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ESTIMATED BYCATCH MORTALITY OF MARINE MAMMALS IN THE GULF OF MEXICO SHRIMP OTTER TRAWL FISHERY DURING 2012 TO 2014

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Cover photograph: Common bottlenose dolphin in South Carolina, June 2005. Photo was edited to remove vessel name for privacy protection.
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ABSTRACT

The Gulf of Mexico shrimp otter trawl fishery operates throughout the U.S waters of the Gulf of Mexico including coastal and shelf waters and bays, sounds and estuaries. The Atlantic and Gulf of Mexico shrimp fisheries are defined as a Category II fishery under the Marine Mammal Protection Act, and the Gulf of Mexico otter trawl fishery has the potential to impact Gulf of Mexico common bottlenose dolphin (*Tursiops truncatus*) and Atlantic spotted dolphin (*Stenella frontalis*) stocks which include one spotted dolphin stock, one bottlenose dolphin continental shelf stock, three bottlenose dolphin coastal stocks, and 31 bottlenose dolphin bay, sound, and estuary (BSE) stocks. Total annual bycatch mortalities of marine mammals in the shrimp otter trawl fishery from 2012 – 2014 are estimated using data from NMFS's shrimp fishery observer program and stratified shrimp fishery effort models. Bycatch rates are calculated under two stratification scenarios and under two species identification assumptions. Annual mortality estimates for 2012, 2013, and 2014 are calculated using the ratio estimator with stratified annual fishery effort data for 2012 to 2014 and aggregate bycatch rates for 1997 to 2014. For each of the three years, 5-year unweighted mean mortality estimates are calculated for Gulf of Mexico dolphin stocks. BSE stock mortality estimates are aggregated at the state level.

Resulting bycatch mortality estimates over the three years indicate that under both stratification scenarios and both species identification scenarios, bycatch mortality estimates exceed 10% of potential biological removal (PBR) for the Western Coastal bottlenose dolphin stock while bycatch mortality estimates for the Northern Coastal bottlenose dolphin stock declined and were at or below 10% of PBR in 2013 and 2014. As in prior years, it remains possible that bycatch mortalities have substantially exceeded the PBR threshold for LA BSE bottlenose dolphin stocks. Additionally, the PBR threshold may have been exceeded for the TX BSE stocks in 2014, while bycatch mortalities may have dropped below the PBR threshold for the AL/MS BSE bottlenose dolphin stocks in 2014. However, further data on both abundance and bycatch rates in inshore waters are required to determine whether this has occurred for these BSE stocks. Other stocks which may have shrimp otter trawl bycatch mortalities above 10% PBR include the Continental Shelf bottlenose dolphin stock and the Atlantic spotted dolphin stock, while the Eastern Coastal and FL BSE bottlenose dolphin stocks are at lower risk and approaching the zero mortality rate goal (i.e., under 10% PBR). Potential sources of bias and uncertainty in these bycatch mortality estimates are discussed.

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INTRODUCTION

The commercial Gulf of Mexico shrimp trawl fishery is one of the largest and most economically important fisheries in the southeastern US. The fishery, with a fleet of more than 4000 vessels of which approximately 1500 are federally permitted[1], operates year-round in the Gulf of Mexico, with highest effort during May through December (Nance 1993). The fishery targets primarily three species of penaeids [brown shrimp (*Farfantepenaeus aztecus*), pink shrimp (*F. duorarum*), and white shrimp (*Litopenaeus setiferus*)], and to a lesser extent, rock shrimp (*Sicyonia* spp.), Trachypenaeus shrimp (*Trachypenaeus* spp.), seabobs (*Xiphopenaeus kroyeri*), and royal red shrimp (*Pleoticus robustus*) (NOAA 2002, Scott-Denton et al. 2012). Main fishery activity extends throughout estuarine waters and coastal waters of less than 10 m depth and extends out over shelf waters to 120 m depth, with some effort for royal red shrimp in deeper waters (Nance et al. 2010, Caillouet Jr et al. 2011). Otter trawls are the main gear type used by the fishery throughout the Gulf of Mexico, and skimmer trawls are additionally used in the bays, sounds and estuaries of Louisiana, Alabama, and Mississippi (Hein & Meier 1995, Epperly et al. 2002, Scott-Denton et al. 2006, Price & Gearhart 2011, Scott-Denton et al. 2012).

The shrimp trawl fishery observer program is cooperatively managed by the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) and the Gulf and South Atlantic Fisheries Foundation (Foundation). The program was established to monitor significant bycatch of finfish species and protected species, including sea turtles (Pellegrin Jr. 1982, Henwood & Stunz 1987, Nichols et al. 1987, Alverson et al. 1994, NMFS 1995, NMFS 1998, Epperly et al. 2002, NOAA 2012, Scott-Denton et al. 2012, Waring et al. 2012). Since 1991, managing organizations have evaluated and subsequently required bycatch reduction devices (BRDs) and turtle excluder devices (TEDs) to reduce the bycatch of red snapper and sea turtles, respectively (Epperly et al. 2002, Epperly & Teas 2002, Scott-Denton 2007, Scott-Denton et al. 2012). Additionally, under the authorization of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) and the Endangered Species

[1] Federal permits are required for all commercial shrimp vessels that fish in Federal waters of the Gulf of Mexico. Federal waters range from 9 to 200 nautical miles off the coast of Florida and Texas and from 3 to 200 nautical miles off Alabama, Mississippi, and Louisiana.

Act (ESA), NMFS and the Foundation implemented voluntary observer programs in 1992 and enacted a mandatory NMFS observer program in July 2007 to characterize shrimp trawl bycatch of finfish and protected species, characterize fishery behavior, and evaluate gear types for bycatch reduction (Scott-Denton et al. 2012, Federal Register 71:56039–56047, 26 September 2006).

The Southeastern US Atlantic, Gulf of Mexico Shrimp Trawl Fishery is defined as a Category II fishery under the Marine Mammal Protect Act (75FR 68468, November 8, 2010) due to documented interactions with marine mammals. These interactions include 11 marine mammal interactions with the shrimp fishery that lead to mortality or serious injury[2] (MSI) [7 unidentified dolphins, 4 common bottlenose dolphins (*Tursiops truncatus*)] observed in the Gulf of Mexico by the shrimp trawl Observer Program during 1993-2010, and an additional 13 dolphin mortalities [1 Atlantic spotted dolphin (*Stenella frontalis*), 12 common bottlenose dolphins] in Southeast US research trawl operations or sea turtle relocation trawls prior to 2010 (Wade & Angliss 1997, Waring et al. 2012). While the shrimp trawl fishery includes southeastern US Atlantic and Gulf of Mexico waters, more than 95% of Observer Program effort and all Observer Program marine mammal takes have occurred in the Gulf of Mexico. Similarly, skimmer trawls, which account for over 48% of effort in Louisiana, Alabama, and Mississippi inshore waters, have had limited Observer Program coverage and no observed marine mammal takes (Scott-Denton et al. 2006, Pulver et al. 2012). Annual bycatch mortality of Gulf of Mexico common bottlenose dolphin and Atlantic spotted dolphin stocks[3] in the Gulf of Mexico otter trawl portion of the shrimp fishery have recently been estimated to document the fishery's impact for future management and conservation of these stocks (Soldevilla et al. 2015).

