EXPERT REPORT OF DR. JOHN W. TUNNELL, JR.

Reply Report to the Expert Reports of:

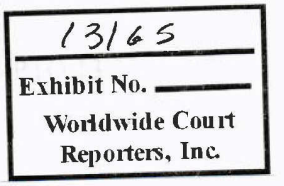
Donald F. Boesch, Stanley D. Rice, and Charles Mason

In Re Oil Spill by the Oil Rig "*Deepwater Horizon*" in the Gulf of Mexico, on April 20, 2010
MDL 2179
U.S. District Court for the Eastern District of Louisiana

September 26, 2014

Dr. John W. Tunnell, Jr.

Confidential Pursuant to



Introduction

1. This short rebuttal responds to Drs. Donald Boesch and Stanley Rice's Round 2 (2014) responses to my Expert Report (Tunnell 2014a) as well as Dr. Charles Mason's Round 2 response (Mason 2014).

The government has still not provided an analysis of publicly available data (much of which is actually government data) regarding northern Gulf of Mexico fisheries and wildlife populations, despite having access to these data

2. The government and their experts – including Drs. Boesch and Rice – have access to the data cited and used in my reports. They chose not to analyze the data for either of the two reports submitted to the Court thus far.

3. Drs. Boesch and Rice claim that I did not present "a comprehensive evaluation of the actual or potential harm to ecosystems and resources of the Gulf of Mexico" (Boesch and Rice 2014, p.5). To the contrary, I used a varied and comprehensive approach, analyzing population data for 36 of the most abundant and important species of fish and shellfish, as well as 23 of the most abundant and important bird species, across the entire geography of the northern Gulf of Mexico. My approach was to use those multiple species, along with five lines of evidence on 10 selected key Gulf of Mexico species. I used information and data from six different datasets (one state, three federal, and two independent) to establish the current status of these most important and common species.

4. Drs. Boesch and Rice spent considerable time and effort criticizing my choice of geography, statistics, species, and chemical impacts to marine life and birds, but they still have not demonstrated actual environmental harm except in a few localized areas that I acknowledged in my Report. Their silence on the subject of widespread actual harm to the environment or populations speaks volumes.

5. Oddly, Drs. Boesch and Rice criticize my use of Southeast Area Monitoring and Assessment Program (SEAMAP) data to evaluate the current status and trend in red snapper populations. According to Drs. Boesch and Rice, using these data to evaluate red snapper is inappropriate because SEAMAP collection techniques do not target "larger fish" (Boesch and Rice 2014, pp.8-9). However, for precisely this reason, SEAMAP data are useful for evaluating abundance of younger fish and their entry (often called "recruitment") into the adult population. These younger fish should be of interest to those who are evaluating the effects of the spill. Similarly, Drs. Boesch and Rice claim that I did not "consider" Murawski et al. 2014's recent article on red snapper and other species, yet I included a discussion of this article in my Expert Report on page 40, paragraph 76 (Tunnell 2014a).

Four years after the spill, the peer reviewed literature contains very little evidence of actual harm to the environment or the biota in the ecosystem

6. Drs. Boesch and Rice claim that I failed to rely upon the "voluminous literature" related to environmental impacts from the spill. This claim is misleading. NOAA maintains an extensive bibliography on publications related to the *Deepwater Horizon* oil spill (Belter 2014). Unfortunately – and without explanation – NOAA stopped updating this bibliography on May 13, 2014. In any event, I classified all 359 peer-reviewed journal articles and book chapters in the "natural sciences" section (pp. 3-37) of NOAA's bibliography. Of the nearly 360 entries, 218 (60.7%) are about the fate and transport of oil or dispersants (without reporting on any actual harm to populations in the Gulf); 94 (26.2%) are about theoretical or hypothetical environmental harm, 16 (4.5%) are about actual harm in 2010; 4 (1.1%) are about actual harm in 2011; and 2 (0.6%) are about actual harm in 2012. Of the 359 publications, there is not a single publication about actual environmental harm occurring in 2013. In addition, 10 papers conclude that there was little or no harm to selected parts of the environment or selected groups of organisms (Figure 1).[1]

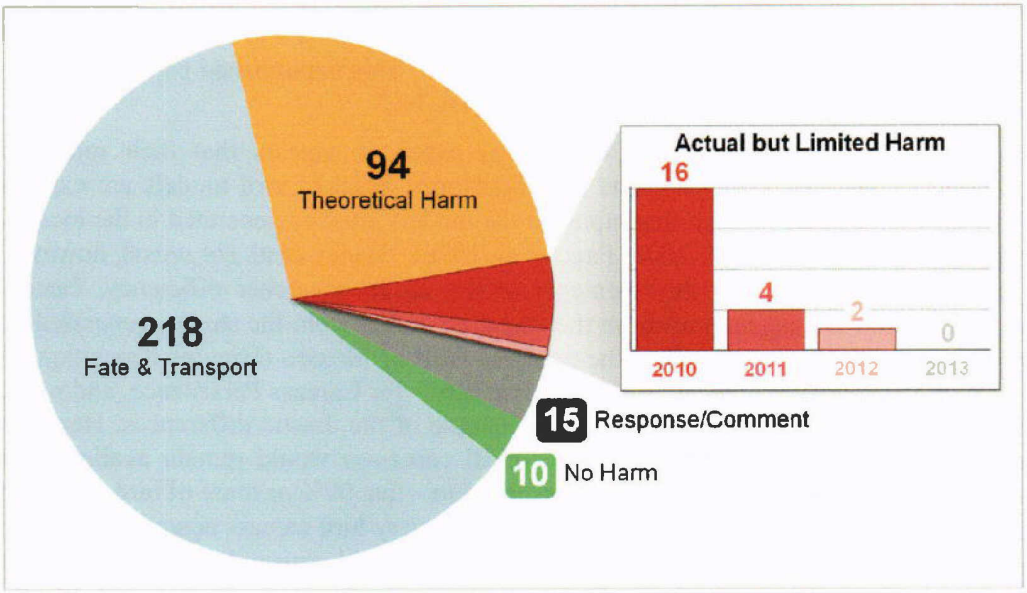


Figure 1 – Graph of the different kinds of Natural Science peer-reviewed journal articles and book chapters listed in the NOAA "Deepwater Horizon: A Preliminary Bibliography of Published Research and Expert Commentary" (Belter 2014). I have categorized these publications as follows: Fate & Transport = physical and chemical papers on oil and dispersants, biodegradation, weathering, remote sensing, and methodology; Theoretical Harm = papers on potential, possible, projected, or speculated harm, modeling studies, ecotoxicology, and other lab studies; Actual but Limited Harm = papers which show damages or impact to species, populations, or habitats; No Harm = papers listed in NOAA's bibliography that show little or no harm to selected species, populations, or habitats; Response/Comment = short communications that are responses or comments to other published papers in this listing.

[1] As an example, for birds, there are 14 papers listed in the NOAA Bibliography, and 12 of those are about theoretical, not actual, harm. Only 1 bird paper in the entire NOAA database is about actual harm (limited to 2010). One paper reports that there was no environmental harm to birds in the selected area of study (outside of 2010).

7. In sum, the relevant "voluminous literature," which Drs. Boesch and Rice speak about, is quite small when seeking data or information about the actual harm to the Gulf of Mexico due to the oil spill. There was no reason to cite these papers beyond what I did in my Report, since they did not bring any important information to the table on actual harm to populations, and their citation would not add to the real assessment of Gulf species.

8. A recent peer-reviewed publication confirms my conclusion that no population level impacts have been detected in estuarine areas (Fodrie et al. 2014).

9. Another very recent (September 15, 2014) published scientific article highlights and confirms my overall conclusions. In this study, the authors – including two United States scientists – found that the impacts from the *Deepwater Horizon* oil spill to birds, turtles, and marine mammals were "significantly less" than from the *Exxon Valdez* spill. In addition, the authors found that "commercial landings data suggest that a majority of its fisheries [in the Gulf of Mexico] were on the way to recovery just one year after the spill, if not earlier" (Nelson et al. 2014). These published findings are consistent with the conclusions in my two Reports.

10. As discussed in my Rebuttal Report (Tunnell 2014b), Drs. Boesch and Rice do not even follow their own advice regarding use of published literature. When talking about potential harm to birds, for example, they rely almost exclusively on a still unpublished[2] article about a theoretical bird impact model (Haney et al. *in press*). This unpublished paper is undated and labeled on every page "DO NOT COPY OR DISTRIBUTE."

