Deepwater Horizon / Mississippi Canyon 252 Oil Spill
Natural Resource Damage Assessment

TECHNICAL REPORT: Simplified Live Oiled Bird Model Avian Injury Estimation

Prepared by the U.S. Department of the Interior, Fish and Wildlife Service
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To quantitatively estimate the avian injury along the shoreline of the northern Gulf of Mexico resulting from the *Deepwater Horizon* oil spill, the Trustees developed two primary models. A Shoreline Deposition Model (SDM) estimated bird mortality in coastal areas during the most active phase of the oil spill response (April 21 to September 30, 2010, IEc 2015). The SDM considered bird mortality from approximately Freeport, Texas, to Cape San Blas, Florida. A second model was used to estimate bird mortality in coastal areas occurring between September 30, 2010, and April 1, 2011. This model, called the Live Oiled Bird Model (LOBM), considered bird mortality from approximately Apalachicola Bay, Florida, to Vermillion Bay, Louisiana.

The LOBM used three primary types of input data to estimate bird mortality, including: 1) the number of birds occurring in areas affected by the oil spill (abundance), 2) the incidence and degree to which birds were oiled (oiling rate), and 3) the likelihood a bird would die due to oiling (fate). A similar approach was used to estimate bird injury in the *M/T Athos 1* oil spill in New Jersey (NOAA et al. 2009). The Trustees have taken a simplified application of this approach to estimate bird mortality. We refer to this model herein as the "Simplified LOBM."

The general outline of the approach, as well as assumptions and constraints, are described below.

Simplified LOBM Methods

The Simplified LOBM was used to estimate mortality of visibly oiled birds by multiplying:

1. abundance for selected species and guilds,
2. oiling rates for these species, and
3. probability of mortality for specific guilds and oiling category.

The area considered in the Simplified LOBM included coastal habitats extending from approximately Apalachicola Bay, Florida, to Vermillion Bay, Louisiana (84.0° and 92.0° West longitude, respectively). This area included the majority of oiled bird sightings. Separate mortality estimates were calculated for each month (October 2010 through March 2011) and for predominant species (e.g., brown pelicans and laughing gulls). For less predominant species, birds were grouped by guilds. Monthly mortality estimates

were summed to provide a total mortality estimate from October 1, 2011, to March 31, 2011.

Abundance

The abundance of predominant birds in the area considered in the Simplified LOBM was estimated for the fall (September 11 to December 31, 2010) using aerial surveys (Ford et al. 2014, Table 1). Direct abundance estimates were used for predominant species (e.g., brown pelicans and laughing gulls). For less predominant species or birds that were not easily identifiable to species during aerial surveys (e.g., other gulls or shorebirds), the birds were grouped by guilds. Aerial surveys are not an effective method for counting certain species, such as marsh dwelling species or passerines. Therefore, these species were not included in the Simplified LOBM. Because most species of concern in the Simplified LOBM winter in the Gulf of Mexico, it was assumed that abundance estimates from January through March, 2011, remained the same as September 11 to December 31, 2010.

Oiling Rates

Oiling rate estimates were developed from avian oiling rate data collected during avian surveys conducted as part of four NRDA studies. The study plans and date ranges of data collection (in brackets) include:

1) *Work Plan for Estimating Oiling and Mortality of Breeding Colonial Waterbirds from the Deepwater Horizon (MC 252) Oil Spill (Bird Study #4)* [May 25, 2010 to April 22, 1011],
2) *Bird Study #5: Estimating Shorebird Oiling and Mortality, Deepwater Horizon (Mississippi Canyon 252) Oil Spill (Bird Study #5)* [September 9 to December 3, 2010],
3) *Estimating Wintering Waterfowl Oiling and Mortality (Bird Study #10)* [November 9, 2010 to February 15, 2011], and
4) *Deepwater Horizon Mississippi Canyon 252 Oil Spill Winter Open-Water Waterbirds (Bird Study #12)* [January 17, 2010 to April 5, 2011].

Each study documented the incidence and degree of external oiling of birds in the area of the Gulf of Mexico that was considered in the Simplified LOBM. External oil on an individual bird was characterized as not visibly oiled, trace oiled (less than 5 % of the body surface), light (5 to 20 %), moderate (21 to 40 %), and heavy (greater than 40 %).

Monthly oiling rates (percent of the total observed birds within each of the four oiling rate categories for that particular month) were calculated for each species. In cases where abundance estimates were provided for a group of species (e.g., "Other Gulls"), the abundance of each species was calculated based on the proportion of individuals of a species within the overall group observed during the model period. Bird observation records in the oiling rate datasets identified as "unidentified" were not included in the analysis.

