Deepwater Horizon Oil Spill (DWHOS)
Water Column Technical Working Group

NRDA Late-Summer 2011 McArthur II
Small Pelagics Sampling Plan

Sampling Vessel: NOAA Ship *McArthur II*

October 8, 2011

Prepared by:
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Reviewed by:
NOAA: Dan Hahn (NOAA)
Louisiana: Amanda Vincent (LDEQ)
BP: William Graeber, Wayne Kicklighter, Jeffrey Simms (Cardno ENTRIX) on behalf of BP.

Cruise and Sampling Dates
McArthur II Leg 1: A. Shakedown, September 8-11, 2011 (4 days; 3 Days at Sea)
B. September 14-17, 2011 (4 days; 3 Days at Sea; if needed)
McArthur II Shipboard Sampling: September 20- October 7, 2011 (18 days; 16 Days at Sea)
Airborne LIDAR Survey: September 22- October 10, 2011 (19 days; 75 hours of Air Surveys)

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 or the rationale provided for it.

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.

Small pelagic fish and other epipelagic biota in the surface waters of the north-eastern Gulf of Mexico are among those biota potentially exposed to the released oil and spill-related chemicals. 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. Small pelagic fish are important components of the marine food web, consuming plankton and providing food to predators including large pelagic fish (e.g., tuna, billfish, etc.).

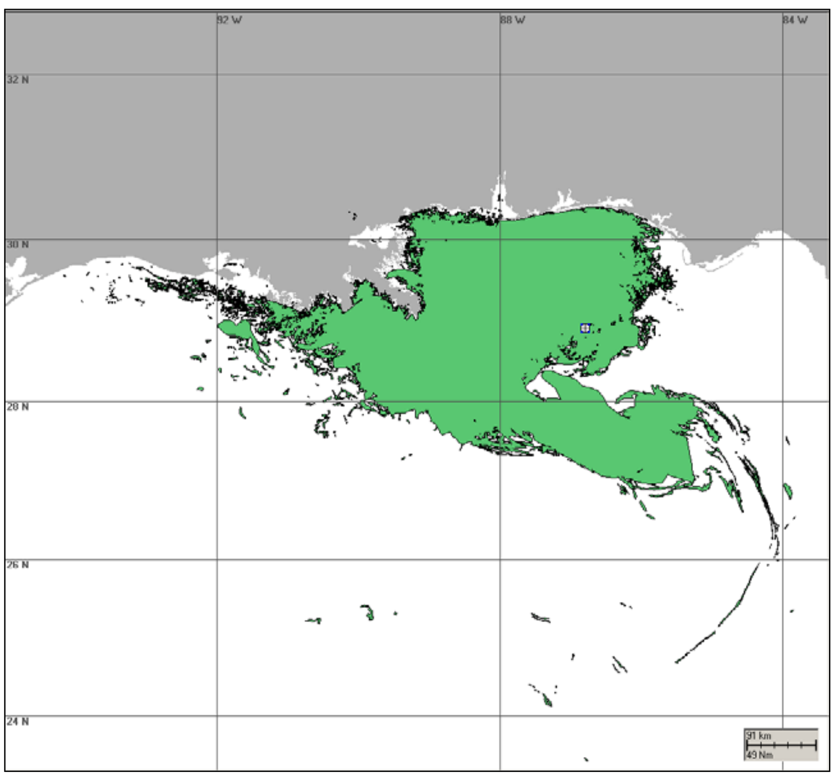

Figure 1. Cumulative potential surface floating oil extent of the Deepwater Horizon oil spill. (Figure derived from compositing April, May, June, and July 2010 radar shape files available on the National Oceanic and Atmospheric Administration (NOAA) Environmental Response Management Application (ERMA) website. Note that radar images with noted anomalies were not included in composite.)

Limited information is available on the abundance and distribution of schooling pelagics and other difficult-to-sample organisms in near surface waters of the northern Gulf of Mexico. Because this

epipelagic habitat may have been impacted by response activities and contaminants during the course of the DWHOS, additional data regarding small pelagics in this habitat are needed for the damage assessment.

One method for acquiring relevant data is through the use of airborne LIDAR (LIght Detection And Ranging). LIDAR is similar to RADAR or acoustics in that energy is propagated through the environment and returned in the form of backscatter from a target, but the energy source in LIDAR is a brief pulse of laser light. Airborne LIDAR is a well established technology and has the additional benefit that a given area can be surveyed rapidly and repeatedly with minimal gear avoidance problems.

