


Original Draft: June 3, 2010
Latest Revisions: July 10, 2010

**WORK PLAN FOR ESTIMATING OILING AND MORTALITY
OF BREEDING COLONIAL WATERBIRDS FROM THE
DEEPWATER HORIZON (MC 252) OIL SPILL
(BIRD STUDY #4)**

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INTRODUCTION

The Deepwater Horizon (MC 252) oil spill began April 22, 2010. Oil spill related injury to wildlife is of major concern to the natural resource trustees and the American public. Seabirds, colonial waterbirds, coastal marsh birds, and shorebirds are particularly susceptible to impacts from the oil. Several work plans have been developed to concurrently evaluate oil spill related injuries to these different avian guilds. This plan, the fourth in a series of avian injury ephemeral data collection studies, specifically seeks to evaluate injury to colonial waterbirds (seabirds such as gulls, terns, and pelicans; and wading birds such as egrets and herons) by addressing the following objectives: (1) estimation of the percentage of adult and sub-adult birds that are visibly-oiled within representative breeding colonies and roosting sites throughout the study area, and (2) estimation of mortality rates of both oiled and unoled adult birds via radio and satellite telemetry. The initial emphasis of this study encompasses the oil-impacted coastal areas of Louisiana and unoled reference areas outside of the Gulf of Mexico. Expansion into other areas may be included as shoreline and/or near shoreline areas become oiled.

Waterbirds often nest in mixed colonies where all species are of interest for assessing impacts of oil. Nevertheless, for the purposes of sampling, we have identified primary species (relatively common and widespread species that represent groups of species with similar nesting habits) and secondary species that may be specifically evaluated in additional areas as necessary. The primary species are: great egret (*Ardea alba*), brown pelican (*Pelecanus occidentalis*), royal tern (*Thalasseus maximus*), and black skimmer (*Rynchops niger*). Secondary species are reddish egret (*Egretta rufescens*), laughing gull (*Leucophaeus atricilla*), sandwich tern (*Thalasseus sandvicensis*), and least tern (*Sternula antillarum*) (see Table 1). This list may change if the initial sampling area expands, and as impacts of the spill demand.

Initially, colonies and roost sites of primary species will be targeted for regular sampling, but if there is poor representation of the secondary species within the sample, additional colonies may be selected to ensure adequate coverage of secondary species as well. The intent is to insure that all common breeding species of waterbirds are included by selecting areas with colonies and/or

roost sites that include adequate numbers of the primary and secondary species for rigorous sampling.

Mortality of colonial waterbirds could be estimated with an avian injury model for each species or species group (conceptual model as shown below):

[Number of waterbirds present in areas affected by oil^a] * [the estimated proportion of birds that are visibly oiled^b] * [the mortality rate of oiled birds with transmitters^b, corrected with estimates of baseline mortality and/or possible transmitter effect^c]

^a Derived primarily from aerial survey data, collected under a different study plan

^b Derived primarily from this study, and/or other relevant data.

^c Derived primarily from this study, and/or other relevant data.

As indicated in the footnote above, population abundance could be estimated from colony photographs taken from aerial survey data collected under another work plan (Aerial Surveys; Bird Study #2) and from ground and boat surveys conducted by trustee agencies and other groups that are part of ongoing monitoring programs.

Breeding colonies and regular roost sites present cost-effective opportunities to collect data on the proportion of individual waterbirds that are visibly oiled. The proportion of oiled birds is also being estimated on beaches where carcass surveys are being conducted (Beached Birds; Bird Study #1) and at sampling points in marshes where secretive marsh birds are being studied (Secretive Marsh Birds; Bird Study #3). These data may be used to derive overall temporal and spatial estimates of the proportion of live-oiled birds of various species.

The proportion of visibly-oiled birds that die (an input for the above model) will be estimated by obtaining data derived from the placement of satellite transmitters on a sample of visibly oiled birds in colonies. Transmitters also will be placed on a sample of birds in locations outside of the Gulf region where no oiling is occurring (and where trajectory models indicate oiling probabilities are lowest) to evaluate transmitter effects on survival of birds that are not visibly oiled. Please see appendix 2 for further information.

