

Deepwater Horizon Oil Spill (DWHOS)

NRDA Plankton Sampling Plan & Winter 2011 Cruise Plan

March 29, 2011

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Reviewed by: William Graeber, Jeffery Simms, Amy Piko (Cardno ENTRIX) & Mark Benfield (LSU) on behalf of BP

Proposed Cruise Dates

R/V *Oregon II* – February 16 – March 22, 2011

Leg 1: February 16 – March 2, 2011

Leg 2: March 8 – March 22, 2011

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 nor is BP endorsing the full geographic extent of sampling, the rationale provided for it, or the use of multiple gear types at numerous locations within 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, flocculated 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 contaminated water, spending time on/in contaminated sediments, taking up contaminants through body surfaces, passing contaminated water over respiratory structures, and ingesting water, oil droplets, contaminated biota, and particulates contaminated with oil 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 many 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. Plankton in the upper 200m of the water column were exposed both offshore and on the shelf. Figure 1 shows the approximate extent of oil observed on the water surface using radar data, which indicates some areas potentially affected by floating oil.

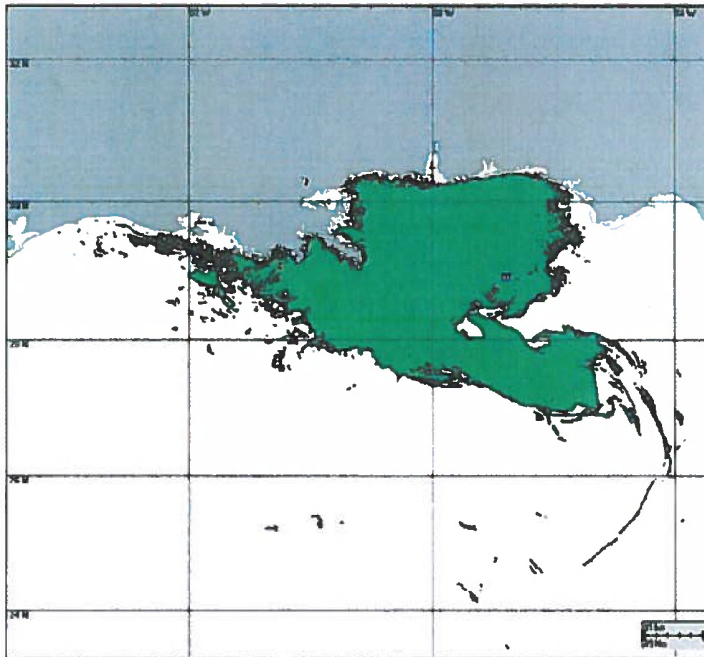


Figure 1. Cumulative potential surface oil extent of the Deepwater Horizon spill. (Figure derived from compositing April, May, June, and July radar shape files available on the NOAA ERMA website. Note that radar images with noted anomalies were not included in composite.)

Summary of Historical Shelf and Offshore Plankton Data

The NMFS/NOAA SEAMAP program is a long-standing plankton survey that covers nearly all of the Gulf of Mexico. With 25 years of data, this program offers a significant resource for understanding the characteristics of the natural state of this community. This is augmented by several state-based surveys that sample in waters closer to shore. In 2009, the SEAMAP program completed a winter, spring, and fall plankton survey. Each of these surveys took over a month to complete. The spring and fall surveys sample using the bongo and neuston net procedures; the strength of this data set is the longevity, 2009 was the 28th year¹. The winter survey targets ichthyoplankton that are underrepresented in the spring/fall sampling programs and attempts to capture the presence of winter-spawning species (mainly grouper species and tilefish). The main limitation of the historical SEAMAP plankton surveys is that only the spring survey covers the offshore area. Plankton in the nearshore waters are well covered over all the seasons as plankton samples are collected in conjunction with the shrimp/groundfish surveys. Figures 1-10 of Attachment 1 summarize the historical and current datasets for plankton fish and crustaceans.