Only two delphinid species, common bottlenose dolphins and Atlantic spotted dolphins, are commonly found in waters where the shrimp trawl fishery operates (Scott 1990, Mullin & Hansen 1999), and the unidentified takes described above may belong to either of these species.

[2] Any injury that will likely result in mortality (50 CFR 216.3). Throughout this report, the term bycatch mortality is used to indicate MSI bycatch interactions.

[3] As defined by the MMPA, the term "stock" means a group of marine mammals of the same species or smaller taxa in a common spatial arrangement, that interbreed when mature.

Common bottlenose dolphins (hereafter referred to as bottlenose dolphins) are currently managed by NOAA-NMFS as 36 distinct stocks within the Gulf of Mexico. These include one oceanic, one continental shelf, three coastal (Western Coastal, Northern Coastal, and Eastern Coastal), and 31 bay, sound and estuary stocks (Waring et al. 2016). The Northern Gulf of Mexico Oceanic Stock is found in waters deeper than 200 m, outside of shrimp trawl fishing areas, and is unlikely to interact with the fishery. The management boundaries of the Gulf of Mexico Continental Shelf Stock are the 20-m and 200-m isobaths, and the three coastal stocks are bound by shore, barrier islands, or bays and the 20-m isobath. Additional climatic and oceanographic boundaries delineate the three coastal stocks such that the Gulf of Mexico Eastern Coastal Stock ranges from 84^{o}W to Key West, FL, the Gulf of Mexico Northern Coastal Stock ranges from 84^{o}W to the Mississippi River Delta, and the Gulf of Mexico Western Coastal stock ranges from the Mississippi River Delta to the Texas/Mexico border (Figure 1). Ranges of the Western Coastal, and Continental Shelf stocks may continue into Mexican waters. Gulf of Mexico Bay, Sound, and Estuary (BSE) stocks were delineated in each of 31 areas of nearly contiguous, enclosed, or semi-enclosed bodies of water adjacent to the US Gulf of Mexico Knowledge of seasonal movements of stocks is limited (e.g. Irvine et al. 1981, Fazioli et al. 2006). Spatial overlap may occur between BSE and coastal stocks where their distributions meet, and likewise the Continental Shelf stock may overlap with coastal and Oceanic stocks where their distributions meet; for these stocks, crossing of "stock boundaries" is likely to occur. Abundance estimates for most of these stocks are uncertain, as survey data are older than eight years (Table 1, Appendix A). Although no confirmed Atlantic spotted dolphin takes have been documented by the Observer Program, this species has been documented foraging around shrimp trawls in the Gulf of Mexico (Caldwell 1955, Delgado Estrella 1997, Fertl & Leatherwood 1997), and was documented as bycatch in the Gulf of Mexico on several occasions in the 1980's (Ford 1991 pers. comm. in Fertl & Leatherwood 1997). Additionally, two Atlantic spotted dolphin (hereafter referred to as spotted dolphin) bycatch mortalities were documented in research shrimp trawls, one in the Atlantic and one in the Gulf of Mexico. Their range almost completely overlaps with that of the Continental Shelf stock of bottlenose dolphins.

Dolphin entanglements in shrimp fishery gear have occurred in the lazy line, in the main body of the trawl net, and in the TED (Soldevilla et al. 2015). Otter trawl gear includes two outriggers each equipped with one or two relatively fine-meshed otter trawl nets of

approximately 30-50 ft. headrope length and variable net design, wooden doors at the net edges, a tickler chain, lead ropes, and headrope floats (Appendix B; Jenkins 2012, Scott-Denton et al. 2012). The net tapers from the mouth to the back to form a funnel ending in a codend, to which a lazy line is attached for bringing the net on board for emptying (Maril 1983, 1995, Maiolo 2004). A variety of TED and BRD designs are approved for use in the Gulf of Mexico shrimp trawls, and are integrated into the main body of the otter trawl net, ahead of the codend, enabling the escape of larger animals while retaining shrimp catch (Jenkins 2012, Scott-Denton et al. 2012).

In this report, estimates of annual marine mammal stock bycatch mortality are calculated for otter trawl gear in the commercial Gulf of Mexico shrimp trawl fishery for the years 2012, 2013, and 2014. Additionally, unweighted five-year mean estimates are provided for the years 2008-2012, 2009-2013, and 2010-2014. Annually-aggregated bycatch rates (catch per hour fished) for otter trawl gear are quantified based upon observer data from 1997-2014, stratified by fishing area, depth, and season. The estimated bycatch rate is then multiplied by the total annual fishing effort (hours fished) estimated from landings and port interviews for each stratum for the years 2012, 2013, and 2014. Stratified bycatch mortality estimates are summed within dolphin stock distributional ranges to obtain estimates of total annual mortalities from otter trawl gear for the bottlenose dolphin and spotted dolphin stocks expected to be interacting with the fishery. Best-case and worst-case bycatch mortality estimates are developed for the stocks to account for uncertainty in species identification of some documented marine mammal takes. Sources of bias and variability in bycatch mortality estimates are discussed.

METHODS

Data Sources

Fishery Effort Data

Total effort data for the commercial Gulf of Mexico shrimp trawl fishery are obtained from modeled effort parameters derived by Nance et al. (2008). Stratified effort estimates (for both otter and skimmer trawls) are modeled from landings data collected by seafood dealers and port agent interviews with fishermen (Nance 1992, Nance 2004, Nance et al. 2008). Seafood dealer reports provide monthly data on total pounds of catch per species in 21 statistical subareas

(Figure 1) and 9 depth zones (Patella 1975). Shrimp catch per unit effort (CPUE) in each stratum is obtained from port agent interviews with fishermen at the termination of their trips, and by electronic logbooks (ELB) since 2006. While data are collected in fine resolution strata (12 months, 21 subareas, 9 depth zones), the models are built for coarser resolution strata to account for uncertainty in combining dealer reports and port agent interviews. The 36 coarse spatio-temporal strata used in the models are: a) four state-area groupings of the 21 statistical subareas [Florida (FL): subareas 1-9; Alabama/Mississippi (AL/MS): subarea 10-12; Louisiana (LA): subareas 13-17; Texas (TX): subareas 18-21]; b) three groupings of the 9 depth zones (inshore, nearshore, and offshore waters); and three seasonal strata or trimesters (Jan-Apr, May-Aug, and Sept-Dec). Inshore waters are those internal to the International Regulations for Preventing Collisions at Sea 1972 (COLREGS) line. Nearshore waters are those extending from the COLREGS line to the 10-fm (18-m) isobath. Offshore waters are those beyond the 10-fm (18-m) isobath. Total fishery effort per stratum, in nominal days fished (i.e., total trawl bottom time divided by 24 hours), is modeled as the total shrimp catch divided by CPUE (see Nance 1992, Nance 2004, Nance et al. 2008 for full details). Shrimp fishery effort data include all three depth zones, while the Observer Program (next section) only covers nearshore and offshore waters.