11. Regarding the Haney et al. (*in press*) paper, it appears that their model is seriously, or even fatally, flawed. Scientists who developed beached bird models are explicit about each oil spill being different and that input for the models must be generated in the locality of a particular spill (Ford et al. 1987, 2006; Page et al. 1990). Haney et al. (*in press*), however, chose to pick their percentages of key elements of the model (searcher efficiency, carcass persistence, and carcass sinking rate) all from the literature, rather from the studies generated on site for the *Deepwater Horizon* oil spill in the northern Gulf of Mexico (Higgins deposition, p. 66, Exhibit 12606 for Search Efficiency, p. 87, Exhibit 12611 for Carcass Persistence, and p. 95, Exhibit 12612, for Carcass Sinking Rates). As an example of the drastic differences, Haney et al. (*in press*) assumed that "less than 1% of the [bird] carcasses would remain available for shoreline deposition after four days" (p.9). This assumption—that 99% or more of bird carcasses would sink—is a critical step in Haney et al.'s model. For every bird carcass actually found, the model predicts that there are dozens more that could not be found because they sank. Compare this assumption to a joint BP-government study on sinking rate, which determined that 45% of bird carcasses did not sink (Higgins Deposition, p. 105). Haney et al.'s (*in press*) use of inaccurate assumptions makes their model results unreliable.

12. Drs. Boesch and Rice claim after reading my report that "[p]opulation estimates based solely on counts at land-based sites are inadequate to assess the effects on coastal and offshore bird populations," yet 20 of the 23 birds graphed were coastal birds that were heavily represented in all the graphs I presented in Appendices F and G of my Expert Report (Tunnell 2014a, pp. 130-149). These birds rest, nest, and feed right in the areas where the Christmas Bird Counts (CBCs) are made, so Drs. Boesch and Rice's comments are misplaced, or they do not

[2] As of the date of this reply, Haney et al. (*in press*) has not been published and the draft as cited by the United States is not publicly available.

understand how and where the counts are made. I considered Laughing Gull (p. 130 CBC and p. 139 Breeding Bird Survey (BBS)) and Brown Pelican (p. 131 CBC and p. 135 BBS), which they say I did not.

Even Drs. Boesch and Rice appear to agree that actual harm occurred only in limited circumstances

13. Drs. Boesch and Rice appear to agree that actual harm in the nearshore environment was limited. According to Drs. Boesch and Rice, the populations I focused on were "not extensively exposed to Macondo well oil" and "have large portions of their populations included in the analysis that live in naturally protected habitats and along the coast beyond the extent of oiling" (Boesch and Rice Report, pp. 6- 7). This is true, according to Drs. Boesch and Rice, even in Louisiana. They also appear to agree that "apocalyptic fears" of widespread harm to the ecosystem as a whole have no place in this analysis (Boesch and Rice Report, p. 28).

Analyzing datasets in a smaller geographic region does not change my analysis

14. Drs. Boesch and Rice criticize me for selecting too large of a geographic area to evaluate for environmental harm. This is an implicit acknowledgement that they would not expect a population-level impact at that geographic scale.

15. In any event, I do not agree that I selected data from too large an area. I have looked for evidence of population impacts in the northern Gulf of Mexico only (about 25% of the Gulf of Mexico). I did not include the southern Gulf of Mexico or data near the international boundaries in the central Gulf of Mexico.

16. Selecting a smaller area does not change the analysis, nor the outcome. In Appendix A, I show plots from the Louisiana Department of Wildlife and Fisheries (LDWF) and SEAMAP in the more limited, or smaller, areas where Drs Boesch and Rice argue I should have focused (Boesch and Rice Report, p. 8). A review of these plots shows that there is little difference between the data from the larger area shown in my first report and data from the smaller areas shown herein. Pre-spill trends are similar to post-spill trends in both sets of plots. In fact, aside from increases in abundance in some fish species in 2010, there appears to be little remarkable about that year in the data, even in these more limited graphs that Drs. Boesch and Rice said I should have selected to see the impact of the spill in the heaviest oiled areas.

17. Similarly for birds, a small geographic focus does not change the analysis. For example a review of the CBC 15-mile diameter circles of Venice and Grand Isle in Louisiana's Mississippi Delta, BBS routes of Dauphin Island and Alabama Point, and CBC circles at Dauphin Island and Gulf Shores,[3] show similar abundance trends after the spill compared to before it. The graphs in Appendix B provide this information for Brown Pelican and Laughing Gull, two species which Drs. Boesch and Rice say were heavily impacted by the spill. Drs. Boesch and Rice indicate drastic reductions in Brown Pelican and Laughing Gull from the

[3] I note that the depiction of the Dauphin Island and Alabama Point Breeding Bird Survey routes in Figure 3 is incorrect (Boesch and Rice, p.10). I include in Appendix C, Figure C-3 a map to clarifies the location of those routes and shows their relationship to the Christmas Bird Count circles at Dauphin Island and Gulf Shores.

unpublished Haney et al. (*in press*) paper.[4] However, if you look at the actual data, that is clearly not the case. Perhaps they looked at the Laughing Gull drop at Venice from 2010 to 2011, but did not see, or know about, the very high abundance count in 2012 for Laughing Gull at that station (Appendix B Figure B-1) or the second highest abundance count for Brown Pelican in over two decades at that same station (Figure B-4).

18. Drs. Boesch and Rice attack my use of short-term statistical analysis, but there are many different approaches and ways to apply statistical tools. Drs. Boesch and Rice's method appears to include 2010 in the "pre-spill" trend line, despite the fact that for many species, 2010 data would likely have seen increased abundance due to the fisheries closures. Inclusion of the one-time effects of closures from 2010 arguably inflates the baseline. In any event, I did a regression over the 10-year period as one of five methods of evaluating the available data and information, and the short-term trend should always be used in conjunction with the long-term trend analysis when such data are available.

19. Drs. Boesch and Rice imply that one should not consider background trends as described by fishery managers in evaluating current data. From an ecological perspective, I disagree completely on the significance and importance of baseline, long-term trends, especially when they show decades-long similar trends, such as with the blue crab. Ignoring such trends would hardly be consistent with accepted scientific practice. It is well-known that Gulf of Mexico blue crab landings peaked in 1987 and 1988, and that "[a]lthough landings continue to fluctuate, a general downward trend in Gulf-wide landings began in 2000 and has continued through 2010" (VanderKooy 2013, p.1). This most-recent stock assessment for blue crab also notes that "[f]ishery-independent estimates of abundance for both juvenile and adult stocks have shown either decreasing or steady trends throughout the last two decades while commercial landings have declined" (VanderKooy 2013, p.1). Furthermore, the Western stock, which extends from central Texas to Apalachicola Bay and is centered in Louisiana, has "undergone a strong decline in juvenile abundances since the mid-1980s, and a decline in adult abundances from the mid-1980s until the mid-1990s, after which it has remained relatively stable" (VanderKooy 2013, p.1). The graph shown in Appendix A (Figure A-3) for blue crab reveals the fluctuating nature of the population from LDWF trawl data between 1968-2013, and it is easy to see that the population in southern Louisiana in recent years since the spill is within trend levels of the past four decades.

Other claims by Drs. Boesch, Rice, and Mason Are Misplaced

20. Drs. Boesch and Rice claim that I made "sweeping conclusions" about the status of populations and impacts from the spill without considering deep-water corals, sea turtles, and dolphins. The evidence of limited effects to deep-water corals, sea turtles, and dolphins was addressed in my Rebuttal Report so I will not cover them again here. See Rebuttal Report pp.1-3, 3-5, 6-8.

[4] The unpublished Haney et al. (*in press*) paper looks at the CBC data across the entire northern Gulf including Texas (apparently contrary to what Drs. Boesch and Rice suggest I should have done in my Report). They report large declines in these populations, but such declines are not evident in the data I presented in my Report. Nowhere in their report do Drs. Boesch and Rice do anything but uncritically adopt Haney et al.'s (*in press*) unpublished account, even though the underlying data are publicly available.

