Summary of Necropsy Findings for Non-visibly Oiled Sea Turtles Documented by Stranding Response in Alabama, Louisiana, and Mississippi 2010 through 2014

Prepared by

Brian A. Stacy, DVM, PhD, DACVP

U.S. Department of Commerce

National Oceanic and Atmospheric Administration

National Marine Fisheries Service

2015

ACKNOWLEDGMENTS

Although Brian Stacy prepared this summary document, many individuals and organizations provided vital contributions. Investigation of sea turtle mortality in the northern Gulf of Mexico and monitoring of the region following the BP Deepwater Horizon disaster would not be possible without the dedication of the stranding network and many others. Jennifer Keene (University of Florida, UF) manages evidentiary materials and records, and assists with necropsies at the UF, Aquatic Pathobiology Laboratory. Individuals include personnel from the Louisiana Department of Wildlife and Fisheries (LDWF), Florida Fish and Wildlife Conservation Commission (FWC), National Oceanic and Atmospheric Administration-National Marine Fisheries Service (NMFS)(Southeast Science Center), National Park Service (NPS), U.S. Fish and Wildlife Service (USFWS), Institute for Marine Mammal Studies (IMMS), and Audubon Nature Institute (ANI). The state stranding coordinators for the region included in this report are Melissa Cook (NMFS, MS), Jackie Sablan (NPS, AL), and Mandy Tumlin (LDWF, LA). The Sea Turtle Stranding and Salvage Network (STSSN) is coordinated nationally by Wendy Teas (NMFS). Lisa Belskis (NMFS) contributes to STSSN record review, data validation, and management. The national Sea Turtle Program is coordinated by Barbara Schroeder (NMFS). Biotoxin analyses were performed by Leanne Flewelling of FWC's Fish and Wildlife Research Institute (FWRI) in St. Petersburg, Florida, and Spencer Fire and Maggie Broadwater of NOAA's National Ocean Service, Marine Biotoxins Program (NOAA-NOS). Although by no means a complete list, other individuals that deserve credit are Sara McNulty (NMFS), Wendy Hatchett (IMMS), Andrew Coleman (IMMS), Delphine Shannon (IMMS), Robert Hardy (FWC), Suzanne Smith (ANI), the invaluable staff from their respective institutions, and animal transportation teams from Dade Moeller and Associates, Inc. In addition, much of the content herein was also shared among a Northern Gulf of Mexico Sea Turtle Mortality Working Group that was convened in July 2014 in St. Petersburg Florida. This report benefited considerably from the thoughtful discussion and comments provided by expert participants.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure | Page

EXECUTIVE SUMMARY

FOLLOW-UP REPORT: SUMMARY OF NECROPSY FINDINGS FOR NON-VISIBLY OILED SEA TURTLES DOCUMENTED BY STRANDING RESPONSE IN ALABAMA, LOUISIANA, AND MISSISSIPPI 2010 THROUGH 2014

Prepared by

BRIAN A STACY, DVM, PhD, DACVP

This report is a follow-up to previous reports on the BP Deepwater Horizon (DWH) oil spill, related activities, and sea turtle strandings within the northern Gulf of Mexico. The principal focus of this report is necropsy findings in non-visibly oiled sea turtles found in Alabama, Louisiana, and Mississippi during 2010 through 2014. Relatively large numbers of mostly dead, decomposed sea turtles, primarily Kemp's ridley turtles, were documented by stranding response in all years. Most of the strandings have occurred as seasonal pulses with peak activity during spring and early summer months. Although multiple contributing causes of strandings, including vessel strikes, were identified, the majority of turtles were in fair or good nutritional condition and did not have any traumatic injuries or evidence of disease. Many had food within the stomach, and had been feeding on fish. Sediment within the lungs and upper respiratory tract was another common finding. Diagnostic testing did not indicate biotoxins produced by harmful algae or other toxins were a cause of the strandings. Evidence suggests that many of the sea turtles died in a sudden manner, sank, and were found as beach strandings after becoming positively buoyant due to putrefaction. Drowning of otherwise healthy animals is suspected based on necropsy findings and exclusion of other apparent causes of death. Forced submergence due to incidental capture in fishing gear is a primary consideration given the numbers of animals found and evidence of foraging on food items commonly regarded as bycatch or otherwise fisheries-related (fish and penaeid shrimp). A separate finding of necropsies was a general decline in nutritional condition of stranded turtles since intensive necropsy efforts began in 2010 as part of long-term monitoring following the DWH oil spill.

INTRODUCTION

Large numbers of threatened and endangered sea turtles have been found dead along the coasts of Alabama, Louisiana, and Mississippi since 2010 and have generated significant concern among government agencies, non-governmental organizations, and the public. These concerns have been especially heightened given the unprecedented scale of the BP Deepwater Horizon (DWH) oil spill in 2010, long-standing issues related to bycatch of sea turtles in commercial fisheries in the Gulf of Mexico, and reduced nesting of endangered Kemp's ridley sea turtles below levels predicted by population modeling.

Prior to 2010, detection and documentation of stranded sea turtles was inconsistent within the northern Gulf of Mexico (NGOMX), especially in Louisiana and Mississippi. The Sea Turtle Stranding and Salvage Network (STSSN) was enhanced in response to the DWH oil spill and has continued efforts to respond to stranded sea turtles in subsequent years. In support of these activities, NOAA Fisheries Office of Protected Resources (OPR) has collaborated with NOAA's Office of Response and Restoration, US Fish and Wildlife Service, state wildlife agencies, and participants in the STSSN to conduct postmortem examinations (necropsy) of stranded sea turtles as part of the investigation into the causes of strandings.

This follow-up report summarizes necropsy findings for stranded sea turtles observed during and in the four years following the DWH spill, and builds upon a previous report of findings from the formal DWH oil spill response (April 26, 2010 to October 20, 2010) (Stacy 2012). Relatively few oiled turtles have been encountered since this period (Stacy 2012). The current report focuses on non-visibly oiled sea turtles due to the continuation of seasonally high strandings in the years following the DWH spill and general concerns regarding the causes and potential linkages to the spill and other possible sources of mortality, including commercial fisheries.

GENERAL METHODOLOGY

Stranding data

Stranding data for 2010 through 2014 were obtained from the Southeast Fisheries Science Center (SEFSC). All stranding data are undergoing validation by the SEFSC and are considered preliminary. In addition to reported strandings in Alabama, Louisiana, and Mississippi, data for neighboring statistical zones in Texas and Florida were also examined for comparative purposes. This report is not an exhaustive analysis of available stranding data, but rather focuses on general numbers and spatiotemporal characteristics that provide essential context for necropsy findings as is relevant to investigating potential causes of mortality. The method in which identification information is assigned in the field in Louisiana and chain of custody requirements resulted in some minor discrepancy between the dates a carcass was initially reported and when it was actually documented by stranding responders for some cases. Resolution of the stranding dates in a manner consistent with regular STSSN protocol is ongoing. For the purposes of this report, the date on the chain of custody is considered the date of discovery unless corrected information has been confirmed by the SEFSC. These minor differences and subsequent changes that occur as a result of stranding data validation are not expected to significantly affect the findings in this report, but may be relevant to any future examination of necropsy and stranding data. Lastly, sea turtles that died as a result of observed incidental capture by recreational fishermen, fisheries research, dredging, and other operations are not included in this report.

In order to characterize periods of relatively high numbers of strandings and examine necropsy findings during those times, the calendar year was divided into regular 15-day intervals. Any 15-day period in which numbers of strandings were 40 or greater was considered a "peak" stranding period, whereas those with less than 40 were regarded as "non-peak." The threshold of 40 was simply selected as a general characterization of relative magnitude of strandings based on the numbers documented rather than subjectively delineating the rise and fall of peaks in stranding activity.

Necropsy protocols and data format

During the DWH spill, all sea turtle carcasses were salvaged for necropsy whenever possible. After official response operations concluded in October 2010, carcasses in advanced stages of decomposition were no longer collected in Alabama and Mississippi. In Louisiana, the state wildlife agency continued to recover most of the reported sea turtle carcasses in 2011 and 2012, regardless of postmortem condition, and all animals were subsequently examined. This practice is reflected in some of the data presented (e.g., higher proportions of turtles found in LA in which only limited assessment was possible). In 2013 and 2014, selection of cases for necropsy was similar among all states with prioritization of carcasses in conditions most likely to yield information regarding general health parameters, diet, and cause of stranding.

Most of the necropsies were performed by Dr. Brian Stacy, a board-certified veterinary pathologist with OPR based at the University of Florida, College of Veterinary Medicine. Assistance was provided by Ms. Jennifer Keene (OPR/UF). In 2011 and 2012, some gross necropsies were attended by Ms. Mandy Tumlin (LDWF), Dr. Terry Norton (Georgia Sea Turtle Center), Dr. Andy Coleman (IMMS), and Dr. Heidi Zurawka (IMMS). Most necropsies were performed at the University of Florida (Gainesville, Florida). Some were performed at IMMS and Audubon Nature Institute (ANI). Eleven necropsies were performed early in the spill response by Ms. Lisa Belskis (SEFSC) and one by Ms. Carrie Horton (SEFSC).

All carcasses received were examined to the extent possible, as determined by postmortem condition. Cases were accessioned into a sea turtle necropsy and evidentiary database. The format of the data forms used for gross examination notes and findings have been modified over the period of study. The current forms are provided in Appendix C. Necropsy findings and related results were summarized into a “Pathology Consultation Report” for each case. The signed final hardcopies or digital copies of these documents comprise the official record. Electronic copies of reports and digital photographs documenting examinations were archived and are included in a searchable database (Microsoft Access™).

Please note that differences in numbers presented compared to previous reports may be attributed to data from additional turtles that were examined after earlier reports were written, differences in how some data are presented (e.g., time intervals, case definitions), and exclusion of all sea turtles reported as or suspected to be oiled, which are considered in detail elsewhere (Stacy 2012).

Explanation of key terms

Necropsies were categorized as full, partial, or limited. Full necropsies were performed on carcasses that were complete and in a condition that allowed some degree of assessment of major organ systems. Partial examinations were performed on carcasses that were badly damaged due to scavenging, trauma, or decomposition. Limited examinations were performed most often on skeletalized carcasses or desiccated remains. Nonetheless, findings such as major traumatic injuries often were detected by these limited assessments.

Postmortem condition was assigned a number based on the standard convention of the STSSN. The numerical designations are as follows: (1) fresh dead animals (no foul smell and little or no decomposition); (2) moderate decomposition (foul smell, skin and scutes intact or beginning to peel, internal organs distinguishable); (3) severe decomposition (foul odor, scutes lifting or gone, skin peeling or liquefying, internal organs beginning to liquefy and hard to distinguish); (4) desiccated carcasses (dried remains, leathery, internal organs completely decomposed); and (5) skeletal remains (minimal to no soft tissue remaining). Nutritional condition was subjectively scored as (1) emaciated, (2) thin, (3) fair, or (4) good based on the state of skeletal muscle and fat stores. Species was determined using key morphological characteristics (Wyneken 2001). Gender was determined whenever the condition of the carcass allowed sufficient examination of the gonads. Sizes of turtles were reported as straight carapace length (SCL) from nuchal notch to tip of the supracaudal scute. If SCL was not recorded, it was converted from curved measurements using regression equations (Teas, 1993) or estimated from photographs using internal scales within the images. The SCL was also estimated for carcasses in which the carapace was incomplete, damaged, or disarticulating. For the purposes of this report, SCL measurements obtained at necropsy were used in preference over STSSN data due to greater consistency in technique and use of calibrated calipers.

Cause of death was assigned when determinable based on available findings. When possible, consideration was given to proximate cause of death (condition or process that initiated a chain of events leading to death) and immediate cause of death (condition or complication that directly precedes death). Cause of death was considered probable when strong evidence of likely cause was present, but definitive information was considered lacking. Conclusions regarding cause of death were conservative, often because assessment was limited by decomposition or insufficient circumstantial information.

Traumatic injuries were classified as antemortem, postmortem, or as undetermined in relation to time of death. Antemortem indicates that injuries were inflicted prior to death. Postmortem injuries were inflicted after death. Determinations were based on a combination of wound characteristics, presence of associated hemorrhage, inflammatory exudate or generalized blood loss, and observations noted in the stranding record. Wounds were only diagnosed as antemortem if there was an inflammatory response (vital reaction) or clear evidence of hemorrhage or blood loss. Histological evaluation of wound margins was included in assessment of sea turtles examined in 2012, 2013, and 2014 based on relevant research that came available during the period of this report (Stacy et al. 2015).

Major injuries were classified as blunt trauma, linear blunt trauma, chop wounds, shark bites, entanglements/fishing gear-related injuries, or miscellaneous injuries, including malicious human interaction and injuries of unknown cause. Blunt trauma was characterized by fractures, contusions, abrasions, or lacerations involving one or more areas of the body. Linear blunt trauma was characterized by a distinct linear pattern, as is consistent with collision with propulsion and steering components of watercraft, including skegs and rudders. Chop wounds were characterized as linear, curvilinear, or sigmoidal injuries with sharp force features and wastage of bone. Serial parallel chop wounds are typical of injuries from watercraft propellers. Single chop wounds also can be caused by collisions with sharp, non-rotating features of watercraft, such as some skegs and rudders. Shark bite wounds were identified by semicircular ablations of the carapace or plastron or amputations, sharply incised tooth marks, or characteristic deep scoring of bone at the wound margins.

Proximate cause of death was attributed to drowning only if circumstances surrounding death were known (e.g., a turtle found dead within a trawler net), which did not apply to any cases included in this report. Probable drowning was considered the immediate cause of death if copious froth or fluid (if postmortem state was sufficient for interpretation) or foreign material was found within the lungs and no other lesions explaining cause of death were present, but circumstances surrounding death were unknown (e.g., a sea turtle found dead on a beach). A determination of probable drowning did not imply a specific scenario, such as drowning in fishing gear, but was taken with other findings to consider possible causes of mortality.

Contents of the gastrointestinal (GI) tract were examined and specifically characterized whenever possible by type and location within the GI tract. Data are given by total numbers of animals in which postmortem condition was sufficient for examination of the GI contents, and excludes those cases in which contents could not be evaluated due to decomposition or missing organs. Some variability in numbers examined between different segments of the GI tract reflects postmortem state (e.g., cases where the oral cavity and esophagus were intact and examinable, but the stomach was missing or decomposed beyond recognition). General taxa of interest, especially fish and penaeid shrimp, are given in this report; however, representative samples of GI contents are archived for potential future detailed analysis.

Case categories and comparisons

Due to postmortem state, cause of death (COD) was not determined for most individual cases. Nonetheless, significant information pertinent to mortality investigation could be attained, such as presence or absence of severe injuries, nutritional condition, GI contents, and gross evidence of disease. All cases were categorized by COD or similar necropsy findings if COD was undetermined using the criteria in Table 1. Turtles in which COD was attributed to probable drowning (exclusion of other findings in conjunction with intrapulmonary sediment) were grouped with turtles that were in fair to good nutritional condition and did not have any major traumatic injuries. All turtles with major injuries are grouped together regardless of whether timing of injury in relation to death was determined. All turtles with depleted adipose stores or pathological lesions that could have been related to death are considered with those in which COD was attributed to a disease state. Various comparisons between groups were evaluated for statistical significance using Pearson's chi-squared test (PCS) if expected frequencies were ten or greater (with one degree of freedom). Two-tailed Fisher's exact test (FE) was used if expected frequencies were less than ten. Differences were considered significant if p-values were less than 0.05. These intergroup comparisons were made with data from all years (2010-2014) combined and with 2010 data excluded (2011-2014 only). Exclusion of 2010 data considered potential differences unique to the year of the DWH oil spill, such as irregularity in fisheries openings/closures and response activities.

Additional analyses of nutritional condition

Based on apparent decline in nutritional condition of necropsied Kemp's ridleys from 2010 to 2014, as indicated by subjective assessment at necropsy, nutritional condition was re-evaluated by blind review. Photographs of pericoelomic fat that were consistently taken during necropsies were reviewed for quality and then assigned a semi-quantitative score of 1 to 4 based on the degree of atrophy (see Appendix B5). The data were examined by state, year, season, and SCL using Mann-Whitney tests (MWT) for single pairwise comparisons or the Kruskal-Wallis method (KW) for groups followed by Bonferroni correction. Any p-values less than 0.05 were considered significant.

Analyses for biotoxins

Organ samples and GI contents from 40 turtles, fourteen from 2010, ten from 2011, eleven from 2012, and five from 2013 were submitted to one of two laboratories and analyzed for biotoxins of concern for the northern Gulf of Mexico, including brevetoxin, domoic acid, saxitoxin, and okadaic acid. Cases were selected to be representative of predominant necropsy findings and included sea turtles in good nutritional condition with fish or other dietary items in the digestive tract. Samples from one red drum (*Sciaenops ocellatus*), one gafftopsail catfish (*Bagre marinus*), and one double-crested cormorant (*Phalacrocorax auritus*) that were found with dead sea turtles in 2013 also were analyzed. Analyses were conducted by the harmful algae laboratories of FWC's Fish and Wildlife Research Institute (FWRI) in St. Petersburg, Florida and NOAA's National Ocean Service, Marine Biotoxins Program (NOAA-NOS) in Charleston, South Carolina. Availability for receipt of samples and immediate needs related to mortality investigation determined which laboratory analyzed the samples.

Tissues were homogenized, and subsamples were taken for each toxin analyzed. Toxins were extracted using organic solvents (acetone or aqueous methanol for brevetoxin; aqueous methanol for okadaic acid and domoic acid; and aqueous acetonitrile or dilute HCl for saxitoxins). Extracts were screened for the presence of brevetoxin and brevetoxin metabolites using a competitive ELISA performed according to Naar et al. (2002) or Maucher et al. (2007). Toxin concentrations were calculated using a PbTx-3 standard curve and results are reported in PbTX-3 eq g^{-1}. Liquid chromatography-tandem mass spectrometry (LCMS-MS) analyses for okadaic were based on Deeds et al. (2010). Domoic acid analyses were also performed using LCMS-MS based on the method of Wang et al. (2012). Extracts were analyzed for saxitoxin and other Paralytic Shellfish Poison toxins using a microliter plate-based receptor binding assay (RBA; Doucette et al., 1997, Van Dolah et al. 2012) or through high-performance liquid chromatography with fluorescence detection (HPLC-Fl) according to Lawrence et al. (2005).

Other toxicological analyses

Other diagnostic testing included analysis of a stomach contents from one Kemp's ridley that stranded in 2012 for clostridium botulism at the University of Pennsylvania Animal Diagnostic Laboratory System. Samples were analyzed by real time polymerase chain reaction and mouse bioassay. Also, stomach contents from two Kemp's ridleys that stranded in 2013 were analyzed by gas chromatography-mass spectrometry (GCMS) for known organic toxicants at the Diagnostic Center for Population and Animal Health at Michigan State University.

SUMMARY OF SEA TURTLE STRANDINGS AND NECROPSY FINDINGS IN ALABAMA, LOUISIANA, AND MISSISSIPPI FROM APRIL 2010 THROUGH SEPTEMBER 2014

Sea turtle strandings in the Gulf of Mexico

Available stranding data from Alabama, Louisiana, and Mississippi for 2010 through 2014 included 2,360 sea turtles. Numbers of sea turtles documented as strandings and necropsied for these years are given by state in Table 2. Confirmation of species identification is pending validation for all years. Based on preliminary identification of stranded turtles, Kemp's ridleys (*Lepidochelys kempii*) were the predominant species documented, comprising 85.5% of all reports (2,018/2,360). Fewer loggerheads (*Caretta caretta*) (5.6%, 131/2,360), green turtles (*Chelonia mydas*) (4.5%, 107/2,360), leatherbacks (*Dermochelys coriacea*) (0.3%, 7/2,360), and hawksbills (*Eretmochelys imbricata*) (<0.1%, 2/2,360) were observed. Ninety-five carcasses were not yet identified to species (4.0%, 94/2,360). A map of the Gulf of Mexico statistical zones and sea turtle strandings by year are shown in Figure 1. The zones with greatest numbers of stranded Kemp's ridleys were 11 and 12, which includes the Mississippi Sound and western Mobile Bay. Other regions of relatively large numbers of documented strandings were the barrier islands of Louisiana around the Barataria Bay region (zones 13 and 14) and the mainland shore of western Louisiana (zone 17). Specific stranding locations of animals within these areas are shown in Figure 2.

Given the clear predominance of Kemp's ridleys among strandings within the NGOMX, historical stranding numbers for this species were specifically considered for Alabama, Louisiana, and Mississippi, and adjacent statistical zones in eastern Texas and the western Florida panhandle (Figure 3). The following is a general description of these data. Significant caveats related to comparisons of stranding data among states and years will be considered in the discussion. Notably greater numbers of stranded Kemp's ridleys were documented in Alabama, Louisiana, and Mississippi in 2010 compared to the previous 10 years. Strandings also exceeded 100 per year during multiple years in Louisiana in the 1990's. In Alabama, the large numbers of strandings reported in 2010 was followed by consistent annual decreases. Documented strandings in Louisiana slightly decreased from 2010 to 2011, and increased again in 2012 and 2013; with 2013 being the year of the highest number of strandings within that state on record. Reported strandings were most dramatically higher in Mississippi as compared to previous years, decreased from 2010 to 2012, and increased again in 2013. All three states had relatively fewer reported strandings in 2014. Both Florida and Texas have had general increases in Kemp's ridley strandings over the last several years. Kemp's ridley strandings in Texas have increased to the degree that they are similar to relatively high stranding levels documented in the late 1990's and early 2000's. As in Alabama, Louisiana, and Mississippi, strandings in Texas were lower in 2014 than during the previous four years.

Numbers of reported strandings (all species) in Alabama, Louisiana, and Mississippi were examined by 15-day intervals (Figure 4). In 2010, strandings began in April in Mississippi and Alabama (May in Louisiana), peaked in May and June, and notably decreased in July. During 2011, 2012, and 2013, large peaks in sea turtle strandings occurred during March through May, persisted throughout the summer, and decreased after July. The onset of spring strandings occurred in early March in 2011 and 2012, and early April in 2013 and 2014. In all years, including 2010, an initial peak in activity is followed by a smaller peak or peaks in May, June, and/or July.

The multi-year average number of Kemp's ridley strandings per 15-day period was compared between Texas and Alabama, Louisiana, and Mississippi to compare timing of strandings within these states (Figure 5). Stranding data from Texas was focused upon because the magnitude strandings and historical necropsy findings within this state are similar to those documented in Alabama, Louisiana, and Mississippi. Texas stranding data for the years 1995 through 2013 were specifically selected due to relative consistency in commercial fisheries regulations, especially use of turtle excluder devices (TEDs), after the mid-1990's. For Alabama, Louisiana, and Mississippi, only data for 2010 through 2014 were examined because of concerns related to lack of comparability in stranding response and reporting effort prior to 2010. Mean strandings in all four states similarly peaked within the spring and early summer and persisted at lower levels throughout the summer. There is a consistent decrease on Texas strandings from mid-May to mid-July, which is largely attributed to seasonal closure of states waters to shrimping (L. Howell pers. com.). A somewhat similar pattern was observed in Alabama and Mississippi strandings in which the initial spring peak in strandings is followed by a decline in activity during May and early June, and then a second smaller peak in June and July.

Necropsy findings

Summary, species, size, and gender

One thousand three hundred and eighty-four of 2,360 (58.6%) stranded turtles were necropsied. Of those necropsied, 1,355 (97.9%) were not reported or suspected to be visibly oiled. By year, the greatest proportion of stranded turtles was necropsied in 2010 as part of the response to the DWH spill. Most necropsied turtles were Kemp's ridleys (1,219/1,355, 90.0%) due to the predominance of this species among the strandings. Fewer loggerheads (65/1,355, 4.8%), green turtles (66/1,355, 4.9%), leatherbacks (3/1,355, 0.2%), and hawksbills (1/1,356, <0.1%) were necropsied. A single skeletal remnant could not be confidently identified to species.

Size structure of necropsied turtles is presented by species in Figure 6, and was not statistically different from SCL's measured by the STSSN. Median SCL of Kemp's ridleys was 34.0 cm (range = 16.6 to 66.5 cm, excluding a single hatchling). Gender was determinable for 846 Kemp's ridleys; 577 were female and 269 were male (ratio = 2.1:1). The median SCL of loggerheads was 74.0 cm (range = 25.7 cm to 112.0 cm, excluding three hatchlings). Gender was determinable for 40 loggerheads; 37 were female and three were male (ratio = 12.3:1). The median SCL of green turtles was 35.7 cm (range = 22.8 to 94.6

cm). Gender was determinable for 36 green turtles; 27 were female and nine were male (ratio = 3:1). Gender was determined for one male leatherback and one female hawksbill.

There was no significant difference in median SCL of necropsied Kemp's ridley's between states; however, there were significant differences in proportions of discrete sizes classes, specifically small juveniles <25 cm and subadult and adult turtles >60 cm (Figure 7). Seventy-eight of 84 (92.9%) of all necropsied turtles <25 cm SCL were found in Louisiana, which was 20.5% (78/379) of Kemp's ridleys (with measurable SCL) from that state as compared to 1.4% (2/141) and 1.0% (4/394) of cases from Alabama and Mississippi, respectively. Similarly 71.4% (15/21) of larger Kemp's >60 cm SCL that were necropsied were found in Louisiana. This size class represented 4.0% (15/379) of necropsied Kemp's ridleys found in Louisiana as compared to 0.7% (1/141) found in Alabama and 1.3% (5/394) from Mississippi.

Size classes of stranded Kemp's ridleys were compared by date of discovery for Louisiana (Figure 8). In all years, peak strandings of smaller turtles <25 cm SCL occurred in mid-May to early June, approximately one month following initial peaks in strandings of larger turtles (>25 to 60 cm SCL) during all years except for 2010. Both size classes stranded around the same time in 2010. Stranding dates of turtles >60 cm SCL were also examined, but numbers were too low to evaluate the data for any consistent pattern (data not shown).

Postmortem condition

The state of decomposition and extent of necropsy are given by species in Tables 3 and 4, respectively (by state in Appendices A1 and A2). Most (1,230/1,355, 90.8%) sea turtles were moderately or severely decomposed. Twenty-seven (2.0%) necropsied turtles were found alive and subsequently died. Collection of more severely decomposed carcasses and desiccated and skeletal remains resulted in higher proportions of turtles that received partial or limited examinations. Numbers of postmortem examinations for all species and all states include 666 full examinations, 515 partial examinations, and 174 limited examinations. Histology, which was also dependent on postmortem condition, included all major tissues from 50 turtles, partial tissue sets for 17, and evaluation of specific pathological lesions for 15 cases.

Nutritional condition

The nutritional condition of necropsied sea turtles is provided by species in Table 5 (given by state in Appendix A3). Of those animals in which nutritional condition could be evaluated, 94.8% (938/989) of Kemp's ridleys, 86.5% (45/52) of loggerheads, and 91.6% (44/48) green turtles were in fair or good nutritional condition. From 2010 to 2014, there was general trend of greater proportions of Kemp's ridleys considered to be in fair or thin nutritional condition. More Kemp's ridleys in thin condition were observed in 2013 than in any previous year. The total number of loggerheads and green turtles in thin nutritional condition also was highest 2013; however, numbers of examined animals were inadequate for confident comparison among years.

Median scores of robustness of fat stores in Kemp's ridleys were compared across years by size class, state, and season (Figure 9). There was a significant trend in declining scores from 2011 to 2013 when all data were considered. Median scores for turtles found in 2010 and 2011, and 2013 and 2014 were not significantly different, and both year-pairs were different from one another and 2012. The following size groups were specifically examined: small juveniles <25 SCL (expected to include those turtles that most recently recruited into near-shore waters), medium and larger neritic juveniles 25 to 60 cm SCL, and adult-size turtles (>60 cm SCL). Findings for turtles 25-60 cm SCL exhibited the same declining trend as the larger combined data set, but scores for turtles <25 cm and >60 cm SCL were not significantly different from year to year. Most small juveniles had little to no atrophy and only one of 23 adult-sized turtles scored had any atrophy of fat.

Median scores for Mississippi and Alabama have very similar trends and significant differences year to year with declining fat condition from 2011 through 2013. Sample sizes for Alabama were small (<25) for all years other than 2010. For Louisiana, turtles in 2013 had significantly lower fat condition than 2010-2012, but 2014 was intermediate (not significantly different from any other year). The sample size for 2014, however, was only 28 turtles. The aforementioned greater numbers of small juveniles and adult-sized turtles is a source of confounding for animals found in Louisiana. There were no significant differences in fat condition when compared by spring (March through May) and summer months (June through August) within years.