In the inshore waters of the LA and AL/MS state areas, fishery effort estimates include effort from skimmer trawls and otter trawls. The Observer Program primarily places observers on otter trawl vessels, and the skimmer trawl fishery does not have enough observer coverage to estimate marine mammal bycatch. Therefore, skimmer effort is removed to yield stratified fishery effort estimates for commercial harvest from otter trawls only. Available effort data include stratified total fishery effort and stratified catch by weight apportioned to otter and skimmer trawls. Shrimp CPUE data stratified for skimmer and otter trawl gear in the Gulf of Mexico are not available. Limited comparisons of otter and skimmer trawl CPUEs in North Carolina estuaries indicate high variability seasonally and by penaeid species caught (Coale et al. 1994), and CPUEs have been shown to vary spatially, temporally, and by species for both gear types in the Gulf of Mexico (Nance 1992, Coale et al. 1994, Nance 2004, Warner et al. 2004, Scott-Denton et al. 2006, Pulver et al. 2012). Since there was no systematic difference between CPUEs for the two gear types (Coale et al. 1994), we assumed equal CPUE for skimmer and otter trawls, and removed skimmer effort by multiplying the stratified total effort by the stratified

proportion of catch by weight from otter trawls only to total catch (Table 2). Effort estimates in inshore LA and AL/MS strata may be biased if this assumption is invalid; implications of this assumption are considered further in the Discussion.

Observer Program Data

NMFS Gulf of Mexico Shrimp Trawl Observer Program data collection methods have been described in detail previously (Scott-Denton 2007, Scott-Denton et al. 2012). Briefly, in the Gulf of Mexico, NMFS-approved observers were placed on randomly selected shrimp vessels based on lists of federally permitted vessels which were active in the previous year. Random selection was based on the previous year of effort stratified by state area, depth zone, and season. The list of active vessels was derived from a cross-reference of NMFS shrimp landings files and US Coast Guard documentation records. Under the MSFCMA (MSFCMA; 16 USC1801), ESA, and MMPA, federal fishery permit holders are required to carry an observer if selected (MSFCMA § 303(b)(8)). Mandatory observer coverage compliance in the Gulf of Mexico shrimp trawl fishery has increased since 2007 as safety compliance by shrimp vessels has improved. For selected vessels, a minimum sea-day requirement of 18 days within a seasonal selection period was established to prevent potential early trip termination as a result of having an observer on board. A vessel may carry an observer for multiple trips to meet this minimum-sea-day requirement.

For each trip, a variety of vessel and gear characteristics are recorded, and for each tow, a variety of fishery-specific data are collected (See the observer manual, NMFS 2010, and Scott-Denton et al. 2012 for further details). The trip-level data used in bycatch analyses include number of observed tows and number of unobserved tows (unobserved tow data were available for 2007 – 2014, only). The tow-level data used in bycatch analyses include trip, date, time, location, depth, tow duration, number of nets towed, and number of mammals caught. Marine mammal bycatch documentation included information on the trip and tow in which bycatch occurred, number of animals, species identification, date, time, latitude, longitude, depth, gear entanglement location (e.g. TED net, lazy line), final disposition (e.g. dead/unresponsive, alive, unknown), and additional comments (Appendix C). Only data collected by the NMFS Observer Program for the Gulf of Mexico shrimp otter trawl fishery were used in these analyses. Data

from the voluntary Foundation Observer Program (16.8% of tows), Atlantic shrimp trawl fishery (7.8% of tows), and skimmer and roller trawls (5.8% of tows) were not analyzed.

Analyses

Annual bycatch mortality estimates were calculated for 2012, 2013, and 2014 using the stratified ratio of means estimator method and associated assumptions described in detail for previous mortality estimates (Soldevilla et al. 2015), and briefly described here. The estimates follow a stratified random sample single-stage design with observed trip as the sampling unit.

Data Preparation

All Gulf of Mexico shrimp otter trawl tows observed by the NMFS observer program from 1997 to 2014 (N = 35,059) were assigned to one of the 36 fishery effort strata based on date, sub-area and depth at the start of the tow. When possible, missing depth values at the start of tows (N = 1,057) were assigned a depth based on the depth at the end of the tow or the ETOP01 depth (Amante & Eakins 2009) for the location of the start or end of the tow. A total of 33 tows were discarded due to missing year or depth data.

To analyze Observer Program effort and bycatch data at the trip level, tow data were aggregated by summing both observed hours fished and bycatch over all observed tows within a stratum for each trip. Effort was represented as total hours fished per trip; number of nets towed was not included because the total fishery effort did not account for number of nets towed and the stratified design accounts for bycatch rate differences in numbers of nets towed between inshore and offshore waters (Soldevilla et al. 2015). In some instances, trips were split if they occurred in multiple strata. Marine mammal bycatch is reported for all tows per trip, however, a small portion of tows (5.6%) were not observed with respect to the recording of fish bycatch and fishing effort. To correct the lower total documented effort per trip on trips with unobserved tows, data from 2007 to 2014 of the number of unobserved tows per trip were used to estimate corrected total effort per trip, $h_{corr,_l}$, as

$$h_{corr,_l} = (n_l + m_l)\,\frac{h_l}{n_l}$$

where n_l is the number of observed tows on the l^{th} trip, m_l is the number of unobserved tows on the l^{th} trip, and h_l is the total observed hours fished on the l^{th} trip.

Species Identification Scenarios and Final Disposition Status

During 1997-2014, 7 observed marine mammal takes identified to species were bottlenose dolphins, however, the remaining 7 takes were unidentified to species and may have been bottlenose dolphins or spotted dolphins. During the 1980s in the Gulf of Mexico, several spotted dolphins were documented as bycatch (Fertl & Leatherwood 1997), and spotted dolphin foraging in association with shrimp vessels has also been described (Delgado Estrella 1997, Fertl & Leatherwood 1997). Two spotted dolphin mortalities have occurred in research trawls, one in the southeastern US Atlantic and one in the Gulf of Mexico. Additionally, during BRD gear studies, the shrimp trawl Observer Program documented spotted dolphins present and sometimes following gear during 11 tows from 2007 to 2012 (by comparison, bottlenose dolphins were identified around 19 tows). All unidentified takes occurred in $\geq$57 ft. (17.3 m) waters and therefore cannot be confidently assigned to either species based on bathymetric distribution boundaries. To account for this uncertainty, bycatch rates are estimated under best-case and worst-case scenarios for bottlenose dolphin stocks and spotted dolphin stocks in which all unidentified dolphin takes are assigned to one species or the other.

The final disposition of observed marine mammal interactions with the shrimp fishery were evaluated to determine if they met the criteria for mortality or serious injury, as defined by Angliss and DeMaster (1998). One marine mammal observed during 1997-2014 was released alive with no evidence of serious injury and was not included in bycatch mortality calculations. Three marine mammal takes identified as decomposed animals with no supporting description or photographs were included in bycatch mortality estimates as it is impossible without a necropsy to determine whether the animals died in the net or were dead prior to interacting with the trawl. Each of these animals lacked species identification, so the best-case and worst-case scenarios still encompass the range of mortalities if any of the animals were captured in this state.

Stratified Bycatch Rate Estimation

The shrimp otter trawl fishery is such a large fishery (annual mean of 2.3 million hours actively fished for 2007-2014) that the Observer Program, with current resources, can only cover

about 0.5% of active fishing effort. Therefore, observed marine mammal bycatch is a relatively rare occurrence. Due to the relatively low level of observer effort (Table 3) and the low number of observed takes (14) during 1997-2014, a fully stratified bycatch rate estimate per year (24 strata by 18 years) is unreasonable, as most strata will have zero takes and may only sample a single fishing trip. Variability in bycatch rates is lowest across years compared with fishery strata and does not vary significantly between voluntary and mandatory periods of the NMFS Observer Program (Soldevilla et al. 2015); therefore, we estimate bycatch rates on area-season-depth stratified data aggregated across 18 years to improve precision given the low number of observed takes. The complete 18 years of data were included in the bycatch rate analysis to reduce the number of zeros in some strata as these zeros are likely due to limited observer effort rather than true absence of bycatch within these strata, and the bycatch rate estimates including 18 years of data are thought to be more representative (e.g. Soldevilla et al. 2015).

