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Chronological effects of the Deepwater Horizon Gulf of Mexico oil spill on regional seabird casualties

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Abstract

In April 2010, the Deepwater Horizon (DH) oil platform in the Gulf of Mexico vented oil uncontrollably for 90+ days. This 'persistent' spill resulted in oil washing up daily on the shoreline of numerous Gulf of Mexico states, and created an oil spill lasting 30 times longer and 5 times larger than the 'rapid' 1989 Exxon Valdez (EV) spill. There is ongoing controversy regarding the effect of oil spills on seabird population, with few opportunities to analyze its daily effect. This paper describes the daily effect of the DH spill regarding the number of seabirds recovered alive and dead, and compared its overall population effect to the EV spill. Analyzing daily seabird collection data between days 38-138 after the DH spill, the dead bird collection average (48.2$\pm$35.5/day) was significantly ($p<0.05$) more than the live bird collection average (20.8$\pm$27.0/day). Data also shows a significant reduction in daily intake of live seabirds after day 110, while the daily dead bird intake saw a significant increase. Between days 110 to 138, live seabird collections only rose by 206 compared to the dead bird collection of 1834. The EV spill yielded 600+ live birds and 35,000 dead ones while the DH spill had 2053 live birds but only 7726 dead ones despite the DH spill being 5 times smaller in spill size. This data reveals that after 110 days of a 'persistent' spill, collecting live birds significantly decreases while the number of dead birds increases. Also, there were a significantly lower number of dead birds collected during the 'persistent' DH spill than the 'rapid' EV spill. This study reveals the first concrete evidence suggesting 'persistent' oil spills may have a greater environmental impact than 'rapid' spills, and immediate reaction is required to lessen the number of seabird casualties. [JMATE. 2010;3(2):10-14]

Keywords: Seabird, Casualty, Oil Spill, Gulf of Mexico, Deepwater Horizon

Introduction

Oil spills are dramatic events that involve various amounts of oil spilled either in short bursts (ie: ruptured ships) or longer periods of time (ie: drilling platforms) usually within specific areas (8). This results in immediate and drastic consequences to the environment and the wildlife within it depending on several factors such as the type of crude oil spilled, environmental conditions, time of year, currents, etc. (8). Clean up efforts usually vary widely again depending on several factors such as weather conditions, financial considerations, public outcry, legal responsibilities and size of the spill.

The most immediate data to be generated from an oil spill usually is the number of animals collected, treated and released, or casualties and these usually include seabirds, marine mammals, or sea turtles (7). Most studies look at population declines or recovery of various species over many months or years and within the research literature there is still ongoing controversy as to whether there is any correlation between oil spill size and the number of sea birds affected (1,4). In 2010, Tan *et al* published that there was a strong correlation between oil spill size and number of sea bird casualties when the oil spill was under 50,000 tonnes (8). However, there is still no data that shows a chronological sequence in collecting seabirds during the course of an oil spill.

The recent oil spill of the Deepwater Horizon (DH) oil platform in the Gulf of Mexico was a long lasting event, affected the coastline of several U.S. states, and was under the intense scrutiny of scientists, media and locally affected communities. The rescue and recovery efforts of both the BP oil company and Unified Area Command with respect to seabirds was well documented. We suggest that the DH oil spill is quite different than other spills, in that it is a 'persistent spill', venting oil continuously as opposed to a ship strike which may be considered a 'rapid spill'. This study evaluated the effect this type of oil spill would have on the number of recovered seabirds as well as the number of seabird causalities collected and documented over a 138 days after the spill. A comparison to the Exxon Valdez (EV) oil spill was also done regarding the total number of seabirds collected alive and dead.

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Methods

Deepwater Horizon Spill Data Collection

The DH data on the number of seabirds recovered or casualties was obtained from the efforts of British Petroleum (BP) and the various components of the Unified Area Command which included the U.S. Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA), incident area commands, rehabilitation centers and other authorized sources operating within the Deepwater Horizon/BP incident impact area. This data was reported on a daily basis on their website and tabulated (5). These tables included the number of seabirds collected alive or dead and total collected. The data includes the first report released on May 28th until the final report 100 days later.

Exxon Valdez Spill Data Collection

The EV data on the number of recovered and deaths of seabirds was obtained from the Exxon Valdez Oil Spill Council (EVOSC) (2,3) which has the most reputable information source on that oil spill. Several sources were used to collate the rest of the data including scientific journal articles, dissertations, conference presentations and reports.

Statistical Analysis

Data were expressed as means$\pm$SD. Differences in alive and dead birds collected between 38-110 days and after 110 days were compared by the Mann-Whitney U-test. P-value of less than 0.05 was considered statistically significant.

