Deepwater Horizon (MC 252) Oil Spill Natural Resource Damage Assessment and Restoration

Data Report for Data Collected under the _Work Plan for Determining Physiological Injury to Oiled Birds from the Deepwater Hoizon (MC 252) Oil Spill_

I. Purpose

As part of the Natural Resource Damage Assessment (NRDA) for the *Deepwater Horizon*/Mississippi Canyon 252 Oil Spill (the Spill), the Trustees agreed to implement the "*Work Plan for Determining Physiological Injury to Oiled Birds from the Deepwater Horizon (MC 252) Oil Spill*" and addendum (Bird Study #13).[1] The goal of this plan was to address potential spill impacts by collecting physiological data on birds collected as part of NRDA assessment efforts. This document includes a description of the data collection activities that occurred under this work plan as well as a description of any associated electronic datasets. This Data Report was prepared for the Department of the Interior by Industrial Economics, Incorporated (Cambridge, Massachusetts).

II. Overview of the Data

The objective of this study (Bird Study #13) was to examine the relationship between exposure to *Deepwater Horizon* oil and avian physiological parameters. As part of Bird Studies #3, #4, and #5, American oystercatchers (*Haematopus palliates*), black skimmers (*Rynchops niger*), brown pelicans (*Pelecanus occidentalis*), clapper rails (*Rallus longirostris*), great egrets (*Ardea alba*), and seaside sparrows (*Ammodramus maritimus*) were captured from impact and reference sites in the Gulf and the southern Atlantic coast, respectively.[2] Captured birds were assessed for their degree of oiling and blood and feather samples were collected. This work plan covers the processing of the blood and feather samples collected as part of these efforts. Blood analyses were conducted by Virginia Polytechnic Institute and State University (Department of Fish and Wildlife Conservation), Avian and Exotic Clin. Path. Labs, and the University of Connecticut's Center for Environmental Sciences and Engineering laboratory.

New methylene blue stained slides were prepared within minutes of field collection for a subset of captured birds to quantify Heinz bodies and reticulocytes. Field teams also processed samples for packed cell volume (PCV) (%), total hemoglobin (Hb) (g/dl), and red blood cell count (RBC) within 12 hours of collection. Plasma for ferritin and haptoglobin analyses was frozen and stored at -80 °C until processing. Heparinized whole blood and heparinized plasma were shipped to Avian and Exotic Clin Path Labs for complete blood cell count (CBC) and biochemical analyses (calcium (Ca), total protein, phosphorus (P), lactate dehydrogenase (LDH), creatine phosphokinase (CPK), chloride (Cl), uric acid (UA), glucose, cholesterol, and aspartate aminotransferase (AST). Finally, the University of Connecticut's Center for Environmental Sciences and Engineering laboratory determined total polycyclic aromatic hydrocarbon (PAH) concentrations, as well as the concentration of naphthalene, acenaphthylene, acenaphthene, fluorine, anthracene, phenanthrene, fluoranthene, pyrene, chrysene, benzo-a-anthracene, benzo-b-fluoranthene, benzo-k-fluoranthene, benzo-a-pyrene, dibenzo-a-h-anthracene, benzoperylene, and

[1] https://www.fws.gov/doiddata/dwh-ar-documents/787/DWH-AR0226930.pdf and https://www.fws.gov/doiddata/dwh-ar-documents/787/DWH-AR0226921.pdf

[2] *Data Verification and Validation Report for: Avian Capture Dataset, Avian Status Assessment Dataset, and Avian Lab Sample Dataset (Bird Studies #3, 4 and 5).*

indeno(1,2,3-cd) pyrene levels. The final dataset resulted in almost 50 variables that could potentially be used to assess effects of oiling on birds. Additional information on study protocols and the results of this assessment effort are described in the end of study report: "Evaluating Blood Parameters as a Measure of Physiological Injury to Oiled Birds from the Deepwater Horizon (MC252) Oil Spill."

Feather samples were archived at the USGS Columbia Environmental Research Center (CERC) in Columbia, Missouri after being collected in the field. Samples were then sent to Alpha Analytical Services (Alpha) in Westborough, Massachusetts for analysis. Only six feather samples were selected and analyzed for total petroleum hydrocarbons, total saturated hydrocarbons, parent and alkylated PAHs, steranes, triterpanes and triaromatic steroids. All samples were observed for oiling and photographed. Samples also underwent chemical extraction and UV lamp assessment before they were frozen in foil or sample jars and archived. Additional information on study protocols and the results of this assessment effort are described in the administrative report: "Small-Scale Assessment of Petrochemical Contamination of Avian Feathers Collected for the Deepwater Horizon/Mississippi Canyon 252 Natural Resource Damage Assessment, 23 October 2013."