The SEAMAP sampling area covers the entire northern GOM in the US EEZ from the 10 m isobath to approximately the 200 m isobath, and comprises approximately 300 designated sampling sites (i.e. 'SEAMAP' stations). Most stations are located at 30-nautical mile or 0.5° (~56 km) intervals in a fixed, systematic, 2-dimensional latitude-longitude grid of transects across the GOM. This grid extends from the Texas shelf to the Florida west coast shelf. Some SEAMAP stations are located at < 56 km intervals, especially along the continental shelf edge; while others have been moved to avoid obstructions, navigational hazards or shallow water. In general, the array of stations or standard cruise track for plankton sampling varies by survey (fall, winter, spring, summer) (Attachment 1).

Historically the winter SEAMAP survey has been a dedicated plankton sampling effort. Survey years include 1983, 1984, 1993, 1996, 2007, 2008, and 2009. There has been variable spatial coverage in this time series in U.S. GOM waters, although 2007, 2008, and 2009 shared similar cruise tracks. For example the survey effort for both 2007 and 2008 is shown in Figure 2. Unlike the fall and spring plankton SEAMAP surveys, there is no established "standard" cruise track for the winter.

¹ NOAA, 2010. Annual Report of the Southeast Area Monitoring and Assessment Program (SEAMAP). Number 177.
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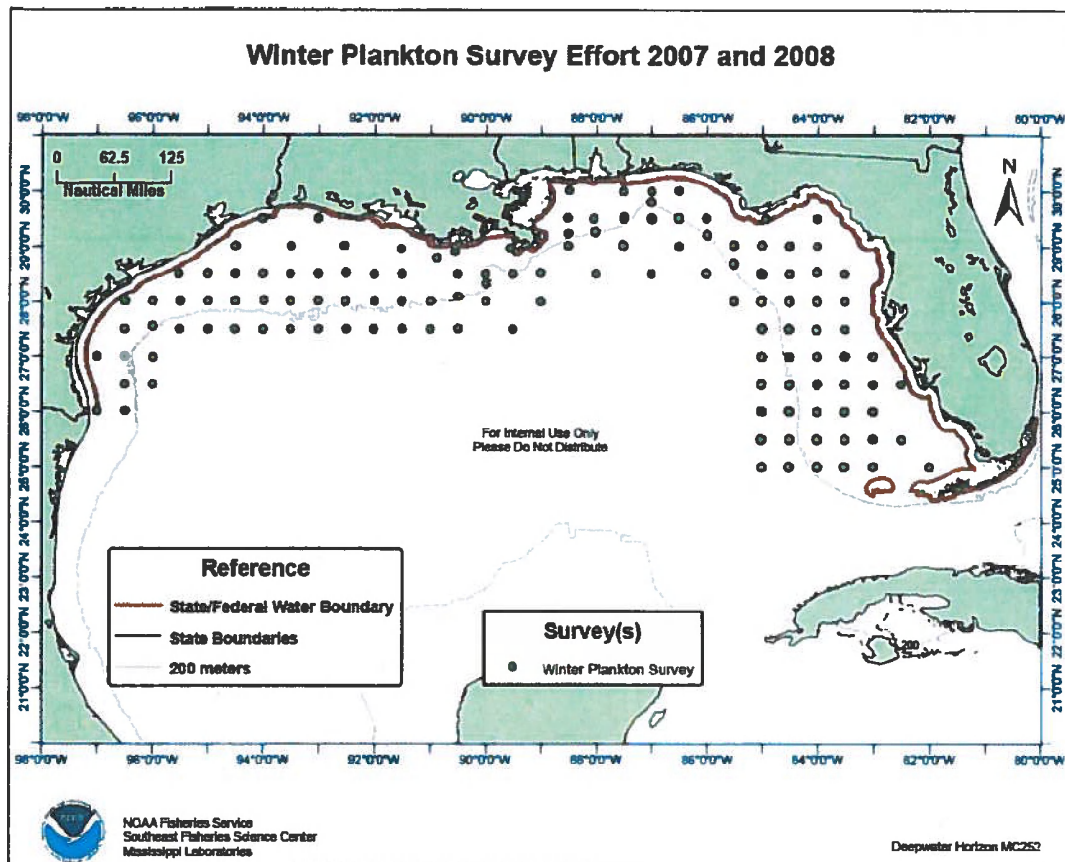


Figure 2. SEAMAP winter plankton survey effort for both 2007 and 2008.

