_252_Site_Safety_Plan_5.13.10
Attachment 6. NRDA_Field_Sampler_Data_Management_Protocol_7_5_2010
Attachment 7. MC 252_Incident_SIMOPS_Plan_May10_2010_Rev2 (2)
Attachment 8. Transfer of Personnel and Material at Sea 070510
Attachment 9. MC252 HSSE Incident Reporting Final 02 May 10 rev 1
Attachment 10. MC252 Analytical QAP V2.1

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NRDA Plankton Sampling Plan & Fall 2010 Cruise Plan

Specialty Diver 1 – September 2010 SIPPER Cruise

Water Column Technical Working Group

Cruise Dates: September 8-18, 2010

Plan Date: November 15, 2010

Approvals

Approval of this work plan is for the purposes of obtaining data for the Natural Resource Damage Assessment. Parties each reserve its right to produce its own independent interpretation and analysis of any data collected pursuant to this work plan.

BP Approval	Cook Fay Printed Name	Cook Fay Signature	11/19/10 Date
Federal Trustee Approval	Jessica White Printed Name	Jessica White Signature	11/17/10 Date
Louisiana Approval	KARA DEBUSSCHERE FOR Printed Name	FOR ROLAND GUIDRY Signature	2/16/11 Date