To further reduce the impact of zeros given the high stratification and low percentage observer coverage and observed takes, in estimating dolphin stock annual bycatch mortality, two methods of bycatch rate stratification are compared to examine the trade-offs of accurately representing the sampling design (reduced bias) over pooling data (improved precision). The first method estimates semi-stratified (2 areas, 3 seasons, 2 depths) bycatch rates and applies them to fully stratified (4 areas, 3 seasons, 3 depths) effort data to obtain total annual bycatch mortality per stock[4]. In this case, the four state areas are combined into two larger regions of western Gulf (TX, LA, MS/AL) and eastern Gulf (FL). These regions are appropriate as they represent two major provinces with differences in oceanographic circulation, freshwater input, and benthic habitat characteristics (Gallaway 1981) that lead to differences in fishery target catch with brown and white shrimp targeted in the western Gulf and pink and rock shrimp targeted in the eastern Gulf. The second method estimates fully-stratified (4 areas, 3 seasons, 2 depths) bycatch ratios and applies them to fully stratified (4 areas, 3 seasons, 3 depths) effort data to

[4] The shrimp trawl Observer Program does not cover inshore waters; bycatch rates for nearshore strata were applied to the corresponding inshore strata. This method assumes that otter trawl bycatch rates are the same in coastal and inshore waters. The accuracy of this assumption will remain unknown until Observer Program coverage can be extended into inshore waters.

obtain total annual bycatch mortality per stock[5]. This method accurately reflects the study sampling design.

For each of the stratification methods and species identification scenarios, stratified bycatch rates are estimated using the ratio of means method (Cochran 1977). This method weights longer duration trips more heavily than shorter duration trips and was selected under the assumption that long duration trips more accurately estimate catch rates of rare events than short duration trips.

The stratified bycatch rate, r_{ijk}, for the i^{th} area, j^{th} trimester, and k^{th} depth zone is calculated as

$$r_{ijk} = \frac{\sum_{l=1}^{n_{ijk}} y_{ijkl}}{\sum_{l=1}^{n_{ijk}} h_{ijkl}}$$

where n_{ijk}, y_{ijkl}, and h_{ijkl} are the number of observed trips, the total trip bycatch, and the corrected total hours fished per trip, respectively, on the l^{th} trip in the i^{th} area, j^{th} trimester, and k^{th} depth zone.

Stock Bycatch Mortality Estimation

To estimate annual bycatch mortality per bottlenose dolphin stock, strata were assigned to bottlenose dolphin stocks as follows: a) strata from all areas and seasons in offshore waters were assigned to the Continental Shelf stock; b) TX and LA area strata from all seasons in nearshore waters were assigned to the Western Coastal stock; c) AL/MS area strata from all seasons in nearshore waters were assigned to the Northern Coastal stock; d) FL area strata from all seasons in nearshore waters were assigned to the Eastern Coastal stock; e) inshore strata were limited to state area resolution and seasonal strata were aggregated per state area and assigned to aggregated BSE stocks for each state (Table 4, Figure 1). For spotted dolphins, all offshore and nearshore strata were aggregated. Overall, the fishery strata boundaries match the dolphin stock boundaries well, with the exception of the AL/MS to FL state boundary and the 84°W boundary between the Eastern Coastal and Northern Coastal bottlenose dolphin stocks (Figure 1). The Northern Coastal stock range is underestimated and the Eastern Coastal stock range is

overestimated. Similarly, state area boundaries for inshore waters do not provide the resolution needed to assign bycatch to individual BSE stocks.

To obtain annual bycatch mortality, we multiply the stratified bycatch rates by annual stratified effort estimates for 2012, 2013 and 2014 to obtain stratified bycatch mortality estimates for the three years. We then combine these estimates over the appropriate strata to obtain annual bycatch mortality estimates per stock. The stratified estimator of the total annual bycatch mortality per stock is calculated as

$$\hat{\tau}_{stock} = \sum_{i}\sum_{j}\sum_{k} M_{ijk} r_{ijk}$$

where M_{ijk} is the total hours fished in the i^{th} area, j^{th} trimester, and k^{th} depth zone summed over areas and depth zones that fall within each stock's boundaries (Table 4).

Coefficients of Variation and Confidence Intervals

Bias corrected and accelerated (BCa) bootstrapping (Efron 1987) techniques were used to derive the confidence intervals (CIs) and standard bootstrapping (Efron & Tibshirani 1994) techniques were used to derive the coefficients of variation (CV) for the bycatch mortality estimates for each stock. As with bycatch rate estimation, the re-sampling unit used was an entire trip rather than an individual tow to ensure that any within-trip dependence was carried over into the estimated CV.

Five-year Mean Annual Bycatch Mortality Estimate

Following the Guidelines for Assessing Marine Mammal Stocks (GAMMS) (Wade & Angliss 1997), the unweighted 5-year mean annual bycatch mortality estimates for 2012, 2013, and 2014 were calculated for the trailing five years (2008-2012, 2009-2013, and 2010-2014) based on the 2008 to 2014 annual stock bycatch mortality estimates derived in this study and by Soldevilla et al. (2015).

Comparison with Potential Biological Removal

The estimated annual stock bycatch mortalities are compared against the allowable mortalities determined by potential biological removal (PBR) from the most recent stock assessment report (SAR) in which a valid minimum abundance (N_{min}) and PBR was available (Table 1, Waring et al. 1999, Waring et al. 2009a, Waring et al. 2009b, Waring et al. 2016). Wade and Angliss (1997) recommend that N_{min} values older than 8 years not be used in the calculation of PBR values as they are unreliable. The PBR values of the Gulf of Mexico Atlantic spotted dolphin stock and 25 Gulf of Mexico bottlenose dolphin BSE stocks are older than 8 years and are presented only to give a general scale of where bycatch mortality may fall with respect to stock abundance; updated N_{min} and PBR values are required to accurately represent any impact of the fishery on these stocks. The abundances of seven BSE stocks with reported abundance estimates of 0 due to limited survey effort are likely higher than zero; therefore, calculated N_{min} and PBR values are underestimates. For BSE stocks, for which shrimp fishery effort is only available at the state area resolution, the lowest, the highest, and the summed N_{min}s and PBRs of all BSE stocks within the state area are included. The minimum BSE PBR provides a conservative estimate in the event that all takes are from a single stock with low abundance, while the maximum BSE PBR provides an estimate if all takes are from a single stock with the highest abundance, and the aggregate BSE PBR provides an estimate if all stocks are proportionally affected by bycatch mortalities.

RESULTS AND DISCUSSION

Reported Fishery Effort and Observer Coverage

From January 2012 through December 2014, annual effort in the Gulf of Mexico shrimp otter trawl fishery averaged 92,556 ± 3,011 nominal days fished (Table 2), similar to effort levels since 2006 (Soldevilla et al. 2015). Geographically, the greatest effort during 2012 - 2014 occurred off LA (56%), followed by TX (27%, Table 2, Figure 2), and seasonally, the most effort occurs between May – August (45%) and September - December (38%, Table 2). By depth, most otter trawl effort took place in offshore waters (> 10 fathoms, 39%), followed by nearshore waters (36%) and inshore waters (25%, Table 2).