Results

Footprint of the Deepwater Horizon and Exxon Valdez Spills

The amount of total oil spilled from the two events was approximately 750,000 barrels for the EV and approximately 4,350,290 barrels for the DH spill. This means that the DH oil spill was more than 6 times greater than the EV spill (Table 1). Comparing the area covered by the two spills, the DH spill was approximately 28,900 square miles or 2.5 times larger in size than the EV spill, approximately 11,000 square miles (Table 1, Figure 1).

	Deepwater Horizon	**Exxon Valdez**
Date	April 2010	March 1989
Location	Gulf of Mexico	Prince William Sound, Alaska
Type	Persistent	Rapid
Amount (barrels)	4,350,290	750,000
Coverage (sq mi)	28,900	11,000
Seabird recoveries	2,080	1,630
Seabird casualties	7,726	35,000

Table 1 - A comparison between the Deepwater Horizon spill and the Exxon Valdez spill

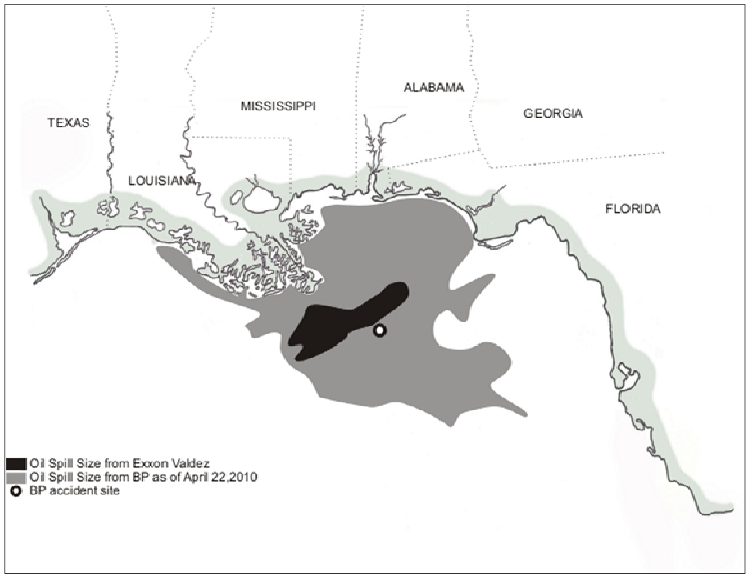

Figure 1 - Artistic impression of the Exxon Valdez oil spill (black) in relation to the Deepwater Horizon spill (grey). (Not to scale).

Number of Seabirds Affected

The total number of live seabirds recovered from the EV spill was approximately 1,630 birds while 2,080 birds from the DH spill were captured (Table 1). The number of live recovered seabirds from the DH spill was only approximately 22% more than the EV spill despite the fact that the DH spill was 2.5 times bigger in area covered and had approximately 6 times more oil spilled. There were 35,000 dead seabirds collected during the EV spill but only 7,726 from the DH spill (Table 1). This demonstrates an unexpected greater number of casualties (4.5 times) from the EV spill than the DH spill despite more oil being spilled or covering a larger area in the Gulf of Mexico.

DH Spill's Effect on Seabirds

The data from the BP/Unified Command website shows that the total number of birds collected (7,726) rose constantly for the entire 100 day period with a higher amount of dead birds compared to live birds throughout (Figure 2). When comparing the daily collection averages of live (20.8±27.0 birds/day) and dead (48.2±35.5 birds/day) seabirds, there are significantly more dead birds collected (Table 2). Upon further analysis, it appears that both the number of live and dead birds collected changed over time. Specifically, there is a drastic change in the average birds collected alive and dead at day 110, represented by the change in slopes of these graphs. During the first 72 days of collection (day 38-110), the average amount of birds collected alive was 25.2±28.8 birds/day. Conversely, after 110 days this average was significantly lower at 4.2±2.7 birds/day ($p<0.05$) (Figure 3a). Not surprisingly,

Birds	**Alive**	**Dead**	**Total**
Start (Day 38)	63	444	507
End (Day 138)	2,053	5,673	7,726
Average Daily Intake*	20.8±27.0	48.2±35.5	70.0±49.8

*Table 2 - A comparison between the effects the DH spill on the alive and dead seabirds collected. *Intake= mean±SD*