Objectives and Approach: Plankton Sampling Plan

This plan is part of a series of cruises intended to evaluate the distribution and densities of ichthyoplankton, other zooplankton and phytoplankton 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.

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 water column is sparse. A series of cruises in the fall of 2010 (aboard *Walton*

Smith and Nick Skansi) targeted 30 deepwater stations around and southwest of the MC252 incident site. Subsequent sampling in other seasons at the sites in those plans provides additional quantitative information and to document the plankton community in subsequent time periods.

This plan describes a NRDA survey for winter 2011 plankton sampling where a subset of the standard SEAMAP stations have been selected for sampling, as well as additional offshore stations. The sampling and analysis protocols in the upper 200m of the water column are those used in the SEAMAP program. Ichthyo- and zooplankton will be sampled using paired bongo nets and at the water surface with a neuston net. Depth-discrete plankton samples taken at various intervals will be carried out using a Multiple Opening/Closing Net and Environmental Sensing System (MOCNESS).

Methodology

NRDA SEAMAP Plan and Sampling Stations

The NOAA Ship *Oregon II* will depart Pascagoula, MS on February 16, 2011 to conduct the NRDA Winter Plankton survey. The 30-day cruise will be conducted in 2 legs; one 15 day (February 16 – March 2) and one 15 day leg (March 8 – March 22). In this work plan, the NRDA effort will support the entire survey aboard the R/V *Oregon II*.

Due to the extent of the area potentially affected by oil, there is need to sample additional stations beyond the shelf region off the coast of Louisiana, Mississippi, Alabama, and Florida. For the NRDA effort, stations have been added to the cruise track to fill the gap in the deepwater areas of interest relative to the spill. The stations used to fill out the grid are there because the spill was in deep water and, in the case for most surveys, was initiated at a location that was beyond the normal scope of standard sampling. Figure 5 shows the stations sampled by the Gordon Gunter in the fall 2010 SEAMAP cruise, supported in part by NRDA. The deep water offshore stations are located in >200m of water and specifically capture information about plankton beyond the shelf and in the vicinity of the release location of the oil spill. The position of the additional stations was determined by extending the standard 30NM SEAMAP sampling grid into the offshore area. Figures 3-4 shows the position of the plankton stations that the *Oregon II* will target for the winter 2011 survey. In addition, the State of Louisiana will survey 7 stations that it sampled in fall 2010 (light blue stations in Figure 3) in March 2011. Mississippi will not be sampling in winter 2011.

For more detail on SEAMAP operations and protocols see Attachment 2 "SEAMAP Field Operations Manual" and the annual SEAMAP environmental and biological atlas reports found at: http://www.gsmfc.org/default.php?p=sm_ov.htm#:content@12:links@13

The cruise track and selected station array for the 2011 winter survey is designed to attain data at offshore and inshore stations, and to perform more sampling in the deep water areas than is normally performed as part of the SEAMAP program (Figures 2-4). This station configuration encompasses surface waters that are potentially influenced by major physical factors in the Gulf, e.g., the Mississippi River discharge and the loop current. SEAMAP stations having time series data (i.e., winter SEAMAP surveys prior to 2011) near the spill area were included and prioritized. Stations on the Florida shelf were included as those areas show higher (chlorophyll) productivity in satellite color imagery, are connected hydrodynamically to at least part of the spill-affected area, and are thought to be important grouper spawning grounds. In addition, ancillary observations by academics and others have suggested oil contamination may have been present in areas on or near the Florida Shelf.