Fate

The Trustees convened an expert panel to identify the expected fate for a number of oiled bird species and guilds, by season (Dobbs et. al, 2015). This panel effort was reviewed by an avian toxicologist with expertise in petroleum toxicants and was revised based on his understanding of new toxicity data collected specifically for DWH (Ziccardi, 2015). The fall and winter fate estimates for each oiling category from the revised table (Ziccardi, 2015) were used to estimate mortality in the Simplified LOBM. September through December was considered to be within the fall season, while January through March was considered to be in the winter season. Due to the variability in the fate estimate being depicted as ranges, the monthly mortality estimate (fate) was defined as a range extending from the first quartile (low) to the third quartile (high) of the overall fate range for that species or group.

The Trustees recognized the need to ensure that the LOBM and SDM do not estimate mortality for the same birds. Since the Simplified LOBM was designed to capture mortality occurring after September 30, 2010, it must still account for birds that became oiled prior to September 30, but may have died during the Simplified LOBM time period. Therefore, some temporal overlap of the models was necessary to capture this loss. It was assumed that trace and light oiled birds would survive for at least three weeks before dying. This assumption is consistent with Trustee avian toxicity studies that found that the majority of cormorants externally oiled with weathered *Deepwater Horizon* oil survived for three weeks (Bursian et al. 2015). The application rate was at the high end of the "light oil" range (20% of the body surface). Therefore, data from trace and lightly oiled birds observed alive between September 10, 2010 and October 1, 2010 were used in the Simplified LOBM. Since the mortality of these birds was assumed to occur on or after October 1, 2010, there was no double-counting of injury.

Simplified LOBM Mortality Estimates

Table 2 provides the Simplified LOBM estimates of mortality for species and guilds of birds in the coastal nGOM (approximately Apalachicola Bay, Florida, to Vermillion Bay, Louisiana.) for the fall of 2010 (September 30, 2010, to December 31, 2010) and the winter of 2011 (January 1, 2011 to March 31, 2011). The Simplified LOBM produced an estimated range of mortality during this time period of between 6,204 and 15,300 birds.

Uncertainties

Abundance and oiling rate estimates included in the model were used to model bird mortality. The Trustees recognized that abundance and oiling rate estimates varied widely among geographic locations. Accordingly, the Simplified LOBM estimate was not intended to provide a precise estimate, but rather a general estimate of avian mortality within the spill-affected area after September 30, 2010.

Ford et al. (2014) noted that their abundance estimates were low at the time the draft results were reported because the data were incomplete and there was a corresponding

lack of interpolation into areas that were not sampled. The absence of interpolation resulted in the underestimation of certain species, such as northern gannets and loons. The findings of other recent surveys provided higher abundance estimates for these species in the northern Gulf of Mexico (Montevecchi et al. 2011, Long and Paruk 2014). Similarly, individuals of certain species, such as magnificent frigatebirds, were observed oiled in the field but were not observed during aerial surveys. Therefore, mortality could not be estimated because no abundance data were available. Additionally, methods used to develop abundance and oiling rate estimates were not effective for certain species, such as passerine birds and marsh dwelling species. Therefore, these species were also not included in the Simplified LOBM. Accordingly, it is recognized that abundance estimates used in the Simplified LOBM, and subsequent mortality estimates derived using the abundance estimate, are low.

References

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Table 1. Estimated seasonal abundance for bird species and groups in the coastal northern Gulf of Mexico (Atchafalaya Bay, LA, to Apalachicola Bay, FL) in the fall, 2010 (Ford et al. 2014).

Species or Group	***# Birds***
Brown Pelican	80,317
American White Pelican	15,868
Double-crested Cormorant	37,521
Laughing Gull	74,873
Other Gulls	17,761
Royal Tern	67,566
Sandwich Tern	4,328
Forster's Tern	14,712
Black Skimmer	14,855
Other Terns and Skimmers	21,887
Shorebirds	16,773
Great Egret	11,979
Snowy Egret	269
Tricolored Heron	593
White Ibis	12,926
Other Waders	571
Northern Gannet	2,416
Waterfowl	4,927
Common Loon	222
Other Loons and Grebes	0
TOTALS	**400,356**

Table 2. Preliminary estimate of mortality of species and groups of birds in the coastal northern Gulf of Mexico (approximately Atchafalaya Bay, LA, to Apalachicola Bay, FL) for the fall, 2010 (September 11, 2010, to December 31, 2010), the winter, 2011 (January 1, 2011 to March 31, 2011), and combined seasons using the simplified Live Oiled Bird Model.