III. Datasets

The following electronic dataset was tabulated with the results of the various chemical analyses conducted as part of Bird Study #13: "BS13_AvianPhys 4.20.2014". No electronic datasets were tabulated based on the feather analysis. Instead, photographs of the analysis and the results are included in the "Small-Scale Assessment of Petrochemical Contamination of Avian Feathers Collected for the Deepwater Horizon/Mississippi Canyon 252 Natural Resource Damage Assessment, 23 October 2013" report. These data will not undergo comprehensive verification and validation.[3] This Data Report is designed to assist potential users in understanding the data available and the data fields used.

"BS13_AvianPhys 4.20.2014" was originally compiled by Jesse Fallon (Virginia Tech). The first 14 data fields were taken from the Bird Study #3, #4 and #5 avian capture dataset and can be linked to that dataset using the "Band Number" field. The remaining data fields contain the results of the various analytical tests that were performed on the blood samples collected from the birds.

The sections below provide a brief description of any data cleanup or standardization that was done to prepare the final data package associated with this report, and a data dictionary with definitions for each data field.

Data Standardization

During the preparation of this Data Report, the following field was removed from the electronic dataset since it did not contain any data collected in the field or any analytic results: "Count". Values in the "Age" field were standardized including standardizing all "U", "UK", and "Unknown" values to "UNK".

Data Definitions

Table 1 below contains definitions for all data fields in the electronic dataset, and Table 2 lists field names that were changed to improve clarity. Finally, Table 3 below lists the feather samples that were included in the feather analysis and the analytic results – this table is copied from the "Small-Scale

[3] Data verification and validation refers to a specific data quality evaluation process that is conducted pursuant to the *U.S. Department of the Interior Deepwater Horizon Natural Resource Damage Assessment Procedures for Cooperative Data Verification and Validation*, November 2013.

Assessment of Petrochemical Contamination of Avian Feathers Collected for the Deepwater Horizon/Mississippi Canyon 252 Natural Resource Damage Assessment, 23 October 2013" report.

TABLE 1. BIRD STUDY #13 AVIAN PHYSIOLOGY DATA DICTIONARY

DATA FIELD	DEFINITION
Band Number	The band ID number that was attached to the bird after capture.
Date	The date the bird was captured.
Capture Site	A description of the location where the bird was captured.
State	The state where the bird was captured.
Latitude	The latitude coordinate where the bird was captured.
Longitude	The longitude coordinate where the bird was captured.
Site Characteristics	A description of the capture site – i.e., was it a foraging, loafing or nesting site.
Classification	Identifies if the capture site was a "reference" site or an "impacted" site.
Species	The species of the bird that was captured: American oystercatcher (AMOY), black skimmer (BLSK), brown pelican (BRPE), clapper rail (CLRA), great egret (GREG), and seaside sparrow (SSSP).
Age	The age of the bird that was captured, including: hatch year (HY); after hatch year (AHY); after second year (ASY); hatch year/second year (HY/SY); 8A; NR; second year (SY); third year (TY); or unknown (UNK).
Bird Weight (g)	The weight of the captured bird.
Visible Oil Assessment	The visible oil assessment of the bird: none, trace (<5%), light (6-20%), moderate (21-40%), and heavy (>40%).
UV Light Oil Assessment	The UV oil assessment of the bird: none, trace (<5%), light (6-20%), moderate (21-40%), and heavy (>40%).
Oil at Capture Site	"Y" or "N" if oil was present at the capture site.
Heinz Body Count	The number of dark-staining round bodies along the surface of erythrocytes observed in blood smear slides treated with methylene blue.
Reticulocytes Count	The number of erythrocytes observed in blood smear slides treated with methylene blue with reticular remnants encircling > 50% of the circumference of the nucleus.
Plasma Haptoglobin (g/dl)	Plasma haptoglobin concentration measured using a standard microplate colorimetric assay.
Plasma Ferritin (ng/ml)	Plasma ferritin concentration measured using a standard colorimetric assay.
Packed Cell Volume (%)	The percentage of red blood cells in circulating blood; calculated using a standard hematocrit reader following centrifugation at 11,000 rpm for 5 minutes.
Hemoglobin (g/dl)	Total hemoglobin; quantified using a Hemocue Hb Analyzer Hb201.
MCHC (g/dl)	Mean corpuscular Hb concentration; calculated by dividing the total hemoglobin by PCV (expressed as a proportion).
Buffy Coat	Buffy coat is a measurement of the quantity of white blood cells in a sample.
Total Solids	Total blood solids.
PAH (ng/ml)	Polycyclic aromatic hydrocarbon concentration; measured using gas chromatography.
Naphthalene (mg/ml)	Naphthalene concentration; measured using gas chromatography.
Acenaphthylene (ng/ml)	Acenaphthylene concentration; measured using gas chromatography.
Acenaphthene (ng/ml)	Acenaphthene concentration; measured using gas chromatography.
Fluorene (ng/ml)	Fluorene concentration; measured using gas chromatography.
Anthracene (ng/ml)	Anthracene concentration; measured using gas chromatography.
Phenanthrene (ng/ml)	Phenanthrene concentration; measured using gas chromatography.
Fluoranthene (ng/ml)	Fluoranthene concentration; measured using gas chromatography.
Pyrene (ng/ml)	Pyrene concentration; measured using gas chromatography.