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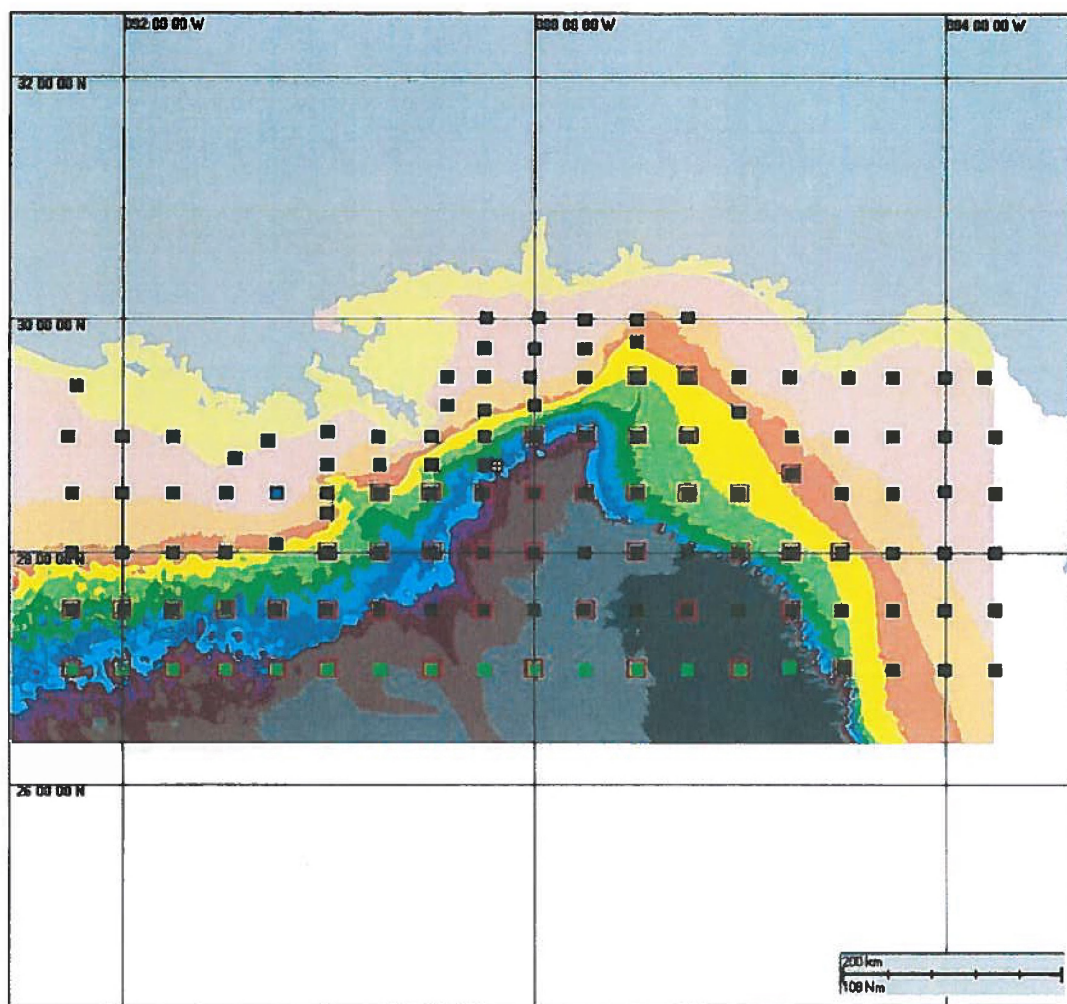


Figure 4. 2011 NRDA winter plankton stations with bathymetry. Black squares and green represent Oregon II stations for bongo-neuston sampling. (Black squares are part of the regular SEAMAP program; green squares were added for the DWHOS plankton program in fall 2010.) Red outlined stations are those where a MOCNESS tow will also be attempted (time and weather permitting). Light blue squares are stations that Louisiana is going to sample.