21. Drs. Boesch and Rice claim I should have looked at offshore pelagic species such as tuna and amberjack. While there are no long-term, robust fisheries-independent data for these species (Tunnell 2014a), available evidence and the lack of peer-reviewed published papers suggests that there has been no population effect on these species. A 2011 analysis of bluefin tuna by the National Oceanic and Atmospheric Administration (NOAA) found that a 20% reduction in the 2010 year class (an upper bound estimate based on conservative assumptions) would result in a 4% reduction in future spawning biomass (ABTSRT 2011). A 4% reduction in a limited geographic area would not result in a significant adverse impact to the bluefin tuna population, which is known to range throughout the northern Gulf of Mexico. Furthermore, a study after the spill showed that the spawning area for bluefin tuna extended much further west than previously known and that "the proportion of spawning habitat impacted by oil was generally predicted to be small (<10%)." (Muhling et al. 2012).

22. In a stock assessment that was recently released (March 2014), NOAA set out to evaluate effects of the *Deepwater Horizon* and other "episodic" events on the greater amberjack stock. Although they were unable to evaluate such effects due to data limitations, they found potential evidence of "strong recruitment classes" after the spill (SEDAR 2014, p. 27).

23. Drs. Boesch and Rice claim that I should have considered offshore shrimp species. I did. I included a plot of the abundance of rock shrimp, one of the species they requested, from the SEAMAP dataset. That graph is included in Appendix E on page 124 (Tunnell 2014a), and post-spill rock shrimp abundance appears similar to pre-spill levels, even increasing in abundance since 2009.

24. Drs. Boesch and Rice claim that I should have addressed sargassum. Sargassum, which is a golden-brown, floating seaweed, is ubiquitous and abundant in the Gulf of Mexico. Reported effects in 2010 were confined to that summer, and there have been no further published reports on alleged impacts to sargassum. Since sargassum is an annual "crop" and it grows rapidly and widely (Rooker et al. 2006; Gaskill 2013), it is clear that the 2010 impact was a temporary event. Sargassum abundance in the Gulf of Mexico in 2014 was the largest that has been seen in years in most places, decades in others (Rice 2014).

25. Drs. Boesch and Rice repeatedly raise the issue of potential food web accumulation of polycyclic aromatic hydrocarbons (PAHs) without any evidence of actual harm to Gulf species. Chanton et al. (2012) indicate merely that bacteria may have consumed methane and then themselves been consumed by other organisms. Mitra et al.'s (2012) findings have not been confirmed by subsequent publications. The Ortmann et al. (2012) research was a laboratory study using fresh Macondo oil mixed in water taken from the coastal environment and put into a closed "mesocosm" system; its relevance for field conditions in the open coastal waters of the Gulf is unclear, as an internal EPA analysis recognized (Barron deposition, pp.220-230 and Ex. 12057).[5] Ortmann also used dispersants in their study, although as the same EPA analysis recognized, application of dispersants in nearshore areas was not permitted.

[5] The EPA analysis concluded "It is unclear why unweathered oil was used when offshore oil reaching the surface during the DWHS was weathered, and oil reaching coastal areas was more extensively weathered. . . . The results obtained with fresh oil should not be extrapolated to the conditions in the Gulf of Mexico during the DWHS." EPA Research Ecologist Dr. Robyn Conmy also noted that the concentration of oil used in this experiment was "ridiculously high" and "hard to compare to real world scenarios in the DWH spill." US_PP_EPA094257.

26. Dr. Charles Mason, another U.S. expert, relies on Sumaila et al. (2012) for his theory that commercial fish stocks declined as a result of the *Deepwater Horizon* accident and are likely to stay at lower levels for some time in the future (Mason Expert Report, p.7). However, Sumaila et al. (2012) do not consider any environmental data specific to the *Deepwater Horizon* incident and built an argument by analogy to *Exxon Valdez* and other spills. As I noted in my Report, the analogy to *Exxon Valdez* is flawed for many reasons (Rebuttal Report, p.9). Some of the flaws in this analogy have been articulated by the government's own experts in this case over the years. For example, Dr. Rice has reported that "the argument for a direct continuing oil effect [on herring in Prince William Sound] is not supported" and "long term (multi-year) damage caused by oil exposure in 1989 is not supported by the data" (Rice and Carls 2007, p.19). In sum, I have reviewed the Sumaila article and extensive data collected in the Gulf before and after the *Deepwater Horizon* accident and find the speculations in Sumaila et al. (2012) to be without basis and inconsistent with the actual data and evidence.

Conclusion

27. For the reasons discussed above and in my earlier reports, my conclusions remain unchanged. In fact, after zooming in on the smaller study areas and providing graphs of multiple species from those areas that were most heavily oiled, I reaffirm my conclusions even more.

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Appendix A - Graphs of fish and shellfish in smaller areas of the northern Gulf of Mexico within LDWF CSAs 1-4 and SEAMAP statistical areas 10-14

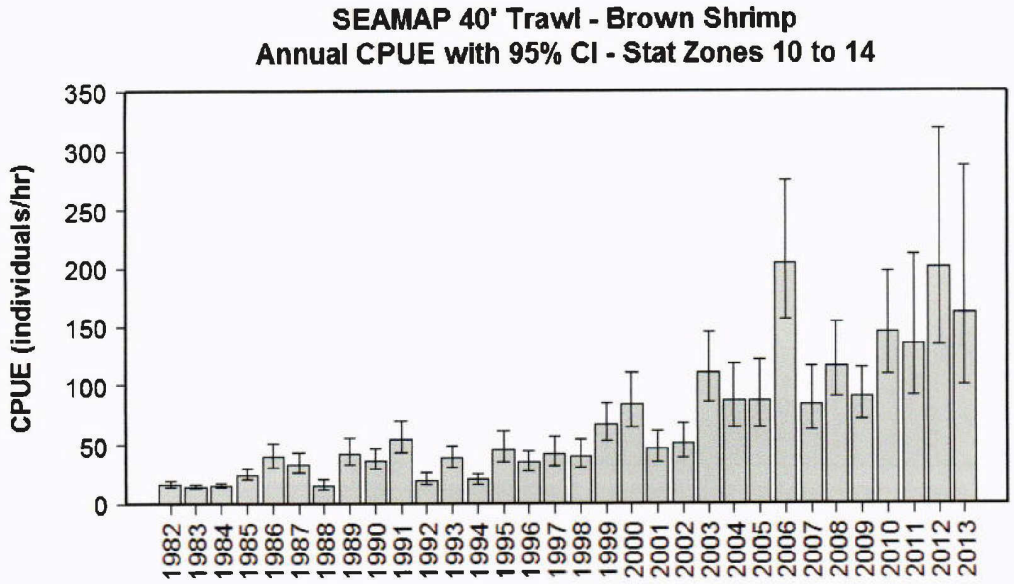

Figure A-1 – SEAMAP 40-foot trawl data for brown shrimp plotted in CPUE from statistical areas 10-14 (far western Florida to mid-Louisiana coast) from 1982-2013.

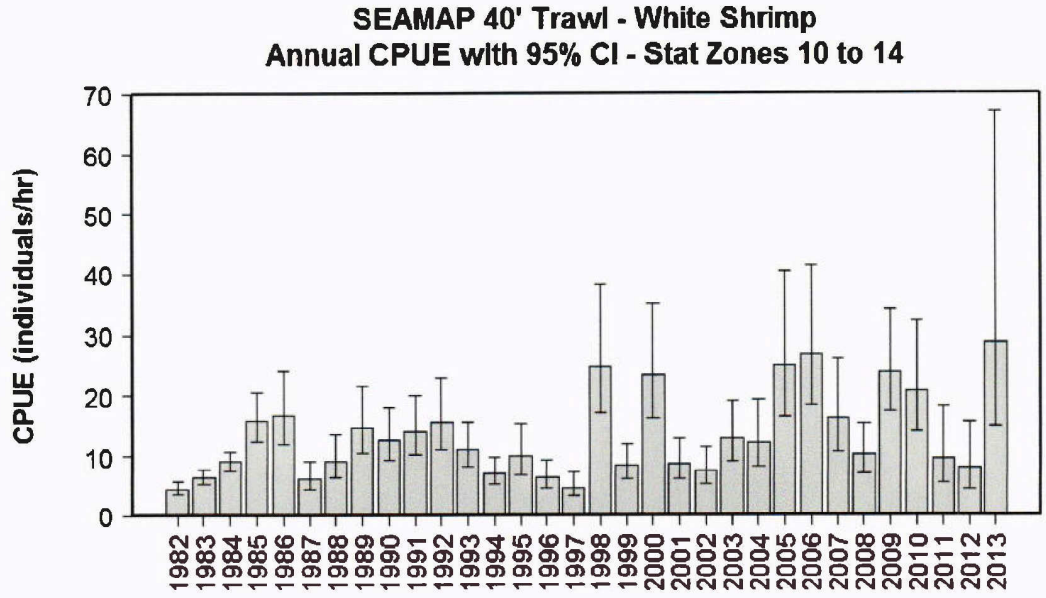

Figure A-2 – SEAMAP 40-foot trawl data for white shrimp plotted in CPUE from statistical areas 10-14 (far western Florida to mid-Louisiana coast) from 1982-2013.