NOAA has been deploying a LIDAR system (NOAA Fish LIDAR) for approximately 10 years to measure distributions of epipelagic fish schools and plankton layers (see bibliography for relevant publications and Figure 2 for example plots from the Gulf of Mexico). Given the utility of this instrumentation and the specific problem that it can address, this work plan describes airborne LIDAR surveys in the northern Gulf of Mexico in coordination with a ship-board (McArthur II) sampling program that will help groundtruth the LIDAR measurements. Data returned from this program is intended to provide information on the distribution and abundance of schooling pelagic and other organisms (i.e., herring, sardine, menhaden, bumper, flyingfish, anchovies, silversides, shad, scad, mullet, butterfish, and harvestfish, as well as gelatinous organisms) inhabiting the epipelagic environment from the surface to approximately 20-50 meters.

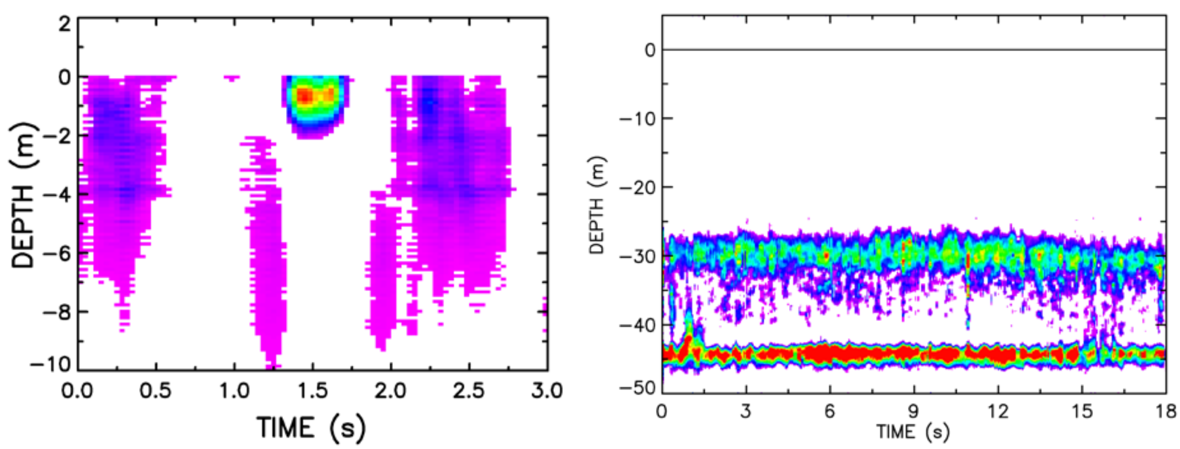

Figure 2. - Plots of LIDAR returns as a function of depth and time along the flight track in the Eastern Gulf of Mexico. The left panel shows the signal produced by a school of mullet right at the surface. The right panel shows a persistent plankton layer at a depth of 30 m over at the ocean bottom which is at about 45 m. Flight speed was about 60 m s^{-1}, so the left panel corresponds to 180 m on the water and the right to just over 1 km.

Objectives and Approach

This plan, the NRDA Late-Summer 2011 Small Pelagics survey, describes the NRDA survey for September-early October 2011 where a subset of the SEAMAP stations, and transits/transects between them, have been selected for sampling of epipelagic organisms (juvenile and adult small pelagic fish and gelatinous zooplankton) in the surface waters of the northern Gulf of Mexico potentially affected by the DWHOS and in surrounding areas.

There are five specific objectives of this work plan:

1. Document the large scale distribution of epipelagic fish and plankton in the study area. Large scale aerial surveys corresponding to, and extending beyond, ship cruise station and tracks will be performed. This is intended to provide information on the distribution of epipelagic organisms and identify spatio-temporal changes that may be associated with hydrographic variability, the passage of weather fronts, etc.
2. Document day/night differences in the distribution of fish and plankton. Selected regions will be surveyed during the day and again at night. Diel vertical migration has been a particular focus of some of the NRDA cruises and this effort will afford additional insights into that process more synoptically than can be accomplished with ship-board surveys.
3. Investigate spatial scales not available to the ship survey. Ship surveys are often a compromise between covering a large enough area and covering an area with sufficient spatial resolution. Aerial surveys can extend beyond the area of ship surveys to ensure that most of the biological concentrations are captured and can also cover some areas with finer resolution to ensure that small-scale processes are captured.
4. Use aerial imagery/LIDAR to direct ship sampling to regions of high biological concentrations. The aerial surveys can easily detect biological hot spots that may be missed by a ship survey. These areas may be located beyond the planned extent of the ship survey or may be located between survey stations or transects. They may even be directly on a surface-transect but occur before or after the ship passes. Any hot spots will be intensively investigated by the aircraft, and the Chief Scientist on the ship notified of its position. If the ship is in the area and can be feasibly redirected to the hot spot identified by the aircraft, the ship will sample in the area of interest for ground truth measurements if logistics allow.
5. Collect biological, physical, and acoustic data aboard the *McArthur II* to help support and interpret the LIDAR observations.