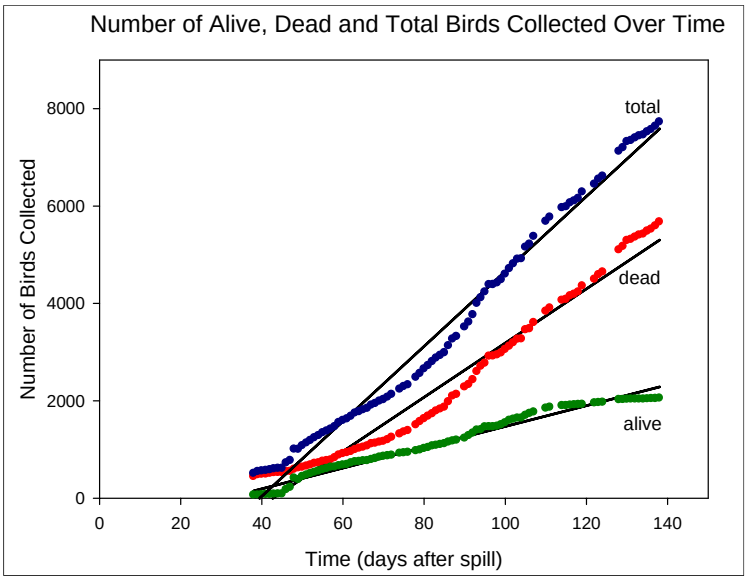

Figure 2 - A scatterplot graph depicting the number of alive (green), dead (red) and total (blue) number of birds collected during the Deepwater Horizon oil spill reported on a daily basis. Note: The first release of data was reported 38 days after the spill commenced and ends 138 days later.

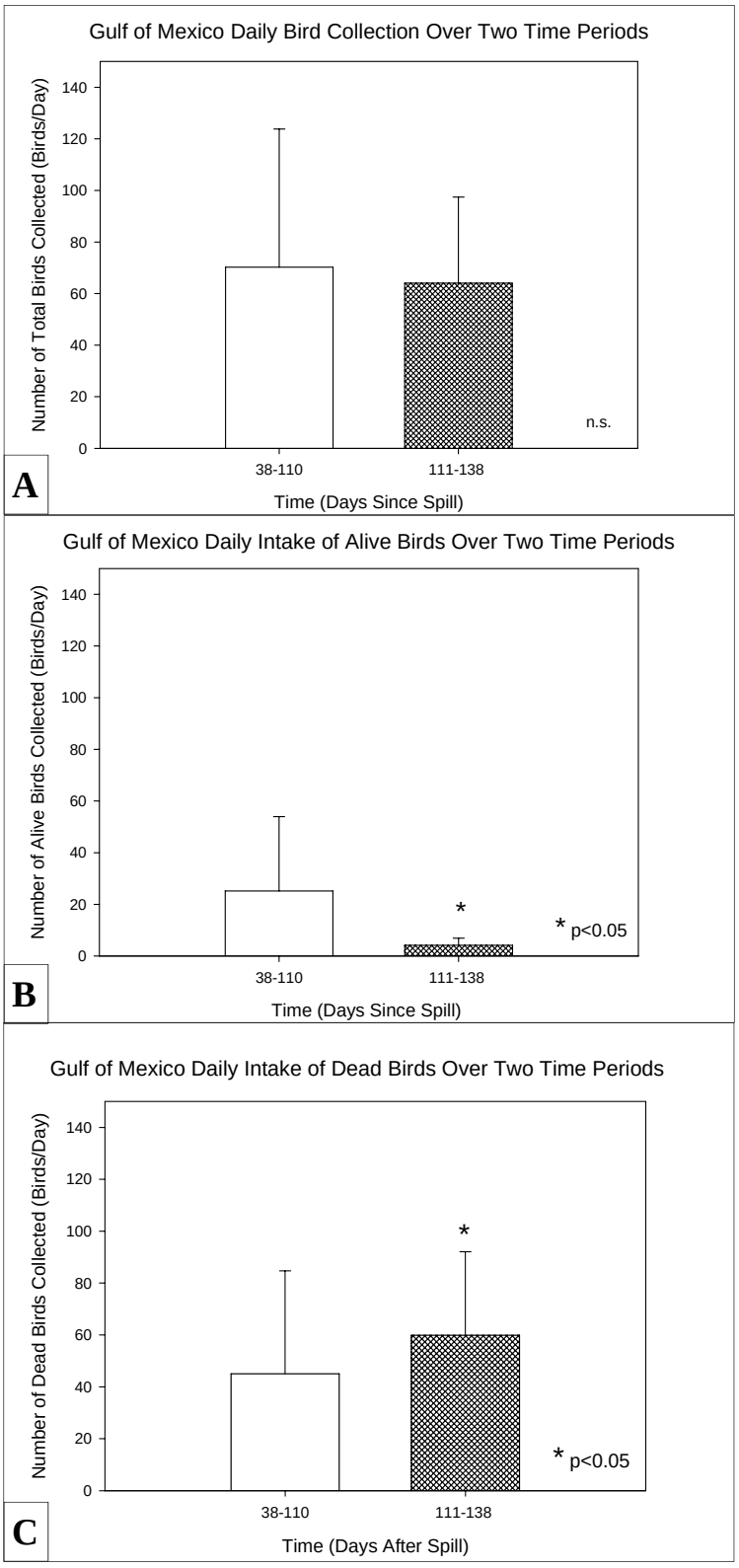

Figure 3 - The differences in the number of birds collected daily (mean±SD) between days 38 and 110 (white), and 111 and 138 (pattern). A Mann-Whitney U-test was used to compare the means. A) Total birds B) Alive birds C) Dead birds collected