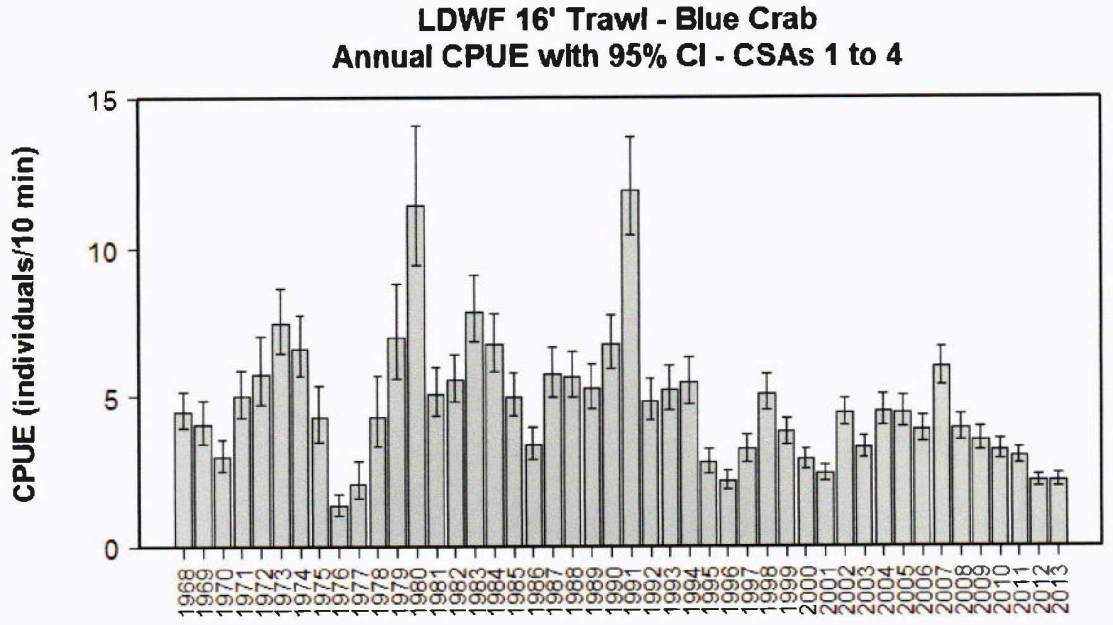

Figure A-3 – LDWF 16-foot trawl data for blue crab plotted in CPUE from CSAs 1-4 (southeastern Louisiana) from 1968-2013.

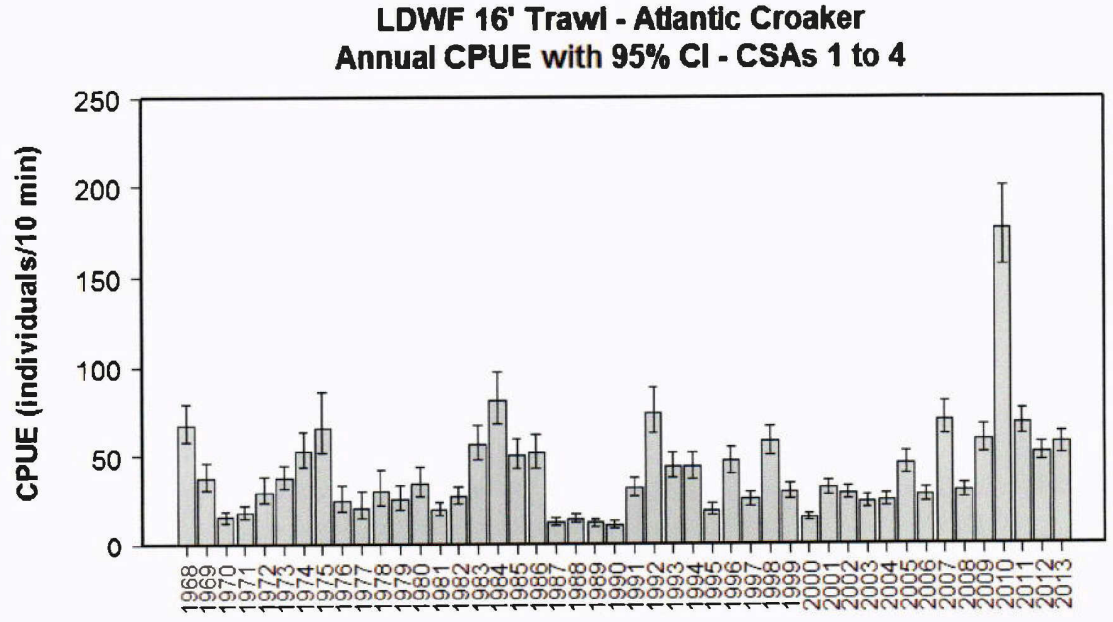

Figure A-4 – LDWF 16-foot trawl data for Atlantic croaker plotted in CPUE from CSAs 1-4 (southeastern Louisiana) from 1968-2013.

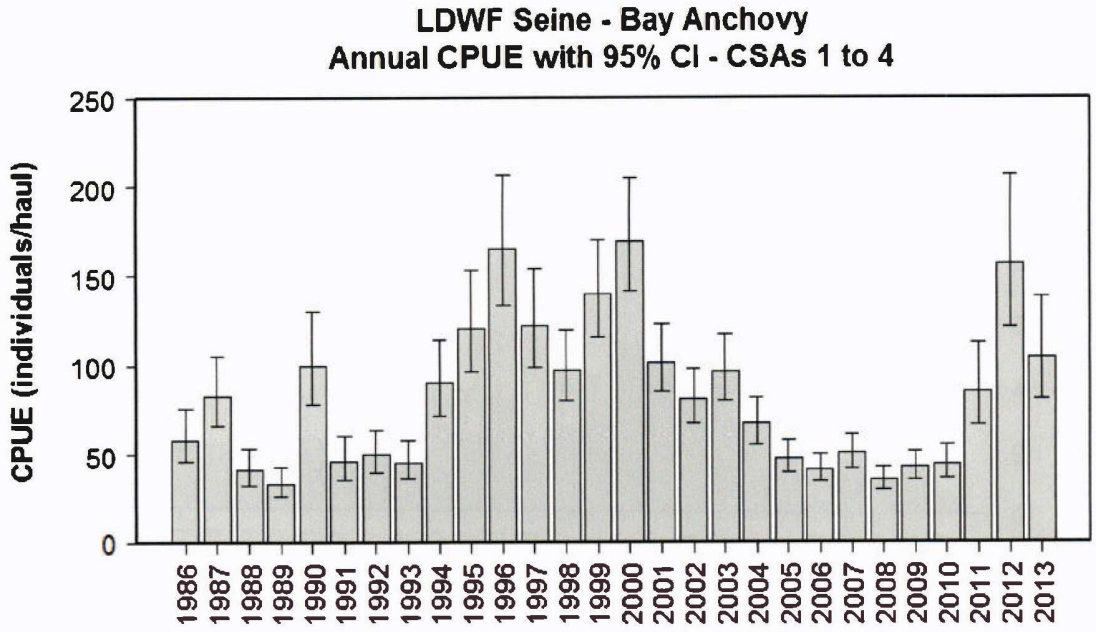

Figure A-5 – LDWF seine data for bay anchovy plotted in CPUE from CSAs 1-4 (southeastern Louisiana) from 1986-2013.