Airborne LIDAR Survey

The NOAA Fish LIDAR system and a video camera will be installed in a suitable twin-engine aircraft. Although the preferred aircraft would be a NOAA Twin Otter out of Tampa, Florida, it was difficult to obtain this platform on short notice. Instead, this work will use a King Air chartered from Dynamic Aviation in Virginia, which has worked with Dr. Churnside in the past. The aircraft will be based near Pascagoula, Mississippi, and we expect to perform surveys from September 20 through October 10. The general area of operations is shown in Figures 3 - 4, which is based on historical surveys conducted by the SEFSC, Gulf states, and the NRDA.

Aerial surveys will be conducted between longitudes 87^{o} and 90^{o} 30’ W and north of 27^{o} 30’ N, and will occupy transects aligned (north-south) with the SEAMAP survey grid during both day and night (see details below). In addition, some survey time (adaptive sampling) will be devoted to characterizing smaller scale physical features such as Langmuir cells, fronts, weed lines, etc. (see below). We expect that the aerial survey will alter the flight path (i.e., add to the planned gridded surveys) to provide higher resolution data in those locations where aggregations are present, such as in convergence zones and areas with weed.

The *MacArthur II* will be used to ground truth the LIDAR survey and will generally sample a subset of the locations surveyed by the aircraft. In some circumstances, as indicated by conditions and based on the location and activities of the vessel, the *McArthur II* will be directed to particular features by the aircraft for targeted field sampling and ground truthing. There will be close coordination of the vessel and the aircraft throughout this effort.

Ship-board Sampling

Ship-board sampling will consist of acoustic methods (towed upward-looking array and standard hull-mounted EK60), trawl net sampling, and visual observations. Day-night paired sampling will be

performed, at times in concert with the aerial survey, to evaluate diel changes. If feasible and subject to logistical constraints and other cruise objectives (such as completion of a sampling station's activities), as judged by the Chief Scientist and vessel officers, the vessel will respond to directions from the aircraft for targeted sampling of particular features. We expect 50-67% of the vessel sampling effort to be at fixed stations, and have provided a list of fixed stations with priorities for the vessel. The actual effort placed on adaptive versus fixed stations will depend on the identification of targeted areas of interest that can be feasibly sampled by the vessel in a timely manner.

In addition, this survey will also take advantage of the opportunity to observe the occurrence of adult and juvenile flyingfish (multiple species in the family Exocoetidae) while transiting between the selected sampling stations. Data on the occurrence of flyingfish will be collected by visual observation only, and no gear will be deployed to target flyingfish. This component is included in this cruise plan because the task was not successfully completed on the July 2011 *McArthur II* cruise due to time limitations, and additional data is needed to evaluate distributions. If the ship identifies large aggregations of flying fish, as indicated by greater than the (running) mean number of flights counted per time, it will notify the aircraft and the aircraft will attempt to fly over and sample these areas, as logistics permit.

General Logistics

This plan will be implemented consistent with existing trustee regulations and policies. All applicable state and federal permits must be obtained prior to conducting work.

Attachments 9 and 9A through 9F provide standard operating procedures (SOPs) for the protection and conservation of marine mammals and any species listed under the Endangered Species Act as appropriate for the vessel and sampling equipment operations to be conducted on this cruise. See in particular the provisions in Attachment 9F when deploying net trawls. Two marine mammal observers will be utilized in this effort,

This particular effort is being developed as a cooperative program, but is ultimately Trustee-led as required by the Oil Pollution Act of 1990 (OPA) regulations. As such, these cruises will be led at sea by a Trustee-appointed Chief Scientist who serves as a Trustee representative. This Chief Scientist will work to ensure that cruise objectives are met and that time at sea is utilized efficiently for collecting information pertinent to the investigation. When not on duty, the Chief Scientist will designate a Watch Lead. This Watch Lead will also be a Trustee representative. The Chief Scientist may be supported on-board by a senior scientist appointed by the Responsible Parties. This senior scientist is to consult with the Chief Scientist on logistical and scientific matters, but ultimate decision making authority rests with the Chief Scientist. The Chief Scientist will also consult as needed with shore-side Trustee support (*i.e.*, Drs. French McCay, Hahn, and Quinlan).

The Captain and Chief Scientist will confer regarding the operational plan and schedule, and any changes to the plan or schedule that are required due to logistics, breakdowns or weather concerns. The Chief Scientist will be responsible for notifying the designated NOAA and RP leads regarding schedule changes, so that each lead may notify staff and adjust their respective staff mobilization schedules, as needed.

Aerial efforts will be led by Dr. Jim Churnside of NOAA.

Methodology

Sampling Stations and Transects

The cruise track and selected stations for the NRDA *McArthur II* Late-Summer 2011 survey are designed to obtain data at offshore and inshore stations, to perform sampling in the areas affected by surface oiling

during July-August 2010, and to sample at stations previously and currently sampled during other NRDA biological surveys (Figures 3 and 4, Table 1). The LIDAR survey design (Figure 4) is designed to meet the objectives described above.