BACKGROUND

Oil adherence to water resistant feathers will cause matting and loss of feather integrity, which subsequently may result in mortality or various negative sub-lethal effects to condition or health (Bowman 1995, Vos et al. 2000). Sub-lethal exposure to oil can significantly reduce hatching and fledging success in a dose-dependent manner particularly during late incubation and early in the post-hatching period (Butler et al. 1988). Laboratory studies demonstrate that reduced hatching success can occur when oil is transferred from nesting birds to eggs during incubation (Albers and Szaro 1978, Albers 1980). For example, breeding success of cormorants was 50% lower in oiled colonies compared to unoiled colonies following the Prestige oil spill in Spain (Velando et al. 2005). In brown pelicans, oil from a spill was transferred to eggs from adults during incubation and hatching success of oiled eggs was significantly less than unoiled eggs (Parnell et al. 1984).

STUDY AREA

Waterbird colonies and roost sites, where oiling has been recorded (by personnel from wildlife response, refuges, WMAs, parks, SCAT teams, or other sources) will be surveyed initially along the Louisiana coast in areas where observations can be made from a boat or on foot at an appropriate distance to avoid disturbance. Outside this intensive initial focus area in Louisiana a sample of colonies would be monitored, at a lower density initially along the coasts of TX, AL, MS and FL. A reference area outside the of the oil spill zone will be selected.

SAMPLING DESIGN

Objective 1: Estimate the percentage of adult birds that are visibly-oiled within representative areas (e.g., Area Contingency Plan [ACP] units identified by the U.S. Coast Guard, Figure 1) containing colonies or roosts to record the proportion of visibly-oiled and not visibly-oiled birds of each common species.

Sampling Frame.—The sampling frame is all ACP units that have at least 50 colonial waterbirds of one or more species that can be regularly classified for degree of oiling and for which regular access is permitted (e.g., land owner permission has been granted).

Sample Units.—The sample unit is an observation (on a particular day) in one area (ACP units) of all birds of each species that can be identified as being visibly oiled or as not visibly oiled following guidance under appendix 1. As indicated, the observations will be made at breeding colonies or roost sites and can include dense flocks or loose aggregations.

Sample Selection — The current pattern of oiling in the Gulf of Mexico, suggests a multi-tiered approach to sample selection. In the areas currently affected by oiling, a systematic sampling of each ACP unit that contains colonies, roost sites, and/or congregational areas with at least 50 colonial waterbirds will be conducted. In order for the ACP to be sampled, the colonies, roosts and/or congregations must also contain one or more species whose oiled status can be regularly classified. This sampling will likely occur in at least 50% of the ACP units. A less intense sampling effort (initially no more than 50% of the ACPs) would be implemented, if necessary, in western Louisiana, Texas, and in Florida including, because of the Loop Current, the Florida Keys, Dry Tortugas, and potentially elsewhere. Emphasis in the expanded zone could be primarily on National Wildlife Refuges, Parks and Estuarine Reserves and state areas with permission of the land managers.

Appropriate scientific and other use permits will be obtained for all sample locations. At National Parks, resource specialists will accompany survey crews, at least initially. It is expected that a representative for the property being visited may accompany survey crews, if managers desire.



Figure 1. Map showing Area Contingency Plan segments in Louisiana. Not all segments contain colonies, roosts, or congregational areas of sufficient size.

Table 1. Indicator species targeted for colony selection to monitor oiling rates of breeding colonial waterbirds (species selection may change if the potential impact area expands).

Representative group	Primary Species	Secondary Species
Wading Birds (including coastal herons, egrets, ibis, etc. that nest in mixed colonies)	<i>Great Egret</i>	<i>Reddish Egret</i>
Large-moderate sized seabirds that typically forage nearshore (< 20 km from the shore)	<i>Brown Pelican</i> ^a <i>Royal Tern</i> ^b	<i>Laughing Gull</i> ^c <i>Sandwich Tern</i> ^b
Moderate-small sized seabirds that typically forage along the coast or in estuaries	<i>Black Skimmer</i> ^d	<i>Least Tern</i> ^e

^a Plunge-diver specializing on menhaden and other schooling fish

^b Surface or near-surface foragers specializing on schooling fish

^c Surface forager, generalist

^d Surface skimmer specializing on small surface fish such as *Fundulus* spp.,

^e Surface or near-surface foragers specializing on small fish

Number of Birds Sampled in ACPs.— All species of colonial waterbirds are of interest, however, observers will strive to classify at least 30 individuals of each primary or secondary species that is present in an ACP (Table 1) during each sampling occasion. Observations of other species will be obtained as conditions and time allows.