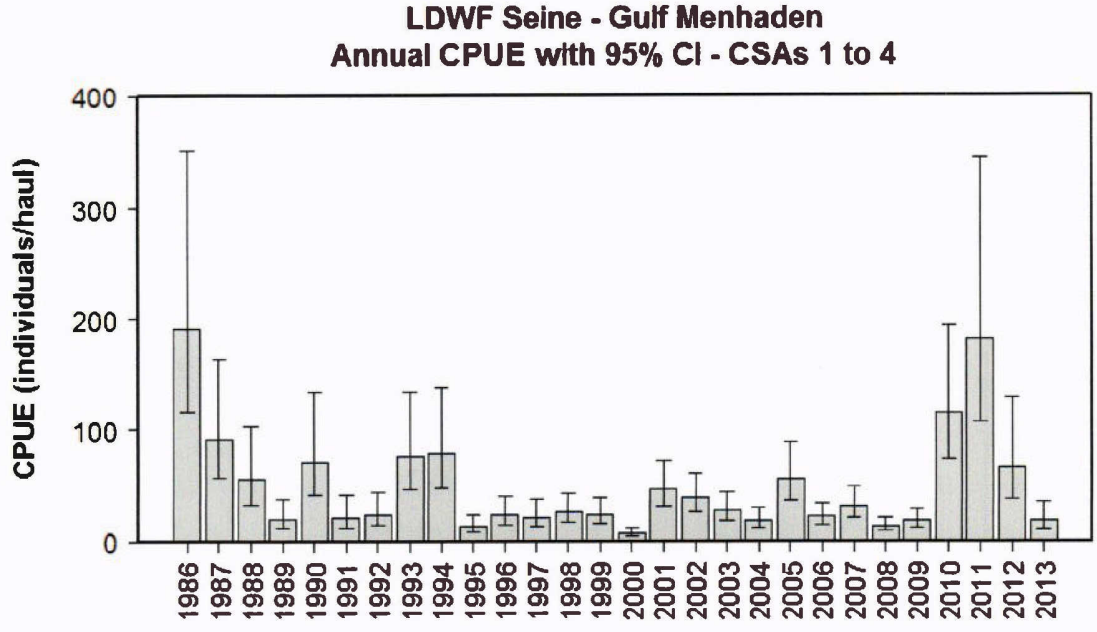

Figure A-6 – LDWF seine data for Gulf menhaden plotted in CPUE from CSAs 1-4 (southeastern Louisiana) from 1986-2013.

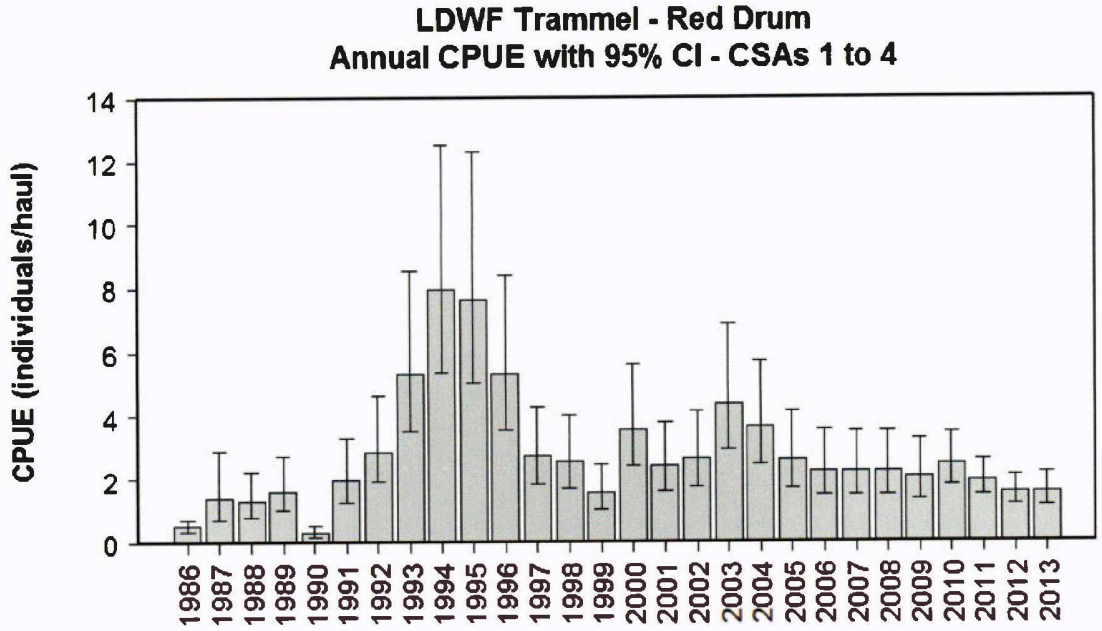

Figure A-7 – LDWF trammel data for red drum plotted in CPUE from CSAs 1-4 (southeastern Louisiana) from 1986-2013.

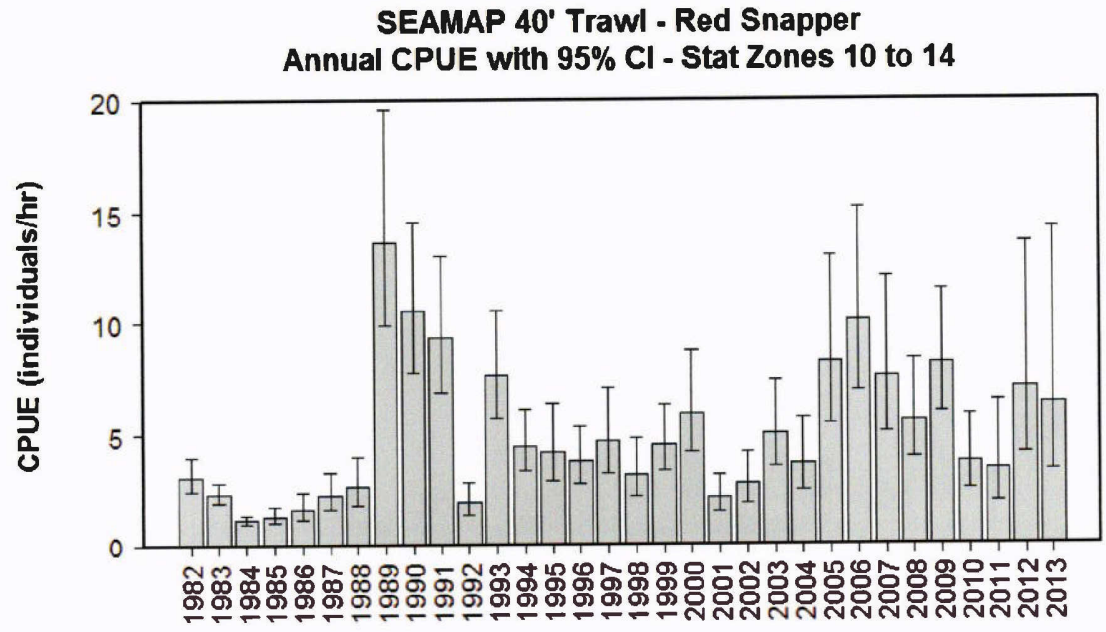

Figure A-8 – SEAMAP 40-foot trawl data for red snapper plotted in CPUE from statistical areas 10-14 (far western Florida to mid-Louisiana coast) from 1982-2013.

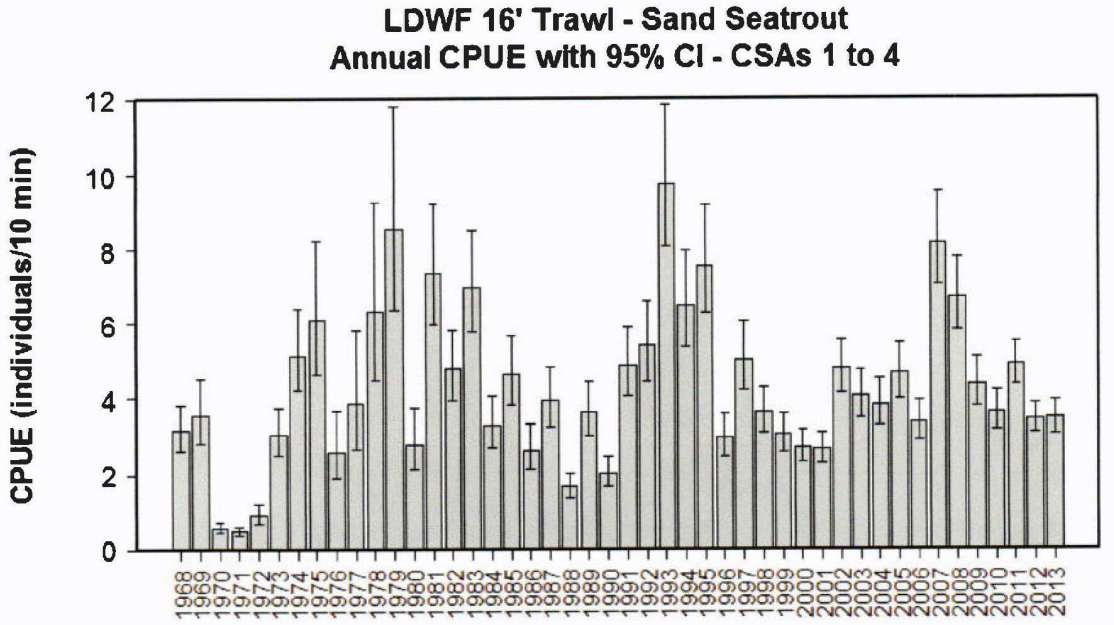

Figure A-9 – LDWF 16-foot trawl data for sand seatrout plotted in CPUE from CSAs 1-4 (southeastern Louisiana) from 1968-2013.