Between January 1997 and December 2014, a total of 1,037 trips and 427 unique vessels were observed by the NMFS Gulf of Mexico shrimp otter trawl fishery Observer Program, which includes periods of voluntary and mandatory coverage. During the 2012 - 2014 period, 248 trips and 190 unique vessels were observed, with a mean of 1.3 trips per vessel. Repeated observation of vessels during the mandatory coverage period is mainly due to multiple observed trips per vessel to reach the 18-day minimum requirement for observer placement. For fully stratified analyses of bycatch rate, the 1,037 trips yielded a total of 1,890 trip*strata observations, as trips frequently crossed strata (years, seasons, depths, state areas), covering, on average, 1.82 strata per trip. In total, 35,059 tows were observed for a total of 185,787 hours fished, of which 9,904 tows and 53,737 hours fished occurred during 2012 through 2014. An additional 1,388 tows were not observed between 2007 and 2014, yielding an estimated 193,270 hours fished, of which 426 unobserved tows occurred between 2012 and 2014 yielding 56,092 hours fished total on observed trips in these three years. Mean annual fishery effort for 2012 to 2014 was 2,221,344 ± 72,272 hours fished, and mean observed effort was 17,912 ± 2,532 hours fished. The Observer Program coverage of the otter trawl fishery was 0.67%, 0.87%, and 0.89% in 2012, 2013, and 2014, respectively. A major limitation for marine mammal bycatch estimation is that the Observer Program does not attempt to cover state-licensed vessels in inshore waters, which represent up to 45% of annual effort from the fishery, or state-licensed vessels operating in nearshore waters.

Observed Marine Mammal Interactions

From 2012 to 2014, two bottlenose dolphin mortalities were observed in offshore (≥10 fathom) waters during the May – Aug season, with one occurring off Louisiana in 2013 and one off Texas in 2014. The 2013 dolphin was entangled in a line running from the trawl footrope to the tickler chain. The 2014 dolphin was entangled in the lazy line and elephant ears (e.g. Appendix B). Including these two, a total of 14 marine mammal interactions were observed by the NMFS Observer Program between 1997 and 2014 (Table 5, Figure 1).

Bycatch Rate and Bycatch Mortality Estimates

The effort, bycatch rate, and annual bycatch mortality estimates for marine mammal stocks from each of the two stratification methods and two species scenarios are presented in

Appendix D, and the five-year unweighted mean annual total bycatch mortality estimates for 2012 through 2014 are presented for each bottlenose and spotted dolphin stock in Table 6.

For the Continental Shelf stock of bottlenose dolphins, median bycatch mortality estimates remain relatively constant over time, at or just above 10% of PBR under the species scenario in which unidentified dolphins are all assigned to bottlenose dolphins, depending on the area-stratification method (Figure 3). Under the species scenario in which unidentified dolphins are all assigned to spotted dolphins, median bycatch mortality estimates exhibit an increasing trend from 2012 to 2014; all median estimates remain under 10% of PBR though 95% CIs extend above 10% of PBR in 2014 (Figure 3). The increasing trend is influenced by increasing bycatch rates in some strata due to the two observed takes in 2013 and 2014 occurring in waters of this stock's range and the improvement in positively identifying observed dolphin takes in recent years (Table 5, Appendix D3). Annual fishery effort in strata overlapping the range of the Continental Shelf bottlenose dolphin stock remained relatively constant over this time period (Appendix D1, 2, Figure 3).

For the Western Coastal stock of bottlenose dolphins, across all models, median annual bycatch mortality estimates range between 10% and 50% of the stock's PBR, with 95% CIs remaining below PBR. Bycatch mortality estimates are relatively constant over time, except for a decrease in 2013 which appears to be influenced by a decrease in fishery effort in LA nearshore waters during winter 2013; the LA nearshore winter strata has the second highest estimated bycatch rates (Table 2, Appendix D3). For the Northern Coastal stock of bottlenose dolphins, across all models, there is a decreasing trend in median annual bycatch mortality estimates with median estimates approaching or below 10% of the stocks PBR, and with 95% CIs remaining below 50% of the stock's PBR. The trends in estimated bycatch mortality appear to be driven by decreased effort in AL/MS state area nearshore waters in 2012 to 2014, particularly during winter which is the stratum with the highest estimated bycatch rates of all strata (Appendix D1-3). For the Eastern Coastal stock of bottlenose dolphins, median annual bycatch mortality estimates remain relatively constant since 2011 and from 2012-2014, 95% CIs remain under 10% of the stock's PBR under the species scenario in which unidentified dolphins are all assigned to spotted dolphins, for both area-stratification models. Under the species scenario in which unidentified dolphins are all assigned to spotted dolphins, bycatch mortality

estimates for the Eastern Coastal bottlenose dolphin stock are zero as all observed takes in waters off FL are unidentified to species.

For the TX BSE bottlenose dolphin stocks 2-area stratification method, annual bycatch mortality estimates were similar to previous years during 2012 and 2013 with the median estimates falling between 10 and 100% of the aggregate TX BSE stocks last known PBRs for both species scenarios (Figure 3). In 2014, the median bycatch mortality estimates spiked to 6-7 times the last known aggregate PBR, mirroring a dramatic increase (5 times the 2013 levels) in fishery effort in TX state area inshore waters (Appendix D1-3, Figure 3). Under the 4-area stratification method, bycatch mortality estimates for TX BSE bottlenose dolphin stocks are zero as there have been no observed MSI takes in TX nearshore waters. For the LA BSE bottlenose dolphin stocks, annual bycatch mortality estimates were lower from 2012 to 2014 than they were from 2009 to 2011; however the median and 95% CI estimates remain at 10 – 20 times greater than the aggregate LA BSE stocks last known PBRs for all models for all three years (Figure 3). The decrease is mainly due to decreasing annual fishing effort in the LA state area inshore waters from 2012 to 2014 (Appendix D1-2). For the AL/MS BSE bottlenose dolphin stocks, annual bycatch mortality estimates were lower from 2012 to 2014 than they were from 2009 to 2011: in 2012 and 2013, the median estimates were between 50-100% aggregate AL/MS BSE stocks last known PBRs for most models, but above the PBR threshold for the 4-area Tursiops-only model (Figure 3), while median estimates from all models for 2014 approached 10% of the aggregate AL/MS BSE stocks last known PBRs. This decrease is mainly due to decreasing annual fishing effort in the AL/MS state area inshore waters from 2012 to 2014 (Appendix D1-2). For the FL BSE bottlenose dolphin stocks, annual bycatch mortality estimates were also lower from 2012 to 2014 than they were from 2009 to 2011, with the median and 95% CI estimates falling at or below 10% of the aggregate FL BSE bottlenose dolphin stocks last known PBRs for all models for all three years (Figure 3). This decrease is mainly due to low annual fishing effort in the FL state area inshore waters during 2012 and 2014, while in 2013 most effort in these waters occurred during summer, a season with no observed dolphin takes in FL state area nearshore waters (Appendix D1-3). Under the species scenario in which unidentified dolphins are all assigned to spotted dolphins, bycatch mortality estimates for FL BSE bottlenose dolphin stocks are zero as all observed takes in waters off FL are unidentified to species.