the average collection of dead birds also changes at 110 days as well, significantly increasing from 45.1±39.7 birds/day to 59.9±32.2 birds/day ($p<0.05$) (Figure 3b). Interestingly, the total amount of seabirds collected before and after the 110 day mark remained similar and not statistically significant 70.2±52.5 bird/day before and 64.1±33.3 birds/day after (Figure 3c). This data demonstrates that despite the number of birds being collected per day remaining similar throughout, the proportion of dead birds collected per day is significantly higher after the 110 day mark, while the portion that are alive is significantly lower.

Discussion

'Rapid' vs. 'Persistent' Spills

The effect of an oil spill on the wildlife is dependent on many factors such as geography of the area, time of year, weather conditions, currents, type of oil plus many others (8). The spread and duration of a spill event results in a 'footprint' which can determine potential effects on seabirds in the area. We make a marked distinction between two different types of spill events termed as either 'rapid spills' or 'persistent spills'. A 'rapid spill' is a spill that occurs quickly and is contained to a specific geographic area, such as an oil tanker event (ie: EV spill). A 'persistent spill' is one that releases oil continuously, which may spread over a larger area, in this case the DH spill. Prior to the DH spill, the largest oil spill in the United States history was the EV spill in Alaska. The EV spill, considered a 'rapid spill', had a footprint that consisted of a huge amount of oil being released in a short burst of time within a region which gradually spreads along the coastline. Conversely, the DH spill in the Gulf of Mexico had a different footprint where large and constant amounts of oil were released increasingly over a long period of time. This 'persistent spill' resulted in waves of pollutants constantly being washed up on shorelines which could have a huge impact on the seabirds either already in the region or those arriving soon or passing through along their migration routes.

Effect Dynamics of a Persistent Spill on Seabird Population

During the first 110 days after the DH oil started to vent from the platform, the number of birds collected both alive and dead rose at a relatively constant rate. As a result, the total bird collected also increased at a constant rate. However, after the 110th day, the average number of dead birds collected daily increased, while the average live birds collected significantly decreased. Despite these changes, the overall collection was unaffected and the change was insignificant. Therefore, we suggest there is a distinct shift after 110 days whereby all the birds that would have otherwise been recovered have since died. As a result, we propose there is a specific time frame to effectively and efficiently implement a response of under 110 days during a persistent spill such as the DH spill. After 110 days, the data suggests that approximately 9 of every 10 birds collected will be dead. To the knowledge of the authors this is the first time that such data has ever been reported in the literature and proves that it is crucial to mount an immediate response with sooner being the better.

Deepwater Horizon Spill vs. Exxon Valdez Spill

Both the Deepwater Horizon and Exxon Valdez spills have resulted in enormous environmental consequences. However, comparing the two reveals each has very different effects on seabirds. The size and amount of oil spilled during the DH event should have resulted in a larger number of collected, dead, or alive birds when compared to the EV spill, which was not the case. As noted previously, there are numerous factors that would influence the number of seabirds captured or affected during an oil spill. Despite this, the number of seabirds (total collected, dead, alive) associated with an oil spill the size of the DH event should have been many times greater than the EV spill. This difference is probably due to the fact that there was significant shift in the manner in which the birds were collected during the DH spill in contrast to the EV event. This shift in bird collection included poorly trained or inexperienced officials who may have hampered the efficient collection of seabirds and the complete exclusion of volunteers from outside agencies (NGOs) who have tremendous amounts experience in this type of response (6). These 2 factors possibly lead to seriously lower than expected numbers of birds being recovered (alive or dead) based on oil spill size. Also based on the oil spill size of the DH event, more well trained volunteers should have been recruited to go out and recover seabirds.

Implications

Our study could explain why there have been no correlations between larger oil spills and the number of seabird casualties as there is a very short window of time to start the collection of seabirds (especially live ones) following an oil spill. Any response effort organized must be done immediately and be thorough in nature. We suggest that during a persistent spill, rather than have a long drawn out continuous response effort, there must be a sizeable response surge as early as possible to collect and rehabilitate any live seabirds. As well it is critical that the collection of as many seabirds as possible be performed by experienced groups or individuals. Not putting any kind of active effort into actually collecting and rehabilitating seabirds may place many species in a threatened or endangered classification and even lead to the extirpation or extinction of already threatened species.

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