DATA FIELD	DEFINITION
Crysene (ng/ml)	Crysene concentration; measured using gas chromatography.
Benzo-a-anthracene (ng/ml)	Benzo-a-anthracene concentration; measured using gas chromatography.
Benzo-b-fluoranthene (ng/ml)	Benzo-b-fluoranthene concentration; measured using gas chromatography.
Benzo-k-fluoranthene (ng/ml)	Benzo-k-fluoranthene concentration; measured using gas chromatography.
Benzo-a-pyrene (ng/ml)	Benzo-a-pyrene concentration; measured using gas chromatography.
Dibenzo-a-h-anthracene (ng/ml)	Dibenzo-a-h-anthracene concentration; measured using gas chromatography.
Benzoperylene (ng/ml)	Benzoperylene concentration; measured using gas chromatography.
Indeno(1,2,3-cd) pyrene (ng/ml)	Indeno(1,2,3-cd) pyrene concentration; measured using gas chromatography.
WBC Count (thousands/uL)	White blood cell count.
RBC Count (million/cubic mm)	Red blood cell count; number of circulating erythrocytes estimated using hemocytometer.
Mean Cell Volume (fL/cell)	Mean cell volume (in femptoliters per cell) was calculated by dividing PCV (as a proportion) by RBC count (in cells/mm3) and multiplying the quotient by 10^9.
Polychromasia	Regenerative anemias result in increased variability in erythrocyte stain uptake (Wright's staining). This is a subjective classification.
Anisocytosis	Regenerative anemias result in increased variability in erythrocyte size. This is a subjective classification.
Heterophil (%)	Concentration of Heterophils, a subtype of white blood cells.
Heterophil Count (10^9/L)	Count of Heterophils, a subtype of white blood cells.
Lymphocyte (%)	Concentration of lymphocytes, a subtype of white blood cells.
Lymphocyte Count (10^9/L)	Count of lymphocytes, a subtype of white blood cells.
Basophil (%)	Concentration of basophils, a subtype of white blood cells.
Basophil Count (10^9/L)	Count of basophils, a subtype of white blood cells.
Eosinophil (%)	Concentration of eosinophils, a subtype of white blood cells.
Eosinophil Count (10^9/L)	Count of eosinophils, a subtype of white blood cells.
Monocyte (%)	Concentration of monocytes, a subtype of white blood cells.
Monocyte Count (10^9/L)	Count of monocytes, a subtype of white blood cells.
Ca (mg/dl)	Calcium concentration.
Total Protein (g/dl)	Total protein concentration.
P (mg/dl)	Phosphorus concentration.
LDH (U/l)	Lactate dehydrogenase concentration.
CPK (U/l)	Creatinine phosphokinase concentration.
Chloride (mEq/l)	Chloride concentration.
Uric Acid (mg/dl)	Uric acid concentration.
Glucose	Glucose concentration.
Cholesterol (mg/dl)	Cholesterol concentration.
SGOT	
H:L ratio	
Serum Condition	A general description of the blood serums condition.