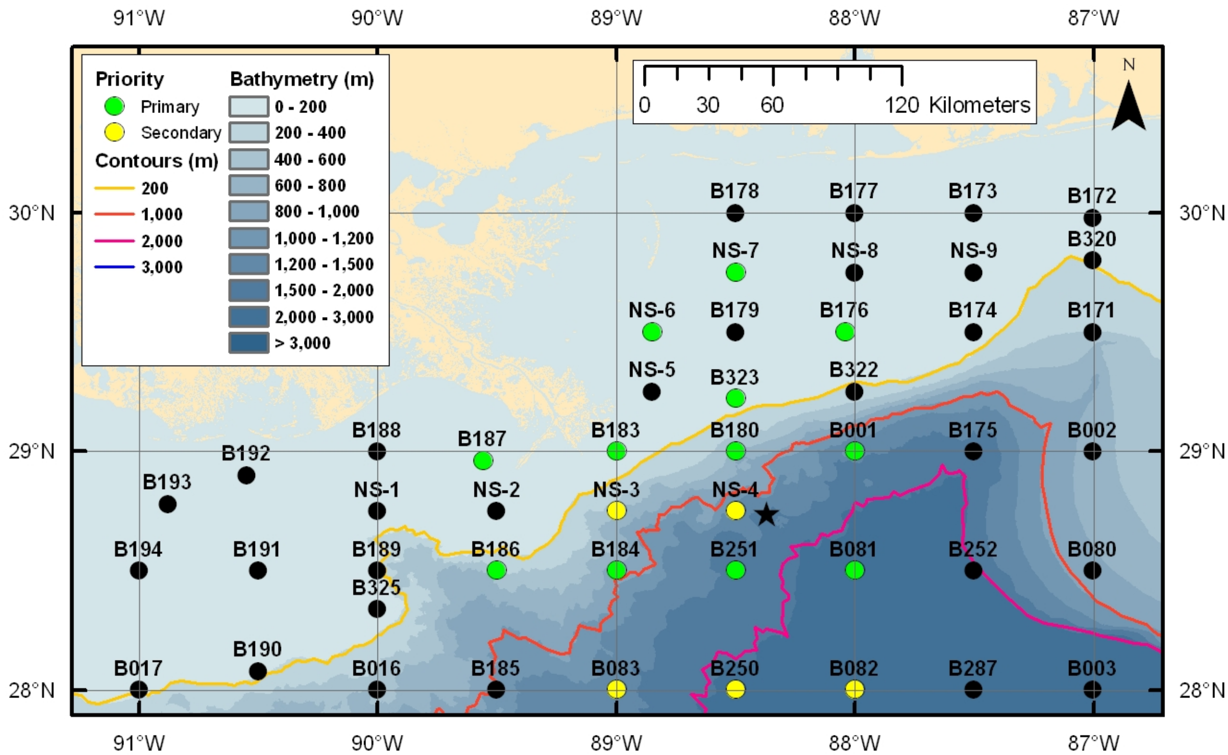

Figure 3. NRDA sampling stations: the star denotes the Deepwater Horizon wellhead position, green and yellow dots denote stations sampled in July 2011 on the McArthur II Epipelagic cruise, and black dots denote nearby SEAMAP stations sampled on other cruises. The twelve green stations will be targeted for sampling on this McArthur II Small Pelagics cruise, time permitting in view of expected sampling activities in response to aircraft sightings and direction.