Appendix B – Graphs of birds in smaller areas of the northern Gulf of Mexico

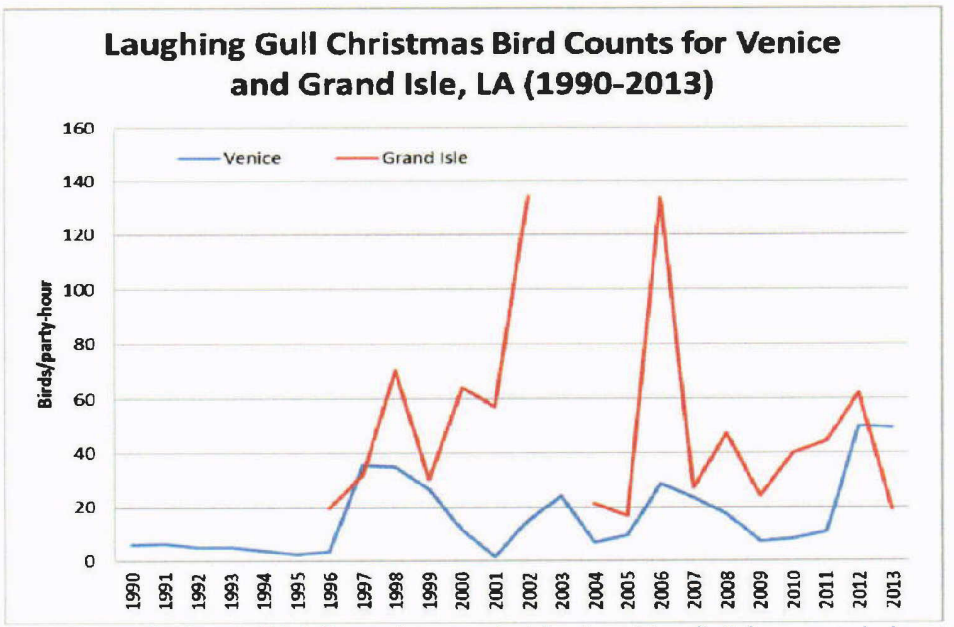

Figure B-1 – Christmas Bird Count data graphed for Laughing Gull for count circles at Venice and Grand Isle, Louisiana, during 1990-2013. No data collected during 1990-1995 or 2003 for Grand Isle.

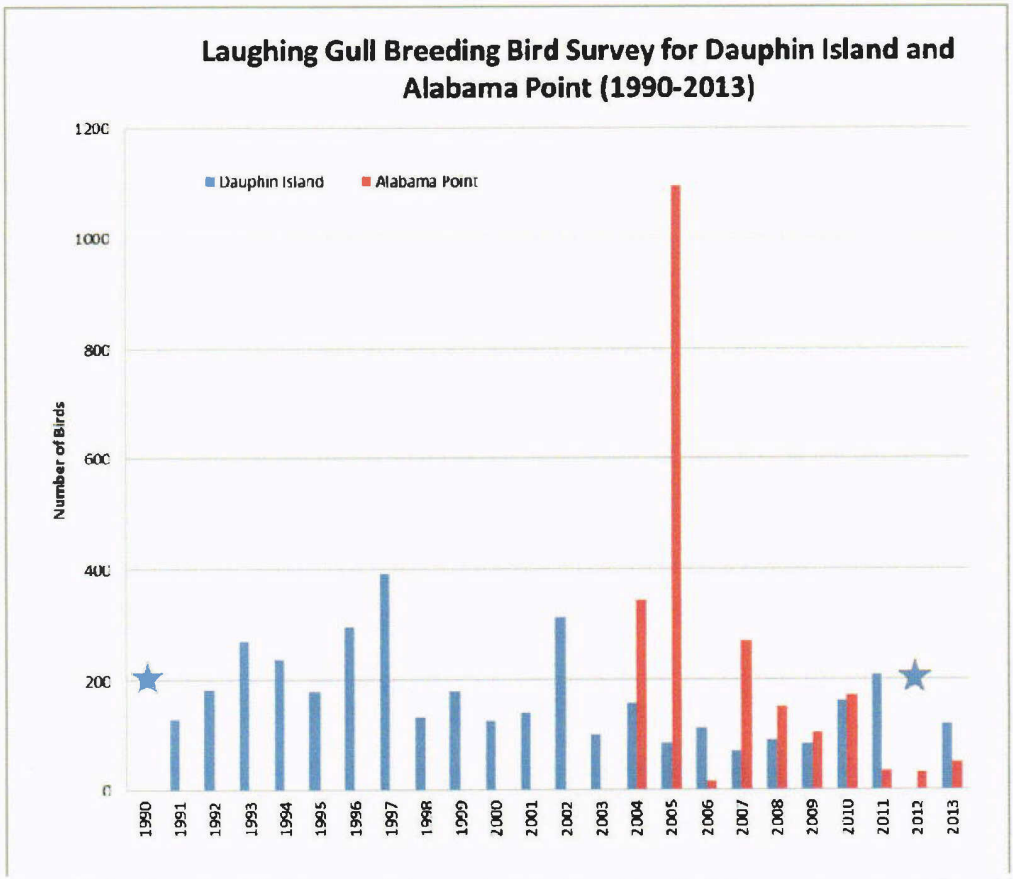

Figure B-2 – Breeding Bird Survey data graphed for Laughing Gull for survey routes at Dauphin Island and Alabama Point during 1990-2013. No data collected during 1990 or 2012 on Dauphin Island, and Alabama Point only started in 2004.

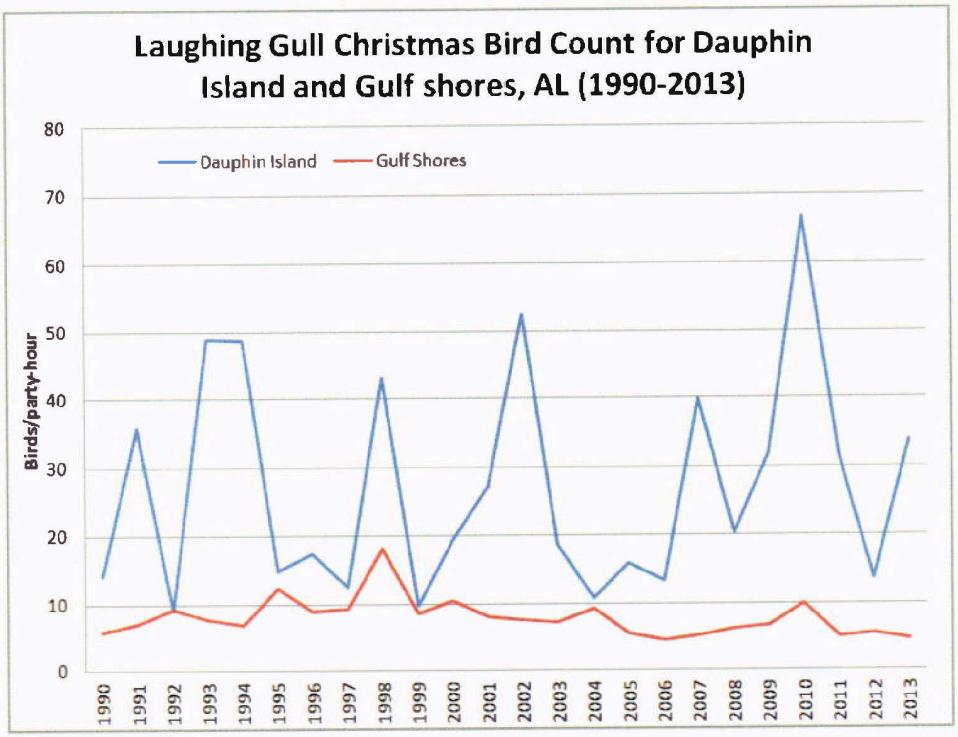

Figure B-3 – Christmas Bird Count data graphed for Laughing Gull for count circles at Dauphin Island and Gulf Shores, Alabama, during 1990-2013.