Cause of death and major necropsy findings

Cause of death (COD) or probable cause of death was determined for 21.4% (290/1,353[1]) of necropsied turtles. Results are given by species in Tables 6, 7, and 8 (by state in Appendices A4, A5, and A6). Probable drowning was the most frequently identifiable cause of death of Kemp's ridleys, whereas trauma was the most frequent cause in green turtles. Death was attributed to probable drowning, traumatic injuries, and disease states in similar proportions of loggerheads. Cause of death was undetermined for 1,063 sea turtles, including 79.0% (963/1,219) of Kemp's ridleys. Of those cases in which COD was undetermined, numbers of animals without any significant abnormalities (fair to good nutritional condition without significant injuries or evidence of disease); those with major injuries; and turtles with evidence of disease or that were underweight are given by species in Tables 6, 7, and 8, respectively. The proportions of cases categorized within these groups were similar to proportions represented by COD's with similar findings, e.g., most green turtles without a determinable COD had major injuries. As stated under general methodology, drowning was a primary consideration for animals

---

[1] Excludes beach-cast hatchlings documented by stranding response; includes leatherbacks and single hawksbill.

without significant abnormalities based on exclusion. Considerable numbers of all species, including 15.0% of Kemp's ridleys, 20.6% of loggerheads, and 18.2% of green turtles, could not be further characterized due to postmortem condition.

Small numbers of individuals of other species examined included three leatherbacks and one hawksbill. One of the leatherbacks was a probable drowning, one did not have any anomalies, and one died of a vessel strike. The hawksbill was underweight, but cause of death and diminished nutritional condition could not be determined.

In all four years, the majority of necropsied turtles did not have any visible anomalies or were probable drownings (Group A) (689/1,355, 50.8%) (Figure 10). Photos of example cases from each year are shown in Appendix B1. This proportion is higher (689/1,146, 60.1%) if all turtles that could not be categorized due to decomposition are excluded. The highest proportion of turtles within this category by species and year was the Kemp's ridley in 2013, when 70.6% (151/214) of categorized necropsied turtles did not have any visible anomalies or were probable drownings. Major traumatic injuries (Group B) were observed in 28.3% (383/1,355) of necropsied turtles (all species), and comprised the highest total proportions of necropsied green turtles and loggerheads. The proportion of necropsied turtles with injuries was greatest in 2010 (all species) with 41.6% (179/430) of categorized cases having major injuries. Turtles found to have complete atrophy of fat or evidence of disease (Group C) comprised the smallest category of necropsied turtles. Notable changes within this category over the years of study largely mirrored the aforementioned trend in declining nutritional condition and included significant increases in proportions in 2012, 2013, and 2014 as compared to 2010 and 2011.[2] The lowest

[2] Pearson's chi-square or Fisher's exact test, depending on expected frequencies; uncategorized cases excluded; 2011 only significantly different from 2013 and 2014.

proportion of turtles with atrophied fat/disease category was 2.8% (12/430) in 2010 as compared to 12.2% (29/238) in 2013 and 12.0% (11/92) in 2014. Also, six of eight loggerheads with atrophied fat or evidence of disease were examined in 2013 and made up over half of the loggerheads examined that year.

During periods of peak strandings, Group A comprised a significantly greater (PCS) proportion of necropsied turtles than in non-peak periods (Figure 11). In contrast, Group B comprised a significantly lower (PCS) proportion of necropsied strandings during peak periods. Equivalent numbers of turtles in Group C were observed during peak and non-peak periods. All differences remained significant when 2010 data were excluded.

In addition, fat scores were compared between necropsy findings groups. Group C was not examined because severe atrophy of fat was a specific criterion for this group. Median fat scores for group A were significantly greater than group B when all years were considered and with the exclusion of 2010 data. As previously described for the larger dataset, both groups exhibited similar trends of declining fat stores fat scores in 2012, 2013, and 2014 as compared to 2010 and 2011 (data not shown).

Gastrointestinal contents

Percent occurrence of fish and shrimp within the GI tract are shown by species, year, and state in Table 9. Examples are shown in Appendices B2 and B3, respectively. Fish were found in the GI tracts of 76.1% of Kemp's ridleys (683/897), which was significantly more than either loggerheads (26.3%, 10/38) or green turtles (6.7%, 2/30). Penaeid shrimp were found in 8.4% (70/831) of Kemp's ridleys and were not found in any loggerhead (0/35) or green turtles (0/30). There were six additional Kemp's ridleys in which antennae suspicious for penaeid shrimp were found, but are not included in these numbers. Shrimp were only found in the mouth, esophagus, or stomach in 66 of 68 cases in which location within the GI tract was determinable and in two cases had been aspirated into the trachea. Locations of shrimp included the small intestine or colon in only 2.9% (2/68) cases, whereas locations of fish within the GI tract included the small intestine or colon in 74.3% (517/696) of cases. Three instances of aspiration of fish into the trachea were documented.

Gastrointestinal contents of Kemp's ridleys were specifically considered (Figure 12). Over half (39/70) of the occurrences of shrimp ingestion during the study period occurred in 2010, including 31 of 32 occurrences of shrimp within Kemp's ridleys found in Mississippi. The proportions of shrimp in turtles were more consistent among Louisiana strandings and sporadic across years for those found in Alabama. In all years, shrimp were only found in strandings during May and later months with most cases being observed in June (49/70, 70%). When the presence of shrimp within the GI tract was compared by SCL, mean rank SCL of Kemp's ridleys with shrimp was significantly lower (MWT) as compared to those without shrimp. Of necropsied Kemp's ridleys that were ≤25.0 cm SCL, 19.7% (15/76) contained shrimp, which was significantly greater (FE) compared to 7.1% (55/770) of Kemp's ridleys >25.0 cm. Notably, 54.5% (30/55) of instances of shrimp ingestion by turtles >25.0 cm occurred in Mississippi in 2010 as compared to 6.7% (1/15) of cases involving smaller turtles.

The anatomic locations (e.g., mouth, esophagus, stomach, and intestine) and type of food items found in Kemp's ridleys were considered as indicators of active or recent feeding near the time of death. The presence of food items within the mouth, esophagus, or stomach (referred to hereafter as upper GI tract) and the type of food item are shown by the date of discovery in Figure 12 and as related to peak strandings in Figure 13. Similar proportions of turtles that were found during periods of peak strandings (>40 within a 15-day period) and non-peak periods had food items within the upper GI (78.1% and 81.1%, respectively) (Figure 13). When contents of the upper GI tract were compared between groups that were found during peak and non-peak periods, significant differences were detected in the proportions with organisms other than fish or penaeid shrimp (e.g., mollusks, crustaceans) (PCS). When 2010 data were excluded, significantly more turtles found during peak periods contained fish (PCS).

There was no significant difference in the proportions with other organisms during peak and non-peak periods when 2010 data were excluded. There was no significant difference in the proportion of turtles containing shrimp or without any food items present in the upper GI tract.

Gastrointestinal contents are shown by necropsy findings category in Table 10. Significantly more turtles in group A had food within the mouth or esophagus at the time of death as compared to groups B and C, and recovered food items more often were fish or shrimp. With one exception, findings were similar when 2010 data were excluded, although the differences in the type of food items were not statistically different among groups. Comparison of stomach contents yielded similar results regardless of exclusion of 2010 data. Food items were found in the stomachs of more turtles in group A as compared to groups B and C, and more in group B than C (2011-14 data only). Fish or shrimp were included in the stomach contents of significantly more turtles in group A than either group B or C. Stomach contents of turtles in group B more often were organisms other than fish or shrimp as compared to group A. When the contents of the entire GI tract were considered, fish was found in a higher proportion of turtles in group A than groups B and C. There was no significant difference in the proportions of turtles in groups A and C that had ingested fish when 2010 were excluded. No significant differences were found among the groups with regard to the proportions that had ingested shrimp (entire GI considered) or in which the GI tract was empty.

Sediment within the respiratory tract

The occurrence of sediment within the respiratory tract of turtles was also compared between necropsy findings groups (Table 10). The location of the sediment within the respiratory tract was specifically considered. Separation of those animals without intrapulmonary sediment excluded those animals that only had sediment within the upper airways, which may occur as a result of aspiration or postmortem passive intrusion. Significantly greater proportions of turtles in group A had sediment within the respiratory tract as compared to those in groups B and C, regardless of exclusion of 2010 data. When only intrapulmonary sediment was considered, more turtles in group A had sediment within the lungs as compared to group B.

Traumatic injuries

Traumatic injuries (antemortem and undetermined) were categorized by wound characteristics and cause, if determinable, and are summarized by species in Table 11 (by state in Appendix A7). Photographs of examples of different wound types are shown in Appendix B4. The proportions of injury types were somewhat similar among years, including 2010 when necropsied turtles included the highest numbers of turtles with traumatic injuries. The most commonly observed type of injury was blunt trauma, which included 51.0% (195/382) of all major injuries. Although blunt force injuries are relatively less specific to cause, the vast majority are assumed to be the result of injury by watercraft given the force required to produce skeletal fractures in water and much greater likelihood of vessel strikes relative to other potential causes. Other traumatic injuries that were more specific to watercraft, including chop wounds and linear blunt trauma, comprised 15.7% (60/382) of injuries. If all blunt injuries and chop wounds are considered as evidence of watercraft interactions, vessel strikes were the cause of as many as 66.8% (255/382) of major injuries. Other injury categories included bite wounds (predominantly shark bites), fishing gear-related injuries, combinations of injuries (all shark bites and other injuries), and other wound types, which included malicious human interactions. As previously mentioned, decomposition was significant limiting factor in the ability to determine cause of death. Of those injuries with evidence to support antemortem occurrence and determination of cause of death as trauma or probable trauma, blunt injuries accounted for 54.5% (61/112), chop wounds were observed in 17.9% (20/112), linear blunt injuries were 7.1% (8/112), entanglement-type/fishing gear-related were 12.5% (14/112), 'other' injuries were 6.3% (7/112), and 1.8% were shark attack (2/112).

Shark bites - For the purposes of this summary report, turtles with extensive shark bites resulting in amputation, decapitation, substantial tissue loss, or deep trauma were categorized into the trauma mortality group as a conservative treatment of data in consideration of the advanced decomposition of most cases. Minor, superficial bite wounds were observed in an additional 4 cases. It was assumed that some proportion of these cases was scavenging interactions.[3] Inflammation or other vital tissue response was only observed in 2 of 99 cases (2.0%) with shark bite wounds. Shark bites were observed in combination with other injuries in 34[4] cases, and in eleven of these cases the other injuries were clearly antemortem and the bite wounds were attributed to scavenging (assessment of other cases was limited by decomposition). Thirty turtles with perimortem shark bites and no other major injuries were sufficiently intact to evaluate for evidence of exsanguination, as indicated by visceral pallor and/or absence of blood within the heart, which is expected to occur in many turtles given the extent of the injuries. Clear evidence of major blood loss was only observed in two cases (6.7%). In addition, during the period of the study, skeletal muscle was collected from bite wound margins to look for supravital changes in a subset of 18 turtles with perimortem wounds. Only one turtle had discoid and segmental disintegration of myofibers, a histologic process related to contractile potential that does not occur in later postmortem intervals (Stacy et al. 2015). This turtle did not have obvious evidence of blood loss, suggesting that the bite wounds were inflicted within the early postmortem interval. Histological findings were consistent with postmortem (scavenging) injury in the remaining 17 cases. Although evaluation of turtles with shark bites is often limited by decomposition and the incomplete condition of the carcass, these findings suggest that a substantial proportion of bite wounds (over 90%) in stranded sea turtles within this region are the result of scavenging rather than predation. Of those turtles with shark bites as the principal necropsy finding, no other major injuries or anomalies, and undetermined

---

[3] Shark bites are attributed to scavenging in individual necropsy reports for those cases considered to allow sufficient assessment, but all are grouped under cases with injuries in this summary report.

[4] Includes two additional cases with minor bite wounds not included in total (n=32) given in Table 11.

COD (n=58), most that could be evaluated (46/47, 97.8%) were in fair or good nutritional condition, 17/23 (73.9%) had food in the upper GI tract, and 11/25 (44.0%) had been feeding on fish.

Entanglement and fishing gear-related injuries - Of those 25 turtles with significant injuries resulting from entanglement or obvious fishing gear-related injuries (including three with concurrent shark bites), 15 had trauma involving the mouth, esophagus, or other structures of the neck caused by or consistent with hooking injuries, and 10 were entanglements. Four turtles were subadult and adult Kemp's ridleys found in western Louisiana during March 2012. Three were hooked through the mandible by large circle hooks with attached leaders identified as commercial shark long-line gear.[5] The fourth larger Kemp's ridley associated with this group was found without attached gear and an identical puncture wound in the rostral mandible. All four turtles had ingested similar cut bait and all with intact respiratory tracts (n=3) had sediment within the lungs. Material associated with entanglements included fishing line in six cases and single cases with unidentified braided line, a complete rod and reel, monofilament line tied to a crab ring trap, and a plastic bag. The turtle entangled in the crab trap also had severe enteric plication resulting from ingestion of hook and line. Plication of the GI tract was also observed one of the turtles entangled in monofilament line. Fish hooks were recovered from 27 additional turtles (all Kemp's ridleys; 19 from Mississippi, 6 from Alabama, 2 from Louisiana), but were associated with relatively minor, chronic lesions (incidental to COD). All recovered gear from these animals was smaller recreational-type hooks. Multiple hooks were found in five individuals. Chronic periesophageal abscesses, which frequently are caused by penetrating foreign bodies from the esophagus, such as hooks, were found in eleven additional turtles, all Kemp's ridleys (9 from Mississippi, 1 from Alabama, 1 from Louisiana).

---

[5] Identified by Charles Bergmann, NOAA SEFSC Pascagoula Laboratory

Malicious human interaction - Seven sea turtles had injuries indicative of or suspicious of malicious human action. Two were found near the Grand Terre islands of Louisiana within approximately two miles of one another in June 2011 and May 2012. Both turtles died from incised wounds inflicted to the ventral neck that severed the trachea, esophagus and major blood vessels. In addition, the plastron had been removed (also incised wounds) from one of these turtles and the GI tract was missing. The stomach of the other turtle was full of fish. Another Kemp's ridley found in Louisiana had been shot multiple times at close range with a shotgun (recovered as a severely decomposed carcass). Other cases included various sharp and blunt force injuries.

Disease and diminished nutritional condition

A summary of necropsy findings for turtles in which the cause of death was attributed to disease or there was diminished nutritional condition or necropsy evidence of compromised health is provided in Table 12. Twenty percent (14/70) of group C turtles were recovered alive or in good postmortem condition, as compared to <0.1% (1/689) of group A and 2.9% (11/383) of group B. Various conditions that are encountered in sporadic strandings outside of the NGOMX were observed.

As previously mentioned, more sea turtles with severe atrophy of fat were necropsied in 2013 and 2014 as compared to previous years. Most (29/46) had depleted fat and no identifiable underlying cause, and most were moderately or severely decomposed. Species included 23 Kemp's ridleys, 3 loggerheads, 2 green turtles, and one hawksbill. Eleven were found in Louisiana, 14 in Mississippi, and 4 in Alabama. Concurrent findings in the other cases included traumatic injuries (3/17), GI lesions (6/17), pneumonia (4/17), and inflammatory conditions involving various other or multiple systems (4/17).

Given observations of pneumonia in bottlenose dolphins in the Barataria Bay (Schwacke et al. 2014), cases with diagnoses of pneumonia were specifically examined (n=28) and are summarized in Table 13. All but 4 cases in which assessment was possible were acute or subacute and 16 (57.1%) were associated with other conditions, including traumatic injuries and inflammatory lesions within other organ systems. Of the 12 cases in which a significant problem other than pneumonia was not observed, 7 (58.3%) were aspiration pneumonia associated with intrapulmonary sediment and other foreign material. Three additional turtles were in fair or good nutritional condition and had fish in the esophagus or stomach and no other significant findings, thus aspiration was a potential cause of pneumonia in these animals as well. When compared by year of stranding, numbers per year were less than 10 with no obvious differences in presentation over the period of the study.

Previously rehabilitated sea turtles

Thirty-three turtles that were documented dead by stranding response had been previously admitted to rehabilitation centers. All but two were treated after being caught by recreational hook and line fishermen. Two had previously stranded alive, one of which was cold-stunned. All were Kemp's ridleys except for the cold-stunned case; a green turtle that cold-stunned again and died three years after the first episode in the same area where it originally stranded. The median interval from original admission to stranding was 220 days (range 6 to 1,012 days). Just over half (17/33) of these turtles were included in group A, of which 16/17 had food within the upper GI tract (fish in 11/16 occurrences) and three had sediment within the lungs. Six turtles had traumatic injuries, included three with wounds consistent with vessel strikes, one entanglement, one with esophageal trauma from subsequent hooking, and one with a penetrating wound of unknown cause. Two previously caught Kemp's had acquired additional hooks since release. Both of the turtles that stranded six days after release died of trauma; one from blunt trauma and the other from subsequent hook and line capture. Diminished nutritional condition or evidence of disease was observed in seven of these Kemp's ridleys, primarily atrophied fat without any apparent underlying condition and/or relatively minor inflammatory lesions that may have been incidental to death.

Biotoxin analyses and related observations

Environmental observations of HAB activity in the GOMX included a domoic-acid producing *Pseudo-nitzschia* bloom near Dog Key Pass, Mississippi in early March 2011. By March 19, 2011, however, organism abundances had declined and a bloom was no longer present. No additional reports of HAB activity in Alabama, Louisiana, or Mississippi waters could be verified by consultation with FWRI and NOAA-NOS laboratories, although *Karenia brevis* blooms were documented in 2011 and 2012 in Southwest Florida and in 2012 along the upper Texas coast.

Results of biotoxin analyses are shown in Table 14. Low concentrations of brevetoxin or brevetoxin-like compounds (mean = 28.6, range = 9.2-62.2 ng PbTX-3 equivalents per gram) were detected by ELISA in samples from 86.7% (13/15) of turtles analyzed by FWRI and 2 of 25 turtles (3-4 ng PbTX-3 equivalents per gram) analyzed by NOAA. Samples from an addition seven turtle tested positive for brevetoxin by ELISA (NOAA), but no toxin was detected by LC-MS confirmatory analysis. The concentration of brevetoxin was below the limits of detection in 2 turtles analyzed by FWRI and 15 animals analyzed by NOAA-NOS. Turtles tested for brevetoxin exposure included one underweight Kemp's ridley with mild bronchopneumonia that stranded alive and moribund in Harrison County, Mississippi on 4/28/2012. Levels of the brevetoxin were below levels of detection in the liver and feces.

Trace concentrations of domoic acid were found in samples from 1 of 8 turtles analyzed by FWRI and 4 of 24 turtles analyzed by NOAA-NOS. The domoic acid concentration was quantifiable (3.8-9 ng/g) by liquid chromatography-tandem mass spectrometry in GI content samples from 5 turtles analyzed by NOAA. Concentrations of okadaic acid were below detectable limits in all of the turtles analyzed (n=13, NOAA); n=8, FWRI). Saxitoxin was below detectable limits in 18 of 20 cases analyzed by NOAA and all 8 cases tested by FWRI. Saxitoxin was detected by RBA (276 and 228 ng STX equivalents/g) in kidney from two Kemp's ridleys that stranded in Mississippi in 2013, but was not detected in any other samples from these animals or other individuals. Saxitoxin concentrations were below the levels of detection in the kidneys in other samples upon re-analysis using an ELISA method, thus the RBA results are regarded as false positives.

In 2013, samples from a double-crested cormorant, red drum, and gafftopsail catfish that were found with a dead Kemp's ridley were analyzed for brevetoxin, domoic acid, and saxitoxin (NOAA). Domoic acid was detected in low concentrations in skeletal muscle of both fish (19 and 20 ng/g). All other toxins were below detectable limits in all other samples.

Other toxicological analyses

A Kemp's ridley that was found moribund near Pass Christian, Mississippi on 4/15/2012 died within hours of discovery and was found to have partially digested fish within the stomach. Samples were negative for Clostridium botulism by mouse bioassay. Real-time polymerase chain reaction also was performed (for toxin genes type A, B, and C) and was negative. No known toxic organic compounds were detected by GCMS in the stomach contents of two additional Kemp's ridleys that stranded in 2013.

Table 1. Categories of necropsy findings in non-visibly oiled sea turtles that were documented by stranding response in Alabama, Louisiana, and Mississippi during 2010 through 2014.

Group	Criteria
A	Fair or good nutritional condition AND no evidence of any significant disease process AND no major injuries
B	Major injuries (antemortem or undetermined)
C	Diminished nutritional condition (severe atrophy of fat) OR significant pathological lesions indicating disease
D	Uncategorized due to limited assessment
E	Hatchlings, post-hatchlings, cold-stunning

Table 2. Numbers of necropsied non-visibly oiled sea turtles that were documented by stranding response in Alabama, Louisiana, and Mississippi during 2010 through 2014. The proportion of total strandings necropsied is shown in parentheses. All stranding numbers are considered preliminary and pending validation by the Southeast Fisheries Science Center.

Year	Alabama	Louisiana	Mississippi
2010			
Estimated total strandings	163	168	316
Total necropsied	109 (66.9%)	95 (56.5%)	294 (93.0%)
Necropsied by species			
Kemp's ridley	97	76	278
Loggerhead	8	6	11
Green	4	13	5
Unknown	0	0	0
2011			
Estimated total strandings	97	148	283
Total necropsied	26 (26.8%)	140 (94.6%)	51 (18.0%)
Necropsied by species			
Kemp's ridley	24	122	49
Loggerhead	2	11	1
Green	0	6	1
Unknown	0	1	0
2012			
Estimated total strandings	68	157	163
Total necropsied	23 (33.8%)	145 (92.4%)	72 (44.2%)
Necropsied by species			
Kemp's ridley	17	131	71
Loggerhead	4	3	1
Green	2	11	0
Unknown	0	0	0
2013			
Estimated total strandings	49	267	213
Total necropsied	8 (16.3%)	218 (81.6%)	76 (35.7%)
Necropsied by species			
Kemp's ridley	7	192	75
Loggerhead	0	10	1
Green	1	15	0
Leatherback	0	1	0
Unknown	0	0	0
2014			
Estimated total strandings	40	76	153
Total necropsied	16 (40.0%)	49 (64.5%)	33 (21.6%)
Necropsied by species			
Kemp's ridley	14	35	31
Loggerhead	1	5	1
Green	0	7	1
Hawksbill	1	0	0
Leatherback	0	2	0
Unknown	0	0	0

Table 3. Postmortem condition of necropsied non-visibly oiled sea turtles (by species) that were documented by stranding response in Alabama, Louisiana, and Mississippi during 2010 through 2014. This table does not include three leatherback turtles, one hawksbill, and the partial skeleton of one individual that was not identified to species.

	Fresh dead	Moderate decomposition	Severe decomposition	Desiccated remains	Skeletal remains	Total
Kemp's ridley						
2010	7 (1.6%)	109 (24.2%)	311 (69.0%)	16 (3.5%)	8 (1.8%)	451
2011	8 (4.1%)	91 (46.7%)	82 (42.1%)	7 (3.6%)	7 (3.6%)	195
2012	10 (4.6%)	68 (31.1%)	127 (58.0%)	10 (4.6%)	4 (1.8%)	219
2013	2 (0.7%)	86 (31.4%)	177 (64.6%)	6 (2.2%)	3 (1.1%)	274
2014	6 (7.5%)	36 (45.0%)	37 (46.3%)	1 (1.3%)	0 (-)	80
Total	33 (2.7%)	390 (32.0%)	734 (60.2%)	40 (3.3%)	22 (1.8%)	1,219
Loggerhead						
2010	1 (4.0%)	2 (8.0%)	17 (68.0%)	1 (4.0%)	4 (16.0%)	25
2011	0 (-)	6 (42.9%)	5 (35.7%)	1 (7.1%)	2 (14.3%)	14
2012	1 (-)	5 (-)	2 (-)	0 (-)	0 (-)	8
2013	3 (27.3%)	1 (9.1%)	7 (63.6%)	0 (-)	0 (-)	11
2014	1 (-)	1 (-)	2 (-)	0 (-)	0 (-)	7
Total	6 (9.2%)	15 (23.1%)	33 (50.8%)	2 (3.1%)	6 (9.2%)	65
Green						
2010	5 (22.7%)	4 (18.2%)	12 (54.5%)	1 (4.5%)	0 (-)	22
2011	0 (-)	4 (-)	3 (-)	0 (-)	0 (-)	7
2012	1 (7.7%)	4 (30.8%)	6 (46.2%)	2 (15.4%)	0 (-)	13
2013	1 (7.1%)	4 (14.3%)	9 (64.3%)	2 (14.3%)	0 (-)	16
2014	1 (-)	3 (-)	3 (-)	0 (-)	1 (-)	8
Total	8 (12.1%)	19 (28.8%)	33 (50.0%)	5 (7.6%)	1 (1.5%)	66
Grand total	47 (3.5%)	424 (31.4%)	800 (59.3%)	47 (3.5%)	29 (2.1%)	1,350

Table 4. Extent of postmortem examination (necropsy) of non-visibly oiled sea turtles (by species) that were documented by stranding response in Alabama, Louisiana, and Mississippi during 2010 through 2014. A full necropsy was conducted when condition of the carcass allowed for complete examination of the major organ systems. A partial necropsy was conducted when parts of the carcass were missing or decomposed beyond recognition. A limited examination was conducted when the carcass was desiccated or skeletonized. Most of the sea turtles that were not examined were severely decomposed, skeletonized, desiccated, or incomplete, and were not collected by stranding responders.

	Full examination	Partial examination	Limited examination	Total examined
Kemp's ridley				
2010	279 (61.9%)	130 (28.8%)	42 (9.3%)	451
2011	89 (45.6%)	75 (38.5%)	31 (15.9%)	195
2012	98 (44.7%)	89 (40.6%)	32 (14.6%)	219
2013	104 (38.0%)	129 (47.5%)	41 (14.4%)	274
2014	47 (58.8%)	28 (35.0%)	5 (6.3%)	80
Total	617 (50.6%)	418 (34.3%)	245 (20.1%)	1,219
Loggerhead				
2010	8 (32.0%)	11 (44.0%)	6 (24.0%)	25
2011	3 (21.4%)	7 (50.0%)	4 (28.6%)	14
2012	5 (62.5%)	3 (37.5%)	0 (-)	8
2013	5 (45.5%)	5 (45.5%)	1 (9.1)	11
2014	5 (-)	1 (-)	1 (-)	7
Total	21 (32.3%)	25 (38.5%)	10 (15.4%)	65
Green				
2010	10 (45.5%)	11 (50.0%)	1 (4.5%)	22
2011	1 (14.3%)	5 (71.4%)	1 (14.3%)	7
2012	5 (38.5%)	5 (38.5%)	3 (23.1%)	13
2013	4 (25.0%)	9 (56.3%)	3 (18.8%)	16
2014	2 (-)	4 (-)	2 (-)	8
Total	22 (33.3%)	34 (51.5%)	8 (12.1%)	66
Grand total	660 (48.9%)	477 (35.3%)	263 (19.5%)	1,350

Table 5. Nutritional condition of necropsied sea turtles documented by stranding response in Alabama, Louisiana, and Mississippi during 2010 through 2014. Determinations were based on subjective assessment of muscle mass and abundance of adipose tissue. For the purposes of this report and assessment of necropsy findings, good and fair conditions are considered within normal limits for free-ranging sea turtles.