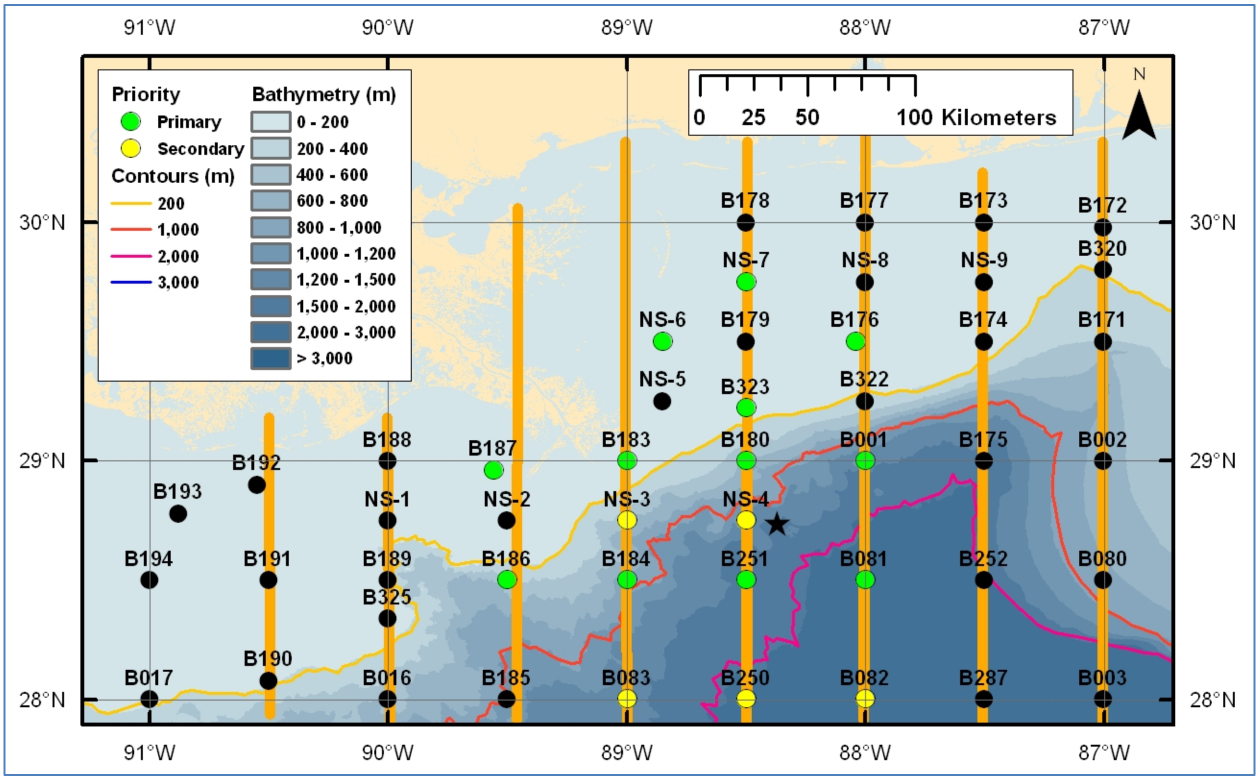

Figure 4. NRDA sampling stations: the star denotes the Deepwater Horizon wellhead position, green and yellow dots denote stations sampled in July 2011 on the McArthur II Epipelagic cruise, and black dots denote nearby SEAMAP stations sampled on other cruises. The twelve green stations will be targeted for sampling on this 2011 McArthur II Small Pelagics cruise, time permitting in view of expected sampling activities in response to aircraft sightings and direction. Yellow lines indicate proposed aerial LIDAR survey tracks.

Table 1. NRDA August 2011 McArthur II Small Pelagics Sampling Stations. It is likely that only twelve stations may be sampled in the 18 days at sea; thus the stations noted by a * (and yellow in Figure 3) will only be sampled if time permits and/or if priority stations cannot be sampled for logistical reasons.

Station Priority Order	Station Number	Longitude (W)	Latitude (N)	Depth Range (m)
1	B176	-88.04	29.5	< 200
2	B001	-88	29	1200-1500
3	B081	-88	28.5	2000-3000
4	B251	-88.5	28.5	1500-2000
5	B180	-88.5	29	400-600
6	NS-7	-88.5	29.75	< 200
7	NS-6	-88.85	29.5	< 200
8	B183	-89	29	< 200
9	B184	-89	28.5	800-1000
10	B186	-89.5	28.5	400-600
11	B187	-89.56	28.96	< 200
12	B323	-88.5	29.22	< 200

Station Priority Order	Station Number	Longitude (W)	Latitude (N)	Depth Range (m)
13*	NS-3	-89	28.75	400-600
14*	NS-4	-88.5	28.75	1200-1500
15*	B083	-89	28	1200-1500
16*	B250	-88.5	28	2000-3000
17*	B082	-88	28	2000-3000

Shipboard Sampling Procedures

Small pelagics sampling will require 24 hour operations. Net sampling will largely be centered around noon and midnight, but can occur anytime at the discretion of the Chief Scientist (i.e., to facilitate the sampling of acoustic/optical targets). Each station will be sampled twice during the day (around noon) and twice at night (around midnight) while avoiding the periods that are +/- 30 minutes of sunrise and sunset. If two tows are not possible at a given station and diurnal period, than a single tow shall be conducted. This protocol is designed to capture changes in densities due to the diel cycle of vertical migration by the biota.

At each station, a CTD profile will be conducted to a maximum depth of 250m (or to 10m shallower than seafloor if the local water depth is <260m). This will be followed by two 20-minute deployments of the towed array and/or trawl net. The towed array is deployed to a constant depth based on the configuration of the sensors (Attachment 12) for the entirety of the 20 minutes, while the net is deployed and towed off the side of the ship, lowering it slowly down to ~40m followed by a slow retrieval (Attachment 13). If sea conditions and boat configuration allow, the towed array and net may be deployed simultaneously. If not, they will be deployed sequentially. Data from paired deployments will allow for inter-gear comparison and ground-truthing.