TABLE 2. BIRD STUDY #13 AVIAN PHSYIOLOGY FIELD NAME CHANGES

ORIGINAL FIELD NAME	MODIFIED FIELD NAME
Bird IDNum	Band Number

ORIGINAL FIELD NAME	MODIFIED FIELD NAME
CaptrSiteType	Classification
Bird Weight	Bird Weight (g)
HeinzBodyNum	Heinz Body Count
RecticsNum	Reticulocytes Count
HaptoglbnRslts	Plasma Haptoglobin (g/dl)
FerrtnRslts	Plasma Ferritin (ng/ml)
PCV	Packed Cell Volume (%)
Hemoglobin	Hemoglobin (g/dl)
Buffy_Coat	Buffy Coat
Total_solids	Total Solids
Total_PAH	PAH (ng/ml)
Naphthalene	Naphthalene (ng/ml)
Acenaphthylene	Acenaphthylene (ng/ml)
Acenaphthene	Acenaphthene (ng/ml)
Fluorene	Fluorene (ng/ml)
Anthracene	Anthracene (ng/ml)
Phenanthrene	Phenanthrene (ng/ml)
Fluoranthene	Fluoranthene (ng/ml)
Pyrene	Pyrene (ng/ml)
Crysene	Crysene (ng/ml)
Benzo_a_anthracene	Benzo-a-anthracene (ng/ml)
benzo_b_fluoranthene	Benzo-b-fluoranthene (ng/ml)
Benzo_k_fluoranthene	Benzo-k-fluoranthene (ng/ml)
benzo_a_pyrene	Benzo-a-pyrene (ng/ml)
Dibenz_a_h_anthracene	Dibenzo-a-h-anthracene (ng/ml)
benzo(g,h,i)perylene	Benzoperylene (ng/ml)
Indeno(1,2,3-cd)pyrene	Indeno(1,2,3-cd) pyrene (ng/ml)
WBC	WBC Count (thousands/uL)
RBC	RBC Count (million/cubic mm)
MCV	Mean Cell Volume (fL/cell)
He_NePct	Heterophil (%)
He_NeAbsNum	Heterophil Count (10^9/L)
LymphPct	Lymphocyte (%)
LymphNum	Lymphocyte Count (10^9/L)
BasoPct	Basophil (%)
BasoNum	Basophil Count (10^9/L)
EoPct	Eosinophil (%)
EoNum	Eosinophil Count (10^9/L)
MonoPct	Monocyte (%)
MonoNum	Monocyte Count (10^9/L)
Ca	Ca (mg/dl)
A-E_TP	Total Protein (g/dl)
Phos	P (mg/dl)
LDH	LDH (U/l)
CPK	CPK (U/l)
Cl	Chloride (mEq/l)
UA	Uric Acid (mg/dl)
Glu	Glucose
Chol	Cholesterol (mg/dl)

TABLE 3. BIRD STUDY #13 FEATHER SAMPLE ANALYSIS

SPECIES	BAND NUMBER	COLLECTION DATE	LAB CHARACTERIZATION OF UV FLUORESCENCE	FIELD CHARACTERIZATION OF VISIBLE AND UV FLUORESCENCE	MATCH TO MC252 OIL	NOTES FROM LABORATORY
Black Skimmer	1633-03459	1/10/2011	multiple feather tips fluoresced orange	light visible oil and moderate UV signal in field	Probable match to MC252	PAHs detected in petrogenic pattern and comparable to sample 2 & 3. Dominated by alkyl-Chrysenes (very weathered oil pattern). Proportion of sulfur in oil is reasonably close to MC252 and petroleum biomarkers are reasonable match to MC252
Black Skimmer	1633-03487	1/11/2011	1 feather tip fluoresced orange	trace visible oil and trace UV signal in field	Probable match to MC252	PAHs detected in petrogenic pattern and comparable to sample 1 & 3. Dominated by alkyl-Chrysenes (very weathered oil pattern). Proportion of sulfur in oil is reasonably close to MC252 and petroleum biomarkers are reasonable match to MC252
Black Skimmer	1633-03488	1/11/2011	3 feather tips fluoresced orange	trace visible oil and light UV signal in field	Probable match to MC252	PAHs detected in petrogenic pattern and comparable to sample 1 & 2. Dominated by alkyl-Chrysenes (very weathered oil pattern). Proportion of sulfur in oil is reasonably close to MC252 and petroleum biomarkers are reasonable match to MC252
Clapper Rail	1095-42466	10/4/2010	No visible fluorescence	no visible oil and trace UV signal in field	Indeterminate	No obvious PAHs above background. Small amount of biomarkers - too low to fingerprint trace oil in this sample.
Great Egret	1917-31036	9/27/2010	Faint orange fluorescence in margin of stained area	light visible oil and light UV signal in field	Indeterminate	No obvious PAHs above background. Small amount of biomarkers - too low to fingerprint trace oil in this sample.
Great Egret	1917-31089	2/8/2011	No visible fluorescence	No visible oil and no UV signal in field	Non Match	PAHs detected in petrogenic pattern. Highest abundance are sulfur dominated PAHs (dibenzothiophenes and naphthobenzothiophenes) - Non-match to MC252. Biomarkers also don't match MC252 - there is small amount of oil but it's not MC252; oil appears distinct from South Louisiana Sweet crude oil family.