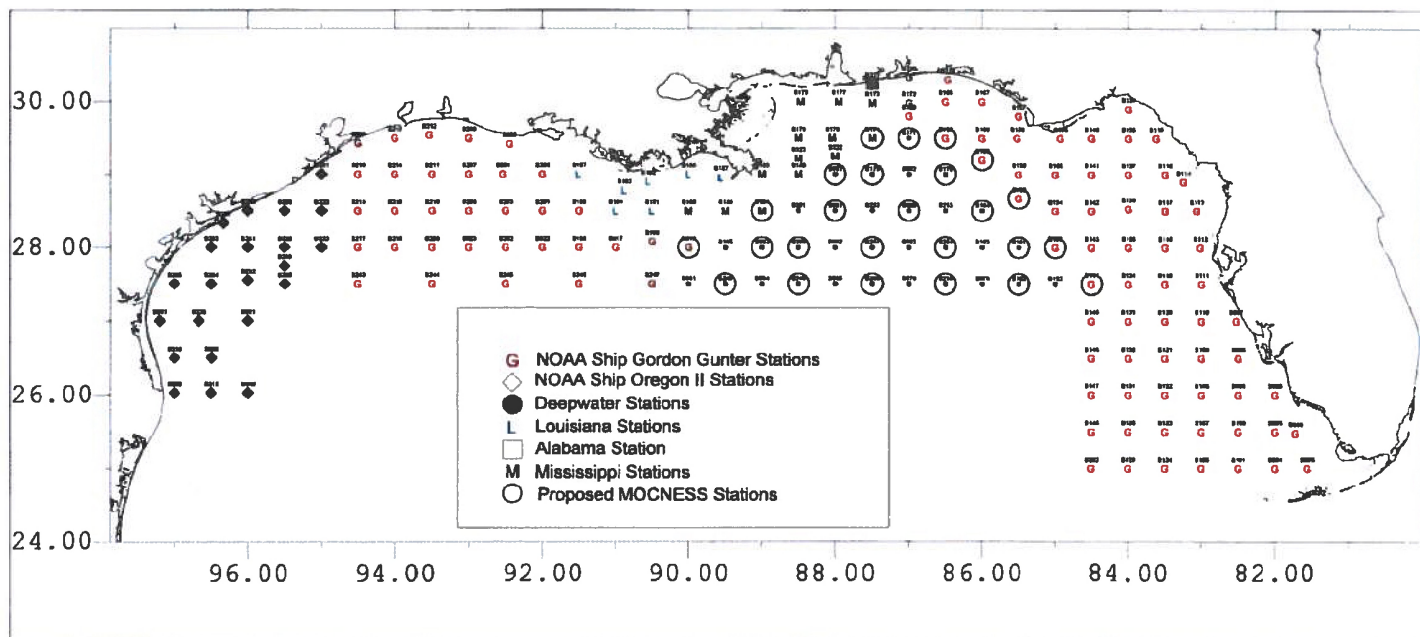


Figure 5. Fall 2010 plankton SEAMAP stations. Symbols represent various ships/state SEAMAP partners and additional MOCNESS sampling sites. Note: stations sampled in the fall 2010 cruise aboard the R/V *Gordon Gunter*, are marked as a red G (NOAA Ship Gordon Gunter Stations) and a black dot (• Deepwater Stations). Stations with a black circle around them were planned for sampling with the MOCNESS.

Sampling Procedures

The primary objective of the survey is to assess the occurrence, abundance, and distribution of the early life stages of winter spawning fishes, especially grouper, tilefish, mullet, and menhaden. Early life stages of commercially important invertebrates (lobsters, decapods) and other invertebrates will also be assessed. Additional organisms of interest include other zooplankton and ichthyoplankton not mentioned above.

In the upper 200m of the water column ichthyo- and zooplankton will be sampled using paired bongo nets and at the water surface using a neuston net. Standard SEAMAP sampling protocols will be followed at each station for the primary gear: oblique bongo tow to a maximum depth of 200 m, 10 min neuston tow, and CTD profile to a maximum depth of 200m. (The bongo tow and CTD cast will be shallower than 200m if the local water depth is <200m.) The sample attained from the left bongo net will be immediately preserved in 10% formalin and transferred approximately 24-48 hours later into 95% ethanol. Samples from the right bongo and neuston nets will be immediately preserved in 95% ethanol and transferred approximately 24-48 hours later into fresh 95% ethanol. For detailed SEAMAP protocols and sample processing see Attachment 2 "SEAMAP Field Operations Manual".