Data Collection.—Observations of birds at sampling sites will be made every five days with good quality 10 x 40 binoculars and/or with a 20-60x spotting scope. Typically no more than two hours would be spent at a colony or roost site for an oiling observation bout. Only birds that can be observed well enough to be confidently classified as being visibly-oiled or not visibly-oiled will be included in the sample (i.e., we will not count all birds in a flock, record the number of visibly-oiled birds, and assume all the others are visibly unoiled). Birds that cannot be observed well enough to be classified as either visibly-oiled or not visibly-oiled will not be used in determining the oiling rate under this objective. The proportion of visibly oiled birds in the observable population will be reflective of the percentage of visibly oiled vs. not visibly oiled

birds in the non-observable population. A laser range-finder will be used to categorically measure (e.g., to the nearest 10 m) the distance between the observer and group of birds being observed. Measurements will not be needed for every bird, but will be used to help calibrate 10 m categories.

Survey Frequency and Duration.—Colonies or regularly-used roosting area will be surveyed from ground observation points distant from the colony to eliminate disturbance. Colonies and roosts will be surveyed approximately once per 5-day period for one month following execution of a contract for this workplan. After 30 days, BP and the Trustees will evaluate all avian percent oiling data and make a determination regarding the need for additional work under this objective. The Trustees reserve the right to continue this workplan component for the originally-proposed time frame of four months (minimum) depending on their assessment of the spill status (e.g. source control and distribution of oil impacts).

Data Analysis — Estimates will be made of the percentage of visibly-oiled birds over time (i.e., over 5 day intervals) in each area. Data on distances from observers to birds will be used to estimate detection probabilities for various species.

Objective 2: Estimate of colony-specific mortality rates of adult birds determined via radio and satellite telemetry in both oiled and unoiled areas.

Capturing and handling birds will occur mainly at roost sites or edges of breeding areas, as long as birds in the colony are not incubating eggs, and all appropriate permits (such as scientific research permits on National Parks and Special Use Permits on National Wildlife Refuges) will be obtained prior to implementing Objective 2.

Sample Unit.—Single adults

Sample Selection.— Individual oiled birds will be captured opportunistically.

Sample Size.— To determine adult mortality rates, at least 40 individuals for each of the primary species (great egrets, brown pelicans, royal terns, black skimmers) will be selected for telemetry studies in colonies or roost site areas where oiled adults are observed. A similar number of transmitters will be deployed on the same species in colonies or roost sites in areas outside the region where oil from this spill has not been recorded in nearshore marine waters or on land.

Data Collection.—Satellite transmitters (see Appendix 2 for rationale and details) with activity sensors and radio transmitters will be deployed to evaluate mortality rates of egrets, pelicans, and royal terns. Blood samples and feather samples will be taken from all captured individuals. Blood samples will be collected and prepared for archiving in the following manner. Hematocrit will be read using microcapillary tube, and a blood smear will be stained, fixed, and archived. Whole blood will be centrifuged to separate plasma and red blood cells, transferred to separate cryovials, and stored at -80 ° Celsius.

Transmitters will be monitored for up to four months. When activity sensors indicate that a bird has died, the radio transmitter will be used to locate the carcass. Trackers will use helicopters in accordance with Incident Command flight operations protocols to attempt to locate the carcass. Personnel on the ground/water (or from the helicopter, if one is used for tracking and if landing is possible without harming surrounding habitat or birds) will retrieve the carcass. The carcass will be collected, processed, and deposited at the appropriate Intake Center, according to the Deepwater Horizon (MC 252) Oil Spill Carcass Collection Protocol. Transmitters will be removed from the carcass before submitting it to the intake center. Birds with transmitters that are turned into the intake centers will be categorized as dead birds.

Only radio transmitters with mortality switches will be placed on black skimmers because they are too small to carry both devices based on U.S. Geological Survey standard guidance that the mass of the device will not exceed 3% of the individual's body mass. Trackers will use boat and/or aerial surveys to monitor the birds. Upon receiving a mortality signal, trackers will locate the carcass, and personnel on the ground/water (or from the helicopter, if one is used for tracking and if landing is possible without harming surrounding habitat or birds) will retrieve the carcass.

SAMPLE AND DATA HANDLING

Chain-of-custody procedures will be observed at all times for all samples. All samples will be transferred with appropriate chain of custody forms.