	Good	Fair	Thin	Emaciated	Undetermined	Total
Kemp's ridley						
2010	317 (70.3%)	35 (7.8%)	12 (2.7%)	1 (0.2%)	86 (19.1%)	451
2011	120 (61.5%)	37 (19.0%)	4 (2.1%)	0 (-)	34 (17.4%)	195
2012	112 (51.1%)	61 (27.9%)	9 (4.1%)	1 (0.5%)	36 (16.4%)	219
2013	77 (28.1%)	111 (40.5%)	19 (6.9%)	0 (-)	67 (24.5%)	274
2014	25 (31.3%)	43 (53.8%)	5 (6.3%)	0 (-)	7 (8.8%)	80
Total	651 (51.0%)	287 (23.5%)	49 (4.0%)	2 (0.2%)	230 (18.0%)	1,219
Loggerhead						
2010	15 (60.0%)	3 (12.0%)	0 (-)	1 (4.0%)	6 (24.0%)	25
2011	9 (64.3%)	0 (-)	0 (-)	0 (-)	5 (35.7%)	14
2012	7 (-)	1 (-)	0 (-)	0 (-)	0 (-)	8
2013	4 (36.4%)	1 (9.1%)	4 (36.4%)	0 (-)	2 (18.2%)	11
2014	4 (-)	2 (-)	0 (-)	1 (-)	0 (-)	7
Total	39 (60.0%)	6 (9.2%)	4 (6.2%)	2 (3.1%)	13 (20.0%)	65
Green						
2010	14 (63.6%)	2 (9.1%)	1 (4.5%)	0 (-)	5 (22.7%)	22
2011	4 (57.1%)	2 (28.6%)	0 (-)	0 (-)	1 (14.3%)	7
2012	8 (61.5%)	1 (7.7%)	0 (-)	0 (-)	4 (30.8%)	13
2013	5 (31.3%)	3 (18.8%)	3 (18.8%)	0 (-)	5 (31.3%)	16
2014	1 (-)	4 (-)	0 (-)	0 (-)	3 (-)	8
Total	32 (48.5%)	12 (18.2%)	4 (6.1%)	0 (%)	18 (27.3%)	66
Grand total	722 (53.4%)	305 (22.6%)	57 (4.2%)	4 (0.3%)	261 (19.3%)	1,350

Table 6. Necropsy findings in Kemp's ridley sea turtles documented by stranding response in Alabama, Louisiana, and Mississippi during 2010 through 2014. Sea turtles are grouped by proximate cause of death (COD), if determined, and comparable major necropsy findings if COD could not be determined. Cases were uncategorized due to inability to assess nutritional condition or detect traumatic injury as a result of decomposition.

	A		B		C		D
Year	Probable drowning COD	Unknown COD, no injuries, fair or good nutritional condition	Trauma COD	Unknown COD, major injuries present	Disease COD	Unknown COD, evidence of disease and/or depleted adipose stores	Uncategorized
2010*	36/451 (8.0%)	196/451 (43.5%)	45/451 (10.0%)	103/451 (22.8%)	3/451 (0.7%)	7/451 (1.6%)	
	A = 232/451 (51.4%)		**B = 148/451 (32.8%)**		**C = 10/451 (2.2%)**		**60/451 (13.3%)**
2011	35/195 (17.9%)	76/195 (39.0%)	12/195 (6.2%)	37/195 (19.0%)	1/195 (0.5%)	4/195 (2.1%)	
	A = 111/195 (56.9%)		**B = 49/195 (25.1%)**		**C = 5/195 (2.6%)**		**30/195 (15.4%)**
2012	32/219 (14.6%)	93/219 (42.5%)	18/219 (8.2%)	35/219 (16.0%)	2/219 (0.9%)	9/219 (4.1%)	
	A = 125/219 (57.1%)		**B = 53/219 (24.2%)**		**C = 11/219 (5.0%)**		**30/219 (13.7%)**
2013	38/274 (13.9%)	113/274 (41.2%)	7/274 (2.6%)	35/274 (12.8%)	0/274 (0%)	21/274 (7.8%)	
	A = 151/274 (55.1%)		**B =42/274 (15.3%)**		**C = 21/274 (7.7%)**		**60/274 (21.9%)**
2014	17/80 (21.3%)	27/80 (33.8%)	9/80 (11.3%)	17/80 (21.3%)	0/80 (0%)	7/80 (8.8%)	
	A = 44/80 (55.0%)		**B = 26/80 (32.5%)**		**C = 7/80 (8.8%)**		**3/80 (3.8%)**
All	158/1,219 (13.0%)	505/1,219 (41.4%)	91/1,219 (7.5%)	227/1,219 (18.6%)	6/1,219 (0.5%)	48/1,219 (3.9%)	
	A = 663/1,219 (54.4%)		**B = 318/1,219 (26.1%)**		**C = 54/1,219 (4.4%)**		**183/1,219 (15.0%)**

*Single hatchling not categorized.

Table 7. Necropsy findings in loggerhead sea turtles documented by stranding response in Alabama, Louisiana, and Mississippi during 2010 through 2014. Sea turtles are grouped by proximate cause of death (COD), if determined, and comparable major necropsy findings if COD could not be determined. Cases were uncategorized due to inability to assess nutritional condition or detect traumatic injury as a result of decomposition.

	A		B		C		D
Year	Probable drowning COD	Unknown COD, no injuries, fair or good nutritional condition	Trauma COD	Unknown COD, major injuries present	Disease COD	Unknown COD, evidence of disease and/or depleted adipose stores	Uncategorized
2010	1/25 (4.0%)	4/25 (16.0%)	4/25 (16.0%)	7/25 (28.0%)	0/25 (0%)	1/25 (4.0%)	
	A = 5/25 (20.0%)		**B = 11/25 (44.0%)**		**C = 1/25 (4.0%)**		**8/25 (32.0%)**
2011	0/14 (0%)	4/14 (28.6%)	0/14 (0%)	5/14 (35.7%)	1/14 (7.1%)	0/14 (0%)	
	A = 4/14 (28.6%)		**B = 5/14 (35.7%)**		**C = 1/14 (7.1%)**		**4/14 (28.6%)**
2012*	2/6 (-)	1/6 (-)	2/6 (-)	1/6 (-)	0/6 (-)	0/6 (-)	
	A = 3/6 (-)		**B = 3/6 (-)**		**C = 0/6 (-)**		**0/6 (-)**
2013	0/11 (0%)	2/11 (18.2%)	0/11 (0%)	3/11 (27.3%)	3/11 (27.3%)	3/11 (27.3%)	
	A =2/11 (18.2%)		**B = 3/11 (27.3%)**		**C = 6/11 (54.5%)**		**0/11 (0%)**
2014	2/7 (-)	1/7 (-)	0/7 (-)	1/7 (-)	1/7 (-)	1/7 (-)	
	A = 3/7 (-)		**B = 1/7 (-)**		**C = 2/7 (-)**		**1/7 (-)**
All	5/63 (7.9%)	12/63 (19.0%)	6/63 (9.5%)	17/63 (22.2%)	5/63 (7.9%)	5/63 (7.9%)	
	A = 17/63 (27.0%)		**B = 23/63 (36.5%)**		**C = 10/63 (15.9%)**		**13/63 (20.6%)**

*Hatchling washbacks not categorized

Table 8. Necropsy findings in green sea turtles documented by stranding response in Alabama, Louisiana, and Mississippi during 2010 through 2014. Sea turtles are grouped by proximate cause of death (COD), if determined, and comparable major necropsy findings if COD could not be determined. Cases were uncategorized due to inability to assess nutritional condition or detect traumatic injury as a result of decomposition.

	A		B		C		D
Year	Probable drowning COD	Unknown COD, no injuries, fair or good nutritional condition	Trauma COD	Unknown COD, major injuries present	Disease COD	Unknown COD, evidence of disease and/or depleted adipose stores	Uncategorized
2010	0/22 (0%)	1/22 (4.5%)	8/22 (36.4.0%)	12/22 (54.5%)	0/22 (0%)	1/22 (4.5%)	
	A = 1/22 (4.5%)		**B = 20/22 (90.9%)**		**C = 1/22 (4.0%)**		**0/22 (0%)**
2011	0/7 (-)	2/7 (-)	1/7 (-)	3/7 (-)	0/7 (-)	0/7 (-)	
	A = 2/7 (-)		**B = 4/7 (-)**		**C = 0/7 (-)**		**1/7 (-)**
2012	0/13 (0%)	2/13 (15.4%)	2/13 (15.4%)	2/13 (15.4%)	1/13 (7.7%)	0/13 (0%)	
	A = 2/13 (15.4%)		**B = 4/13 (30.8%)**		**C = 1/13 (7.7%)**		**6/13 (46.2%)**
2013	0/16 (0%)	2/16 (12.5%)	4/16 (25.0%)	4/16 (25.0)	0/16 (0%)	2/16 (12.5%)	
	A = 2/16 (12.5%)		**B = 8/16 (50.0)**		**C = 2/16 (12.5%)**		**4/16 (25.0%)**
2014*	0/8 (-)	0/8 (-)	0/8 (-)	5/8 (-)	0/8 (-)	1/8 (-)	
	A = 0/8 (-)		**B = 5/8 (-)**		**C = 1/8 (-)**		**1/8 (-)**
All	0/66 (0%)	7/66 (10.6%)	15/66 (22.7%)	26/66 (39.4%)	1/66 (1.5%)	4/66 (6.1%)	
	A = 7/66 (10.6%)		**B = 41/66 (62.1%)**		**C = 5/66 (7.6%)**		**12/66 (18.2%)**

*Single cold-stunned turtle not categorized.

Table 9. Numbers of necropsied sea turtles containing fish and penaeid shrimp within the gastrointestinal tract by species, year, and state. All sea turtles were documented by stranding response in Alabama, Louisiana, and Mississippi during 2010 through 2014.

		Kemp's ridley		Loggerhead		Green	
State		Ingested fish	Ingested shrimp	Ingested fish	Ingested shrimp	Ingested fish	Ingested shrimp
Alabama							
	2010	40/65 (61.5%)	0/62 (0%)	0/4 (-)	0/4 (-)	0/3 (-)	0/3 (-)
	2011	17/21 (81.0%)	3/18 (16.7%)	0/2 (-)	0/2 (-)	0 (-)	0 (-)
	2012	8/13 (61.5%)	1/13 (7.7%)	0/3 (-)	0/3 (-)	1/1 (-)	0/1 (-)
	2013	4/6 (-)	0/6 (-)	0 (-)	0 (-)	0/1 (-)	0/1 (-)
	2014	10/11 (90.9%)	0/11 (0%)	1/1 (-)	0/1 (-)	0 (-)	0 (-)
	Total	79/116 (68.1%)	4/110 (3.6%)	1/10 (10%)	0/10 (10%)	1/5 (-)	0/5 (-)
Louisiana							
	2010	29/48 (60.4%)	8/46 (17.4%)	1/3 (-)	0/3 (-)	0/6 (-)	0/6 (-)
	2011	68/85 (80.0%)	8/73 (11.0%)	1/4 (-)	0/3 (-)	0/2 (-)	0/2 (-)
	2012	57/81 (70.4%)	7/71 (9.9%)	3/3 (-)	0/2 (-)	0/5 (-)	0/5 (-)
	2013	113/136 (83.1%)	11/109 (10.1%)	1/7 (-)	0/7 (-)	0/8 (-)	0/8 (-)
	2014	21/27 (77.8%)	0/25 (0%)	2/4 (-)	0/3 (-)	1/1 (-)	0/1 (-)
	Total	288/377 (76.4%)	34/324 (10.5%)	8/21 (38.1%)	0/18 (0%)	1/22 (4.5%)	0/22 (0%)
Mississippi							
	2010	141/197 (71.6%)	31/193 (16.1%)	1/4 (-)	0/4 (-)	0/2 (-)	0/2 (-)
	2011	36/44 (81.8%)	0/43 (0%)	0 (-)	0 (-)	0 (-)	0 (-)
	2012	57/65 (87.7%)	0/65 (0%)	0/1 (-)	0/1 (-)	0 (-)	0 (-)
	2013	62/69 (89.9%)	1/68 (1.5%)	0/1 (-)	0/1 (-)	0 (-)	0 (-)
	2014	20/29 (69.0%)	0/28 (0%)	0/1 (-)	0/1 (-)	0/1 (-)	0/1 (-)
	Total	316/404 (78.2%)	32/397 (8.1%)	1/7 (-)	0/7 (-)	0/3 (-)	0/3 (-)
All		683/897 (76.1%)	70/831 (8.4%)	10/38 (26.3%)	0/35 (0%)	2/30 (6.7%)	0/30 (0%)

Table 10. Necropsy findings in Kemp's ridleys that were documented by stranding response in Alabama, Louisiana, and Mississippi during 2010 through 2014. Sea turtles are grouped by predominant necropsy findings. Turtles with hooking injuries and ingested bait fish or shrimp, or that were in captivity >24 hours were excluded. Cases were uncategorized due to inability to assess nutritional condition or detect traumatic injury as a result of decomposition. Significant differences ($p<0.05$) in proportions between categories for combined years (shaded areas) are shown in the right-most column. PCS = Pearson's chi-square test (if expected frequencies >10); FE = Two-tailed Fisher's exact test (if expected frequencies <10).

Parameter	Year	Fair or good nutritional condition; no major injuries	Major injuries	Depleted adipose stores and/or evidence of disease	Significant differences in proportions
		Group A	Group B	Group C	
Food in mouth or esophagus	2010	40/216 (18.5%)	8/107 (7.5%)	0/8 (0%)	
	2011	27/107 (25.2%)	6/36 (16.7%)	0/2 (0%)	
	2012	28/121 (23.1%)	3/31 (9.4%)	0/7 (0%)	
	2013	25/146 (17.1%)	1/28 (3.6%)	2/19 (10.5%)	
	2014	8/44 (18.2%)	1/20 (5.0%)	0/7 (0%)	
	All	128/634 (20.2%)	19/222 (8.6%)	2/43 (4.7%)	A≠B (PCS); A≠C (FE)
	2011-14	88/418 (21.1%)	11/115 (9.6%)	2/35 (5.7%)	A≠B (PCS); A≠C (FE)
Fish or shrimp in mouth or esophagus	2010	33/216 (15.3%)	5/107 (4.7%)	0/8 (0%)	
	2011	23/107 (21.5%)	5/36 (13.9%)	0/2 (0%)	
	2012	22/121 (18.2%)	2/31 (6.5%)	0/7 (0%)	
	2013	24/146 (16.4%)	1/28 (3.6%)	2/19 (10.5%)	
	2014	6/44 (13.6%)	1/20 (5.0%)	0/7 (0%)	
	All	108/634 (17.0%)	14/222 (6.3%)	2/43 (4.7%)	A≠B (PCS); A≠C (FE)
	2011-14	34/418 (18.2%)	9/115 (7.8%)	2/35 (5.7%)	
Other food items in mouth or esophagus	2010	7/216 (3.2%)	3/107 (2.8%)	0/8 (0%)	
	2011	4/107 (3.8%)	1/36 (2.8%)	0/2 (0%)	
	2012	6/121 (5.0%)	1/31 (3.2%)	0/7 (0%)	
	2013	1/146 (0.7%)	0/28 (0%)	0/19 (0%)	
	2014	2/44 (4.5%)	0/20 (0%)	0/7 (0%)	
	All	20/634 (3.2%)	5/222 (2.3%)	0/43 (0%)	
	2011-14	13/418 (3.1%)	2/115 (1.7%)	0/35 (0%)	

Table 10 (continued).

Parameter	Year	Fair or good nutritional condition; no major injuries Group A	Major injuries Group B	Depleted adipose stores and/or evidence of disease Group C	Significant differences in proportions
Food in stomach	2010	150/205 (73.2%)	42/67 (62.7%)	3/8 (-)	
	2011	79/96 (82.3%)	23/26 (88.5%)	0/2 (-)	
	2012	92/113 (81.4%)	15/22 (68.2%)	5/7 (-)	
	2013	116/138 (84.1%)	16/23 (69.6%)	12/19 (63.2%)	
	2014	36/42 (85.7%)	10/16 (62.5%)	3/7 (-)	
	All	473/594 (79.6%)	106/154 (68.8%)	23/43 (53.5%)	A≠B (PCS); A≠C (PCS)
	2011-14	323/389 (83.0%)	64/87 (73.6%)	17/35 (48.6%)	A≠B (PCS); A≠C (FE); B≠C (PCS)
Fish or shrimp in stomach	2010	127/205 (62.0%)	20/67 (29.9%)	3/8 (-)	
	2011	67/96 (69.8%)	13/26 (50.0%)	0/2 (-)	
	2012	70/113 (61.9%)	10/22 (45.5%)	3/7 (-)	
	2013	104/138 (75.4%)	8/23 (34.8%)	8/19 (42.1%)	
	2014	31/42 (73.8%)	8/16 (50.0%)	2/7 (-)	
	All	399/594 (67.2%)	59/154 (38.3%)	16/43 (37.2%)	A≠B (PCS); A≠C (PCS)
	2011-14	272/389 (69.9%)	39/87 (44.8%)	13/35 (37.1%)	A≠B (PCS); A≠C (PCS)
Other food items in stomach	2010	23/205 (11.2%)	22/67 (32.8%)	0/8 (-)	
	2011	12/95 (12.6%)	10/26 (38.5%)	0/2 (-)	
	2012	22/113 (19.5%)	5/22 (22.7%)	2/7 (-)	
	2013	12/138 (8.7%)	8/23 (34.8%)	4/19 (21.1%)	
	2014	5/42 (11.9%)	2/16 (12.5%)	1/7 (-)	
	All	74/594 (12.5%)	47/154 (30.5%)	7/43 (16.3%)	A≠B (PCS)
	2011-14	51/389 (13.1%)	25/87 (28.7%)	7/35 (20.0%)	A≠B (PCS)

Table 10 (continued).

Parameter	Year	Fair or good nutritional condition; no major injuries	Major injuries	Depleted adipose stores and/or evidence of disease	Significant differences in proportions
		Group A	Group B	Group C	
Ingested fish (any part of GI)	2010	164/219 (74.9%)	29/69 (42.0%)	4/8 (-)	
	2011	92/107 (86.0%)	20/32 (62.5%)	1/2 (-)	
	2012	97/118 (82.2%)	15/25 (60.0%)	4/7 (-)	
	2013	124/140 (88.6%)	14/27 (51.9%)	17/20 (85.0%)	
	2014	37/43 (86.0%)	9/17 (52.9%)	5/7 (-)	
	All	514/627 (82.0%)	87/170 (51.2%)	31/44 (70.5%)	A≠B (PCS); B≠C (FE)
	2011-14	350/408 (85.8%)	58/101 (57.4%)	27/36 (75.0%)	A≠B (PCS)
Ingested shrimp (any part of GI)	2010	35/213 (16.4%)	1/68 (1.5%)	1/8 (-)	
	2011	3/108 (7.8%)	3/26 (11.5%)	0/2 (-)	
	2012	7/115 (6.1%)	1/22 (4.5%)	0/7 (-)	
	2013	8/136 (5.9%)	2/22 (9.1%)	1/18 (5.6%)	
	2014	0/43 (0%)	0/14 (0%)	0/7 (-)	
	All	58/610 (9.5%)	7/152 (4.6%)	2/42 (4.8%)	
	2011-14	23/397 (5.8%)	6/84 (7.1%)	1/34 (2.9%)	
Empty GI tract	2010	9/217 (2.8%)	4/86 (4.7%)	0/7 (-%)	
	2011	3/108 (2.8%)	0/34 (0%)	1/2 (-)	
	2012	2/122 (1.6%)	1/33 (3.0%)	0/7 (-)	
	2013	4/146 (2.7%)	1/31 (3.2%)	1/20 (5.0%)	
	2014	0/44 (0%)	2/20 (10.0%)	1/7 (14.3%)	
	All	18/637 (2.8 %)	8/204 (3.9%)	3/43 (7.0%)	
	2011-14	9/420 (2.1%)	4/118 (3.4%)	3/36 (8.3%)	

Table 10 (continued).

Parameter	Year	Fair or good nutritional condition; no major injuries Group A	Major injuries Group B	Depleted adipose stores and/or evidence of disease Group C	Significant differences in proportions
Sediment within respiratory tract	2010	74/209 (35.4%)	16/89 (18.0%)	0/7 (-)	
	2011	56/85 (65.9%)	5/19 (26.3%)	1/2 (-)	
	2012	70/92 (76.1%)	6/19 (26.3%)	2/6 (-)	
	2013	78/102 (76.5%)	5/13 (38.5%)	11/16 (68.8%)	
	2014	27/39 (69.2%)	4/14 (28.6%)	1/7 (14.3%)	
	All	305/527 (57.9%)	36/154 (23.4%)	15/38 (39.5%)	A≠B (PCS); A≠C (PCS); B≠C (PCS)
	2011-14	231/318 (72.6%)	20/65 (30.8%)	15/31 (48.4%)	A≠B (PCS); A≠C (PCS)
Sediment within lungs	2010	32/208 (15.4%)	6/89 (6.7%)	0/7 (-)	
	2011	35/83 (42.2%)	3/18 (16.7%)	0/2 (-)	
	2012	38/92 (41.3%)	5/19 (26.3%)	2/6 (-)	
	2013	40/77 (51.9%)	3/11 (27.3%)	7/14 (50.0%)	
	2014	16/28 (42.2%)	2/12 (16.7%)	1/6 (-)	
	All	161/488 (33.0%)	19/149 (12.8%)	10/35 (28.6%)	A≠B (PCS)
	2011-14	129/280 (46.1%)	13/60 (21.7%)	10/28 (35.7%)	A≠B (PCS)

Table 11. Categories of traumatic injuries (antemortem and undetermined) in necropsied sea turtles that were documented by stranding response in Alabama, Louisiana, and Mississippi during 2010 through 2014.

Species	Year	Blunt trauma	Linear blunt trauma	Chop wound(s)	Shark/predator bites	Entanglement, hooking, line ingestion	Combination of injury types	Other	Total
Kemp's ridley									
	2010	82 (55.4%)	10 (6.8%)	12 (8.1%)	17 (11.5%)	7 (4.7%)	16 (10.8%)	4 (2.7%)	148
	2011	29 (59.2%)	1 (2.0%)	4 (8.2%)	9 (18.4%)	1 (2.0%)	4 (8.2%)	1 (2.0%)	49
	2012	24 (45.3%)	5 (9.4%)	3 (5.7%)	11 (20.8%)	6 (11.3%)	3 (5.7%)	1 (1.9%)	53
	2013	18 (42.9%)	3 (7.1%)	4 (9.5%)	8 (19.0%)	4 (9.5%)	4 (8.5%)	1 (2.4%)	42
	2014	15 (57.7%)	1 (3.8%)	2 (7.7%)	2 (7.7%)	3 (11.5%)	2 (7.7%)	1 (3.8%)	26
	Total	168 (52.8%)	20 (6.3%)	25 (7.9%)	47 (14.8%)	21 (6.6%)	29 (9.1%)	8 (2.5%)	318
Loggerhead									
	2010	4 (36.4%)	0 (0%)	1 (9.1%)	4 (36.4%)	0 (0%)	1 (9.1%)	1 (9.1%)	11
	2011	1 (-)	0 (-)	0 (-)	4 (-)	0 (-)	0 (-)	0 (-)	5
	2012	1 (-)	0 (-)	1 (-)	1 (-)	0 (-)	0 (-)	0 (-)	3
	2013	1 (-)	0 (-)	0 (-)	2 (-)	0 (-)	0 (-)	0 (-)	3
	2014	0 (-)	0 (-)	0 (-)	0 (-)	1 (-)	0 (-)	0 (-)	1
	Total	7 (30.4%)	0 (0%)	2 (8.7%)	11 (47.8%)	1 (4.3%)	1 (4.3%)	1 (4.3%)	23
Green									
	2010	7 (35.0%)	0 (0%)	8 (40%)	2 (10.0%)	0 (0%)	3 (15.0%)	0 (0%)	20
	2011	4 (-)	0 (-)	0 (-)	0 (-)	0 (-)	0 (-)	0 (-)	4
	2012	2 (-)	0 (-)	2 (-)	0 (-)	0 (-)	0 (-)	0 (-)	4
	2013	5 (-)	0 (-)	1 (-)	1 (-)	0 (-)	1 (-)	0 (-)	8
	2014	2 (-)	1 (-)	1 (-)	1 (-)	0 (-)	0 (-)	0 (-)	5
	Total	20 (48.8%)	1 (2.4%)	12 (29.3%)	4 (9.8%)	0 (0%)	4 (9.8%)	0 (0%)	41
Grand total (all 3 species)		195 (51.0%)	21 (5.5%)	39 (10.2%)	62 (16.2%)	22 (5.8%)	34 (8.9%)	9 (2.4%)	382

Table 12. Summary information for necropsied sea turtles that were documented by stranding response in Alabama, Louisiana, and Mississippi during 2010 through 2014 and found to have evidence of disease or completely atrophied adipose stores.

Lab Case #	State	Stranding Date	Species	SCL	Code	Nutritional condition	Case summary findings
NMFS10-00281	LA	5/3/2010	Lk	25.1	3	4	Ulcerative tracheobronchitis (cause unidentified)
NMFS10-00150	MS	5/18/2010	Lk	35.4	3	2	Atrophied fat; possible bilateral pneumonia
NMFS10-00154	MS	5/21/2010	Lk	30.2	3	2	Atrophied fat; no other major lesions identified
NMFS10-00075	AL	5/22/2010	Lk	32.3	1	3	Multisystemic inflammatory lesions (suspected septicemia)
NMFS10-00296	LA	5/27/2010	Lk	23.6	2	4	Bilateral pneumonia
NMFS10-00188	MS	6/9/2010	Lk	37.6	2	4	Fibrinous coelomitis; myositis (cause undetermined)
NMFS10-00219	MS	6/12/2010	Lk	30.5	3	2	Atrophied fat; no other major lesions identified
NMFS10-00250	MS	6/16/2010	Lk	40.4	3	2	Atrophied fat; no other major lesions identified
NMFS10-00550	MS	7/19/2010	Lk	53.8	3	2	Atrophied fat; no other major lesions identified
NMFS10-00363	AL	8/28/2010	Lk	34.7	1	4	Septicemia
NMFS11-00211	LA	4/2/2011	Lk	33.5	2	3	Subacute, unilaterally severe pneumonia
NMFS11-00179	MS	6/8/2011	Lk	26.2	1	2	Colon perforation with coelomitis
NMFS11-00237	MS	6/20/2011	Lk	31.9	1	2	Atrophied fat; ulcerative colitis
NMFS12-00025	AL	7/5/2011	Lk	30.3	2	2	Atrophied fat; ulcerative gastritis
NMFS11-00571	LA	11/8/2011	Lk	50.7	3	2	Atrophied fat; no other major lesions identified
NMFS12-00125	LA	3/13/2012	Lk	28.9	2	2	Atrophied fat; no other major lesions identified
NMFS12-00189	MS	3/29/2012	Lk	30	2	4	Aspiration pneumonia
NMFS12-00146	LA	3/30/2012	Lk	61.3	1	4	Fungal meningoencephalitis
NMFS12-00149	MS	4/15/2012	Lk	26.3	1	3	Mild, acute pneumonia
NMFS12-00209	MS	4/17/2012	Lk	32.4	3	2	Atrophied fat; no other major lesions identified
NMFS12-00174	MS	4/28/2012	Lk	40.5	1	2	Atrophied fat; mild, acute pneumonia
NMFS12-00217	MS	5/3/2012	Lk	31.6	1	3	Mild, acute pneumonia
NMFS12-00186	LA	5/8/2012	Lk	29	1	3	Polyarthritis; osteomyelitis; coagulopathy
NMFS12-00339	LA	7/6/2012	Lk	24	3	2	Atrophied fat; no other major lesions identified
NMFS12-00294	MS	7/15/2012	Lk	35.4	1	2	Atrophied fat; no other major lesions identified

Table 12 (continued.)

Lab Case #	State	Stranding Date	Species	SCL	Code	Nutritional condition	Case summary
NMFS13-00372	AL	11/7/2012	Lk	36.5	2	2	Atrophied fat; osteomyelitis (humerus); intrapulmonary sediment
NMFS13-00134	MS	3/30/2013	Lk	34.0	3	2	Atrophied fat; no other major lesions identified
NMFS13-00377	AL	4/6/2013	Lk	43.6	2	2	Atrophied fat; intrapulmonary sediment
NMFS13-00152	MS	4/11/2013	Lk	34.8	3	3	Aspiration pneumonia
NMFS13-00106	MS	4/12/2013	Lk	38.6	3	2	Atrophied fat; no other major lesions identified
NMFS13-00232	LA	4/12/2013	Lk	33.2	2	3	Fungal pneumonia
NMFS13-00104	MS	4/13/2013	Lk	33.4	2	2	Atrophied fat; periesophageal abscess
NMFS13-00107	MS	4/16/2013	Lk	27.4	3	2	Atrophied fat; intrapulmonary sediment
NMFS13-00115	MS	4/18/2013	Lk	32.5	3	U	Atrophied fat; no other major lesions identified
NMFS13-00209	LA	4/20/2013	Lk	46.6	2	2	Atrophied fat; intrapulmonary sediment
NMFS13-00326	LA	4/22/2013	Lk	38.0	2	2	Atrophied fat; no other major lesions identified
NMFS13-00199	MS	4/23/2013	Lk	34.7	3	2	Atrophied fat; intrapulmonary sediment
NMFS13-00329	LA	4/23/2013	Lk	39.9	3	2	Atrophied fat; osteomyelitis (skull, mandible)
NMFS13-00292	LA	4/29/2013	Lk	37.6	3	2	Atrophied fat; no other major lesions identified
NMFS13-00332	LA	5/2/2013	Lk	45.0	3	2	Atrophied fat; no other major lesions identified
NMFS13-00187	MS	5/8/2013	Lk	35.2	3	2	Atrophied fat; no other major lesions identified
NMFS13-00253	LA	5/14/2013	Lk	29.1	3	2	Atrophied fat; no other major lesions identified
NMFS13-00163	MS	5/20/2013	Lk	35.2	3	2	Atrophied fat; chronic pneumonia, dermatitis
NMFS13-00164	MS	5/20/2013	Lk	27.9	1	2	Atrophied fat; chronic injuries; intrapulmonary sediment
NMFS13-00259	LA	5/20/2013	Lk	17.7	2	3	Megacolon and coelomitis
NMFS13-00509	MS	6/18/2013	Lk	32.0	3	2	Atrophied fat; no other major lesions identified

Table 12 (continued).