During the transit between stations, in addition to collecting acoustical data along the route (as feasible), visual observations for flyingfish will be conducted. These observations are based on visual transect procedures as discussed in the literature (see Attachment 11 for a literature review). These surveys will not attempt to speciate individuals, instead counts will be gathered at the family level, concentrating on number encountered.

The following sampling will occur at every station and/or transit during the September 20 – October 7 cruise on the McArthur II.

CTD: At each station prior to the net sampling, a Seabird CTD profiling package will be deployed to 250 m (or to 10m off the seafloor, whichever is shallower) with the following sensors: chlorophyll fluorometer, salinity, temperature, and depth (i.e., pressure).

In general, CTD casts should be conducted while the vessel is drifting. Because the tows are performed over a tow path, as opposed to at a single location, the objective is to characterize the water properties over the general area of the tow. The start and finish locations shall be recorded for both the down- and the up-cast of the CTD. Local conditions in sea state and operational areas will dictate if maintaining position with dynamic positioning (DP) is necessary. It will be recorded whether a cast was completed while drifting or under DP.

Towed Sonar/Echosounder/DIDSON: A multifrequency echosounder (38/120kHz) will be mounted to a tow body and deployed in the upper 2m of the water column in a downward looking configuration. In this configuration, acoustic scattering data can be collected in the upper water column from ~3-50m. Alternatively, if the tow body can be successfully deployed at depth, the echosounder will be mounted

facing up, the tow body deployed at ~20m and data will be collected for the full water column above the unit.

In addition, an imaging sonar (DIDSON) and camera will be mounted to the tow body to ground truth the acoustic data in the upper water column. The DIDSON and camera are able to validate targets within ~15m of the unit. The sonars will be synched with the shipboard sonar system to avoid interference among similar frequencies. For a further description of the data collection methods, please see Attachment 12.

One or two shakedown cruises (September 8-11 and 14-17, the second only if needed) will be used to test and refine the set-up and towing protocols for the towbody-mounted acoustics and cameras. Calibrations of the acoustics will also occur during this shakedown period.

Modified Trawl Net: During the September 20 – October 7 cruise, trawls will be deployed 2-4 times at each station (1-2 day tows, 1-2 night tows, subject to time available and conditions) and oblique tows will be conducted to a maximum depth of 40 m, requiring 24-hour operations. Each tow deployment will be ~20 minutes in duration and will be timed to best capture the differences in diel distribution patterns. Tow duration for the net in the water may be shortened depending on conditions (catch rates, gelatinous organisms, etc.), but will not be lengthened beyond 30 min. For each deployment (day and night), the tows will be conducted centered in time around local noon and midnight. If this is not possible, the tow may still be completed so long as it does not begin until 30 min after sunrise/sunset or end within 30 min of sunrise/sunset. Deployment locations (latitude and longitude) and times, retrieval locations and times, and maximum deployment depth will be logged.

Trawls will be towed at approximately 3.5-4 knots (in order to capture fast moving fishes) to collect organisms distributed in the upper 40m. To determine precise position of the net in the water column, two HOBO time-depth recorders will be mounted to the headrope and footrope. For a further description of the data collection methods, please see Attachment 13.

All samples will be processed and preserved immediately after recovering the nets per the description in Attachment 14. For each pair of net samples (e.g., two taken during the day at a given station, two taken during the night at a given station), one will be preserved in ethanol, and the other in formalin. The ethanol samples provide opportunity for genetic or other analyses, if indicated, whereas the formalin preservation provides a permanent method of preservation requiring less maintenance. Selected individual specimens from the dominant species collected will be frozen and archived for possible food web analysis. All frozen specimens will be fully documented and included in the catch records. If only one net tow is performed, the sample will be split, preserving half in each preservative.

Hull-mounted Acoustics: The vessel's SIMRAD EK60 scientific echosounder system will be used to collect data on acoustic backscatter in the water column. The R/V *McArthur II* has a suite of transducers operating at 12 kHz, 38 kHZ, 120 kHz and 200 kHz frequencies. Hull-mounted acoustic data will be collected throughout the cruise and during all sampling, subject to the protocols related to protected species, as described in Attachments 9 and 9A-9F. The purpose of the acoustic surveys is two-fold: (1) collection of bathymetry data to understand seafloor morphology and plan sampling depths, and (2) potential identification of backscatter anomalies in the water column that may indicate biota. For a further description of acoustic data collection including a deep water collection SOP, please see Attachment 10.