All field and laboratory data will be collected, managed and stored in accordance with US EPA Good Laboratory Practice regulations (GLPs) to the extent practicable. In accordance with GLPs, all field and laboratory work, and the calibration and use of field and laboratory equipment (e.g. scales, hand held GPS devices, etc.) shall be conducted using written Standard Operating Procedures (SOPs). Applicable SOPs will be completed prior to the implementation of the field study. Documentation of appropriate training on particular equipment and/or specific field study protocols may be kept on file at Biodiversity Research Institute for the duration of this project. Ultimately, all data (including electronically archived data), and original data sheets or electronic files, must be transferred to the U.S. Fish and Wildlife Service and other Trustees.

In the event that samples are sent to a laboratory for analysis, 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 (for data regarding the natural resources managed by the state of Louisiana) and to 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 ENTRIX. 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 to all trustees and ENTRIX. 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. 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 ENTRIX."

BUDGET

A description of the budget for this study plan is shown in Table 2. The budget covers all activities described in this study plan for four to eight months, depending upon task. This budget does not include costs associated with (i) expanding the work to areas westward toward Texas or work within the coastal areas of Florida, nor (ii) radio/satellite tracking of adults and retrieval of carcasses beyond the 4-month period. The scope of the study plan and the budget may be expanded upon mutual agreement of the Trustees and BP.

Table 2: Budget for the Work Plan for Estimating Oiling and Mortality of Breeding Colonial Waterbirds from the Deepwater Horizon (MC 252) Oil Spill. Bird Study #4

Category	Item	Unit (hrs)	Cost/Unit	Item Cost
Personnel	Principle investigator	800	\$180	\$144,000
	On-Site Manager	800	\$105	\$84,000
	Photo Manager	800	\$90	\$72,000
	On-site Data Assistant (2)	1280	\$75	\$96,000
	Off-site Data Assistant	640	\$75	\$48,000
	QA/QC Coordinator	640	\$90	\$36,000
	Logistics coordinator	800	\$75	\$60,000
	Telemetry Data Analyst (off-site)	768	\$120	\$92,160
	Telemetry Data Assistant (off-site)	844	\$75	\$63,300
	GIS Spatial analyst (off-site)	1200	\$90	\$108,000
	Lead Veterinarian	320	\$120	\$38,400
	Field Veterinarian (2)	1600	\$90	\$144,000
	Adult oiling rate Project Coordinator	400	\$105	\$42,000
	Louisiana Field Crew Leader #1	200	\$90	\$18,000
	Field Assistant (2)	400	\$75	\$30,000
	Louisiana Field Crew Leader #2	200	\$90	\$18,000
	Field Assistant (2)	400	\$75	\$30,000
	Mississippi/Alabama Field Crew Leader #3	200	\$90	\$18,000
	Field Assistant (2)	400	\$75	\$30,000
	Florida Field Crew Leader #4	200	\$90	\$18,000
	Field Assistant (2)	400	\$75	\$30,000
	Adult Telemetry Project Coordinator	800	\$105	\$84,000
	Egret Project Leader	200	\$105	\$21,000
	Egret Field crew leader	800	\$90	\$72,000
	Field Assistant - Egrets (2)	1600	\$75	\$120,000
	Pelican Field Crew Leader	800	\$90	\$72,000
	Field Assistant – Pelicans	800	\$75	\$60,000
	Telemetry (Tracking) Field Crew Leader	800	\$90	\$72,000
	Field Telemetry Biologists (5 Trackers X 4 mo)	4000	\$75	\$300,000
	Tern/Skimmer Project Coordinator	1200	\$105	\$126,000
	Tern/Skimmer Field Crew Leader	400	\$90	\$36,000
	Field Assistant - Tern/Skimmer (2)	1600	\$75	\$120,000
	Site Coordinator - Terrebonne Parrish	400	\$90	\$36,000
	Site Coordinator - Belle Pass/Grand Isle	400	\$90	\$36,000
	Site Coordinator - Breton Island NWR	400	\$90	\$36,000
	Site Coordinator - LA/MS Border	400	\$90	\$36,000