Vertical distribution of plankton in the epipelagic zone (the top layer of the ocean where sunlight reaches and where photosynthesis can occur) will be measured by sampling at depth discrete intervals at many of the offshore stations using a 1 m MOCNESS (0.505mm mesh). The MOCNESS will not be deployed at the same time as the other gear types while on station. The MOCNESS will be towed obliquely through the water column from a maximum depth of 130m (or from a safe distance off the sea floor). The first net (net 0) will be open all the way down to the maximum depth. Upon commencing the oblique tow back to the surface, net 1 will be opened and cover the depth horizon from 130 to 100. Additional nets will be opened and closed at depth intervals of 20m up to the surface. Much of the water column sampled by the MOCNESS will also be covered by the other plankton sampling gear. The advantages of the MOCNESS sampling as compared to bongo tows include 1) collection of high resolution depth-discrete data, which is not achieved in the bongo tows; 2) a larger sample volume for increased detection of rarer taxa; and 3) a larger net mouth that should reduce net avoidance. The target volume filtered for each depth strata is 250m³. For more detail on MOCNESS deployment and sample processing see Attachment 3 (NOAA Cruise Instructions) and Attachment 12 (1-m MOCNESS Sample Handling and Preservation Protocol).

For all sampling gears, detailed observations (abundance, wet weight volume, and species) of net-caught jellyfish, ctenophores, and other large zooplankton will be recorded and photographed. Sampling will occur around the clock, as normally performed during SEAMAP surveys (Attachments 2, 3), and as such, samples will be obtained both in daylight and during the night.

Additional NRDA Personnel for R/V Oregon II:

2 NOAA Data Managers per leg
1-2 ENTRIX employees per leg

Vessel

Operations will be completed on the NOAA vessel R/V *Oregon II*

Estimated Costs:

<u>NOAA OMAO Vessel Costs</u>	Day Rate				Totals For February 16 - March 2, and March 8 - March 22	
Item	Op Cost/Day - High Op Tempo	Staging/De-Staging Cost - Low/Med Optempo	Op Days	Staging/De-Staging Days	Op Cost/Day - High Op Tempo	Staging/De-Staging Cost - Low/Med Optempo
Vessel Base Pay (14)	2,118.76	2,118.76	30	6	63,562.80	12,712.56
Wage Marine Overtime	2,574.00	2,268.00			77,220.00	13,608.00
Employer Surcharge - 31%	656.82	656.82			19,704.47	3,940.89
NOAA Corps Officer Salaries	528.85	528.85			15,865.57	3,173.11
NC Special Pay/Benefits	259.26	259.26			7,777.86	1,555.57
NOAA Overhead Rate (22.07%)	556.66	556.66			16,699.68	3,339.94
NOAA Line Office Overhead Rate (8.60%)	216.91	216.91			6,507.35	1,301.47
NOAA FMC Rate (0.0%)	0.00	0.00			0.00	0.00
GSA Rent Reimbursable Rate (9.00%)	227.00	227.00			6,810.02	1,362.00
Maintenance surcharge	3,670.00				110,100.00	0.00
Food/Supplies/Services	2,332.00	118.11			69,960.00	708.64
Fuel (\$2.64/gal); 850 gal/day	2,244.00				67,320.00	0.00
MOC Shoreside Support (112.3%) of WM and NOAA Corps Labor costs	2,973.27	2,973.27			89,198.06	17,839.61
Total Vessel Cost:					550,725.81	59,541.80
*Staging/De-Staging=6 days, Arrival/Departure days = 4, Days at Sea = 26						
<u>NRDA Costs</u>	Op Days	Day Rate				
2 NRDA Managers	30	1,500				45,000.00
BP Representatives (Cardno-Entrix)						Provided Elsewhere
TOTAL BUDGET:					655,267.62	

*Cruise will be supported by 6 NOAA NMFS SEFSC science staff, costs of NOAA staff are not included in the cost estimate.