There has been a decreasing trend in annual bycatch mortality of the Atlantic spotted dolphin stock since 2009 under the species scenario in which unidentified dolphins are all assigned to spotted dolphins, for both area-stratification methods (Figure 3), with the median estimated annual bycatch approaching or dropping under 10% of the last known PBR. The range of 95% CI estimates falls between 0 and 50% of the last known PBR for 2012 through 2014. The decreasing trend is mainly influenced by a decreasing bycatch rate due to the lack of unidentified dolphin takes observed in recent years (Table 5); annual fishery effort in strata overlapping the range of spotted dolphins remained relatively constant over this time period. Under the species scenario in which unidentified dolphins are all assigned to bottlenose dolphins, bycatch mortality estimates for spotted dolphins are zero as no takes observed by the Observer Program have been positively identified as spotted dolphins.

Across all dolphin stocks, 5-year means (Table 6) tended to be higher in each year than the annual bycatch mortality estimates (Appendix D3) since bycatch estimates were often decreasing with decreasing effort (Figure 3), as described above and means represent the trailing 5 years. Additionally, as model stratification increases, bycatch mortality estimates for many dolphin stocks increase with corresponding increases in uncertainty. The exceptions are the Western Coastal and TX BSE stocks when all unidentified dolphins are identified as bottlenose dolphins, and spotted dolphins when all unidentified dolphins are identified as spotted dolphins. This difference results from high bycatch rates for AL/MS and LA nearshore winter strata in which there were two bycaught animals and relatively lower Observer Program effort. With lower levels of stratification, these catches are "spread out" over greater effort coverage, hence decreasing the estimated catch in LA and AL/MS nearshore regions and increasing catch in the TX nearshore region.

Sources of Bias and Uncertainty

The greatest sources of error and bias in bycatch mortality estimates come from inadequate knowledge of both the fishery and the stocks it impacts including: 1) distribution of fishery effort in inshore waters, 2) bycatch rates of dolphins in inshore waters, 3) stock abundance, particularly in inshore waters, and 4) whether skimmer trawls and non-commercial fisherman catch dolphins. Brief descriptions of these and additional sources of bias and uncertainty follow and further details can be found in Soldevilla et al. (2015).

Estimation of total fishery effort, and hence bycatch mortality estimates, may be biased by three factors. First, the distribution of total fishery effort by strata may be biased in some areas. Modeled effort may be higher in western offshore waters and lower in western nearshore waters due to misallocation of effort based on landings data and port agent interviews (Nance 1992, Gallaway et al. 2003). This most likely would result in our bycatch mortality estimate for the Western Coastal stock of bottlenose dolphins being biased low, but this effort distribution bias has been reduced in recent years by incorporating effort location information from electronic logbook data into models of total effort (Nance et al. 2008). Additionally, the modeled fishery effort in inshore waters cannot be finely distributed at the BSE level, and therefore the fishery impact on individual BSE stocks cannot be estimated. Second, total inshore fishery effort from skimmer trawls has been removed from total fishery effort as it is unknown whether this commercial fishery gear type results in marine mammal bycatch mortalities. Total otter trawl effort and resulting bycatch estimates for inshore waters of LA, MS, and AL may be biased by the assumption that CPUEs are equal across gear types and therefore the proportion of landings can be used as a proxy for proportion of fishery effort. Also, the removal of the high levels of skimmer trawl effort in the inshore waters of LA, MS, and AL may bias bycatch mortality estimates low if this gear type results in mortalities. Since 2013, two bycatch interactions have been observed in a research skimmer trawl, one in which the animal was released alive and in good condition, and one resulting in mortality (Pers. comm. Keith Mullin, NOAA Fisheries, SEFSC). Observer Program coverage is being increased on commercial skimmer trawls to evaluate whether commercial skimmer trawl effort results in marine mammal bycatch mortalities. Finally, total inshore effort, and possibly bycatch mortality estimates for BSE stocks, may be biased low as commercial shrimp fishery effort data do not include shrimp harvested by recreational fishermen, small-scale commercial fishermen that sell their catches along roadsides (Poffenberger 1991), or those caught for use as bait. It is unknown whether non-commercial fishery effort results in marine mammal bycatch mortalities.

Two factors associated with Observer Program coverage may bias estimation of bycatch rates. First, a major data gap in Observer Program coverage in inshore waters led to our assumption that bycatch rates in inshore waters are similar to those in nearshore waters of the same area and seasonal strata. The direction and degree of the resulting bias in bycatch mortality estimates for inshore waters is completely unknown, but is likely more reasonable than

assuming no bycatch mortality in the inshore waters where effort is high. Pilot projects are underway to place observers on inshore vessels to reduce this data gap. Second, bycatch rates in nearshore and inshore waters may be biased if rates differ between observed federally-permitted vessels and non-observed state-permitted vessels. If smaller vessels that tow fewer nets for shorter durations have lower mammal bycatch rates, as has been suggested for turtles (Epperly et al. 2002), bycatch mortality estimates might be biased high in inshore waters. The effect of vessel size, speed, and number of nets towed on mammal bycatch rates is completely unknown; the observer program pilot projects will also address this data gap.

Lastly, four factors associated with quantifying species and stock information may bias estimation of bycatch rates. First, uncertainty in species ID of unidentified marine mammal takes was addressed by estimating best-case and worst-case scenarios for each species. Given the lack of spotted dolphins in identified takes, the worst-case scenario bottlenose dolphin estimates (all unidentified delphinids are assigned to bottlenose dolphin) are probably more accurate, particularly in western waters where spotted dolphin abundance is lower. Second, errors may have occurred in the assignment of takes to Gulf of Mexico bottlenose dolphin stocks where stock boundaries and shrimp trawl fishery strata boundaries do not align. Three notable deviations include: 1) the discrepancy between the Northern Coastal/Eastern Coastal stock boundaries and the FL vs AL/MS state area boundary which may bias mortalities estimates low for the Northern Coastal stock and high for the Eastern Coastal stock, 2) the grouping of all BSE stocks within a state due to lack of finer resolution effort data and 3) limited knowledge of population boundaries and seasonal movements. Third, there is a high degree of uncertainty in the status of the 26 stocks with abundance and PBR estimates older than 8 years (Waring et al. 2016) and in what levels of shrimp fishery bycatch mortality they can sustain. Recent photo-identification mark-recapture surveys have been conducted and updated abundance estimates are being calculated for the Barataria Bay, LA, Terrebonne/Timbalier Bays, LA, Galveston/East/Trinity Bays, TX, and West Bay, TX stocks of bottlenose dolphins. Finally, bycatch mortality estimates may be biased low for the Continental Shelf bottlenose dolphin and Atlantic spotted dolphin stocks if the one animal observed to be released alive was in fact a serious injury. Observer comments indicated that the animal was entangled in the lazy line, the line was cut, the animal was released alive and appeared in good condition with no noticeable injuries but additional entanglement details were not available to determine the likelihood of

capture myopathy, unobservable internal injuries, or separation from its social group that may have led to subsequent mortality (Angliss and DeMaster 1998)(Andersen et al. 2008, NMFS 2012).