Travel	Airline tickets	50	\$900	\$45,000
	Car rental (10 trucks x 120 days)	1200	\$75	\$90,000
	Truck Gas (estimated 64,000 miles @ \$0.25/mi)	64000	\$0.25	\$16,000
	Boat gas			\$60,000
	Boat rental and Guide (6 per day x 120 days)*	720	\$600	\$432,000
Housing	Hotel and per diem - PI (days)	30	\$175	\$5,250
And per diem	Hotel - project coordinators (3 people)	250	\$125	\$31,250
	Hotel - field crew leaders (10 people)	660	\$125	\$82,500
	Hotel - Egret Project Lead	30	\$125	\$3,750
	Hotel - Tern/Skimmer Field Expert	60	\$125	\$7,500
	Hotel - field biologists (120 person-weeks)	840	\$125	\$105,000
	Per diem (all on-site staff, 120 days)	1870	\$50	\$93,500
Equipment/ Supplies	Dedicated Computers, Cameras, GPS rental			\$60,000
	On site lab needs			\$40,000
	Blood sampling supplies			\$10,000
	Capture Equipment (net guns, cannon nets, etc.)			\$8,000
	Capture Supplies (mist nets, bow nets, traps)			\$20,000
Telemetry	Data satellite transmission costs/unit	240	\$1,500	\$360,000
	Radio telemetry equip. rental (e.g., receivers)			\$30,000
Analysis	TPAH analysis blood samples*	320	\$150	\$48,000
	Preparing blood for measures - on site supplies	320	\$250	\$80,000
Administ.	Administrative overhead on subcontracts *)		20%	\$96,000
Subtotal				\$4,170,610
Contingency	Misc. equip, supplies, other unknown expenses		10%	\$417,061
BRI Total				\$4,587,671
Telemetry	Satellite Transmitter cost ¹	240		\$872,125
	Radio Transmitter cost (for oiled adults)	320	\$250	\$80,000
Telemetry Total				\$952,125
TOTAL BP Cost				\$5,539,796

¹ An invoice for satellite transmitter costs (\$872,125) has already been presented to BP. It will only need to be paid once.

FWS Tracking Costs (non-BP):

\$1,564,800 has been reserved for flight operations to track radio tagged skimmers and to retrieve satellite tagged birds that may die during the 4 month study. Of the reserved amount, up to \$391,200 has been approved for tracking radio tagged skimmers and the remainder is to be expended on a per carcass basis, up to 240 carcasses, where the cost per carcass is not to exceed \$4,890 per satellite tagged bird that dies during the study. Only if all satellite tagged birds die in the 4 month study period will the entire reserved amount of \$1,564,800 be expended.

All satellite and radio tags not used and those that are retrieved during the study will be returned to BP or their representative.

Table 3. FWS Tracking Costs (non-BP)

Bird Tracking	Helicopter flight costs	480	1400	\$672,000
	Plane costs	1440	620	\$892,800
FWS Flight OPS				\$1,564,800

Potential Additional Budget Items:

BP has agreed to fund, as cooperative, all activities identified in Table 2. BP and the Trustees agree that Objective 2 (percent oiling) is an important study component. However, BP has agreed to only provide funding for this objective for the first 30 days, with the understanding that BP and the Trustees will jointly evaluate all avian oiling data at that time. BP will provide the Trustees with its affirmative or negative decision to provide additional funds at that time. Given the logistical difficulties associate with re-mobilizing trained field crews, the Trustees reserve the right to continue this workplan component for the originally-proposed time frame of four months (minimum) depending on their assessment of the spill status (e.g. source control and distribution of oil impacts). The costs associated with this continuation, which BP does not support, are outlined below in Table 4.

Table 4. Costs to Estimate Percent Oiling for an Additional 3 months

Personnel	Adult oiling rate coordinator	1200	\$105	\$126,000
	Louisiana Field Crew Leader #1	600	\$90	\$54,000
	Field Assistant (2)	1200	\$75	\$90,000
	Louisiana Field Crew Leader #2	600	\$90	\$54,000
	Field Assistant (2)	1200	\$75	\$90,000
	Mississippi/Alabama Field Crew Leader #3	600	\$90	\$54,000
	Field Assistant (2)	1200	\$75	\$90,000
	Florida Field Crew Leader #4	600	\$90	\$54,000
	Field Assistant (2)	1200	\$75	\$90,000
Travel	Airline tickets	10	\$900	\$9,000
	Car rental (4 trucks x 90 days)	360	\$75	\$27,000
	Truck Gas (estimated 10,000 miles @ \$0.25/mi)	10000	\$0.25	\$16,000
	Boat gas			\$15,000
	Boat rental and Guide (3 per day x 90 days)*	270	\$600	\$162,000
Housing and per diem	Hotel - project coordinators (1 person)	90	\$125	\$11,250
	Hotel - field crew leaders (4 people)	360	\$125	\$45,000
	Hotel - field biologists (8 people)	720	\$125	\$90,000
	Per diem (all on-site staff, 120 days)	1170	\$50	\$58,500
Total				\$1,135,750

LITERATURE CITED

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[submit with the associated BIRD SEARCH EFFORT and BIRDS COLLECTED DATA FORM]