Flying Fish Observations: Visual counts of flyingfish will be conducted in 10-minute time segments during daylight hours while transiting between sampling stations. During longer transits between the offshore sampling stations, at least 2 hours of each transit (twelve 10-minute time segments) will be used

to conduct flyingfish visual surveys. During shorter transits between the sampling stations that are closer inshore, at least 1 hour of each transit (six 10-minute time segments) will be used to conduct flyingfish visual surveys. The ship's location (latitude and longitude) will be recorded at the beginning and end of each 10-minute time segment. Four observers will simultaneously observe flyingfish during the flyingfish visual surveys: two observers will be stationed at the bow of the ship and two observers will be stationed on the bridgewings (the space on either side of the bridge). One on the bow and one at the bridgewings will be facing towards port and likewise the other two will be facing towards starboard. Each observer will be making independent counts of flying fish. While maintaining a constant bearing at 7 knots, each observer will count (with the use of a hand-held click-counter) the number of flyingfish that they observe leaping from the water, either anywhere on their side of the ship (bow) or within the viewing frame (on bridgewings). At the end of each 10-minute time segment, the observer will record the number of flyingfish on a datasheet and reset the counter. Each observer should conduct visual count surveys for no more than six consecutive 10-minute time segments before resting for at least 30 minutes. For a detailed description of the flyingfish visual survey design and methodology see Attachment 11.

Airborne LIDAR: Concurrent with the shipboard sampling, LIDAR will be deployed in the time window of September 22 – October 10, 2011, on a small aircraft, as described above and in Attachment 16. The aircraft will fly at 1000 feet, 5 knots, for a duration of ~5 hours per survey. We anticipate ~75 hours of survey time for this effort. All phases of the LIDAR survey will be conducted at least two times, once in daylight with a repeat at night. There will be two broadscale surveys, and a set of high resolution process-oriented studies.

Phase 1 – A high resolution broadscale survey will be conducted first. The survey track is depicted in Figure 4 and consists of a series of north-south transects spaced ½ degree apart within a box extending from the shoreline to 27.5 degrees North, and from 87 to 90.5 W.

Phase 2 – Adaptive sampling: A series of 8 boxes measuring 20 nautical miles on a side will be surveyed using a series of flight tracks spaced 1 nautical mile apart. One of these grids will be located (and centered) over the wellhead. Others will be deployed to survey features of interest in the study area present and identified during the Phase 1 survey. These other grids will be located in areas such as the open Gulf (representative locations), the nearshore shelf (representative locations), in areas where dense aggregations of small pelagics are noted, and in areas with convergence zones and other frontal features. Dr. John Quinlan and Dr. Churnside will discuss locations for this adaptive sampling and provide briefings in emails (including requests for comments) to the distribution list identified in the Data management section below.

Phase 3 – This final phase will be a repeat of the broadscale Phase 1 survey, but with 1 degree spacing between transects. This will provide another set of observations across the study region to assess how the system has changed.

Additionally, there will be two flights over the ship during each survey (inbound and outbound flights) and the ship will be directed to hotspots in real time. The ship will also be informed of the LIDAR survey location throughout the effort and can be pre-positioned for sampling.

Data Management and Trustee Oversight

All profile, acoustic, and other electronic data (including photographs and LIDAR returns) 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. Data is generally organized by station and all electronic data files will be filed into this structure by NOAA NRDA data manager with the assistance of the operator/data logger. The hard drive

will be duplicated in full immediately following the cruise and aircraft deployments, and the duplicate hard drives will be provided to (1) the Louisiana Oil Spill Coordinator's Office (LOSCO) on behalf of the State of Louisiana, and to (2) Cardno ENTRIX on behalf of BP. The original hard drive shall be kept in a secure facility in trustee custody.

Under the direction of the Chief Scientist, a NOAA Data Manager on board the vessel will summarize sampling activities and scientific observations throughout the day and email a daily report to a designated list of recipients and NOAA NRDA [redacted] by midnight each day of the cruise. The Principal Investigator of the LIDAR work, Dr. Churnside, will also provide daily reports, emailed to this distribution list.

By the end of the cruise, all documentation produced onboard, 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 LOSCO, on behalf of the State of Louisiana, and BP/Cardno ENTRIX at the end of the cruise. Attachment 8 contains additional details on the NRDA field sampler data management protocol. Results of LIDAR data analysis will be provided to the Trustees and BP within 90 days of the completion of field surveys.

Logistics

Aircraft

King Air chartered from Dynamic Aviation

Personnel aircraft

2 NOAA LIDAR scientists

Vessel

Operations will be completed on the NOAA Ship *McArthur II*, currently ported in Pascagoula, MS.

Personnel for NOAA Ship McArthur II

Chief Scientist: Dr. David Wells
Alternate Watch Lead
2 NOAA Data Managers
3 NOAA Samplers
2 Marine mammal observers
2 Cardno ENTRIX Representatives
2 CSA technicians

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.

Budget Chart #1for McArthur II, September 20 – October 7, 2011.