Variance

Sources of variance uncertainty in these bycatch mortality estimates that could not be accounted for include: 1) estimates of uncertainty from fishery effort models (Nance 1992, Nance 2004); 2) within-vessel variance among trips due to the two-stage vessels then trips sampling design; 3) variation in the number of nets towed, particularly in nearshore and inshore waters; and 4) errors in assigning effort to strata from unobserved tows which could affect both bycatch rate and effort variance. These effects are probably random and non-directional in nature and unlikely to bias bycatch mortality estimates and variances. Finally, variance calculations may be biased due to the inclusion of voluntary Observer Program data from 1997 - 2006; however, this bias is expected to be small compared to the improvements in estimation realized by including more years of data for a dataset with such a high quantity of zeros.

SUMMARY

This report presents estimates of total annual bycatch mortality of marine mammals in the Gulf of Mexico shrimp otter trawl fishery for 2012 to 2014. Two stratification methods were considered along with two scenarios to account for unidentified marine mammal species catch, and in all cases, bycatch mortality estimates exceed 10% of potential biological removal (PBR) for Western Coastal bottlenose dolphin stock while bycatch mortality estimates for the Northern Coastal bottlenose dolphin stock are decreasing and were at or below 10% of PBR in 2013-2014. It remains possible that the PBR threshold has been substantially exceeded for LA BSE bottlenose dolphin stock, and that the threshold may have been exceeded for the TX BSE in 2014, while bycatch mortalities may have dropped below the PBR threshold for the AL/MS BSE bottlenose dolphin stocks in 2014; however, further data on both abundance and bycatch rates in inshore waters are required to determine whether this has occurred. Other stocks which may have shrimp otter trawl bycatch mortalities above 10% PBR include Shelf bottlenose dolphin stock and the Atlantic spotted dolphin stock, while the Eastern Coastal and FL BSE bottlenose dolphin stocks are at lower risk and approaching the zero mortality rate goal (i.e., under 10%

PBR). The greatest sources of error and bias in bycatch mortality estimates come from inadequate knowledge of both the fishery and the stocks it impacts including: 1) distribution of fishery effort in inshore waters, 2) bycatch rates of dolphins in inshore waters, 3) stock abundance, particularly in inshore waters, and 4) whether skimmer trawls and non-commercial fisherman catch dolphins.

Recent stock assessment surveys have been conducted and updated abundance estimates are being calculated for the Barataria Bay, LA, Terrebonne/Timbalier Bays, LA, Galveston/East/Trinity Bays, TX, and West Bay, TX stocks of bottlenose dolphins, but abundance estimates are outdated for most of the remaining inshore stocks. New surveys for the remaining inshore stocks would reduce uncertainty in PBR for these stocks.

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LITERATURE CITED

Alverson DL, Freeberg MH, Murawski SA, Pope JG (1994) A global assessment of fisheries bycatch and discards. FAO Fishery Technical Papers 339:235

Amante C, Eakins BW (2009) ETOPO1 1 Arc-Minute Global Relief Model: Procedures, Data Sources and Analysis. NOAA Technical Memorandum NESDIS NGDC-24

Andersen MS, Forney KA, Cole TV, Eagle T and others (2008) Differentiating serious and non-serious injury of marine mammals: Report of the serious injury technical workshop. NOAA Technical Memorandum NMFS-OPR 39

Angliss RP, DeMaster DP (1998) Differentiating Serious and Non-Serious Injury of Marine Mammals Taken Incidental to Commercial Fishing Operations. NOAA Tech Memo NMFS-OPR-13

Caillouet Jr CW, Hart RA, Nance JM (2011) Simulation of tail weight distributions in biological year 1986–2006 landings of brown shrimp, *Farfantepenaeus aztecus*, from the northern Gulf of Mexico fishery. Marine Fisheries Review 73:27-40

Caldwell DK (1955) Notes on the spotted dolphin, *Stenella plagiodon*, and the first record of the common dolphin, *Delphinus delphis*, in the Gulf of Mexico. Journal of Mammalogy:467-470

Coale JS, Rulifson RA, Murray JD, Hines R (1994) Comparisons of shrimp catch and bycatch between a skimmer trawl and an otter trawl in the North Carolina inshore shrimp fishery. North American Journal of Fisheries Management 14:751-768

Cochran WG (1977) Sampling Techniques. John Wiley & Sons, New York

Delgado Estrella A (1997) Relación de las toninas, *Tursiops truncatus*, y las toninas moteadas, *Stenella frontalis*, con la actividad camaronera en la Sonda de Campeche, México. Anales del Instituto de Biología serie Zoología 68

Efron B (1987) Better Bootstrap Confidence Intervals. Journal of the American Statistical Association 82:171-185

Efron B, Tibshirani RJ (1994) An introduction to the bootstrap. CRC press

Epperly S, Avens L, Garrison L, Henwood T and others (2002) Analysis of sea turtle bycatch in the commercial shrimp fisheries of southeast US waters and the Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-490^, NOAA/National Marine Fisheries Service/Southeast Fisheries Science Center, Miami, FL

Epperly SP, Teas WG (2002) Turtle excluder devices-are the escape opening large enough? Fishery Bulletin 100:466-474

Fazioli KL, Hofmann S, Wells RS (2006) Use of Gulf of Mexico coastal waters by distinct assemblages of bottlenose dolphins (*Tursiops truncatus*). Aquatic Mammals 32:212-222

Fertl D, Leatherwood S (1997) Cetacean interactions with trawls: a preliminary review. Journal of Northwest Atlantic Fishery Science 22:219-248

Gallaway B (1981) An Ecosystem Analysis of Oil and Gas Development on the Texas-Louisiana Continental Shelf. FWS/OBS-81/27, US Fish and Wildlife Service, Office of Biological Services, Washington, DC

Gallaway BJ, Cole JG, Martin LR, Nance JM, Longnecker M (2003) An evaluation of an electronic logbook as a more accurate method of estimating spatial patterns of trawling effort and bycatch in the Gulf of Mexico shrimp fishery. North American Journal of Fisheries Management 23:787-809