Lab Case #	State	Stranding Date	Species	SCL	Code	Nutritional condition	Case summary
NMFS14-00230	MS	10/7/2013	Lk	36.0	2	3	Previous incidental capture, empty GI tract, no major lesions
NMFS14-00149	MS	4/24/2014	Lk	35.6	2	3	Gastric abscess with hook, chronic multisystemic inflammation
NMFS14-00204	AL	4/26/2014	Lk	33.6	2	2	Chronic bacterial osteoarthritis
NMFS14-00151	MS	4/27/2014	Lk	37.5	2	3	Chronic abscess (hooking injury); chronic pulmonary granulomas
NMFS14-00202	AL	5/4/2014	Lk	44.2	2	2	Atrophied fat; mild chronic lesions from prior hooking injury
NMFS14-00240	MS	5/11/2014	Lk	33.4	3	2	Atrophied fat; no other major lesions identified
NMFS14-00242	MS	5/23/2014	Lk	35.1	3	3	Epibiota accumulation, empty GI tract, no major lesions
NMFS14-00252	LA	8/7/2014	Lk	35.5	2	3	Bilateral bacterial pneumonia
NMFS14-00285	LA	4/30/2014	Cc	75	2	4	Necrotizing tracheitis (unknown etiology)
NMFS14-00241	MS	5/12/2014	Cc	93.1	1	1	Emaciated, ulcerative colitis, probable anemia, spirorchiidiasis
NMFS10-00399	AL	7/22/2010	Cc	61.0	3	1	Emaciated; epibiota accumulation
NMFS11-00536	AL	6/22/2011	CC	77	2	4	Aspiration pneumonia
NMFS13-00272	LA	2/26/2013	Cc	74.2	1	2	Enterocolic intussusception
NMFS13-00114	MS	4/9/2013	Cc	84.4	1	2	Atrophied fat, ulcerative colitis, embolic hepatitis
NMFS13-00310	LA	5/8/2013	Cc	67.8	1	2	Aspiration pneumonia
NMFS13-00468	LA	6/4/2013	Cc	81.2	3	U	Atrophied fat; no other major lesions identified
NMFS13-00512	LA	6/22/2013	Cc	82.6	2	2	Atrophied fat; no other major lesions identified
NMFS13-00455	LA	7/10/2013	Cc	81	3	3	Aspiration pneumonia
NMFS10-00103	AL	5/13/2010	Cm	28.9	2	2	Atrophied fat; no other major lesions identified
NMFS12-00143	LA	3/22/2012	Cm	45	2	4	Ulcerative colitis with coelomitis
NMFS13-00342	LA	1/31/2013	Cm	54.4	3	2	Atrophied fat; chronic injuries
NMFS13-00249	LA	5/16/2013	Cm	26.2	3	2	Atrophied fat; no other major lesions identified
NMFS14-00265	LA	4/7/2014	Cm	43.0	2	3	Epibiota accumulation and severe ulcerative dermatitis
NMFS14-00227	AL	8/16/2014	Ei	29.5	1	1	Atrophied fat; intrapulmonary fluid; no other major lesions identified

Table 13. Summary information for sea turtles that were documented by stranding response in Alabama, Louisiana, and Mississippi during 2010 through 2014 that were diagnosed with pneumonia.

Lab Case #	State	Stranding Date	Species	SCL	Nutritional condition	Code	Major injuries	Found alive	Summary findings	Condition other than pneumonia
NMFS10-00150	MS	5/18/2010	Lk	35.4	2	3	N	N	Bilateral pneumonia; severe decomposition, limited gross examination	N
NMFS10-00075	AL	5/22/2010	Lk	32.3	3	1	N	Y	Acute pneumonia; found dehydrated; multisystemic inflammatory disease; origin unknown	Y
NMFS10-00296	LA	5/27/2010	Lk	23.6	4	2	N	N	Severe subacute bronchopneumonia; good nutritional condition; fish within stomach	N
NMFS10-00363	AL	8/28/2010	Lk	34.7	4	1	N	Y	Subacute pneumonia, evidence of septicemia	Y
NMFS11-00079	MS	3/31/2011	Lk	28.1	4	1	Y	N	Mild acute pneumonia; hook trauma	Y
NMFS11-00211	LA	4/2/2011	Lk	33.5	3	2	N	N	Regionally severe (predominantly unilateral), subacute pneumonia	N
NMFS11-00109	MS	4/16/2011	Lk	36.4	4	1	N	N	Acute pneumonia; fish within esophagus	N
NMFS11-00179	MS	6/8/2011	Lk	26.2	2	1	N	Y	Acute pneumonia; chronic colon obstruction and colitis with perforation	Y
NMFS13-00446	MS	10/12/2011	Lk	29.7	3	1	Y	Y	Subacute pneumonia; large chronic intracoelomic abscess (trauma-related); septicemia	Y
NMFS12-00189	MS	3/29/2012	Lk	30	4	2	N	N	Subacute pneumonia associated with aspirated sediment/foreign debris	N

Table 13 (continued).

Lab Case #	State	Stranding Date	Species	SCL	Nutritional condition	Code	Major injuries	Found alive	Summary findings	Condition other than pneumonia
NMFS12-00146	LA	3/30/2012	Lk	61.3	4	1	N	Y	Subacute bronchopneumonia; fungal meningoencephalitis; died during rehabilitation	Y
NMFS12-00149	MS	4/15/2012	Lk	26.3	3	1	N	Y	Mild acute pneumonia; fish within stomach	N
NMFS12-00226	AL	4/16/2012	Lk	38.7	4	2	N	N	Peracute pneumonia associated with aspirated sediment/foreign debris	N
NMFS12-00174	MS	4/28/2012	Lk	40.5	2	1	N	Y	Mild, acute bronchopneumonia; underweight (cause undetermined)	Y
NMFS12-00217	MS	5/3/2012	Lk	31.6	3	1	N	N	Mild, acute pneumonia associated with aspirated sediment/foreign debris	N
NMFS12-00283	MS	7/4/2012	Lk	28.7	1	1	Y	Y	Subacute to chronic bronchopneumonia; chronic entanglement	Y
NMFS12-00382	AL	8/25/2012	Lk	34.6	2	1	Y	Y	Unilateral bacterial pneumonia resulting from carapace wound (vessel strike)	Y
NMFS13-00152	MS	4/11/2013	Lk	34.8	3	3	N	N	Acute pneumonia associated with aspirated sediment/foreign debris; ingested fish within stomach	N
NMFS13-00163	MS	5/20/2013	Lk	35.2	2	3	N	N	Severe decomposition, limited gross examination; mild, multifocal chronic pneumonia; previous capture on hook and line	Y
NMFS14-00097	MS	4/1/2014	Lk	41.0	3	1	Y	Y	Embolic pneumonia; severe open head wound	Y
NMFS14-00149	MS	4/24/2014	Lk	35.6	3	2	N	N	Granulomatous pneumonia; perigastric abscess from fish hook; chronic coelomitis	Y

Table 13 (continued).

Lab Case #	State	Stranding Date	Species	SCL	Nutritional condition	Code	Major injuries	Found alive	Summary findings	Condition other than pneumonia
NMFS14-00151	MS	4/27/2014	Lk	37.5	3	2	N	N	Chronic pulmonary granulomas (mild); ingested fish within stomach	Y
NMFS14-00159	LA	6/1/2014	Lk	18.9	3	1	Y	Y	Acute pneumonia secondary to pulmonary injuries (blunt trauma)	Y
NMFS14-00252	LA	8/7/2014	Lk	35.5	3	2	N	Y	Bilateral bronchopneumonia (histology pending)	Y
NMFS11-00536	AL	6/22/2011	Cc	77	4	2	N	N	Subacute pneumonia associated with aspirated sediment/foreign debris	N
NMFS13-00310	LA	5/8/2013	Cc	67.8	2	1	N	Y	Acute pneumonia associated with aspirated sediment/foreign debris	N
NMFS13-00455	LA	7/10/2013	Cc	81	3	3	N	Y	Acute pneumonia associated with aspirated sediment/foreign debris	N
NMFS14-00285	LA	4/30/2014	Cc	75	4	2	N	N	Acute pneumonia associated with severe necrotizing tracheitis (unknown etiology)	Y

Table 14. Biotoxin analytical results for necropsy samples collected from sea turtles documented by stranding response in Alabama, Louisiana, and Mississippi from 2010 through 2013. Abbreviations are as follows: Lk = Kemp's ridley; Cc = Loggerhead; ELISA - enzyme-linked immunosorbent assay; LCMS-MS - liquid chromatography-tandem mass spectrometry; HPLC - high-performance liquid chromatography; RBA - receptor binding assay; FWRI - Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute; NOAA - NOAA National Ocean Service, Marine Biotoxins Program.

Accession No.	Coordinates	State	Stranding date	Species	Sample Type	Brevetoxin PbTx-3 eq. (ng/g) ELISA	Domoic Acid (ng/g) LCMS-MS	Okadaic acid LCMS-MS	Saxitoxin HPLC	Saxitoxin RBA	Lab
NMFS10-00074	30.205	LA	5/17/2010	Lk	lung	<ld	<ld	<ld			NOAA
	-90.1114				liver	<ld	<ld				NOAA
					kidney	<ld	<ld				NOAA
					stomach	<ld	<ld	<ld		<ld	NOAA
					enteric	<ld	<ld	<ld		<ld	NOAA
NMFS10-00075	30.003805	LA	5/26/2010	Lk	liver	<ld	<ld	<ld			NOAA
	-89.20633				kidney	<ld	<ld				NOAA
					spleen		<ld				NOAA
					feces	<ld	<ld	<ld		<ld	NOAA
					enteric	positive, unconfirmed*	<ld				NOAA
NMFS10-00179	30.39375	MS	6/6/2010	Lk	liver	positive, unconfirmed	<ld	<ld			NOAA
	-88.92016				kidney	<ld	<ld				NOAA
					enteric	<ld	<ld	<ld		<ld	NOAA
NMFS10-00246	30.33843	MS	6/17/2010	Lk	stomach	positive, unconfirmed	<ld				NOAA
	-89.16594				enteric	<ld	<ld				NOAA
NMFS10-00259	30.25385	MS	6/19/2010	Lk	stomach	<ld	<ld				NOAA
	-89.10055										
NMFS10-00261	30.244	MS	6/20/2010	Lk	stomach	<ld	<ld				NOAA
	-88.909										
NMFS10-00212	30.38877	MS	6/11/2010	Lk	stomach	<ld	<ld	<ld		<ld	NOAA
	-89.98797										
NMFS10-00207	30.37837	MS	6/11/2010	Lk	stomach	positive, unconfirmed	<ld	<ld		<ld	NOAA
	-89.04101										
NMFS10-00263	Unknown	MS	6/20/2010	Lk	stomach	positive, unconfirmed	5.0			<ld	NOAA
	Biloxi Beach										
NMFS10-00272	30.35605	MS	6/21/2010	Lk	stomach		3.8	<ld			NOAA
	-88.8961				enteric	positive, unconfirmed	<ld			<ld	NOAA

*No toxin detected by confirmatory analytical methods (LCMS).

Table 14. (continued)

Accession No.	Coordinates	State	Stranding date	Species	Sample Type	Brevetoxin PbTx-3 eq. (ng/g) ELISA	Domoic Acid (ng/g) LCMS-MS	Okadaic acid LCMS-MS	Saxitoxin HPLC	Saxitoxin RBA	Lab
NMFS10-00201	30.37262	MS	6/10/2010	Lk	stomach	<ld	<ld				NOAA
	-89.06721										
NMFS10-00254	30.2596	MS	6/18/2010	Lk	stomach	<ld	<ld				NOAA
	-89.0370				enteric	<ld	<ld	<ld		<ld	NOAA
NMFS10-00217	30.38393	MS	6/11/2010	Lk	stomach	positive, unconfirmed*	3.8	<ld		<ld	NOAA
	-89.01701										
NMFS10-00170	30.34084	MS	6/5/2010	Lk	stomach	<ld	<ld			<ld	NOAA
	-89.15894										
NMFS11-00020	30.30769	MS	3/19/2011	Lk	lung		Trace				NOAA
	-89.29482				liver		Trace				NOAA
					kidney		Trace				NOAA
					stomach		Trace				NOAA
					enteric		Trace				NOAA
NMFS11-00062	30.34188	MS	3/23/2011	Lk	liver	35.11	<ld	<ld	<ld		FWRI
	-89.15635				kidney	14.48	<ld	<ld	<ld		FWRI
					enteric	17.75	<ld	<ld	<ld		FWRI
NMFS11-00064	30.30411	MS	3/23/2011	Lk	liver	20.57	Trace	<ld	<ld		FWRI
	-89.27867				kidney	17.23	<ld	<ld	<ld		FWRI
					stomach	<ld	Trace	<ld	<ld		FWRI
					enteric	39.09	Trace	<ld	<ld		FWRI
NMFS11-00055	30.31176	MS	3/24/2011	Lk	liver	31.88	<ld	<ld	<ld		FWRI
	-89.25006				kidney	18.3	<ld	<ld	<ld		FWRI
					stomach	39.01	<ld	<ld	<ld		FWRI
					enteric	<ld	<ld	<ld	<ld		FWRI
NMFS11-00058	30.26604	MS	3/24/2011	Lk	liver	33.58	<ld	<ld	<ld		FWRI
	-89.38726				kidney	11.8	<ld	<ld	<ld		FWRI
					stomach	19.36	<ld	<ld	<ld		FWRI
					enteric	<ld	<ld	<ld	<ld		FWRI

*No toxin detected by confirmatory analytical methods (LCMS).

Table 14. (continued)

Accession No.	Coordinates	State	Stranding date	Species	Sample Type	Brevetoxin PbTx-3 eq. (ng/g) ELISA	Domoic Acid (ng/g) LCMS-MS	Okadaic acid LCMS-MS	Saxitoxin HPLC	Saxitoxin RBA	Lab
NMFS11-00053	30.26693	MS	3/25/2011	Lk	liver	38.89	<ld	<ld	<ld		FWRI
	-89.38590				kidney	10.53	<ld	<ld	<ld		FWRI
					stomach	<ld	<ld	<ld	<ld		FWRI
					enteric	31.84	<ld	<ld	<ld		FWRI
NMFS11-00037	30.18124	MS	3/29/2011	Lk	liver	24.09	<ld	<ld	<ld		FWRI
	-89.45263				kidney	9.16	<ld	<ld	<ld		FWRI
					enteric	12.2	<ld	<ld	<ld		FWRI
NMFS11-00079	30.21017	MS	3/31/2011	Lk	liver	<ld	<ld	<ld	<ld		FWRI
	-89.25688				kidney	<ld	<ld	<ld	<ld		FWRI
NMFS11-00081	30.15147	LA	3/31/2011	Lk	liver	22.33	<ld	<ld	<ld		FWRI
	-89.19736				stomach	<ld	<ld	<ld	<ld		FWRI
					enteric	<ld	<ld	<ld	<ld		FWRI
NMFS12-00036	29.76950	LA	12/5/2011	Lk	liver	52.61					FWRI
	-93.47832				stomach	<ld					FWRI
					colon/feces	45.74					FWRI
NMFS12-00044	29.21687	LA	1/16/2012	Lk	liver	24.46					FWRI
	-90.01913				stomach	16.45					FWRI
					colon/feces	<ld					FWRI
NMFS12-00019	29.20577	LA	2/20/2012	Lk	liver	10.73					FWRI
	-90.03365				stomach	<ld					FWRI
					colon/feces	47.78					FWRI
NMFS12-00117	29.18302	LA	3/15/2012	Lk	liver	<ld	<ld	<ld		<ld	NOAA
	-90.06085				kidney	<ld	<ld	<ld		<ld	NOAA
					stomach	<ld	<ld	<ld		<ld	NOAA
					colon/feces	<ld	<ld	<ld		<ld	NOAA
NMFS12-00127	29.75392	LA	3/16/2012	Lk	stomach	51.66					FWRI
	-93.62596				enterocolic	51.63					FWRI

Table 14. (continued)

Accession No.	Coordinates	State	Stranding date	Species	Sample Type	Brevetoxin PbTx-3 eq. (ng/g) ELISA	Domoic Acid (ng/g) LCMS-MS	Okadaic acid LCMS-MS	Saxitoxin HPLC	Saxitoxin RBA	Lab
NMFS12-00138	29.21984	LA	3/16/2012	Cc	liver	<ld	<ld	<ld		<ld	NOAA
	-90.01404				stomach	<ld	Trace	<ld		<ld	NOAA
					colon/feces	<ld	<ld	<ld		<ld	NOAA
NMFS12-00067	30.39200	MS	3/18/2012	Lk	liver	<ld	<ld	<ld		<ld	NOAA
	-88.87110				kidney	<ld	<ld	<ld		<ld	NOAA
					stomach	<ld	Trace	<ld		<ld	NOAA
					colon/feces	<ld	<ld	<ld		<ld	NOAA
NMFS12-00111	29.27962	LA	3/18/2012	Cc	liver	35.04					FWRI
	-89.92999				stomach	<ld					FWRI
					colon/feces	62.23					FWRI
NMFS12-00071	30.25010	MS	3/20/2012	Lk	liver	<ld	<ld	<ld		<ld	NOAA
	-89.42230				kidney	<ld	<ld	<ld		<ld	NOAA
					stomach	<ld	<ld	<ld		<ld	NOAA
					colon/feces	<ld	9	<ld		<ld	NOAA
NMFS12-00121	29.22492	LA	3/20/2012	Lk	liver	39.26					FWRI
	-90.00527				stomach	15.36					FWRI
					colon/feces	14.75					FWRI
NMFS12-00087	30.36884	MS	3/28/2012	Lk	liver	<ld	<ld	<ld		<ld	NOAA
	-89.09007				kidney	<ld	<ld	<ld		<ld	NOAA
					stomach	<ld	<ld	<ld		<ld	NOAA
					colon/feces	<ld	<ld	<ld		<ld	NOAA
NMFS12-00174	30.39380	MS	4/28/2012	Lk	liver	<ld					FWRI
	-88.91533				colon/feces	<ld					FWRI

Table 14. (continued)

Accession No.	Coordinates	State	Stranding date	Species	Sample Type	Brevetoxin PbTx-3 eq. (ng/g) ELISA	Domoic Acid (ng/g) LCMS-MS	Okadaic acid LCMS-MS	Saxitoxin HPLC	Saxitoxin RBA	Lab
NMFS13-00152	30.32230	MS	4/11/2013	Lk	liver	<ld	<ld			<ld	NOAA
	-89.22147				kidney	<ld	<ld			276[1]	NOAA
					stomach	<ld	<ld			<ld	NOAA
					feces	<ld	<ld			<ld	NOAA
NMFS13-00125	30.37760	MS	4/16/2013	Lk	liver	<ld	<ld			<ld	NOAA
	-89.04280				kidney	<ld	<ld			228[1]	NOAA
					colon/feces	<ld	<ld			<ld	NOAA
NMFS13-00133	30.3300	MS	4/8/2013	Lk	liver	<ld				<ld	NOAA
	-89.19230				kidney	<ld				<ld	NOAA
					stomach	<ld				<ld	NOAA
					colon/feces	<ld				<ld	NOAA
NMFS13-00105	30.29480	MS	4/13/2013	Lk	liver	4	trace			<ld	NOAA
	-89.34150				kidney	<ld	<ld			<ld	NOAA
					stomach		<ld			<ld	NOAA
					colon/feces	<ld	9			<ld	NOAA
NMFS13-00110	30.25010	LA	4/14/2013	Lk	liver	3	<ld			<ld	NOAA
	-89.42190				kidney		<ld				NOAA
					colon/feces	4	trace			<ld	NOAA
NMFS13-00120	30.33980	MS	4/18/2013	Pa	liver	<ld	<ld			<ld	NOAA
	-89.3398				kidney	<ld	<ld			<ld	NOAA
					proventriculus	<ld	<ld			<ld	NOAA
NMFS13-00116(2)	30.33910	MS	4/18/2013	Bm	muscle	<ld	19			<ld	NOAA
	-88.16430										
NMFS13-00116(2)	30.33910	MS	4/18/2013	So	muscle	<ld	20			<ld	NOAA
	-88.16430										

[1]Saxitoxin concentrations were below detectable limits (<~2ng/g) in subsequent analysis using an ELISA methods (FWRI).

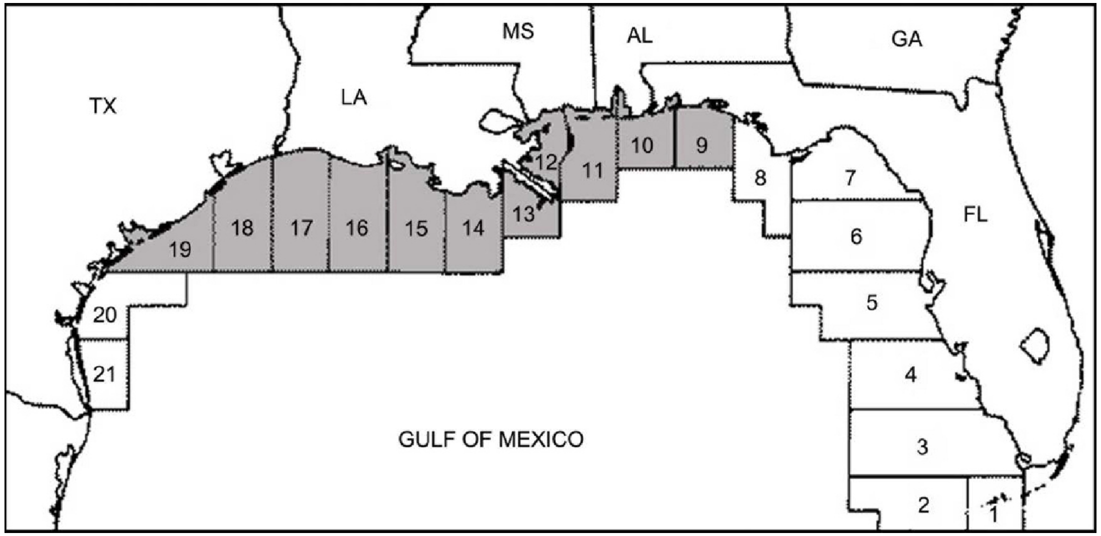
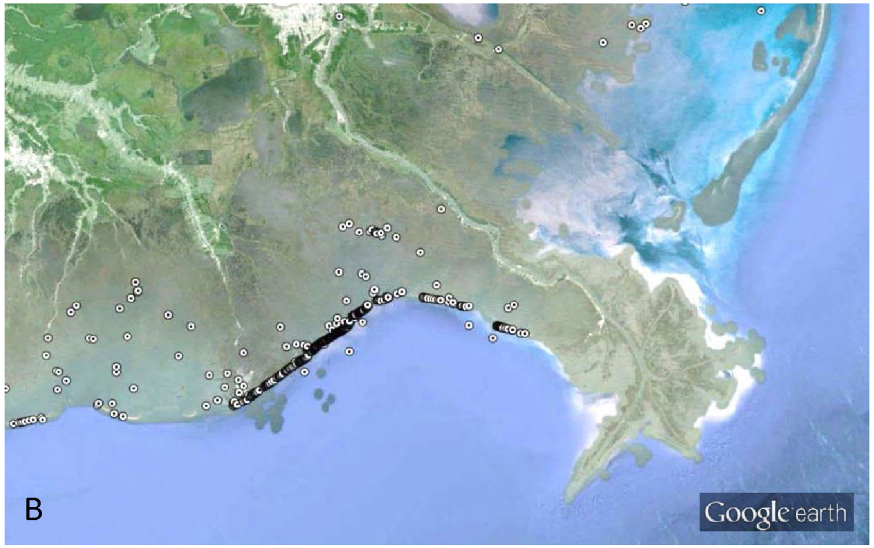


Figure 1. Sea turtles documented by stranding response listed by year and statistical zone. The area of the Northern Gulf of Mexico included in these data is shown in gray (zones 9 through 19). Numbers are provided for Kemp's ridley turtles (Lk) and all species combined, including those in which the species was not identified.

	2010		2011		2012		2013		2014		All years	
Zone	Lk	All	Lk	All	Lk	All	Lk	All	Lk	All	Lk	All
9	15	46	30	55	25	45	16	37	16	36	102	219
10	61	109	36	68	31	50	45	59	41	74	214	360
11	221	233	122	147	66	75	57	72	60	70	526	597
12	178	192	195	207	122	134	146	160	88	97	729	790
13	22	23	66	76	75	81	67	78	33	42	263	300
14	43	57	27	37	40	50	58	84	15	30	183	258
15	2	2	2	2	2	2	0	1	0	0	6	7
16	9	19	0	0	0	0	0	0	1	2	10	21
17	51	58	19	20	17	18	83	104	2	2	172	202
18	73	101	27	92	64	118	70	127	15	147	249	585
19	18	193	17	147	11	40	9	78	6	139	61	597

Figure 2. Locations where necropsied sea turtles (all species) were documented by stranding response during 2010 through 2014 in select areas of Alabama, Louisiana, and Mississippi. Areas shown include (A) the Mississippi Sound and Mobile Bay; (B) Louisiana west of the Mississippi River (including Barataria Bay and regional barrier islands); and (C) western Louisiana near the border with Texas. Coordinates were plotted and imaged on Google Earth™ using Earth Point™.