Field Survey Costs	Days	Day Rate	Total
NOAA Labor (days):			
NOAA Chief Scientist	[redacted]	[redacted]	$45,000
NOAA Alternate Watch Lead	[redacted]	[redacted]	$36,000

3 Plankton/Net handlers/Flyingfish observers	[redacted]	[redacted]	$101,000
2 marine mammal observers	[redacted]	[redacted]	$54,000
2 Data Managers	[redacted]	[redacted]	$27,000
Misc Costs Sample Handling	1	$10,000	$10,000
Travel	1	$15,000	$15,000
DIDSON Equipment rental/insurance	18	500	$9,000
Total NOAA NRDA shipboard (not including vessel)			**$297,000**
NOAA Vessel Cost			$500,000
TOTAL			**$797,000**

Vessel Staffing Days/Trips based on 18 potential cruising days. Labor is estimated days and cost.

Budget Chart #2 for McArthur II Shakedown Cruises, September 8-11, 14-17, 2011.

Field Survey Costs	Days	Day Rate	Total
NOAA Labor (days):			
NOAA Chief Scientist	[redacted]	[redacted]	$20,000
1 Data Managers	[redacted]	[redacted]	$12,000
Travel	1	$2,000	$2,000
DIDSON Equipment rental/insurance	8	500	$4,000
Total NOAA NRDA shipboard (not including vessel)			**$28,000**
NOAA Vessel Cost			$200,000
TOTAL			**$228,000**

Vessel Staffing Days/Trips based on 8 potential cruising days. Labor is estimated days and cost.

Budget Chart #3 **LIDAR Budget**

Field Survey Costs	**Total**
Aircraft Charter	$150,000
LIDAR mobilization/demobilization	TBD
LIDAR Personnel	$65,000
LIDAR data analysis	$60,000
LIDAR Travel and Supplied	$25,000
Total LIDAR	$300,000

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 2). Vessels will report in daily (Attachment 5) using the attached situation report (Attachment 6). Aircraft charter will be handled by a third party, but will conform to NOAA aircraft safety requirements.

Laboratory
At-sea transfer of samples is not anticipated as no samples with designated hold times are planned. At the end of the cruise, small pelagic fish samples will be transported under NOAA NRDA Chain of Custody to Dr. Tracey Sutton's laboratory at Virginia Institute of Marine Science (VIMS) College of William and Mary, VA where they will be stored in a secure facility. Food web samples will be transferred and held under NOAA chain of custody at Alpha Analytical (Mansfield, MA), and stored in a secure facility. Detailed description of analyses to be conducted on samples will be specified in a separate workplan (currently under development).

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.

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 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 Analytical Quality Assurance 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 Analytical Quality Assurance 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).

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Attachments

Attachment 1. Summary of SEAMAP Historical Shelf and Offshore Plankton Data
Attachment 2. NRDA_Ops_Safety_plan_08DEC2010
Attachment 3. MC252 HSSE Incident Reporting Final 02 May 10 rev 1
Attachment 4. Transfer of Personnel and Material at Sea 070510
Attachment 5. NRDA Offshore Vessel Reporting 071311
Attachment 6. DWH Vessel Daily SitRep
Attachment 7. MC252 Analytical QAP V2.2
Attachment 8. NRDA_Field_Sampler_Data_Management_Protocol_10_23_2010
Attachment 9. Protected Species Interaction Prevention Procedures for No-impact Gear Types
Attachment 9A. 20110722_Final NRDA Aug 2011 Small Pelagics Plan BMPs
    Annex A. NMFS Protocol for Dead Entangled Small Cetaceans
    Annex B. Sea Turtle Retrieval Resuscitation Protocols
Attachment 9B. Lazyline-DIDSON Report_March08_DHataway
Attachment 9C. Turtle Stranding Report Forms_STSSN
Attachment 9D. Vessel Strike Avoidance Guidance
Attachment 9E. 201106016_Final acoustic measures_NRDA BMPs.pdf
Attachment 9F. Mid-water trawl sampling mitigation measures_summer&fall cruises_Final
Attachment 10. Acoustic Data Collection EK60
Attachment 11. Flyingfish Visual Survey Protocol
Attachment 12. Towed Acoustic Array Data Collection
Attachment 13. Net Specifications and Deployment
Attachment 14. Net sample processing protocols
Attachment 15. Gelatinous Zooplankton Processing Protocols
Attachment 16. Airborne LIDAR Survey

Deepwater Horizon Oil Spill (DWHOS)
Water Column Technical Working Group

NRDA Late-Summer 2011 McArthur II
Small Pelagic Fish Sampling
Cruise Plan

Sampling Vessel: R/V *McArthur II*

Sampling Dates: September 10 – October 10, 2011

October 8, 2011

Approvals

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

	Printed Name	Signature	Date
BP Approval	Lawrence K Malmer	[signature]	Oct. 14, 2011
Federal Trustee Approval	Jessica White	for Lisa DiPinto Jessica White	10/14/2011
Louisiana Approval	KAROLIEN DEBUSSCHERE	FOR ROLAND GUIDRY [signature]	11/09/11