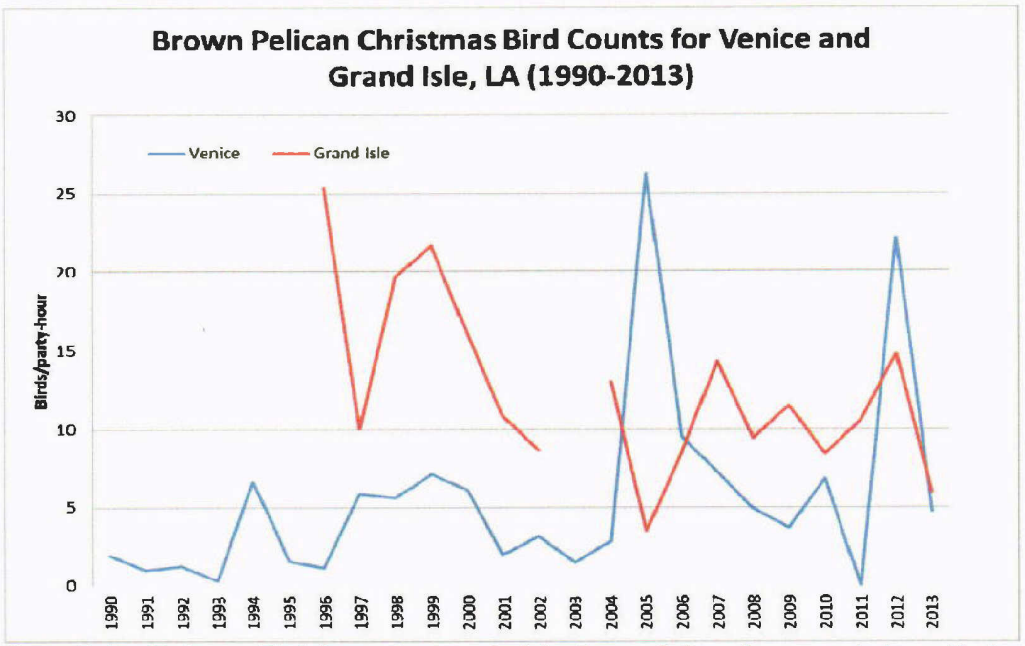

Figure B-4 – Christmas Bird Count data graphed for Brown Pelican for count circles at Venice and Grand Isle, Louisiana, during 1990-2013. No data collected during 1990-1995 or 2003 for Grand Isle.

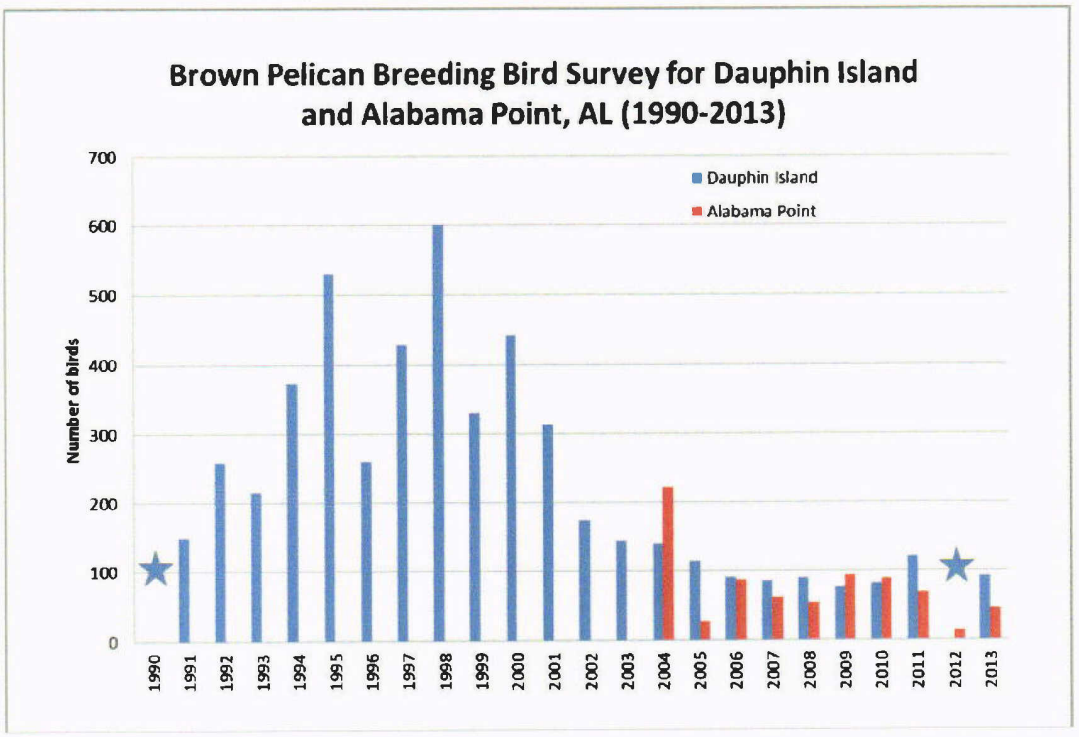

Figure B-5 – Breeding Bird Survey data graphed for Brown Pelican for survey routes at Dauphin Island and Alabama Point during 1990-2013. No data collected during 1990 or 2012 on Dauphin Island, and Alabama Point only started in 2004.

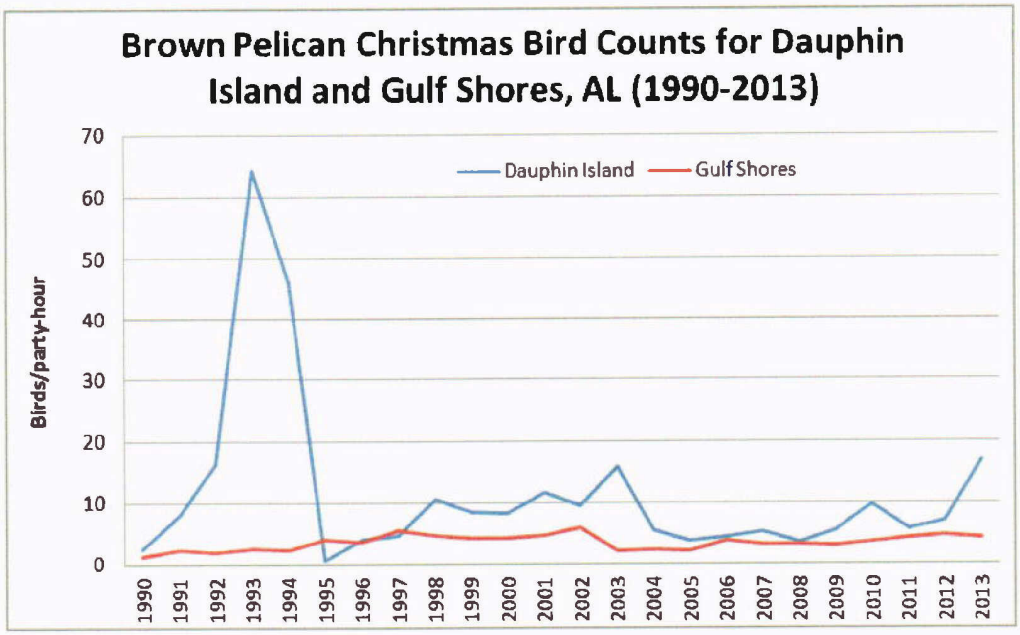

Figure B-6 – Christmas Bird Count data graphed for Brown Pelican for count circles at Dauphin Island and Gulf Shores, Alabama, during 1990-2013.