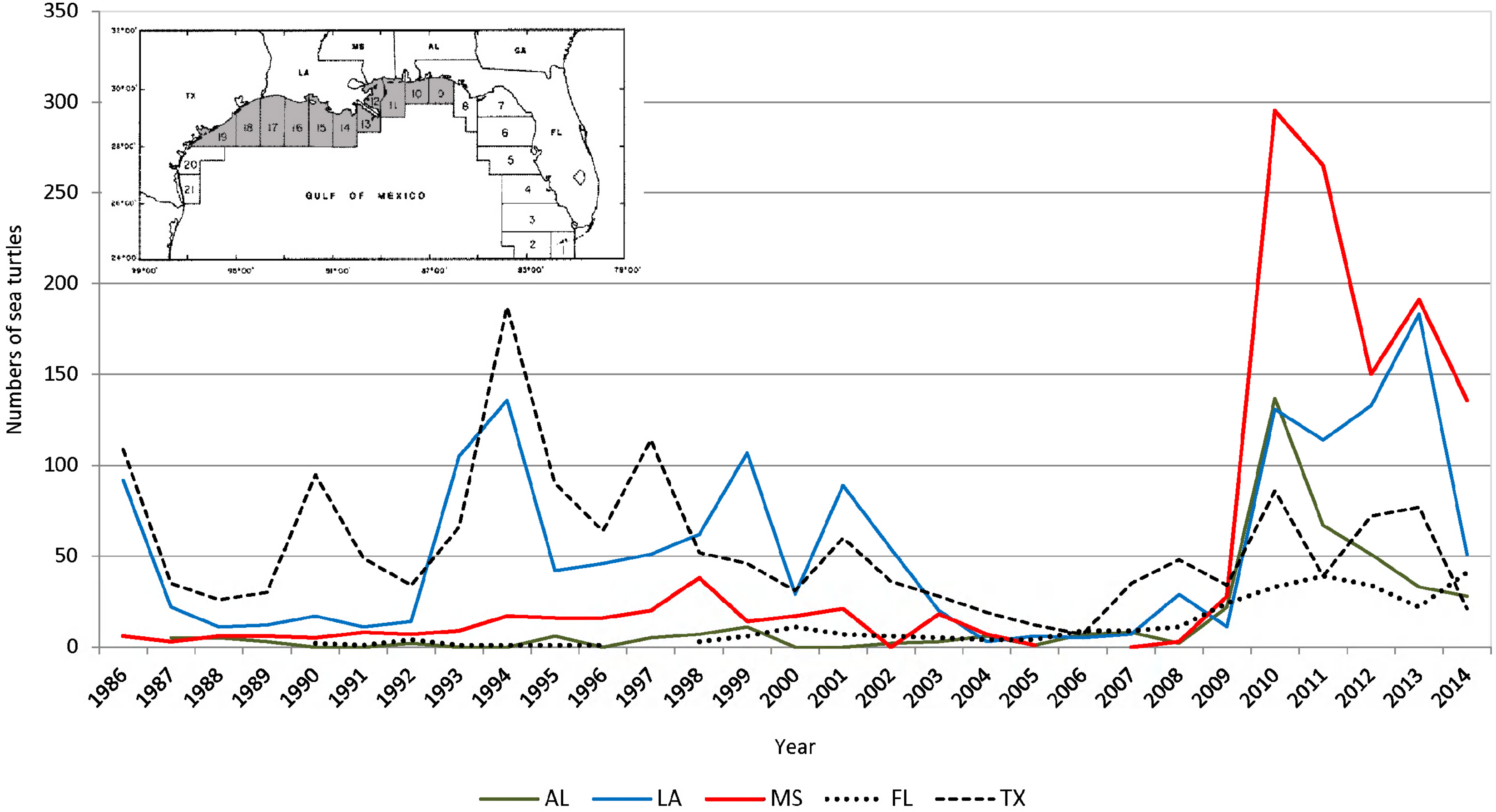


Figure 3. Kemp's ridley turtles documented by stranding response in Alabama, western Florida, Louisiana, Mississippi, and eastern Texas from the 1980's through 2014. The shaded area in the map (inset) shows the area included in the graph. Florida data include statistical zones 9 and 10. Texas data include zones 18 and 19.

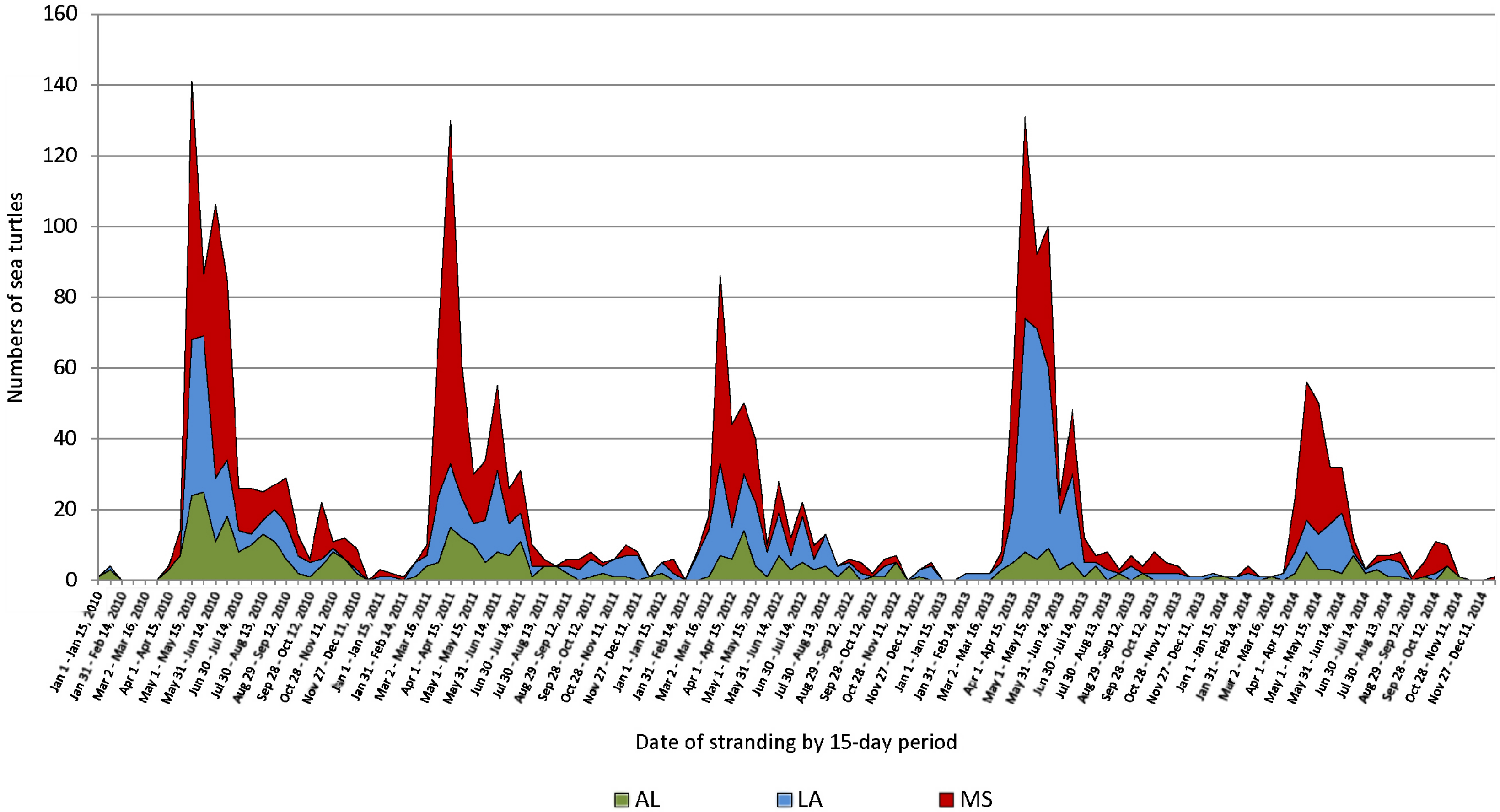
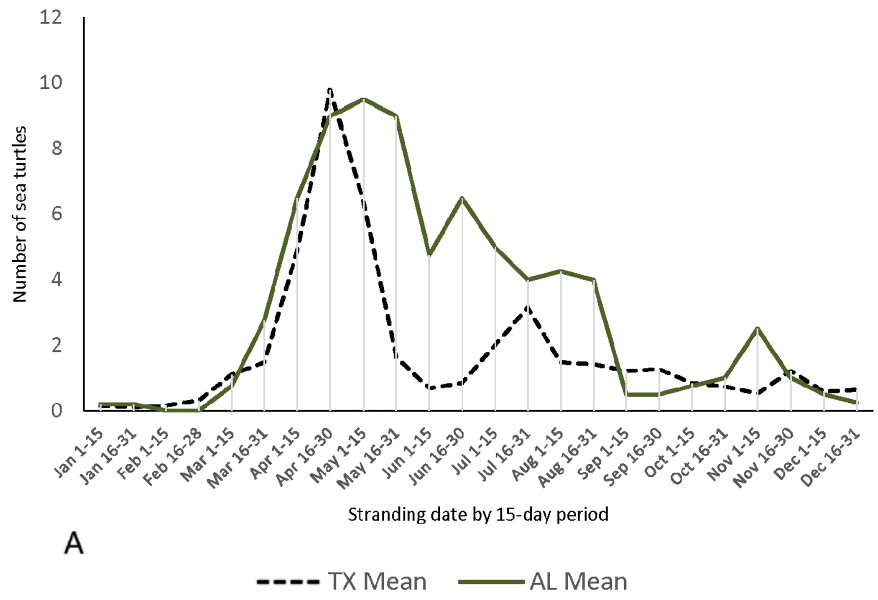
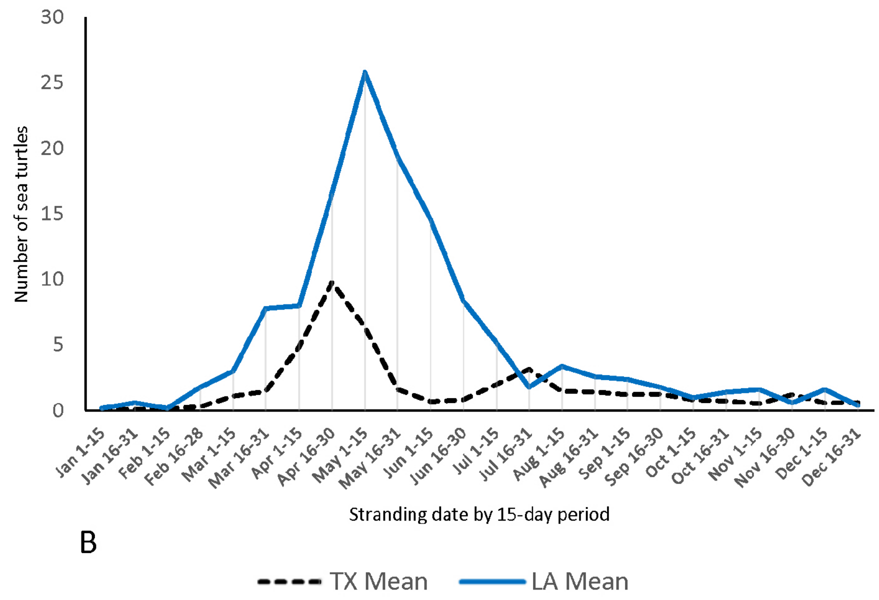


Figure 4. Stacked area graph of sea turtles documented by stranding response in Alabama, Louisiana, and Mississippi during 2010 through 2014.





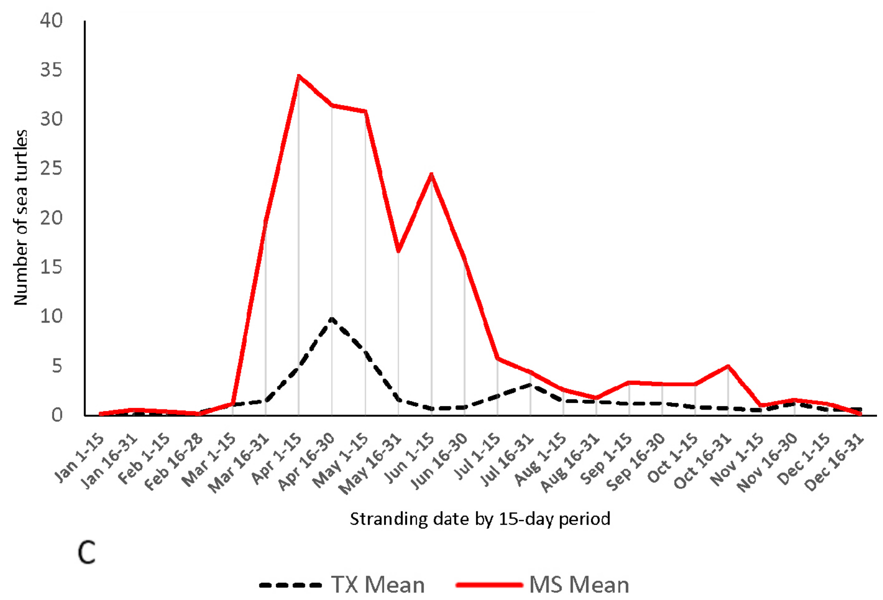
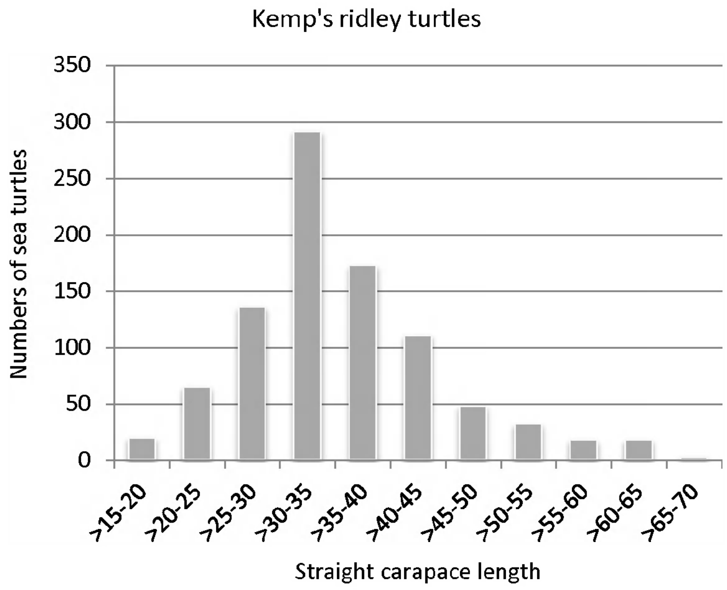
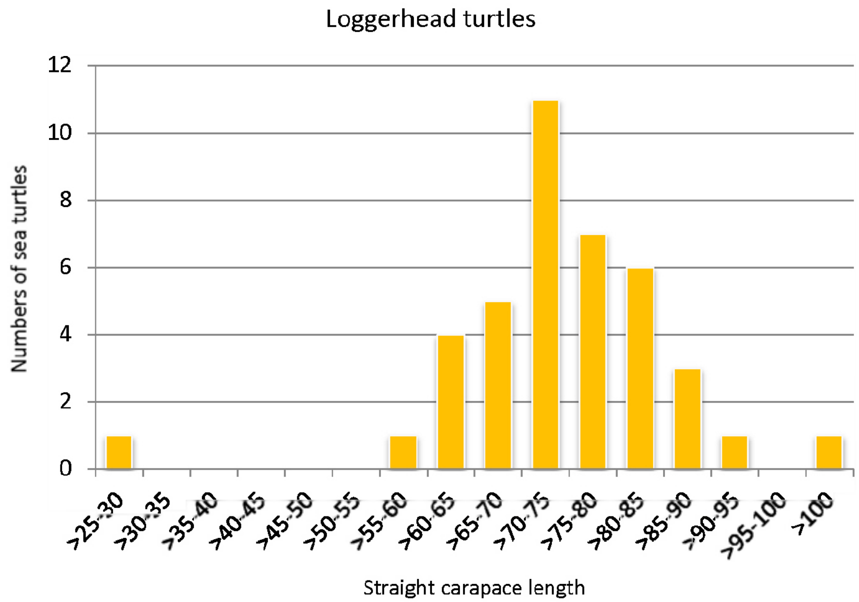


Figure 5. Line graphs of mean Kemp's ridley strandings by 15-day interval for Alabama (A), Louisiana (B), and Mississippi (C) as compared to Texas. Data from Texas is from 1995 through 2014. Means for other states reflect strandings 2010 through 2014.





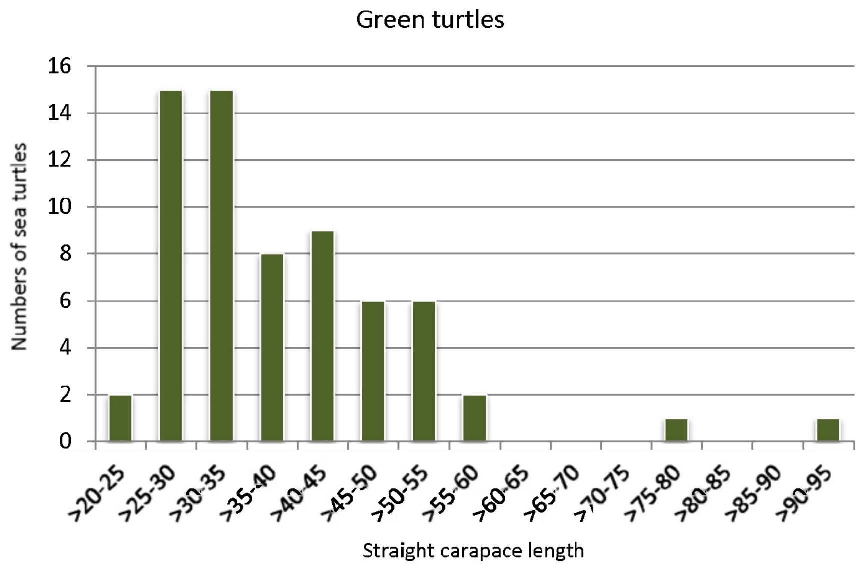


Figure 6. Histogram of straight carapace lengths (nuchal notch to tip of supracaudal scute) of necropsied Kemp's ridley turtles, loggerhead turtles, and green turtles documented by stranding response in Alabama, Louisiana, and Mississippi during 2010 through 2014. Hatchlings and post-hatchlings are not included.

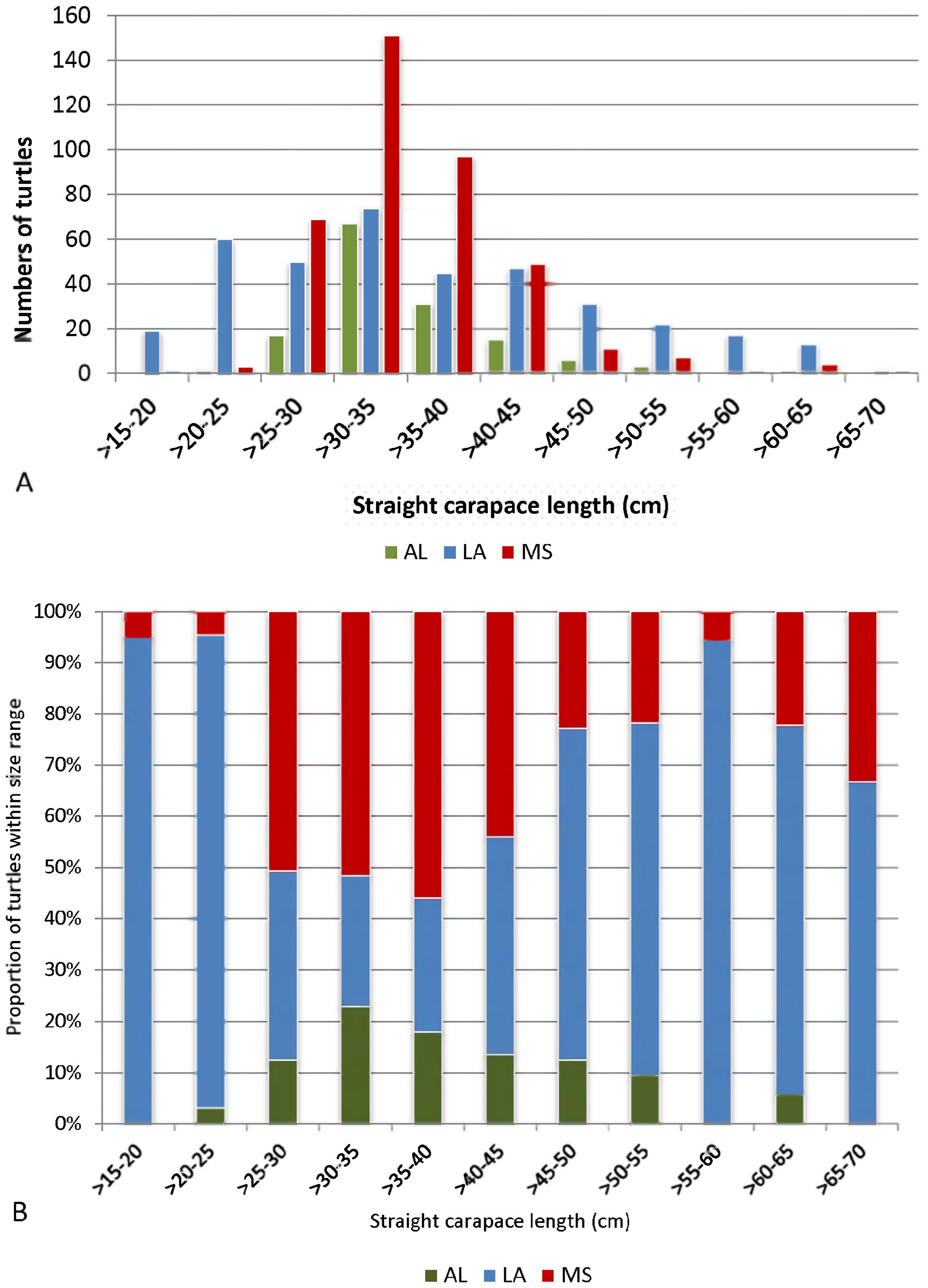


Figure 7. (A) Histogram of straight carapace lengths (nuchal notch to tip of supracaudal scute) of necropsied Kemp's ridley turtles found in Alabama, Louisiana, and Mississippi during 2010 through 2014. (B) Proportional bar graph of size classes by state.

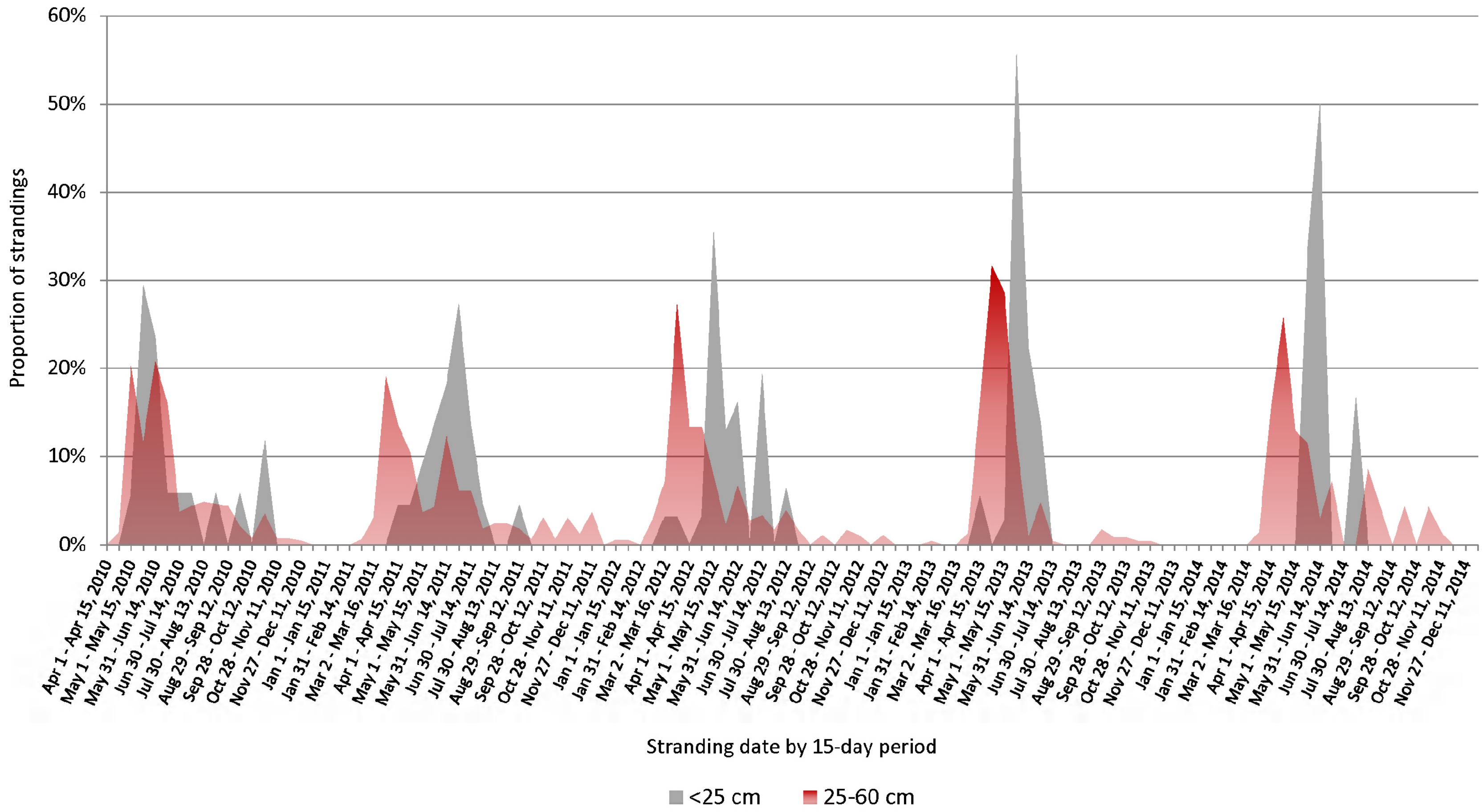


Figure 8. Area graph of Kemp's ridley strandings in Louisiana during 2010 through 2014. Data are presented as proportion of annual strandings documented within each 15-day period for each given size class. Straight carapace length was measured from nuchal notch to tip of the supracaudal scute.

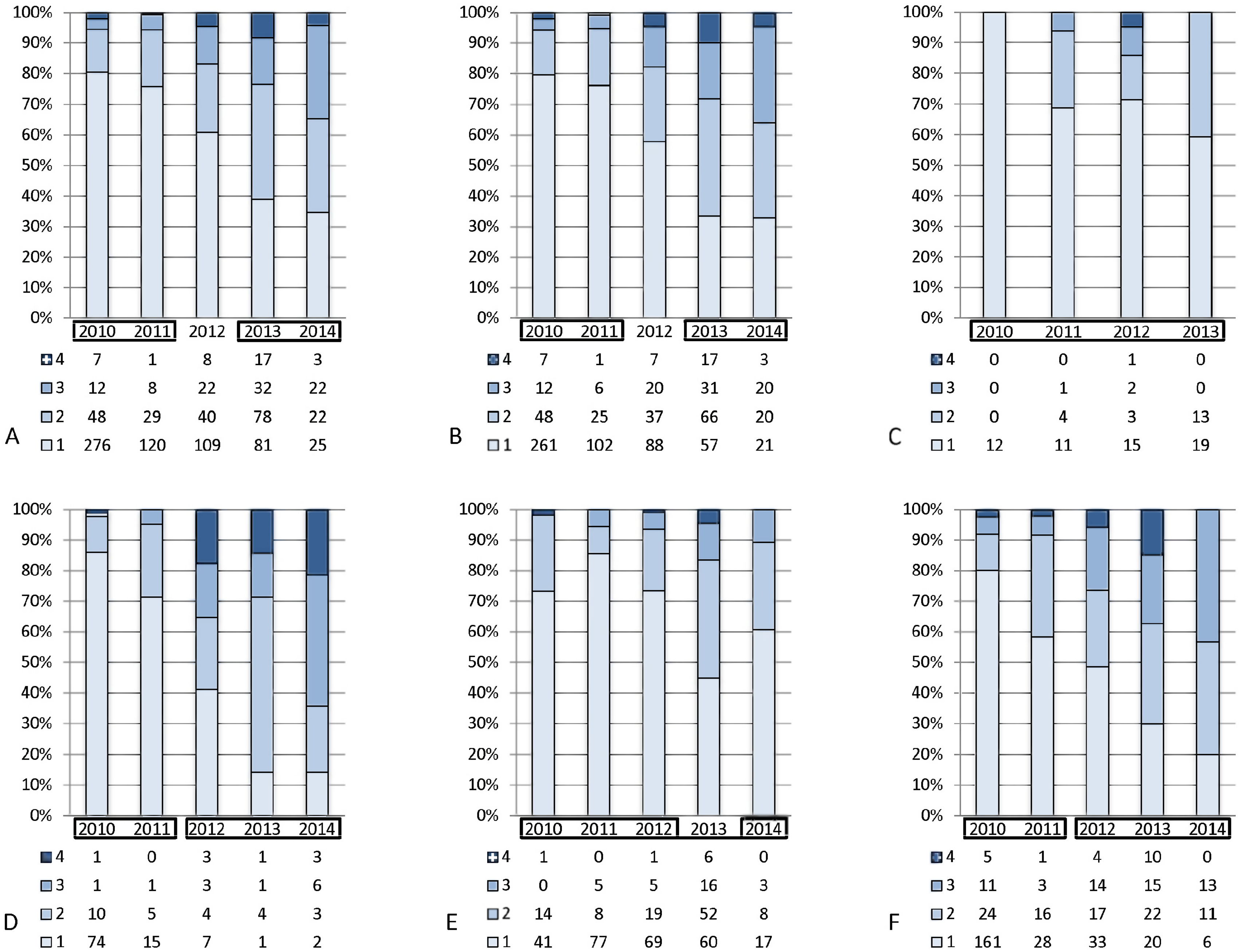

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
A
2010 2011 2012 2013 2014
4 7 1 8 17 3
3 12 8 22 32 22
2 48 29 40 78 22
1 276 120 109 81 25
B
2010 2011 2012 2013 2014
4 7 1 7 17 3
3 12 6 20 31 20
2 48 25 37 66 20
1 261 102 88 57 21
C
2010 2011 2012 2013
4 0 0 1 0
3 0 1 2 0
2 0 4 3 13
1 12 11 15 19
D
2010 2011 2012 2013 2014
4 1 0 3 1 3
3 1 1 3 1 6
2 10 5 4 4 3
1 74 15 7 1 2
E
2010 2011 2012 2013 2014
4 1 0 1 6 0
3 0 5 5 16 3
2 14 8 19 52 8
1 41 77 69 60 17
F
2010 2011 2012 2013 2014
4 5 1 4 10 0
3 11 3 14 15 13
2 24 16 17 22 11
1 161 28 33 20 6

Figure 9 (previous page). Degree of atrophy of fat in Kemp's ridleys determined by review of necropsy photographs and compared among select groups by year. Scores were assigned as follows: (1) no atrophy; (2) mild atrophy; (3) moderate atrophy; (4) severe atrophy. The following groups were compared: (A) all available data; (B) Kemp's ridleys 25 to 60 straight carapace length (SCL); (C) Kemp's ridleys <25 cm SCL (numbers insufficient for 2014); (D) Alabama strandings; (E) Louisiana strandings; and (F) Mississippi strandings. Years were compared by Kruskal-Wallis test and if median scores were significantly different across years, pairwise comparisons were performed with Bonferroni correction. Differences were considered significant if were p-values <0.5. Years without significant differences in median scores are within the same boxes or connected by lines. Those outside of or within separate boxes were different. The only additional non-significant differences not indicated in this manner were between 2013 and 2014 for Louisiana strandings (E) and between 2011 and 2012 for turtles found in Mississippi (F).