Budgeting

The Parties acknowledge that this budget is an estimate, and that actual costs may prove to be higher. BP's commitment to fund the costs of this work includes any additional reasonable costs within the scope of this work plan that may arise. The trustees will make a good faith effort to notify BP in advance of any such increased costs. The vessel costs, field survey costs and miscellaneous costs indicated in chart above shall be reimbursed by BP upon receipt of written invoices submitted by the Trustees.

Safety Plans

BP's full operations and safety plans are attached as appendices. A HASP binder is provided to each vessel. In addition, the NOAA incident site safety plan (which all NOAA employees and contractors must sign prior to the cruise) is attached (Attachment 4). Vessels will call into SIMOPS based on the current regulations (Attachment 5). Vessels will report in daily using the attached situation report (Attachment 6).

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

All profile, acoustic, and other electronic data (including photographs) will be saved to an on-board computer, and all data shall be migrated to a dedicated hard drive. The data will be controlled and managed by the trustees under project protocols, including Chain-of-Custody tracking of the hard drive. The hard drive will be duplicated in full immediately following the cruise, and the duplicate hard drive will be provided to Cardno ENTRIX on behalf of BP. The original hard drive shall be kept in a secure facility in trustee custody.

By the end of the cruise, all documentation, including COCs, field notes, sampling logs, sampling forms, photos, photo logs, ship logs, and GPS tracking shall be transferred to the NOAA NRDA Sample Intake Team following NRDA data management protocols. An identical copy of all documentation will be provided to BP/Cardno ENTRIX at the end of the cruise.

Sample Retention

All materials associated with the collection or analysis of samples under these protocols or pursuant to any approved work plan, except those consumed as a consequence of the applicable sampling or analytical process, must be retained unless and until approval is given for their disposal in accordance with the retention requirements set forth in paragraph 14 of Pretrial Order # 1 (issued August 10, 2010) and any other applicable Court Orders governing tangible items that are or may be issued in MDL No. 2179 IN RE: Oil Spill by the Oil Rig "DEEPWATER HORIZON" (E.D. LA 2010). Such approval to dispose must be given in writing and by a person authorized to direct such action on behalf of the state or federal agency whose employees or contractors are in possession or control of such materials.

Laboratory

Samples will be transferred, and held under NOAA NRDA chain of custody, to Dr. Malinda Sutor of the Department of Oceanography and Coastal Sciences of Louisiana State University for further processing. Samples will be stored in a secure facility, processed in the lab and data distributed as described in a separate workplan (currently under development).

Distribution of Laboratory Results

Each laboratory shall deliver raw data, including all necessary metadata, generated as part of this work plan as a Laboratory Analytical Data Package (LADP) simultaneously 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 Cardno ENTRIX on 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 Cardno 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 Cardno 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. The LADP shall not be released by the DMT, LOSCO, BP or Cardno 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 Cardno ENTRIX on behalf of BP).

Attachments:

- Attachment 1. Summary of Historical Shelf and Offshore Plankton Data
- Attachment 2. SEAMAP Field Operations Manual
- Attachment 3. NMFS/NOAA SEAMAP Oregon II Winter 2011 Cruise Instructions
- Attachment 4. NOAA-NRDA_MC_252_Site_Safety_Plan_5.13.10
- Attachment 5. NRDA SIMOPS Procedures 111710
- Attachment 6. DWH Vessel Daily SitRep
- Attachment 7. NRDA_Field_Sampler_Data_Management_Protocol_10_23_2010
- 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 V2.2
- Attachment 11. Winter2011 SEAMAP Stations maps and coordinates
- Attachment 12. 1-m MOCNESS Sample Handling and Preservation Protocol

Deepwater Horizon Oil Spill (DWHOS)

**NRDA Plankton Sampling Plan
& Winter 2011 Cruise Plan**

R/V Oregon II – February 16 – March 22, 2011

March 29, 2011

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

Robin Bullock [Signature] 7/29/11
Printed Name Signature Date

Federal Trustee Approval

Jessica White [Signature] 7/25/11
Printed Name Signature Date

Louisiana Approval

KAROLINE DEBUSCHER [Signature] 8/11/11
Printed Name Signature Date
FOR KOLAND GULORY