Appendix C - Maps

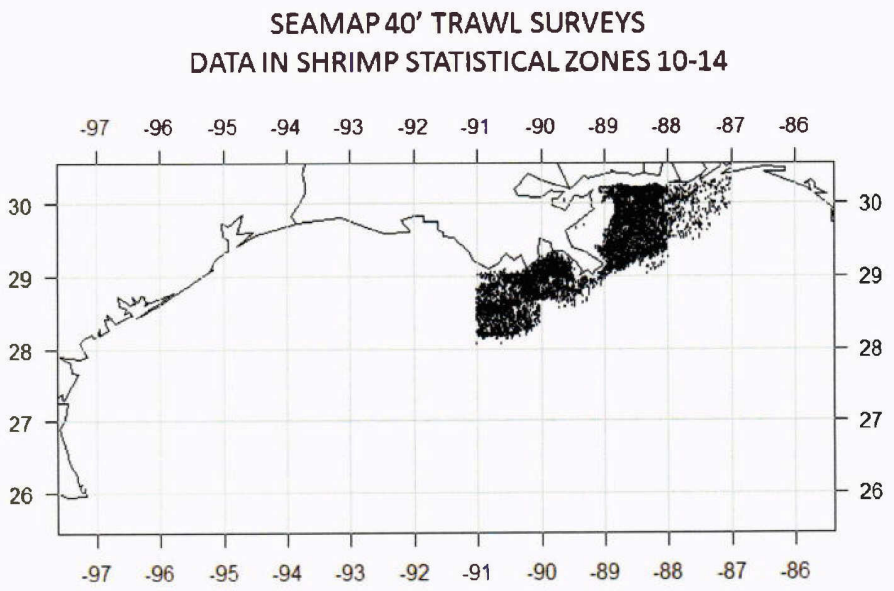

Figure C-1: SEAMAP sampling areas for 40-foot shrimp trawl surveys from 1982-2013 used in this report.

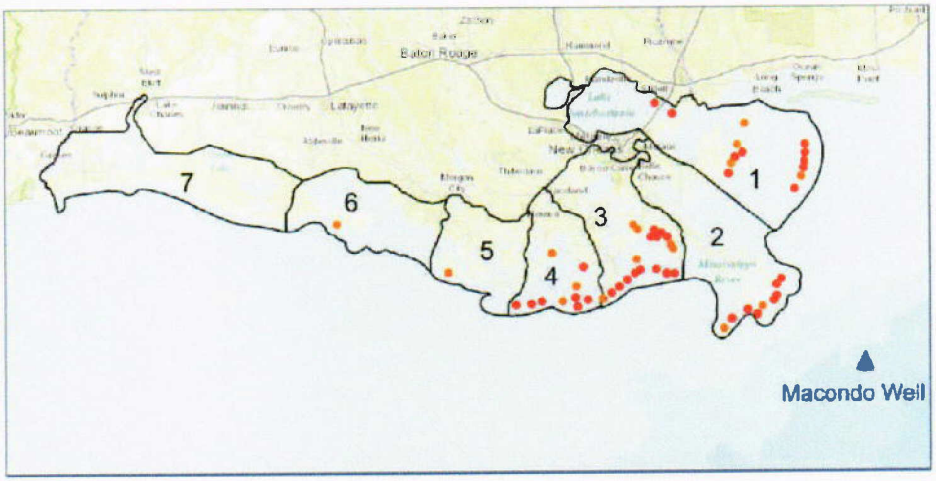

Figure C-2: Louisiana Coastal Study Areas (CSAs) as depicted in Boesch and Rice 2014. Data in Appendix A is from CSAs 1, 2, 3, and 4.

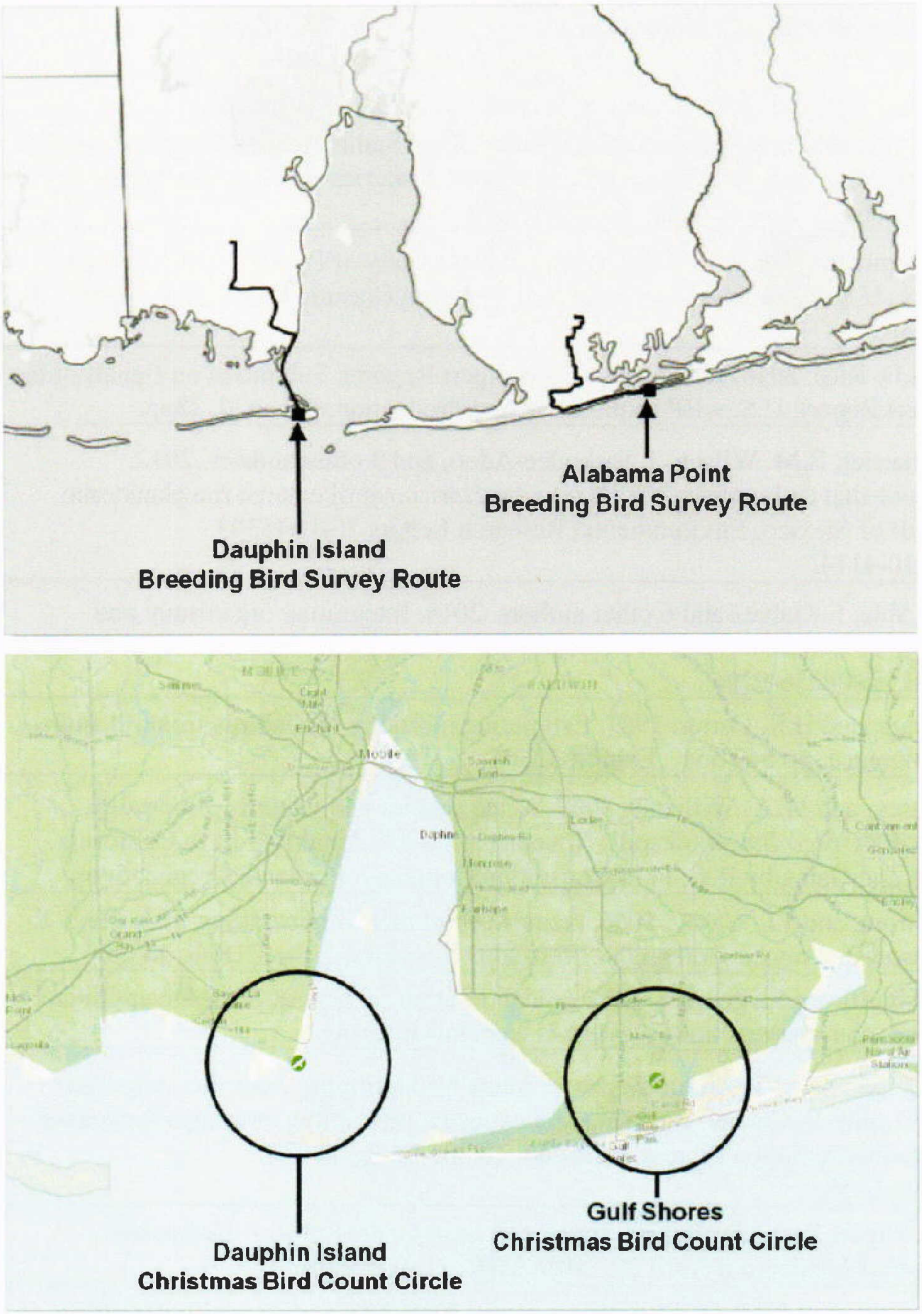

Figure C-3: Locations of Dauphin Island and Alabama Point Breeding Bird Survey routes (top) and Dauphin Island and Gulf Shores Christmas Bird Count Circles (bottom). Data available at http://www.pwrc.usgs.gov/bbs/RouteMap/Map.cfm# (Breeding Bird Survey) and http://audubon.maps.arcgis.com/apps/StorytellingTextLegend/index.html?appid=6332a1e8fcf940ea95d80cdbb48204d3 (Christmas Bird Count).

Appendix D - Consideration Materials

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Damien Higgins Deposition Transcript (July 9, 2014)

Scripts for LDWF and SEAMAP data plots
Work Plan: Detection Probability (Searcher Efficiency) (Study 1B). Exhibit 12606
Table of Bird Persistence Data. Exhibit 12611
Using Radio Telemetry to Determine the Fates of Bird Carcasses Drifting in the Northern Gulf of Mexico. Exhibit 12612
Robin Conmy email dated 8/6/12 re Assessment of Ortmann et al 2012 paper. US_PP_EPA094257