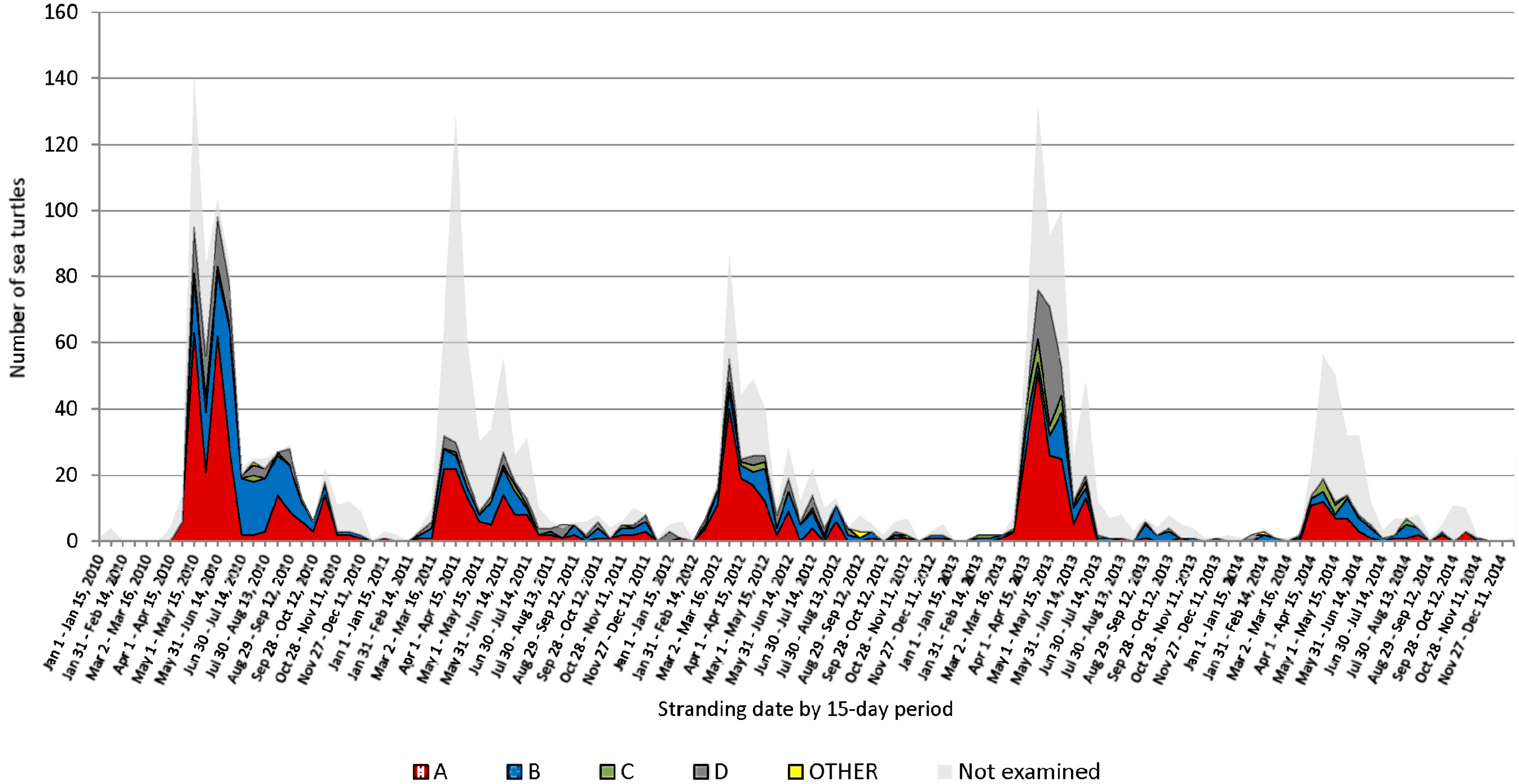


Figure 10. Stacked area graph of necropsy findings in sea turtles (all species) documented by stranding response in Alabama, Louisiana, and Mississippi during 2010 through 2014. Cases are categorized into groups by cause of death (COD) or major necropsy findings if COD was undetermined. Turtles in which COD was attributed to probable drowning (exclusion of other findings in conjunction with intrapulmonary sediment) were grouped with turtles that were in fair to good nutritional condition and did not have any major traumatic injuries (A). All turtles with major injuries are grouped together regardless of whether timing of injury in relation to death was determined (B). All turtles with depleted adipose stores or pathological lesions that could have been related to death are considered with those in which COD was attributed to a disease state (C). Uncategorized cases could not be further characterized due to decomposition (D). Other includes stranded hatchlings and cold-stunnings.

Peak	A	B	C	Necropsies categorized	Non-peak	A	B	C	Necropsies categorized
2010	174 61.9%	89 31.7%	9 3.2%	281	2010	64 40.5%	90 57.0%	3 1.9%	158
2011	71 69.6%	21 20.6%	2 2.0%	102	2011	46 51.1%	37 41.1%	4 4.4%	90
2012	88 61.1%	23 16.0%	8 5.6%	120	2012	42 48.8%	37 43.0%	4 4.7%	86
2013	143 71.9%	33 16.6%	23 11.6%	199	2013	12 31.6%	21 55.3%	5 13.2%	38
2014	19 63.3%	4 13.3%	7 23.3%	30	2014	30 48.4%	28 45.2%	4 6.5%	62
All	495 67.6%*	170 23.2%*	49 6.7%	732	All	194 44.7%*	213 49.1%*	20 4.6%	434
2011-14	321 71.2%*	81 18.0%*	40 8.9%	451	2011-14	130 47.1%*	123 44.6%*	17 6.2%	276

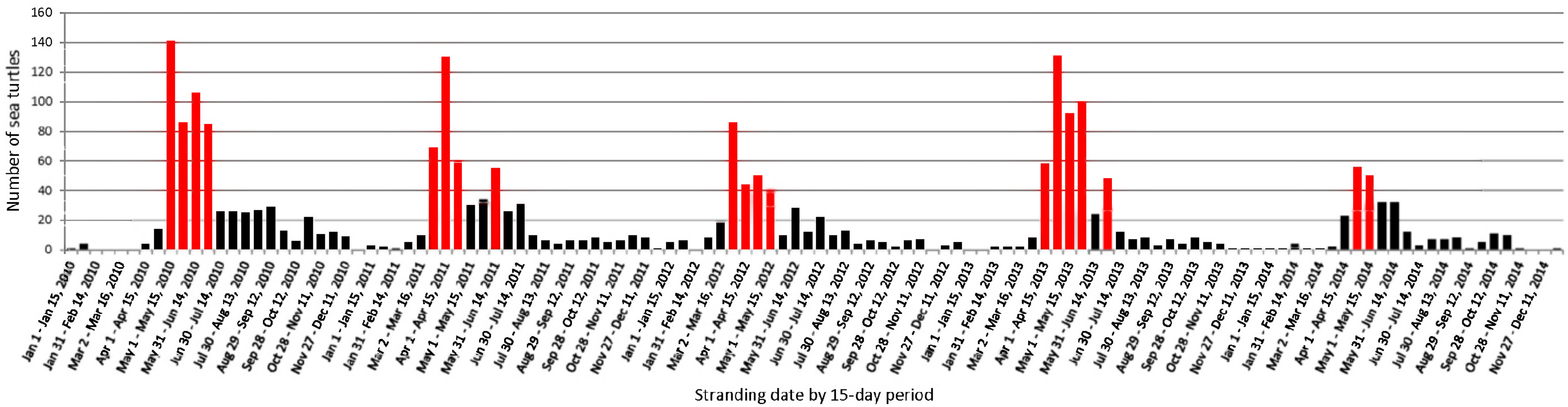


Figure 11. Numbers of stranded sea turtles documented in Alabama, Louisiana, and Mississippi from 2010 through 2014. Periods in which 40 or more turtles were documented are red to indicate "peak" strandings. Designated "non-peak" periods are shown in black. Necropsy findings in Kemp's ridley turtles correlating to peak and non-peak periods of strandings are categorized by cause of death (COD) or major necropsy findings (if COD was undetermined) as follows: probable drowning or no significant anomalies (A), those with major injuries (B), and those with evidence of disease or depleted fat stores (C). Data from oiled or suspect oiled turtles are not included. Significant differences in proportions in each group between peak and non-peak periods are indicated by asterisks (Pearson chi-square $p<0.05$).

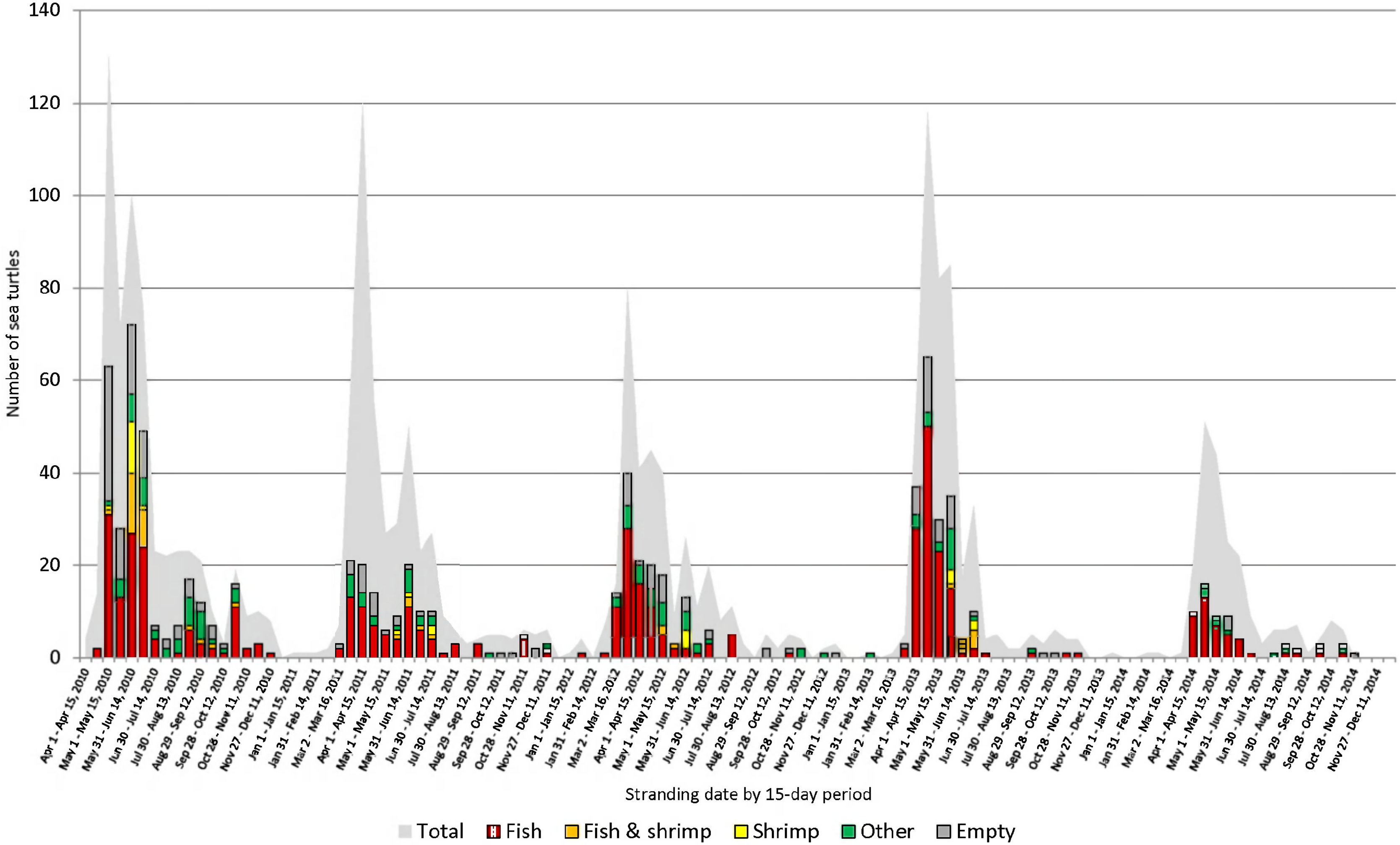


Figure 12. Stacked bar graph of food items observed within the mouth, esophagus, and stomach of Kemp's ridley sea turtles that were documented by stranding response in Alabama, Louisiana, and Mississippi from 2010 through 2014. The stacked bar graph shows numbers of turtles in which fish (red), shrimp (yellow), both fish and penaeid shrimp (orange), or other organisms (green) were found. Other items refer to organisms other than fish and penaeid shrimp, primarily species of crab and gastropod mollusks. Medium gray bars indicate turtles without food items present. Total stranding numbers are shown in the superimposed light gray area graph.

Peak	Fish	Fish & shrimp	Shrimp	Other	Empty	Total examined	Non-peak	Fish	Fish & shrimp	Shrimp	Other	Empty	Total examined
2010	95	22	13	17	64	211	2010	36	4	0	23	14	77
	45.0%	10.4%	6.2%	8.1%	30.3%			46.8%	5.2%	0.0%	29.9%	18.2%	
2011	41	2	1	16	14	74	2011	33	4	3	8	9	57
	55.4%	2.7%	1.4%	21.6%	18.9%			57.9%	7.0%	5.3%	14.0%	15.8%	
2012	60	2	0	18	17	97	2012	25	1	4	13	10	53
	61.9%	2.1%	0.0%	18.6%	17.5%			47.2%	1.9%	7.5%	24.5%	18.9%	
2013	118	5	5	18	31	177	2013	6	0	1	3	4	14
	66.7%	2.8%	2.8%	10.2%	17.5%			42.9%	0.0%	7.1%	21.4%	28.6%	
2014	20	0	0	3	2	25	2014	23	0	0	6	8	37
	80.0%	0.0%	0.0%	12.0%	8.0%			62.2%	0.0%	0.0%	16.2%	21.6%	
All	334	31	19	72	128	584	All	123	9	8	53	45	238
	57.2%	5.3%	3.3%	12.3%*	21.9%			51.7%	3.8%	3.4%	22.3%*	18.9%	
2011-14	239	9	6	55	64	373	2011-14	87	5	8	30	31	161
	64.1%*	2.4%	1.6%	14.7%	17.2%			54.0%*	3.1%	5.0%	18.6%	19.3%	

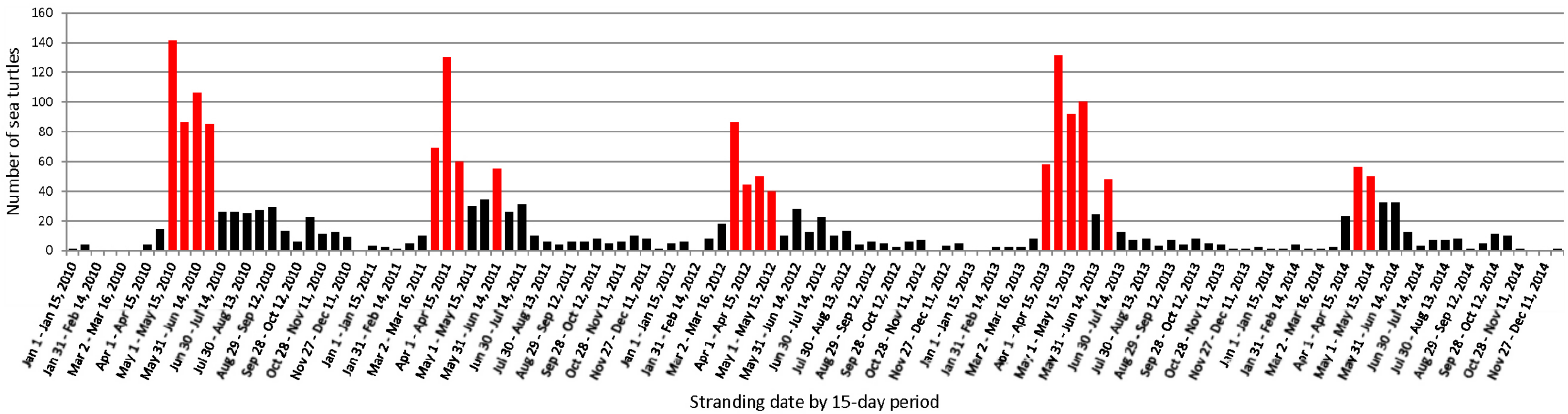


Figure 13. Numbers of stranded sea turtles documented in Alabama, Louisiana, and Mississippi from 2010 through 2014. Periods in which 40 or more turtles were documented are red to indicate "peak" strandings. Designated "non-peak" periods with are shown in black. Contents of the mouth, esophagus, and stomach correlating to "peak" and "non-peak" periods of stranding activity are shown. "Other" refers to food items other than fish or penaeid shrimp. Data from oiled or suspect oiled turtles are not included. Significant differences in proportions of turtles with specific types of food items between peak and non-peak periods are indicated by asterisks (Pearson chi-square p<0.05).

DISCUSSION

Sea turtle strandings within the NGOMX

Sea turtle strandings in Alabama, Louisiana, and Mississippi during 2010 through 2014 were characterized by peak activity during the spring and early summer months and continuation at lower levels throughout the summer. In general, strandings reflect a combination of sea turtle presence (and abundance) within near-shore waters, interaction with sources of mortality, and environmental factors that favor shoreward drift and beaching of carcasses. There are multiple important considerations with regard to interpretation of the magnitude and other aspects of stranding activity during this time, as well as comparisons with previous years. Stranding probability is known to have substantial spatiotemporal variation, including potentially large inter-annual variation within the same area, and is largely unstudied within the NGOMX (Hart et al. 2006, Volker et al. 2013). Factors that influence stranding probability have significant implications on year-to-year variation in numbers of stranded turtles, likelihood of detection of at-sea mortality as strandings, and correlation (or lack thereof) between strandings and activities known to result in sea turtle mortality (Epperly et al. 1996).

Response to strandings and documentation were considerably enhanced during the DWH oil spill and were very inconsistent prior to 2010. Louisiana and Mississippi did not have identified stranding coordinators under the STSSN during some years. In addition, there is little or no necropsy information available for Alabama, Louisiana, and Mississippi prior to 2010. Therefore, comparison of stranding numbers before and after 2010 is extremely limited by the available information and there is little historical information with which to compare many of the other findings in this report. Notably, relatively high numbers of stranded turtles were documented in Louisiana during previous years (e.g., 1993, 1994, and 1999) and are within the range observed since 2010. These data are attributed to dedicated stranding surveillance efforts supported by NMFS during some years (B. Schroeder pers. com.)

Stranding numbers in Mississippi potentially may have undergone the most dramatic increase in recent years. Given the extent of development of the Mississippi coast and level of human use, it stands to reason that large numbers of dead sea turtles likely would have received some attention prior to 2010 regardless of the status of the STSSN. In fact, a series of several stranded sea turtles was reported by the media in 2009 (M. Cook, pers. com.). However, the information necessary to more confidently characterize stranding activity within the NGOMX leading up to 2010 is unavailable.

Necropsy findings, inferences regarding nature of mortality, consideration of potential causes

Findings in many stranded sea turtles consistent with sudden/acute cause of death

Decomposition prevented determination of cause of death for many turtles; however, necropsy allowed general characterization of the strandings and yielded valuable information with regard to investigation of mortality. The majority of sea turtles, especially during periods of peak strandings, were Kemp's ridleys in fair or good nutritional condition without any significant injuries or apparent evidence of any debilitating conditions. Based on robustness of fat, turtles within this group were in slightly better nutritional condition than those with major trauma. Most of these turtles also had food items within the stomach, esophagus, or mouth and had been feeding on fish. In addition, a large proportion of these cases also had sediment within the respiratory tract, which persisted despite decomposition and was regarded as evidence of drowning when inundation of the lungs was found. Results of necropsies of turtles that died from well-documented incidents of incidental capture by hook and line and various trawling activities were not included in this report, but provided a useful basis for comparison with strandings over the years of this study. There were no apparent differences in general presentation (e.g., nutritional condition, presence/absence of ingested food items, apparent disease) between those turtles that died relatively acutely under known circumstances from that of many of the dead stranded sea turtles. This combination of findings is suggestive of a relatively sudden or acute scenario resulting in death. The few known causes of large-scale sea turtle mortality that potentially manifest in this manner include forced submergence resulting in drowning and acute toxicosis caused by exposure to toxin-producing harmful algae (biotoxicosis) (Guinea and Chatto 1992, Shaver 1995, Shoop and Ruckdeschel 1982, Guinea and Whiting 1997, Youngkin 2001, Peckam et al. 2008).

A similar investigative approach was used in all years and included pursuit of any natural or anthropogenic explanation for the deaths of large numbers of sea turtles without obvious signs as detectable by necropsy. Although a wide spectrum of possible differential diagnoses, including toxins and infectious diseases, were considered, the predominant presentation of dead, decomposed turtles and consistent annual occurrence are different from prior sea turtle mass events attributed to debilitating factors or health-related problems, such as cold-stunning events, infectious disease, and harmful algal blooms (HABs). Sea turtle strandings associated with HABs, of which those associated with the red tide organism *Karenia brevis* are the best characterized, typically result in some proportion of live turtles (Fauquier et al. 2006). Similarly, other stranding events caused by infectious disease, cold-stunning, and those suspected to be caused by biotoxins also have manifested with numbers of live and fresh dead turtles (Witherington and Ehrhart 1989; Gordon et al. 1993; Jacobson et al. 2006). In these events, debilitated or moribund animals came ashore and were detected alive or in the early postmortem interval by stranding responders and members of the public. Discovery of predominantly dead and decomposed animals suggests that beach stranding followed a period of submergence and buoyancy resulting from gases produced by putrefaction. One sea turtle found dead and moderately decomposed during peak strandings in 2011 had a functioning satellite tag that supports this scenario. Telemetry data were consistent with normal behavior preceding five days of continuous submergence, followed by four days drifting on the surface (data provided by the Institute for Marine Mammal Studies and analyzed by Robert Hardy (FWC)). This turtle was subsequently found to be in good nutritional condition with evidence of recent feeding and no visible injuries or other anomalies.

Biotoxins produced by harmful algae were not detected in postmortem samples at concentrations expected to cause acute mortality of megavertebrates. The observed values were interpreted as consistent with background exposure and were similar to those detected in free-ranging, apparently healthy bottlenose dolphins (Twiner et al. 2011). In comparison, samples from Kemp's ridleys that were found dead during a red tide event in southwest Florida in late 2011 and early 2012 yielded concentrations of brevetoxin an order of magnitude greater than detected in samples analyzed from the Alabama, Louisiana, and Mississippi (FWC, unpub. data). The domoic acid concentrations found in the muscle of dead fish recovered with a Kemp's ridley in 2013 were well below the seafood safety limit required by the Food and Drug Administration.

Clostridium botulism was pursued as another possible contributing cause of strandings given that many sea turtles were feeding on fish, presumably dead fish, and botulism can develop acutely. Type E botulism is associated with marine sediments and has caused die-offs of fish-eating birds (for example Brand et al. 1988). A disease resembling botulism has also been observed in captive green turtles (Haines 1978). Testing cannot be performed on decomposed carcasses, which limited the availability of appropriate cases for analysis. Although only one turtle could be analyzed, necropsy findings were representative of the majority of strandings without an apparent cause of death. Results of the analyses were negative. Broad screening of samples from two additional Kemp's ridleys by GC-MS also was did not yield any indication of exposure to known organic toxins. Potential effects from the DWH oil spill as related to sea turtle strandings are considered in the last section of this discussion.

There was a relatively high prevalence of ingested fish in stranded turtles found in Alabama, Louisiana, and Mississippi, especially in Kemp's ridleys. The significantly greater proportion of turtles without injuries or evidence of disease that had ingested fish suggests that consumption of fish is related to cause of mortality. The results of biotoxin analyses and other testing do not indicate any apparent direct effect from consuming fish[6]; therefore, risk of death may result from circumstances that afford access to fish. A variety of fish taxa were found, including Ariidae (marine catfish species), Trichiuridae (cutlass fish), Clupeidae (menhaden), Bothidae (flounder), Carangidae (jack), Sciaenidae (weakfish, croaker), Sparidae (sheepshead), and Synodontidae (lizardfish). Sea turtles do not typically prey on live fish as a significant part of their diet. Detection of fish within the GI tract generally is attributed to foraging on dead or injured bycatch (Shoop and Ruckdeschel 1982; Shaver 1991; Youngkin 2001), or potentially marine life that has died of other causes, such as fish kills unrelated to fisheries. An exhaustive review of fish kill information was beyond the scope of this investigation; however, review of reports provided by state agencies did not indicate any association between periods of peak stranding activity and marine fish kills, which generally are more common in the winter and late summer. Although scavenging upon fish from various sources and opportunistic capture of live fish is possible, foraging on discarded bycatch seems to be the most probable explanation for high prevalence of fish ingestion on such a large scale. In comparison, 95 Kemp's ridleys that stranded on the Gulf coast of Florida in 2009 through 2012 were necropsied and fish was only found in two of these animals (2.1%). Florida has many of the same potential sources of dead fish as other areas of the Gulf of Mexico, including recreational fishing, fish cleaning stations, and fish kills; however, net regulations in place since the 1990's may have reduced some sources of commercial bycatch discard in state waters.

Ingestion of penaeid shrimp was found in fewer turtles, but was associated with several notable observations. Like fish, penaeid shrimp are not considered a significant part of the Kemp's ridley diet and turtles are not expected to be able to catch numbers of free-swimming shrimp. Shrimp tended to be found only in the mouth, esophagus, or stomach, suggesting that few of these turtles survive for long

---

[6] Most sea turtles strandings have occurred within areas open to harvest of seafood for human consumption.

after feeding upon shrimp. Shrimp exoskeletons were rarely found in the intestine. In contrast, many turtles had fed upon fish multiple times as evidenced by fish bones throughout the GI tract. In addition, shrimp were found in more small turtles <25 cm SCL and only in strandings during May or later. These findings suggest that circumstances of death of some turtles that ingest shrimp may be somewhat unique, although other findings (e.g. nutritional condition, necropsy observations) are the same as in those turtles that have been eating fish. One possible explanation for shrimp ingestion is that these turtles are able to feed on entrapped shrimp within nets, such as those without TEDs or TEDs that allow passage of smaller turtles into the cod end. There have been two recorded observations of turtles caught with shrimp in TED-less research trawls that had shrimp within their mouths upon boarding (Stacy, unpub data; M. Dodd (GADNR), pers comm.). A specific type of gear or other aspect of interaction could explain the timing of strandings with shrimp ingestion and some differences in observations over the years, especially the higher proportion of turtles containing shrimp among Mississippi strandings in 2010.