	Fall		Winter		TOTAL	
Species	**low**	**high**	**low**	**high**	**low**	**high**
Cormorants						
Double-crested Cormorant	42	126	20	59	62	185
subtotal	**42**	**126**	**20**	**59**	**62**	**185**
Gulls						
Bonaparte's Gull	0	0	0	0	0	0
Franklin's Gull	0	0	0	0	0	0
Great Black-backed Gull	0	0	0	0	0	0
Herring Gull	23	70	13	37	36	107
Laughing Gull	52	150	94	353	146	503
Lesser Black-backed Gull	0	0	11	32	11	32
Ring-billed Gull	1	2	17	49	18	51
subtotal	**76**	**222**	**135**	**471**	**211**	**693**
Loons						
Common Loon	0	0	45	64	45	64
subtotal	**0**	**0**	**45**	**64**	**45**	**64**
Pelagic Birds						
Northern Gannet	0	0	26	77	26	77
subtotal	**0**	**0**	**26**	**77**	**26**	**77**
Pelicans						
American White Pelican	932	1880	904	2172	1836	4052
Brown Pelican	1080	2728	1510	3775	2590	6503
subtotal	**2012**	**4608**	**2414**	**5947**	**4426**	**10555**
Shorebirds						
American Avocet	1	1	0	0	1	1
American Golden-Plover	0	0	0	0	0	0
American Oystercatcher	0	0	1	2	1	2
Baird's Sandpiper	0	0	0	0	0	0
Black-bellied Plover	5	9	5	12	10	21

	Fall		Winter		TOTAL	
Species	**low**	**high**	**low**	**high**	**low**	**high**
Black-necked Stilt	0	0	5	14	5	14
Buff-breasted Sandpiper	0	0	0	0	0	0
Dunlin	21	47	31	91	52	138
Greater Yellowlegs	0	0	0	0	0	0
Killdeer	0	0	0	0	0	0
Least Sandpiper	0	0	0	0	0	0
Lesser Yellowlegs	0	0	0	0	0	0
Long-billed Curlew	0	0	0	0	0	0
Long-billed Dowitcher	1	1	0	0	1	1
Marbled Godwit	0	0	0	0	0	0
Pectoral Sandpiper	0	0	0	0	0	0
Piping Plover	3	6	0	0	3	6
Red Knot	0	0	0	0	0	0
Ruddy Turnstone	2	3	0	0	2	3
Sanderling	10	24	4	12	14	36
Semipalmated Plover	3	5	4	11	7	16
Short-billed Dowitcher	2	2	1	4	3	6
Snowy Plover	0	1	0	0	0	1
Spotted Sandpiper	0	0	0	0	0	0
Stilt Sandpiper	0	0	0	0	0	0
Western Sandpiper	0	1	2	4	2	5
Whimbrel	0	0	0	0	0	0
Willet	7	13	1	4	8	17
Wilson's Phalarope	0	0	0	0	0	0
Wilson's Plover	0	2	0	0	0	2
Wilson's Snipe	0	0	0	0	0	0
total	**55**	**115**	**54**	**155**	**109**	**270**
Terns and Skimmers						
Black Skimmer	178	287	158	447	336	734
Black Tern	0	0	0	0	0	0
Caspian Tern	26	79	36	108	62	187
Common Tern	4	13	54	114	58	127
Forster's Tern	16	42	0	0	16	42
Gull-billed Tern	0	0	0	0	0	0
Least Tern	0	0	0	0	0	0
Roseate Tern	0	0	0	0	0	0
Royal Tern	127	340	123	368	250	708
Sandwich Tern	20	44	0	0	20	44
total	**371**	**805**	**371**	**1037**	**742**	**1842**

	Fall		Winter		TOTAL	
Species	low	high	low	high	low	high
Wading Birds						
Black-crowned Night-heron	10	19	0	0	10	19
Cattle Egret	0	0	0	0	0	0
Great Blue Heron	4	11	0	0	4	11
Great Egret	29	87	17	50	46	137
Little Blue Heron	0	0	0	0	0	0
Little Egret	0	0	0	0	0	0
Reddish Egret	2	4	0	0	2	4
Roseate Spoonbill	6	10	0	0	6	10
Snowy Egret	6	11	0	0	6	11
Tricolored Heron	0	0	0	0	0	0
White Ibis	17	51	491	1370	508	1421
Yellow-crowned Night-heron	0	0	0	0	0	0
total	**74**	**193**	**508**	**1420**	**582**	**1613**
TOTAL	**2630**	**6069**	**3573**	**9229**	**6203**	**15298**