Weather: _____
(describe briefly)

Wind Direction: _____
(Blowing toward or away from shore)

Visibility: <0.1 mi 0.1 mi 0.5 mi 1.0 mi >1.0 mi

[illegible]

1. Record degree of oiling for each bird, record species if possible, if not record guild (waterfowl, shorebird, diving bird ...)
2. If species exhibits more than one behavior, record the number of birds for each behavior (e.g., 25 flying / 10 standing)
3. Count starts at the observer and extends to the first bird for which oiling cannot be determined
4. Use a new data sheet for each live bird survey location

Database Form ID: _____

Database entry from this data sheet by (print and sign): _____

Date Entered: _____

Rev 6.13.10

Appendix 2. Rationale and methodologies for determining mortality rates of unoiled and sub-lethally oiled birds using radio and satellite telemetry

Telemetry on visually unoiled birds

The objective of placing telemetry on visibly unoiled birds is to estimate baseline mortality, including the potential for negative effects of the telemetry equipment on the survival of individual birds. It is acknowledged that, given the magnitude of this event, if a visibly unoiled bird equipped with a transmitter is released within the northern Gulf of Mexico, it has a high probability of switching categories from unoiled to oiled. Therefore, it will be necessary to monitor unoiled individuals of the primary and/or secondary species outside of the Gulf of Mexico. The measured mortality rates of birds known to have been oiled will then be appropriately compensated using a correction factor that contemplates estimates of true baseline mortality rates/telemetry effect (from telemetry of non-oiled birds, pre-spill information and/or other relevant data). This adjusted rate will then be used to develop a specific mortality rate for each species of colonial waterbirds in accordance with the conceptual model (i.e., mortality rate for species = # birds X % oiled X adjusted mortality rate).

Satellite transmitters

As indicated above, a subset of adults will be chosen for study of survival of oiled and unoiled colonial waterbirds of each of the primary species. Capture techniques include net gun, modified footholds, mist nets, and night-lighting. Individuals will be equipped with a North Star Platform Transmitting Terminal (PTT) satellite transmitter, which will last > 1 year. All transmitters will be attached as backpacks and will have activity and temperature sensors. Dedicated satellite transmitters from North Star and with unique transmission codes will be provided through ARGOS. Satellite transmitters will provide on- and off-site movements, survival information, and potentially, scavenging rate data. Transmitters can also provide more long-term monitoring outside of this study window.

Radio transmitters

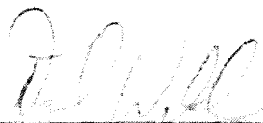
Besides satellite transmitters, individuals will be equipped with appropriately-sized radio transmitters built by ATS coupled with the satellite package on larger birds (great egrets,

pelicans, and royal terns). Skimmers are too small for both devices, so only radio transmitters will be placed on them, and mortality will be initially indicated when a bird fails to return to its colony after each night's foraging. Radio transmitters will be attached using glue and/or small backpack devices. These devices are expected to transmit for up to 4 months but body molt may result in loss of radio transmitters a little sooner than the extent of the battery life for some species. Radio transmitters on larger birds could last one year, since transmitters with larger batteries will be placed on the larger birds. The radio transmitters provide a way to quickly find carcasses when the activity switch on the satellite transmitter indicates mortality has occurred. This is useful in evaluating where these birds die and to evaluate variation in the amount of oil on birds. When a "mortality signal" is received, every effort will be made to recover the individual as soon as is practicable but only if this can be done without disturbance to a breeding colony. Each mortality event will be photographed with a geo-referenced stamp and will be archived. Wildlife Response Branch Carcass Collection and COC documentation protocols will be followed.

WORK PLAN FOR ESTIMATING OILING AND MORTALITY
OF BREEDING COLONIAL WATERBIRDS FROM THE
DEEPWATER HORIZON (MC 252) OIL SPILL
(BIRD STUDY #4)

***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***

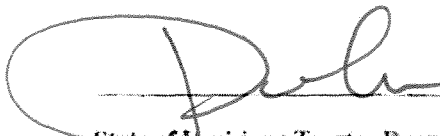
APPROVAL



Trustee NRDA Bird Group Lead

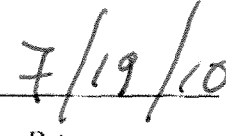


Date




FOR
LOUISIANA
GUIDRY

State of Louisiana Trustee Representative



Date



BP NRDA Representative



Date