The absence of apparent debilitating conditions, injuries, or exposure to biotoxins suggests that many of the strandings resulted from drowning of otherwise healthy sea turtles, as occurs when animals are forcibly prevented from reaching the surface for air (forced submergence/underwater entrapment). Incidental capture in fishing gear (nets) is the only known plausible cause of forced submergence of large numbers of sea turtles and, as in previous reports, remains strongly suspected based on systematic exclusion of other causes of mortality, evidence of drowning in some animals, and a high rate of ingestion of food items commonly associated with fisheries. In addition, three Kemp's ridleys were found with antemortem knife wounds and other findings indistinguishable from suspected drowning cases (good nutritional condition, no other injuries, ingested fish), clearly indicating that they were in human hands prior to death. Notably, many of the same findings described in this report have been documented in other regions, including Texas, where bycatch in commercial fisheries is considered a significant contributing cause of strandings (Shaver 1995, Shoop and Ruckdeschel 1982, Youngkin 2001). The presentation of many of the strandings within the NGOMX is the same as examples of suspected fisheries-related strandings in other regions and findings in dead turtles known to have been killed by fisheries (Guinea and Chatto 1992, Shaver 1995, Shoop and Ruckdeschel 1982, Guinea and Whiting 1997, Youngkin 2001, Peckam et al. 2008). Nonetheless, definitive attribution of specific proximate cause of death is not possible based on necropsy alone due to inherent lack of direct physical evidence and the importance of correlative field information in these situations.

Modelling of drift and strandings in 2011 suggested that a majority of dead turtles found in Mississippi may have originated from eastern Louisiana (Nero et al. 2013). Regional aerial and vessel-based surveys of fishing vessels in Mississippi and Louisiana waters were initiated in multiple years in response to the numbers of sea turtle strandings. Most of these surveys have been conducted during daylight hours. State, federal, and industry sources consistently report lower fishing effort during periods of high strandings. The source(s) of dead fish, which appear to be plentiful based on the necropsy findings, remains a mystery during these times when low fishing effort is reported and no large fish kills are documented. Small numbers of vessels potentially can interact with many animals in areas where turtles are abundant (Peckham et al. 2008, Mancini et al. 2012); however, activity(ies) to explain the strandings has not been demonstrated by the actions undertaken thus far. Fishing effort, especially comprehensive regional characterization, is only one element that requires further investment if seasonal sea turtle strandings in this area are to be better understood. Multiple factors must be considered, including seasonal abundance and movements of sea turtles, possible effects of habituation to feeding on discarded bycatch, and compliance with fishing regulations. Further exploration of the origin(s) of stranded turtles is needed, including prioritization of studies necessary for improvement of drift modeling, real-time investigation of areas from which dead turtles are suspected to originate, as well as possible in-water turtle research studies within those areas. Necropsy of stranded sea turtles yields useful information; however, new insights into sea turtle mortality in the NGOMX require dedication of additional resources and proactive efforts on the water.

Other causes of mortality contributed to strandings

Other mortality factors were identified over the period of the study and provide useful information for future monitoring efforts. As in other areas of the US, traumatic injuries caused by vessels strikes are a significant contributing cause of sea turtle strandings. Other well-known causes of mortality were also represented, including capture by hook and line and entanglements in fish gear and marine debris. It should be noted that the necropsy results have been conservatively presented due to the limitations in examining decomposed carcasses. For example, a number of turtles had been bitten by sharks, including those that had been feeding on fish, and were grouped with turtles that had other types of traumatic injuries. However, necropsy findings and absence of supravital responses within the wound margins of a subset of cases suggests that many were scavenged carcasses that died from causes other than shark attack. Similarly, any turtles with diminished nutritional condition were considered to possibly have some underlying disease state. Nutritional condition varies across individuals of a population, is influenced multiple factors, and is not necessarily related to immediate cause of death.

Considerations related to the DWH oil spill

Health effects from the DWH oil spill on sea turtles are another significant concern given the large numbers of oiled sea turtles documented during the spill, primarily within offshore convergences, and oiling of large areas of the NGOMX coastline. Samples of organs and GI contents from non-visibly oiled stranded sea turtles found in 2010 and 2011 were analyzed for polycyclic aromatic hydrocarbons (PAHs) and dioctyl sodium sulfosuccinate (DOSS , dispersant-related compound) in a study conducted under the Natural Resources Damage Assessment for the DWH spill (Ylitalo et al. 2014). The analytical results from non-visibly oiled stranded turtles were consistent with low level exposure to PAHs from a combination of biogenic, pyrogenic, and petrogenic sources, and were different from the high concentrations of PAHs detected in visibly oiled sea turtles. The detected concentrations in unoiled turtles may reflect background exposure to various PAHs in the NGOMX; however, historical data are not available for comparison. Levels of DOSS were below the limit of quantitation in all samples from non-visibly oiled stranded turtles. Given the rapid metabolism of PAHs, the results do not exclude the possibility of some level of prior exposure among stranded turtles. The vast footprint of the spill covered areas that undoubtedly are inhabited by the same species and size classes represented in the strandings and some long-term impacts from the spill could take decades to detect or could be difficult or impossible to ever conclusively demonstrate. However, with regard to the presentation of mortality that has characterized most of the sea turtle strandings, there is no known mechanistic link to explain how a sea turtle would die relatively acutely from exposure to MC252 crude oil without becoming physically oiled or would die in an acute manner years following the spill. Moreover, non-visibly oiled sea turtles in good nutritional condition, without any injuries, and food within the GI tract were encountered in April and May 2010 in areas before oil from the DWH spill reached near-shore waters or beaches. In addition, as previously mentioned, similar observations have been documented in stranded turtles in neighboring Texas for many years prior to 2010.

One of the approaches to identify potential injury to sea turtles resulting from the DWH spill was to monitor for changes in necropsy findings in the event that chronic conditions or other insidious effects began to manifest in stranded sea turtles during the subsequent years. The poor postmortem condition of most of the strandings is a limiting factor in terms of detection of any subtle abnormalities. The only apparent change during the years of this study has been a decline in nutritional condition. The result has not been an increase in dying emaciated turtles; rather it is a trend across various causes of mortality, consistent with a general reduction in nutritional status of the population. There are many possible explanations related to habitat/environment, prey, sea turtle density, foraging behavior, and other factors; however, this observation in years following a historic spill event warrants careful consideration, including relevance to the broader context of potential ecological effects, and investment in long-term monitoring of sea turtles within the region.

CONCLUSION

This report represents five years of intensive necropsy-based investigation of sea turtle strandings in the NGOMX. The paucity of such information for the region prior to 2010 has created considerable difficulty as the scientific community and resource managers work to understand the impacts of an unprecedented oil spill and disentangle potential effects from the complicated milieu of other anthropogenic sources of mortality and natural factors that contribute to sea turtle strandings. It is intended that the information provided herein will serve as a resource for ongoing efforts and necessary follow-up studies. The continuation of these efforts is necessary to not only shed light on observations of the last several years, but to also ensure the future benefits of critical insight afforded by consistent, long-term monitoring.

LITERATURE CITED

Brand CJ et al. 1988. An outbreak of type E botulism among common loons (*Gavia immer*) in Michigan's upper peninsula. Journal of Wildlife Diseases. 24, 471-476.

Deeds JR et al. 2010. First U.S. report of shellfish harvesting closures due to confirmed okadaic acid in Texas Gulf coast oysters. Toxicon. 55, 1138-1146.

Doucett GJ et al. 1997. Development and preliminary validation of a microtiter plate-based receptor binding assay for paralytic shellfish poisoning toxins. Toxicon 35, 625-636.

Epperly SP et al. 1996. Beach strandings as an indicator of at-sea mortality of sea turtles. Bulletin of Marine Science. 59, 289-297.

Fauquier D et al. 2013. Brevetoxin in blood, biological fluids, and tissues of sea turtles naturally exposed to *Karenia brevis* blooms in central west Florida. Journal of Zoo and Wildlife Medicine, 44, 364-375.

Ylitalo G et al. 2014. Sea turtle exposure to MC252 oil and dispersants in the Northern Gulf of Mexico during and following the Deepwater Horizon Spill. NRDA draft report.

Gordon AN et al. 1993. Epizootic mortality of free-living green turtles, *Chelonia mydas*, due to coccidiosis. Journal of Wildlife Diseases. 29, 490-494.

Guinea ML and Chatto R. 1992. Sea turtles killed in Australian shark fin fishery. Marine Turtle Newsletter. 57, 5-6.

Guinea ML and Whiting S. 1997. Sea turtle deaths coincide with trawling activities in northern Australia. Marine Turtle Newsletter. 77, 11–14.

Haines H. 1978. A herpesvirus disease of green sea turtles in aquaculture. Marine Fisheries Research. 40, 33-37.

Hart KM et al. 2006. Interpreting the spatio-temporal patterns of sea turtle strandings: going with the flow. Biological Conservation. 129, 283-290.

Jacobson ER et al. 2006. Neurological disease in wild loggerhead sea turtles *Caretta caretta*. Diseases of Aquatic Organisms. 170, 139-154.

Lawrence JF et al. 2005. Quantitative determination of paralytic shellfish poisoning toxins in shellfish using prechromatographic oxidation and liquid chromatography with fluorescence detection: collaborative study. Journal of AOAC International. 88, 1714-1732.

Mancini A et al. 2012. Small-scale gill-net fisheries cause massive green turtle *Chelonia mydas* mortality in Baja California Sur, Mexico. Oryx. 46, 69-77.

Maucher JM et al. 2007. Optimization of blood collection card method/enzyme-linked immunoassay for monitoring exposure of bottlenose dolphin to brevetoxin-producing red tides. Environmental Science and Technology. 41, 563-567.

Naar J et al. 2002. A competitive ELISA to detect brevetoxins from *Karenia brevis* (formerly *Gymnodinium breve*) in seawater, shellfish, and mammalian body fluid. Environmental Health Perspectives. 110, 179-185.

Nero RW et al. 2013. Using an ocean model to predict likely drift tracks of sea turtle carcasses in the north central Gulf of Mexico. Endangered Species Research. 21, 191-203.

Peckham SH et al. 2008. High mortality of loggerhead turtles due to bycatch, human consumption and strandings at Baja California Sur, Mexico, 2003 to 2007. Endangered Species Research. 5, 171-183.

Schwacke LH et al. 2014. Health of common bottlenose dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana, following the deepwater horizon oil spill. Envirobmental Science and Technology. 48, 93-103.

Shaver DJ. 1991. Ecology of wild and head-started Kemp's ridley sea turtles in South Texas waters. Journal of Herpetology. 25, 327-334.

Shaver DJ. 1995. Sea turtle strandings along the Texas coast again cause concern. Marine Turtle Newsletter. 70, 2-4.

Shoop CR and Ruckdeschel C. 1982. Increasing turtle strandings in the Southeast United States: a complicating factor. Biological Conservation. 23, 213-215.

Stacy BA 2012. Summary of findings for sea turtles documented by directed captures, stranding response, and incidental captures under response operations during the BP Deepwater Horizon (Mississippi Canyon 252) oil spill. NOAA, NMFS, Office of Protected Resources. DWH NRDA technical report.

Stacy BA et al. 2015. Histologic changes in traumatized skeletal muscle exposed to seawater: a canine cadaver study. Veterinary Pathology. 52, 170-5.

Teas WG. 1993. Species composition and size class distribution of marine turtle strandings on the Gulf of Mexico and Southeast United States coasts, 1985 – 1991. NOAA Technical Memorandum, NMFS-SEFSC-315.

Twiner MJ et al. 2011. Concurrent exposure of bottlenose dolphins (*Tursiops truncatus*) to multiple algal toxins in Sarasota Bay, Florida, USA. PLoS One. 6, e17394.

Van Dolah FM et al. 2012. Determination of Paralytic Shellfish Toxins in Shellfish by Receptor Binding Assay: Collaborative Study. Journal of AOAC International. 95, 795-812.

Volker KH et al. 2013. Estimating at-sea mortality of marine turtles from stranding frequencies and drifter experiments. Plos One, 8: e56776.

Wang Z et al. 2012. Optimization of solid-phase extraction and liquid chromatography-tandem mass spectrometry for the determination of domoic acid in seawater, phytoplankton, and mammalian fluids and tissues. Analytica Chimica Acta. 715, 71-79.

Witherington BE and Ehrhart LM. 1989. Hypothermic stunning and mortality of marine turtles in the Indian River Lagoon System, Florida. Copeia. 3, 696-703.

Wyenken J. 2001. The Anatomy of Sea Turtles. U.S. Department of Commerce NOAA Technical Memorandum NMFS-SEFSC-470, 1-172 pp.

Youngkin DA. 2001. A long-term analysis of loggerhead sea turtles (*Caretta caretta*) based on strandings from Cumberland Island, Georgia. Thesis, Florida Atlantic University.

APPENDIX A. NECROPSY FINDINGS FOR NON-VISIBLY OILED SEA TURTLES DOCUMENTED BY STRANDING RESPONSE IN ALABAMA, LOUISIANA, AND MISSISSIPPI FROM 2010 THROUGH 2014 BY STATE

Appendix A1. Postmortem condition of necropsied non-visibly oiled sea turtles (by state) that were documented by stranding response in Alabama, Louisiana, and Mississippi from 2010 through 2014.

	Fresh dead	Moderate decomposition	Severe decomposition	Desiccated remains	Skeletal remains	Total
Alabama						
2010	4 (3.7%)	32 (29.4%)	68 (62.4%)	3 (2.8%)	2 (1.8%)	109
2011	1 (3.8%)	17 (65.4%)	8 (30.8%)	0 (0%)	0 (0%)	26
2012	4 (17.4%)	12 (52.2%)	7 (30.4%)	0 (0%)	0 (0%)	23
2013	0 (-)	7 (-)	1 (-)	0 (-)	0 (-)	8
2014	3 (18.8%)	12 (75.0%)	1 (6.3%)	0 (0%)	0 (0%)	16
Total	12 (6.6%)	80 (44.0%)	85 (46.7%)	3 (1.6%)	2 (1.1%)	182
Louisiana						
2010	6 (6.3%)	27 (28.4%)	51 (53.7%)	7 (7.4%)	4 (4.2%)	95
2011	0 (-)	51 (36.4%)	71 (50.7%)	8 (5.7%)	10 (7.1%)	140
2012	2 (1.4%)	36 (24.8%)	91 (62.8%)	12 (8.3%)	4 (2.8%)	145
2013	3 (1.4%)	56 (25.7%)	148 (67.9%)	8 (3.7%)	3 (1.4%)	218
2014	3 (6.1%)	13 (26.5%)	31 (63.3%)	1 (2.0%)	1 (2.0%)	49
Total	14 (2.2%)	183 (28.3%)	392 (60.6%)	36 (5.6%)	22 (3.4%)	647
Mississippi						
2010	3 (1.0%)	56 (19.0%)	221 (75.2%)	8 (2.7%)	6 (2.0%)	294
2011	7 (13.7%)	33 (64.7%)	11 (21.6%)	0 (0%)	0 (0%)	51
2012	6 (8.3%)	29 (40.3%)	37 (51.4%)	0 (0%)	0 (0%)	72
2013	3 (3.9%)	29 (38.2%)	44 (57.9%)	0 (0%)	0 (0%)	76
2014	3 (9.1%)	18 (54.5%)	12 (36.4%)	0 (0%)	0 (0%)	33
Total	22 (4.2%)	165 (31.4%)	325 (61.8%)	8 (1.5%)	6 (1.1%)	526

Appendix A2. Extent of postmortem examination (necropsy) of non-visibly oiled sea turtles (by state) that were documented by stranding response in Alabama, Louisiana, and Mississippi from 2010 through 2014. A full necropsy was conducted when condition of the carcass allowed for complete examination of the major organ systems. A partial necropsy was conducted when parts of the carcass were missing or decomposed beyond recognition. A limited examination was conducted when the carcass was desiccated or skeletonized. Most of the sea turtles that were not examined were severely decomposed, skeletonized, desiccated, or incomplete, and were not collected by stranding responders.

	Full examination	Partial examination	Limited examination	Total examined
Alabama				
2010	68 (62.4%)	34 (31.2%)	7 (6.4%)	109
2011	17 (65.4%)	6 (23.1%)	3 (11.5%)	26
2012	16 (69.6%)	7 (30.4%)	0 (0%)	23
2013	7 (-)	1 (-)	0 (-)	8
2014	14 (87.5%)	1 (6.3%)	1 (6.3%)	16
Total	122 (67.0%)	49 (26.9%)	11 (6.0%)	182
Louisiana				
2010	47 (49.5%)	34 (35.8%)	14 (14.7%)	95
2011	37 (26.4%)	69 (49.3%)	34 (24.3%)	140
2012	48 (33.1%)	62 (42.8%)	35 (24.1%)	145
2013	61 (28.0%)	114 (52.3%)	43 (19.7%)	218
2014	17 (34.7%)	25 (51.0%)	7 (14.3%)	49
Total	210 (32.5%)	304 (47.0%)	133 (20.6%)	647
Mississippi				
2010	182 (61.9%)	84 (28.6%)	28 (9.5%)	294
2011	39 (76.5%)	12 (23.5%)	0 (0%)	51
2012	44 (61.1%)	28 (38.9%)	0 (0%)	72
2013	45 (59.2%)	29 (38.2%)	2 (2.6%)	76
2014	24 (72.7%)	9 (27.3%)	0 (0%)	33
Total	334 (63.4%)	162 (30.8%)	30 (5.7%)	526

Appendix A3. Nutritional condition of non-visibly oiled sea turtles that were documented by stranding response in Alabama, Louisiana, and Mississippi from 2010 through 2014. Determinations were based on muscle mass and abundance of adipose tissue. For the purposes of this report and assessment of necropsy findings, good and fair conditions are considered within normal limits for free-ranging sea turtles.

	Good	Fair	Thin	Emaciated	Undetermined	Total
Alabama						
2010	81 (74.3%)	11 (10.1%)	4 (3.7%)	1 (0.9%)	12 (11.0%)	109
2011	15 (57.7%)	8 (30.8%)	1 (3.8%)	0 (0%)	2 (7.7%)	26
2012	11 (47.8%)	8 (34.8%)	3 (13.0%)	0 (0%)	1 (4.3%)	23
2013	2 (-)	5 (-)	1 (-)	0 (-)	0 (-)	8
2014	4(25.0%)	7 (43.8%)	4 (25.0%)	0 (0%)	1 (6.3%)	16
Total	113 (62.1%)	39 (21.4%)	13 (7.1%)	1 (0.5%)	15 (8.2%)	182
Louisiana						
2010	60 (63.2%)	11 (11.6%)	2 (2.1%)	0 (0%)	22 (23.2%)	95
2011	82 (58.6%)	19 (13.6)	1 (0.7%)	0 (0%)	38 (27.1%)	140
2012	79 (54.5%)	26 (17.9%)	3 (2.1%)	0 (0%)	37 (25.5)	145
2013	70 (32.1%)	66 (30.3%)	14 (6.4%)	0 (0%)	68 (31.2%)	218
2014	23 (46.9%)	18 (36.7%)	0 (0%)	0 (0%)	8 (16.3%)	49
Total	314 (48.5%)	140 (21.6%)	20 (3.1%)	0 (0%)	173 (26.7%)	647
Mississippi						
2010	205 (69.7%)	18 (6.1%)	7 (2.4%)	1 (0.3%)	63 (21.4%)	294
2011	36 (70.6%)	12 (23.5%)	2 (3.9%)	0 (0%)	1 (2.0%)	51
2012	37 (51.4%)	29 (40.3%)	3 (4.2%)	1 (1.4%)	2 (2.8%)	72
2013	15 (19.7%)	44 (57.9%)	11 (14.5%)	0 (0%)	6 (7.9%)	76
2014	6 (18.2%)	24 (72.7%)	1 (3.0%)	1 (3.0%)	1 (3.0%)	33
Total	299 (56.8%)	127 (24.1%)	24 (4.6%)	3 (0.6%)	73 (13.9%)	526

Appendix A4. Necropsy findings in Kemp's ridley sea turtles documented by stranding response in Alabama, Louisiana, and Mississippi from 2010 through 2014. Sea turtles are grouped by proximate cause of death (COD), if determined, and comparable major necropsy findings if COD could not be determined. Cases were uncategorized due to inability to assess nutritional condition or detect traumatic injury as a result of decomposition. Turtles that were suspected to be visibly oiled based on field observations are not included.

	Year	Fair or good nutritional condition; no major injuries	Major injuries	Depleted adipose stores and/or evidence of disease	Other	Uncategorized	Total necropsied	Estimated total stranded
Alabama								
	2010	38 (39.2%)	51 (52.6%)	2 (2.1%)	0 (0%)	6 (6.2%)	97	138
	2011	15 (62.5%)	5 (20.8%)	1 (4.2%)	0 (0%)	3 (12.5%)	24	69
	2012	9 (52.9%)	6 (35.3%)	1 (5.9%)	0 (0%)	1 (5.9%)	17	53
	2013	5 (-)	1 (-)	1 (-)	0 (-)	0 (-)	7	34
	2014	7 (50.0%)	4 (28.6%)	2 (14.3%)	0 (0%)	1 (7.1%)	14	28
	Total	74 (46.5%)	68 (42.8%)	7 (4.4%)	0 (0%)	10 (6.3%)	159	322
	2011-14	36 (58.1%)	17 (27.4%)	5 (8.1%)	0 (0%)	4 (6.5%)	62	184
Louisiana								
	2010	36 (47.4%)	24 (31.6%)	2 (2.6%)	0 (0%)	14 (18.4%)	76	133
	2011	60 (49.2%)	33 (27.0%)	2 (1.6%)	0 (0%)	27 (22.1%)	122	122
	2012	65 (49.6%)	35 (26.7%)	4 (3.1%)	0 (0%)	27 (20.6%)	131	138
	2013	95 (49.5%)	33 (16.9%)	8 (4.2%)	0 (0%)	56 (29.2%)	192	207
	2014	17 (48.6%)	15 (42.9%)	1 (2.9%)	0 (0%)	2 (5.7%)	35	51
	Total	273 (49.1%)	118 (21.2%)	15 (2.7%)	0 (0%)	122 (21.9%)	556	651
	2011-14	237 (49.3%)	94 (19.6%)	13 (2.7%)	0 (0%)	108 (22.5%)	480	518
Mississippi								
	2010	158 (56.8%)	73 (26.3%)	6 (2.2%)	1 (0.4%)	40 (14.4%)	278	298
	2011	36 (73.5%)	11 (22.4%)	2 (4.1%)	0 (0%)	0 (0%)	49	267
	2012	51 (71.8%)	12 (16.9%)	6 (8.5%)	0 (0%)	2 (2.8%)	71	152
	2013	51 (68.0%)	8 (10.7%)	12 (16.0%)	0 (0%)	4 (5.3%)	75	192
	2014	20 (64.5%)	7 (22.6%)	4 (12.9%)	0 (0%)	0 (0%)	31	136
	Total	316 (62.7%)	111 (22.0%)	30 (6.0%)	1 (0.2%)	46 (9.1%)	504	1,045
	2011-14	158 (69.9%)	38 (16.8%)	24 (10.6%)	0 (0%)	6 (2.7%)	226	747

Appendix A5. Necropsy findings in loggerhead sea turtles documented by stranding response in Alabama, Louisiana, and Mississippi from 2010 through 2014. Sea turtles are grouped by proximate cause of death (COD), if determined, and comparable major necropsy findings if COD could not be determined. Cases were uncategorized due to inability to assess nutritional condition or detect traumatic injury as a result of decomposition. Turtles that were suspected to be visibly oiled based on field observations are not included.

	Year	Fair or good nutritional condition; no major injuries	Major injuries	Depleted adipose stores and/or evidence of disease	Other	Uncategorized	Total necropsied	Estimated total stranded
Alabama								
	2010	2	3	1	0	2	8	15
	2011	1	0	1	0	0	2	11
	2012	0	2	0	2	0	4	7
	2013	0	0	0	0	0	0	7
	2014	0	1	0	0	0	1	3
	Total	3 (20.0%)	6 (40.0%)	2 (13.3%)	2 (13.3%)	2 (13.3%)	15	43
	2011-14	1	3	1	2	0	7	28
Louisiana								
	2010	2	1	0	0	3	6	9
	2011	3	4	0	0	4	11	13
	2012	3	0	0	0	0	3	3
	2013	2	3	5	0	0	10	15
	2014	2	1	1	0	1	5	8
	Total	12 (34.3%)	9 (25.7%)	6 (17.1%)	0 (0%)	8 (22.9%)	35	48
	2011-14	10 (34.5%)	8 (27.6%)	6 (20.7%)	0 (0%)	5 (17.2%)	29	39
Mississippi								
	2010	1	7	0	0	3	11	12
	2011	0	1	0	0	0	1	3
	2012	0	1	0	0	0	1	3
	2013	0	0	1	0	0	1	11
	2014	0	0	1	0	0	1	11
	Total	1 (6.7%)	9 (60.0%)	2 (13.3%)	0 (0%	3 (20.0%)	15	40
	2011-14	0	2	2	0	0	4	28

Appendix A6. Necropsy findings in green sea turtles documented by stranding response in Alabama, Louisiana, and Mississippi from 2010 through 2014. Sea turtles are grouped by proximate cause of death (COD), if determined, and comparable major necropsy findings if COD could not be determined. Cases were uncategorized due to inability to assess nutritional condition or detect traumatic injury as a result of decomposition. Turtles that were suspected to be visibly oiled based on field observations are not included.

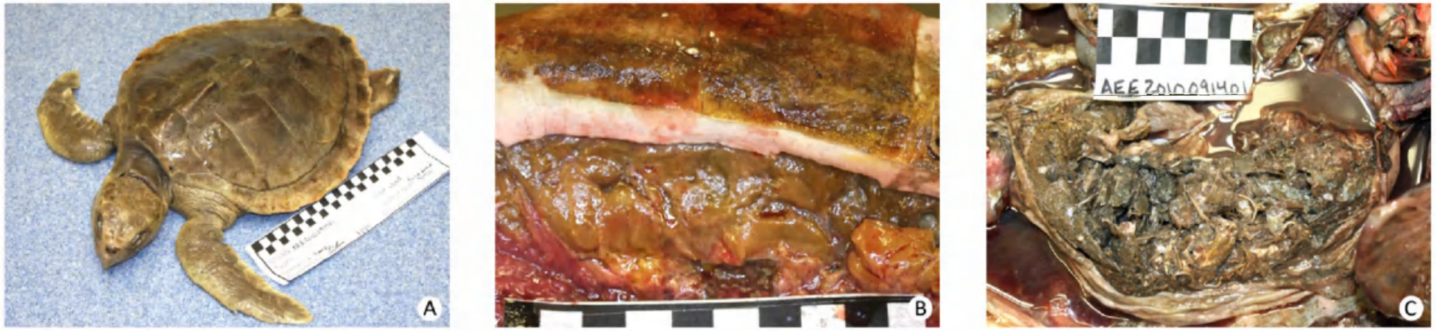
	Year	Fair or good nutritional condition; no major injuries	Major injuries	Depleted adipose stores and/or evidence of disease	Other	Uncategorized	Total necropsied	Estimated total stranded
Alabama								
	2010	0 (-)	3 (-)	1 (-)	0 (-)	0 (-)	4	9
	2011	0 (-)	2 (-)	0 (-)	0 (-)	0 (-)	2	7
	2012	0 (-)	1 (-)	0 (-)	0 (-)	0 (-)	1	3
	2013	0 (-)	0 (-)	0 (-)	0 (-)	0 (-)	0	3
	2014	0 (-)	0 (-)	0 (-)	0 (-)	0 (-)	0	3
	Total	0 (-)	6 (-)	1 (-)	0 (-)	0 (-)	7	25
	2011-14	0 (-)	3 (-)	0 (-)	0 (-)	0 (-)	3	16
Louisiana								
	2010	1 (7.7%)	12 (92.3%)	0 (0%)	0 (0%)	0 (0%)	13	14
	2011	2 (-)	3 (-)	0 (-)	0 (-)	1 (-)	6	8
	2012	2 (18.2%)	2 (18.2%)	1 (9.1%)	0 (0%)	6 (54.5%)	11	12
	2013	2 (13.3%)	7 (46.7%)	2 (13.3%)	0 (0%)	4 (26.7%)	15	17
	2014	0 (-)	5 (-)	1 (-)	0 (-)	1 (-)	7	11
	Total	7 (13.5%)	29 (55.8%)	4 (7.7%)	0 (0%)	12 (23.1%)	52	62
	2011-14	6 (15.4%)	17 (43.6%)	4 (10.3%)	0 (0%)	12 (30.8%)	39	48
Mississippi								
	2010	0 (-)	5 (-)	0 (-)	0 (-)	0 (-)	5	5
	2011	0 (-)	1 (-)	0 (-)	0 (-)	0 (-)	1	7
	2012	0 (-)	0 (-)	0 (-)	0 (-)	0 (-)	0	2
	2013	0 (-)	0 (-)	0 (-)	0 (-)	0 (-)	0	2
	2014	0 (-)	0 (-)	0 (-)	1 (-)	0 (-)	1	4
	Total	0 (-)	6 (-)	0 (-)	1 (-)	0 (-)	7	20
	2011-14	0 (-)	1 (-)	0 (-)	0 (-)	0 (-)	2	15

Appendix A7. Categories of traumatic injuries (antemortem and undetermined) in necropsied sea turtles that were documented by stranding response in Alabama, Louisiana, and Mississippi during 2010 through 2014.

	Year	Blunt trauma	Linear blunt trauma	Chop wound(s)	Shark/predator bites	Entanglement, hooking, line ingestion	Combination of injury types	Other	Total
Alabama									
	2010	29 (50.9%)	1 (1.8%)	4 (7.0%)	7 (12.3%)	3 (5.3%)	9 (15.8%)	4 (7.0%)	57
	2011	2 (-)	0 (-%)	0 (-)	3 (-)	0 (-)	0 (-)	0 (-)	5
	2012	2 (20.0%)	0 (-)	4 (40.0%)	3 (30.0%)	1 (10.0%)	0 (-)	0 (-)	10
	2013	0 (-)	0 (-)	2 (-)	0 (-)	0 (-)	0 (-)	0 (-)	2
	2014	2 (-)	0 (-)	1 (-)	0 (-)	1 (-)	0 (-)	0 (-)	4
	Total	35 (44.9%)	1 (1.3%)	11 (14.1%)	13 (16.7%)	5 (6.4%)	9 (11.5%)	4 (5.1%)	78
Louisiana									
	2010	18 (48.6%)	3 (8.1%)	5 (13.5%)	7 (18.9%)	0 (0%)	3 (8.1%)	1 (2.7%)	37
	2011	23 (57.5%)	1 (2.5%)	3 (7.5%)	9 (22.5%)	0 (0%)	3 (7.5%)	1 (2.5%)	40
	2012	17 (45.9%)	3 (6.1%)	2 (5.4%)	7 (18.9%)	4 (10.8%)	3 (8.1%)	1 (2.7%)	37
	2013	23 (52.3%)	4 (9.1%)	1 (2.3%)	10 (22.7%)	0 (0%)	5 (11.4%)	1 (2.3%)	44
	2014	13 (61.9%)	2 (9.5%)	1 (4.8%)	3 (14.3%)	1 (4.8%)	1 (4.8%)	0 (0%)	21
	Total	94 (52.5%)	13 (7.3%)	12 (6.7%)	36 (20.1%)	5 (2.8%)	15 (8.4%)	4 (2.2%)	179
Mississippi									
	2010	46 (54.1%)	6 (7.1%)	12 (14.1%)	9 (10.6%)	4 (4.7%)	8 (9.4%)	0 (0%)	85
	2011	9 (69.2%)	0 (0%)	1 (7.7%)	1 (7.7%)	1 (7.7%)	1 (7.7%)	0 (0%)	13
	2012	8 (61.5%)	2 (15.4%)	0 (0%)	2 (15.4%)	1 (7.7%)	0 (0%)	0 (0%)	13
	2013	1 (-)	0 (-)	2 (-)	1 (-)	4 (-)	0 (-)	0 (-)	8
	2014	2 (-)	0 (-)	1 (-)	0 (-)	2 (-)	1 (-)	1 (-)	7
	Total	66 (53.2%)	8 (6.3%)	16 (12.7%)	13 (10.3%)	12 (9.5%)	10 (7.9%)	1 (0.8%)	126
Grand total		195 (50.9%)	22 (5.7%)	39 (10.2%)	62 (16.2%)	22 (5.7%)	34 (8.9%)	9 (2.3%)	383

APPENDIX B. EXAMPLE PHOTOGRAPHS OF NON-VISIBLY OILED SEA TURTLES DOCUMENTED BY STRANDING RESPONSE IN ALABAMA, LOUISIANA, AND MISSISSIPPI FROM 2010 THROUGH 2014 BY STATE

Appendix B1. Examples of Kemp's ridley sea turtles representative of many of those documented by stranding response in Alabama, Mississippi, and Louisiana in 2010, 2011, 2012, 2013, and 2014. These cases exhibit findings observed in a majority of strandings, including decomposition, absence of traumatic injuries (A), nutritional condition within normal limits (as demonstrated by fat stores) (B), and ingested fish within the stomach (C). Cases with similar findings found in Texas in 2013 are shown for comparison.



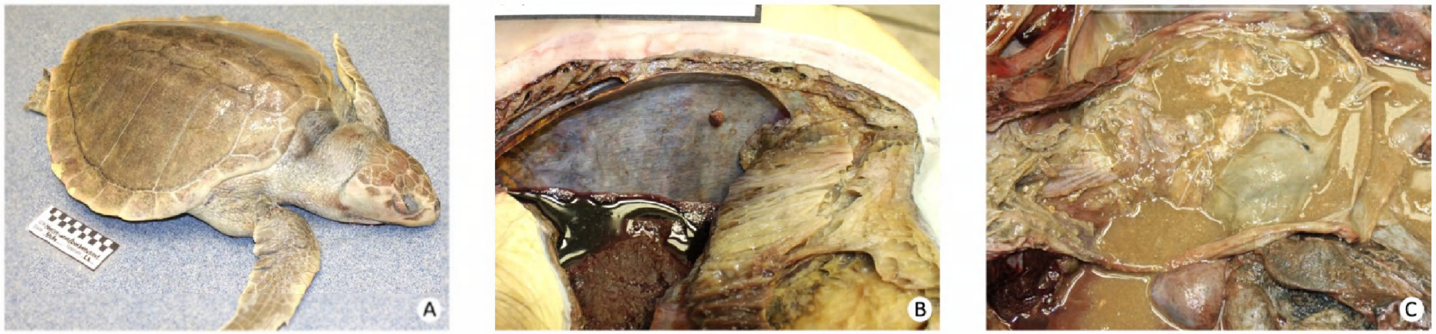
2010

2011

2012

2013

2014



Texas 2013

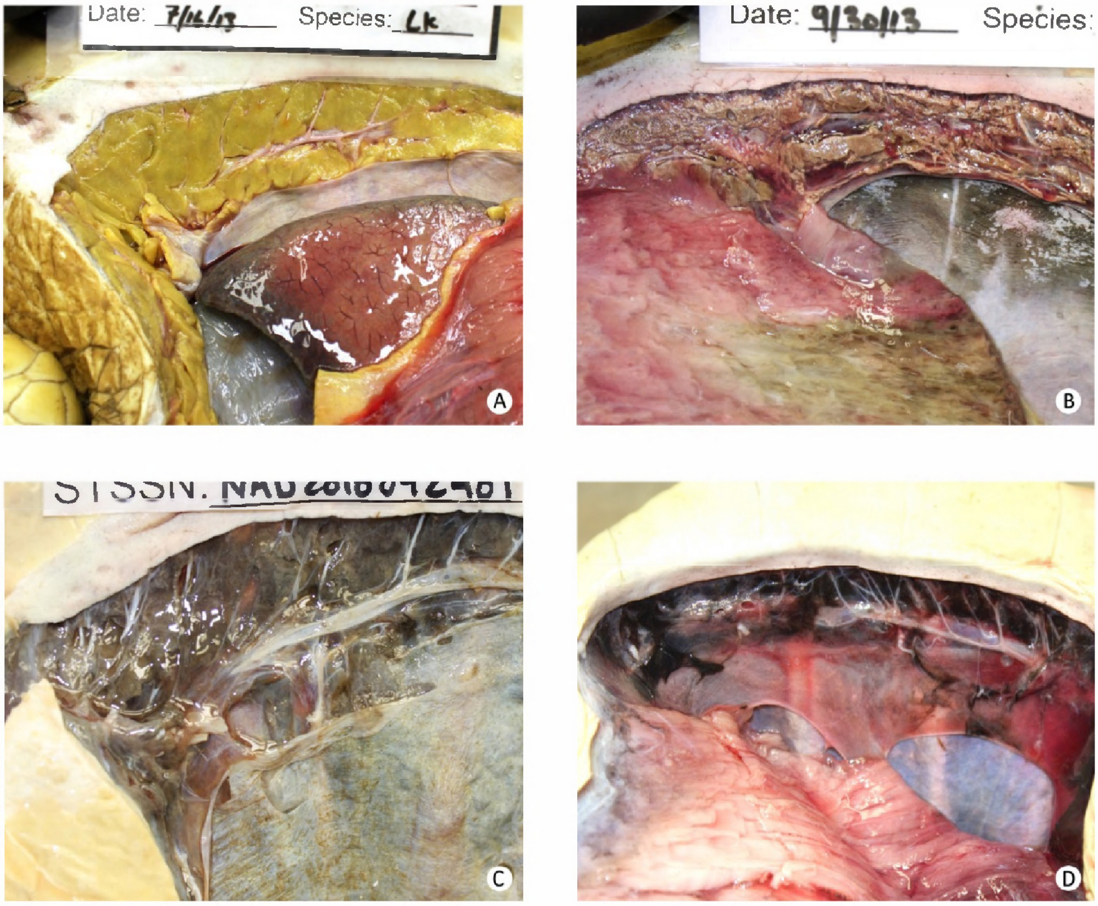
Appendix B2. Examples of necropsied Kemp's ridley sea turtles with ingested fish. All turtles were documented by stranding response in Alabama, Mississippi, and Louisiana in 2010 through 2014. A variety of fish species are shown. Some turtles have fish within the mouth and esophagus, which has prominent pointed papillae in sea turtles (A, C, E, G). The stomach contents of two juvenile Kemp's ridleys include cutlass fish (*Trichiurus lepturus*) and shrimp in one example (D) and a variety of additional fish in the other (F). The stomach of the turtle shown in H is full of masticated fish, including several white otoliths. The last image shows contents screened from the gastrointestinal tract, including several large bones and numerous scales (I).

ID#
Date: 7/6/11
Species: LK.
A
B
Date: 4/5/12
Species:
C
Date:
Species:
D
E
F
G
STSSN: MRC 20100518
H
I

Appendix B3. Examples of necropsied Kemp's ridley sea turtles with ingested penaeid shrimp. All turtles were documented by stranding response in Alabama, Mississippi, and Louisiana in 2010 through 2014. In most of the examples shown, shrimp are within esophagus, which has prominent pointed papillae in sea turtles (A, B, C, E, F, G, I). Masticated shrimp comprise the stomach contents of a juvenile Kemp's ridley shown in (D). The trachea of the turtle in H contains an aspirated shrimp tail and back sediment. Several shrimp fill the stomach of the turtle in the last image (I).


AEE2010091401
A
B
STSSN: WLH 2010061108
C
D
E
STSSN: RAW 2010061002
F
SDD2010090502
G
H
BJL2010061401
I

Appendix B4. Examples of traumatic injuries in stranded Kemp's ridley turtles. (A) Multiple depressed shell fractures (blunt trauma, vessel strike). (B) Shark bites on cranial plastron. (C) Perforation of esophagus and hemorrhage from a recreational fishing hook (inset). (D) Commercial shark hook embedded in the lower jaw with attached metal leader. (E) Kemp's ridley with the plastron removed and incised wound across the ventral neck (malicious human interaction). (F) Kemp's ridley with incised wound across ventral neck transecting the trachea and esophagus (malicious human interaction). Note that the stomach is full of fish (inset).



Appendix B5. Examples of pericoelomic fat in Kemp's ridley sea turtles with different degrees of atrophy used in assessment of nutritional condition. The images show no atrophy (A), mild atrophy (B), moderate atrophy (C), and severe atrophy (D).

APPENDIX C. GROSS NECROPSY DATA FORMS

SEA TURTLE STRANDING AND SALVAGE NETWORK – GROSS NECROPSY REPORT

IDENTIFICATION

1. STSSN #: **2. Other identifier(s)/#:** **3. Rehab:** ☐
4. Found dead: ☐ **5. If no, date of death** leave blank if unknown (Use mm/dd/yyyy for dates)
6. Euthanized: ☐ **7. Frozen/Thawed:** ☐ **8. Condition at necropsy:** ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
9. Date necropsied: **10. Examiner:** **11. Affiliation:**
12. Necropsy description: ☐ External & internal examination ☐ External examination only ☐ Incomplete carcass
13. Disposition of carcass: ☐ Buried on beach ☐ Buried off site ☐ Rendered ☐ Incinerated ☐ Other
14. Species: ☐CC ☐CM ☐DC ☐LK ☐EI ☐LO ☐HYBRID ☐UNK **15. Sex:** ☐Male ☐Female ☐Undetermined

EXTERNAL EXAMINATION

16a. Body weight: ☐kg ☐lb **16b.** ☐actual ☐est. **17. Eyes sunken:** ☐ **18. Skeletal features prominent:** ☐
19. Heavily encrusted w/ epibiota: ☐ **20. Leeches:** ☐ **21. Gooseneck barnacles:** ☐
22. Epibiota coverage: 22a. Head/appendages: % **22b. Carapace:** % **22c. Plastron:** %
23. External Trauma/evidence of Human Interaction (T/HI): ☐ Yes ☐ CBD **(If yes, complete 25)** **Use STSSN scale**
24. Other anomalies: ☐ Yes ☐ CBD **(If yes, complete 26)** CBD - Cannot Be Determined ☐ PHOTOGRAPHS TAKEN

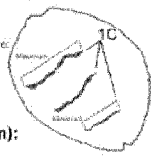
ANATOMIC LOCATION CODES: Head (H) Neck(N) Eyes(E) Mouth(M) Carapace(C) Plastron(P) Tail(T) Vent(V)
Use for 25a & 26a Front flipper - Right(R) Left(L) Rear flipper - Right(F) Left(G) All appendages(Y) Pectoral girdle(J) Pelvis(I)

25a. T/HI-Type: (check all that apply and diagram in 25c)
Enter anatomic codes in blanks: (Example: ⊗ Parallel slicing wounds(1) _C_)
☐ Parallel slicing wounds(1) ☐ Blunt/crushing(2)
☐ Non-parallel/single linear wounds(3) ☐ Dislocations(4)
☐ Partial/complete amputation(5) ☐ Paint transfer(6)
☐ Fractures/Broken bones(7) ☐ Puncture(8)
☐ Probable bite wound(9) ☐ Tar in mouth(10)
☐ Ligature/entanglement-type(11) [a]
☐ Entangling material attached(12) [a]
☐ Hook and/or line present (13) [a] [a] **If yes, complete 25d**
☐ Other(14) **describe under 25c**

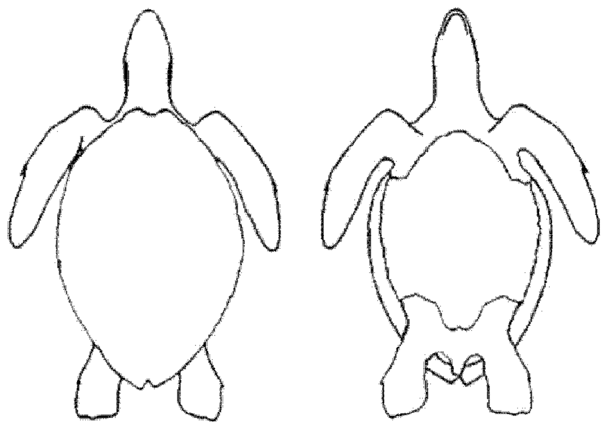
25b. T/HI- Description: (check all that apply)
Enter 25a. + anatomic codes: (Example: ⊗ Exudate/fibrin _1C_)
☐ Exudate/fibrin ☐ Fibrous tissue formation
☐ Bone formation/remodeling ☐ Hemorrhage
☐ Encapsulated sand/debris ☐ Blood clots
☐ Completely healed ☐ Other **describe under 25c**
Diagram wounds/measurements 25c
☐ PHOTOGRAPHS TAKEN **Use STSSN scale in photos**
3 Standard photos: with scale
1. Perpendicular to wound(s)
2. Wound margins (close-up)
3. Head, neck, shoulder region

25c. T/HI-Comments & External Diagram (cont. pg 4):

Parallel slicing wounds (cm):
Straight (chord) cut length
Maximum:
Minimum:



Single linear wounds (cm):
Wound length:
Width: Depth:



Appendix C1. Gross necropsy findings recording form (4 pages).

EXTERNAL EXAMINATION (CONT.)

25d. T/HI-Fisheries/Entanglement data: (Fisheries gear, other entangling material)

☐Material removed prior to necropsy

Gear type:

☐Line & pot ☐Line & buoy ☐Line, buoy & pot ☐Unknown gear/line

☐Netting ☐Hook ☐Monofilament ☐Braided line ☐Other

Number of wraps around body part: , **location:** [1] (use anatomic codes)

Additional areas: , [2]; , [3]; , [4]; , [5] (Example: 4 , R)

Ligature injury: (additional comment under 25c)

☐Ligature – mild, non-penetrating

☐Ligature – skin incised/ulcerated

☐Ligature – full thickness (deep tissue/bone exposed)

☐Ligature – partially/completely healed

T/HI-Material collected*: ☐ **Disposition of material:**

Gear description (color, shape, size):

Gear identification information:

26a. External anomalies-Type: (check all that apply and diagram in 25c)

Enter anatomic codes in blanks: (Example: ⊗ Ulcers(16) Y)

☐Fibropapillomas/Papillomas(15) ☐Ulcers(16)

☐Crust/exudate(17) ☐Masses (non-FP or uncertain)(18)

☐Other(19) describe under 26c

☐PHOTOGRAPHS TAKEN

26b. Other anomalies-Description: (check all that apply)

Extent of observation: *(Refer to Pap Map for FP turtles)*

Enter 26a. + anatomic codes: (Example: ⊗ 10-25% affected 16Y)

☐<5% surface affected ☐10-25% affected

☐>25-50% affected ☐>50% affected

☐ Visual field involved ☐Both eyes

☐ Mouth obstructed ☐Cloaca obstructed

26c. Anomalies-Comments (cont. pg 4):

INTERNAL EXAMINATION (comments extended to page 4 – optional)

NUTRITIONAL CONDITION - INTERNAL

27. Muscle status: ☐Well-muscled/No atrophy ☐Mild to moderate atrophy ☐Severe atrophy

28. Fat status: ☐Abundant/No atrophy ☐Mild to moderate atrophy ☐Severe atrophy ☐PHOTOGRAPHS TAKEN

29a. MUSCULOSKELETAL (internal) – ☐**EXAMINED** **29b. Joint Fluid:** ☐No findings ☐Cloudy/solid material ☐Blood-tinged

29c. Skeletal Findings: ☐No findings ☐Fractures ☐Dislocation ☐Avulsions ☐Deformities ☐Other (note location(s) in comments)

29d. Musculature findings: ☐No findings ☐Trauma ☐Hemorrhage ☐Pallor ☐Necrosis ☐Other

29e. MUSCULOSKELETAL-Findings/Comments:

30a. COELOMIC CAVITY – ☐**EXAMINED** **30b. Coelomic Fluid Volume:** ml **30c.** ☐actual ☐est.

30d. Coelomic Fluid: ☐No findings ☐Cloudy/solid material ☐Blood-tinged ☐Blood clots ☐Fibrin ☐Other

30e. Coelomic Lining: ☐No findings ☐Masses (≤2mm) ☐Masses (>2mm) ☐Hemorrhage ☐Adhesions ☐Other

30f. COELOMIC CAVITY-Findings/Comments:

31a. CARDIOVASCULAR SYSTEM (heart/major vessels) – ☐**EXAMINED** **31b. Blood in Heart chambers:** ☐

31c. Pericardial Fluid: ☐No findings ☐Cloudy/solid material ☐Blood-tinged ☐Blood clots ☐Fibrin ☐Other

31d. CV Findings: ☐No findings ☐Trauma ☐Endocarditis/arteritis ☐Blood clot(s) ☐Vessels thickened ☐Adhesions ☐Other

31e. CV-Findings/Comments:

32a. HEPATOBILIARY SYSTEM (liver and gall bladder) – ☐**EXAMINED**

32b. Liver Findings: ☐No findings ☐Pallor ☐Atrophy (shrunken, black) ☐Trauma ☐Masses (≤2mm) ☐Masses (>2mm) ☐Other

32c. Biliary Findings: ☐No findings ☐Gall bladder thickened ☐Bile ducts thickened ☐Ulcers ☐Exudate ☐Stones ☐ Other

32d. HB-Findings/Comments:

INTERNAL EXAMINATION (CONT.)

ANATOMIC LOCATION CODES: Mouth(O) Esophagus(Es) Stomach(St) Small intestine(Si) Colon(Co) Cloaca(Cl)

33a. ALIMENTARY SYSTEM – ☐ **EXAMINED**

33b. GI-Findings: (check all that apply) **Enter anatomic codes in blanks:** (Example: ⊗ Ulcers(20) _Co_)

☐ Ulcers(20) ☐ Perforation (21) ☐ Masses(22) ☐ Impaction(23)

☐ Obstruction(24) ☐ Intussusception(25) ☐ Plication(26) ☐ Other(27)

33c. GI-percentage of affected area: Enter 33b. + anatomic codes: (Example: ⊗ >25-50 affected _20 Co_)

☐ <5% ☐ 10-25% ☐ >25-50% ☐ >50% ☑ N/A

33d. GI-Foreign material: ☐ (if yes, complete 33k)

33e. Injury/lesion associated with foreign material: ☐ **If yes, give entry for 33b:** (Example: _21 St_)

GI-Contents(include & note any biotic impacted material):

33f. Esophagus: ☐ Empty ☐ Contents, describe:

33g. Stomach: ☐ Empty ☐ Contents, describe:

33h. Small intestine: ☐ Empty ☐ Contents, describe:

33i. Colon: ☐ Empty ☐ Contents, describe:

33j. GI-Findings/Comments:

33k. GI-Foreign material - type: ☐ PHOTOGRAPHS TAKEN

☐ Hook(29) ☐ Line(30) ☐ Hard plastic(31) ☐ Plastic bag(33) ☐ Misc soft plastic(33) ☐ Balloon(34) ☐ Tar(35) ☐ Other(36)

Material/lesion location(s): (use anatomic codes)

Material collected*: ☐ **Disposition of material:**

Foreign material-Description of material & comments:

34a. SPLEEN – ☐ **EXAMINED** **34b. Spleen Findings:** ☐ No findings ☐ Trauma ☐ Enlarged ☐ Masses ☐ Other

34c. PANCREAS – ☐ **EXAMINED** **34d. Pancreas Findings:** ☐ No findings ☐ Trauma ☐ Masses ☐ Congested ☐ Other

34e. SPLEEN/PANCREAS-Findings/Comments:

35a. UROGENITAL SYSTEM (kidneys, reproductive, urinary bladder) – ☐ **EXAMINED**

35b. Kidneys Findings: ☐ No findings ☐ Trauma ☐ Enlarged ☐ Asymmetrical ☐ Masses ☐ Other

35c. Gonads identified as: ☐ Testes(complete 35d-f) ☐ Ovaries(complete 35g-i) ☐ Unknown **(Indicate sex on Page 1, Field 15)**

35d. Testes–characterization: ☐ Cylindrical ☐ Ellipsoidal ☐ Flat **35e. Testes-size:** length x width (cm)

35f. Epididymis–characterization: ☐ Not expanded from wall ☐ Distinct ridge ☐ Pendulous ☐ Obvious white coils

35g. Ovaries–characterization: ☐ All follicles <4mm ☐ Developing follicles (4-24mm) ☐ Corpus luteum (>7mm) ☐ Corpus albicans

35h. Ovary length: (cm)

35i. Oviduct–characterization: ☐ White, straight (<3mm diameter) ☐ Partially convoluted (3-15mm diameter) ☐ Very convoluted (>15mm diameter) ☐ Contains eggs (>24mm) *↑Optional fields by state*

35j. UG-Findings/Comments:

36a. RESPIRATORY SYSTEM – ☐ **EXAMINED** **36b. Foam/froth in trachea:** ☐

36c. If froth present: ☐ Anterior to bifurcation ☐ Posterior to bifurcation **36d. Froth amount:** ☐ Small ☐ Moderate ☐ Copious

36e. Sand/sediment in trachea: ☐ **36f. Trachea/bronchi:** ☐ No findings ☐ Exudate ☐ Masses ☐ Ulceration ☐ Other

36g. Lungs Findings: ☐ No findings ☐ Wet/frothy ☐ Hemorrhage ☐ Trauma ☐ Exudate ☐ Masses (≤2mm) ☐ Masses (>2mm) ☐ Aspirated debris ☐ Other

36h. RESP-Findings/Comments:

INTERNAL EXAMINATION (CONT.)

37a. CENTRAL NERVOUS SYSTEM – ☐ **Brain EXAMINED** **37b.** ☐ **Spinal Cord EXAMINED**

37c. Brain findings: ☐ No findings ☐ Trauma ☐ Hemorrhage ☐ Necrosis ☐ Exudate ☐ Blood fluke eggs ☐ Other

37d. Spinal cord findings: ☐ No findings ☐ Trauma ☐ Hemorrhage ☐ Necrosis ☐ Exudate ☐ Blood fluke eggs ☐ Other

37e. CNS-Findings/Comments:

38. Other Comments (include any continuation from previous sections & label notes by data field number (e.g. 25c):

Specimen (label w/ ID#)	Fixed	Frozen-bagged	Frozen-Foil	Other (specify)	Location
	☐	☐	☐		
	☐	☐	☐		
	☐	☐	☐		
	☐	☐	☐		
	☐	☐	☐		
	☐	☐	☐		
	☐	☐	☐		

DISCLAIMER

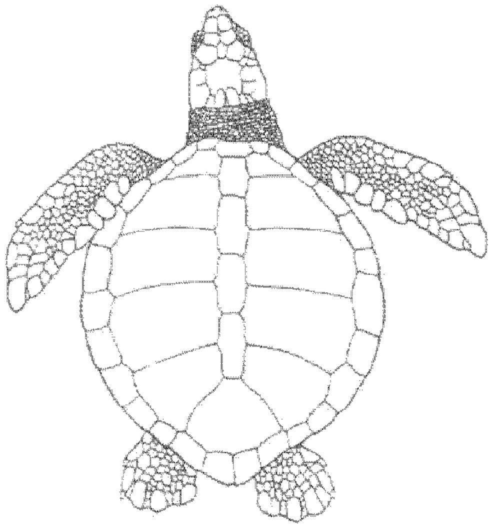
*All fisheries gear should be submitted to Pascagoula (SE) or North Kingston (NE) NOAA laboratories for ID

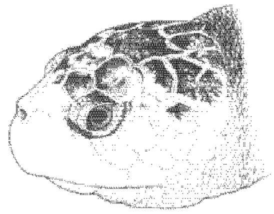
SUPPLEMENTARY DIAGRAM/NOTES CASE NO. ________________________ DATE _______

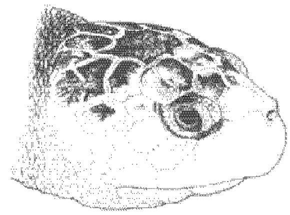
SCL:_________

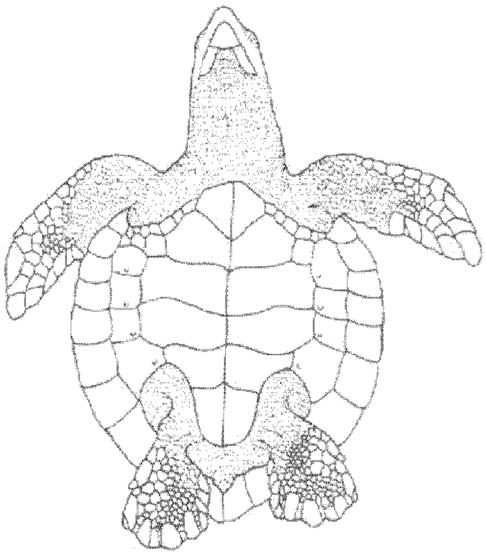
BW:_________

Gender:________









Condition code: 1 2 3 4 5

Muscle mass:________________________

Adipose:___________________________

Stomach:___________________________

Small intestine:_____________________

Colon:_____________________________

Notes:_____________________________

____

____

____

____

Samples:___________________________

____

____

Appendix C2. Supplementary diagram and notes form. Diagrams are different for each species. The Kemp's ridley version is shown here.

This page is intentionally left blank