Hein S, Meier P (1995) Skimmers: Their development and use in coastal Louisiana. Marine Fisheries Review 57:17-24
Henwood TA, Stunz WE (1987) Analysis of sea turtle captures and mortalities during commercial shrimp trawling. Fishery Bulletin 85:813-817
Irvine AB, M.D. Scott, Wells RS, Kaufmann JH (1981) Movements and activities of the Atlantic bottlenose dolphin, *Tursiops truncatus*, near Sarasota, Florida. Fishery Bulletin 79:671-688
Jenkins LD (2012) Reducing sea turtle bycatch in trawl nets: A history of NMFS Turtle Excluder Device (TED) research. Marine Fisheries Review 74:26-44
Maiolo JR (2004) Hard Times and a Nickel a Bucket: Struggle and Survival in North Carolina's Shrimp Industry. Chapel Hill Press
Maril RL (1983) Texas shrimpers: community, capitalism, and the sea. Texas A&M University Press, College Station, Texas
Maril RL (1995) Bay shrimpers of Texas: rural fishermen in a global economy. University of Kansas Press, Lawrence
Mullin K, Hansen L (1999) Marine mammals of the northern Gulf of Mexico. In: Kumpf H, Steidinger K, Sherman K (eds) Gulf of Mexico: A large marine ecosystem. Blackwell Science, Malden, MA., p 269-277
Nance J, Keithly Jr. W, Caillouet Jr. C, Cole J and others (2008) Estimation of Effort, Maximum Sustainable Yield, and Maximum Economic Yield in the Shrimp Fishery of the Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-570
Nance JM (1992) Estimation of effort for the Gulf of Mexico shrimp fishery. US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Galveston Laboratory
Nance JM (1993) Effort Trends for the Gulf of Mexico Shrimp Fishery. NOAA Technical Memorandum NMFS-SEFSC-337
Nance JM, Caillouet Jr. CW, Hart RA (2010) Size-composition of annual landings in the white shrimp, *Litopenaeus setiferus*, fishery of the northern Gulf of Mexico 1960-2006: Its trend and relationships with other fishery-dependent variables. Marine Fisheries Review 72:1-13
Nance JN (2004) Estimation of Effort in the Offshore Shrimp Trawl Fishery of the Gulf of Mexico. SEDAR7-DW-24, NOAA Fisheries, SEFSC Galveston Laboratory
National Marine Fisheries Service (1995) Report to Congress: cooperative research program addressing finfish bycatch in the Gulf of Mexico and South Atlantic shrimp fisheries. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, St. Petersburg, Florida (available at http://galveston.ssp.nmfs.gov/publications/pdf/620.pdf)
National Marine Fisheries Service (1998) Report to Congress: southeastern United States shrimp trawl bycatch program. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Galveston Laboratory, Galveston, Texas (available at http://galveston.ssp.nmfs.gov/publications/pdf/235.pdf)
National Marine Fisheries Service (2010) Characterization of the U.S. Gulf of Mexico and southeastern Atlantic otter trawl and bottom reef fish fisheries. Observer Training Manual. NMFS, Southeast Fish. Sci. Cent., Galveston Laboratory, , Galveston, Tex. (avail. at http://www.st.nmfs.noaa.gov/Assets/Observer-Program/pdf/Shrimp_Reef_fish_Manual_9_22_10.pdf

National Marine Fisheries Service (2012) Guidelines for Distinguishing Serious from Non-Serious Injury of Marine Mammals Pursuant to the Marine Mammal Protection Act.
National Oceanic and Atmospheric Administration (2002) Fisheries of the United States. (available at http://www.st.nmfs.noaa.gov/st1/commercial/index.html), (accessed April 2013)
National Oceanic and Atmospheric Administration (2012) Shrimp Observer Program. (available at http://www.st.nmfs.noaa.gov/observer-home/regions/southeast/shrimp), (accessed April 2013)
Nichols S, Shah A, Pellegrin Jr. G, Mullin K (1987) Estimates of annual shrimp fleet bycatch for thirteen finfish species in the offshore waters of the Gulf of Mexico. Report to the Gulf of Mexico Fisheries Management Council, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, Mississippi
Patella F (1975) Water surface area within statistical subareas used in reporting Gulf Coast shrimp data. Marine Fisheries Review 37:22-24
Pellegrin Jr. G (1982) Fish discards from the southeastern United States shrimp fishery. In: Fish-bycatch … Bonus from the sea: a report of a technical consultation on shrimp by-catch utilization held in Georgetown, Guyana, 27-30 October 1981. FAO International Development and Research Center, Ottawa, Ontario, p 51-54
Poffenberger JR (1991) An overview of the data collection procedures for the shrimp fisheries in the Gulf of Mexico. Unpublished report. National Marine Fisheries Service, Miami, FL, p 19
Price B, Gearhart J (2011) Evaluations of turtle excluder device (TED) performance in the US southeast Atlantic and Gulf of Mexico skimmer trawl fisheries. US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center
Pulver JR, Scott-Denton E, Williams JA (2012) Characterization of the U.S. Gulf of Mexico skimmer trawl fishery based on observer coverage. NOAA Technical Memorandum NMFS-SEFSC-636
Scott-Denton E (2007) U.S. southeastern shrimp and reef fish resources and their management. Ph.D. Dissertation, Texas A&M University
Scott-Denton E, Cryer P, Gocke J, Harrelson M and others (2006) Skimmer trawl fishery catch evaluations in Coastal Louisiana, 2004 and 2005. Marine Fisheries Review 68:30-35
Scott-Denton E, Cryer PF, Duffy MR, Gocke JP and others (2012) Characterization of the U.S. Gulf of Mexico and South Atlantic penaeid and rock shrimp fisheries based on observer data. Marine Fisheries Review 74:1-27
Scott GP (1990) Management-oriented research on bottlenose dolphins by the Southeast Fisheries Center. In: Leatherwood S, Reeves RR (eds) The bottlenose dolphin Academic Press, San Diego, CA, p 623-639
Soldevilla MS, Garrison LP, Scott-Denton E, Nance JM (2015) Estimation of Marine Mammal Bycatch Mortality in the Gulf of Mexico Shrimp Otter Trawl Fishery. NOAA Technical Memorandum NMFS-SEFSC-672, NOAA Technical Memorandum NMFS-SEFSC-672
Wade PR, Angliss RP (1997) Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop, April 3-5, 1996, Seattle, Washington. NOAA Technical Memorandum NMFS-OPR-12, US Department of Commerce, National Oceanic and

Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources
Waring G, Josephson E, Fairfield-Walsh C, Maze-Foley K (2009a) U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2008. NOAA Tech Memo NMFS NE 210
Waring G, Josephson E, Maze-Foley K, Rosel P (2009b) U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2009. NOAA Tech Memo NMFS NE 213
Waring GT, Josephson E, Maze-Foley K, Rosel PE (2012) U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2011 NOAA Technical Memorandum NMFS-NE-221 U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, Massachusetts
Waring GT, Josephson E, Maze-Foley K, Rosel PE (2016) U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2015. NOAA Technical Memorandum NMFS-NE-238, US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA
Waring GT, Palka DL, Clapham PJ, Swartz S and others (1999) U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 1999. NOAA Techniacal Memorandum NMFS-NE-153
Warner DA, McMillen-Jackson AL, Bert TM, Crawford CR (2004) The efficiency of a bycatch reduction device used in skimmer trawls in the Florida shrimp fishery. North American Journal of Fisheries Management 24:853-864

Table 1. Summary of 2014 stock assessment information for Gulf of Mexico bottlenose dolphin (Tt) and Atlantic spotted dolphin (Sf) stocks. Estimates in red are NOT VALID as they are older than 8 years. They are included only for a sense of scale when comparing to bycatch mortality estimates. Updated abundance (N_{best} and N_{min}) and Potential Biological Removal (PBR) estimates MUST be completed before bycatch impacts on stocks can be accurately assessed. There are 32 Bay, Sound and Estuary (BSE) stocks managed by NOAA NMFS, however bycatch can only be estimated at the state level resolution (TX, LA, AL/MS, and FL) for these waters. For BSE stocks, N_{best}, N_{min}, and PBR represent the combined total for all BSE stocks found within state waters (Note eastern LA BSE stocks are included in AL/MS waters). The minimum PBR and maximum PBR for all individual BSE stocks in a given state's waters are included in parentheses, and represent the range of scenarios if bycatch is limited to a single stock within that state. Ideally, it would be best to use the PBR of the affected stock if all of a state's BSE bycatch is limited to a single stock; however, geographic resolution of the shrimp fishery effort is limited to the state level and this cannot be determined.

Dolphin Stock	Stocks	N_{best}	CV	N_{min} (min; max)	PBR (min; max)	Last Survey
Tt Shelf	1	51,192	0.10	46,926	469	2011-2012
Tt Western Coastal	1	20,161	0.17	17,491	175	2011-2012
Tt Northern Coastal	1	7,185	0.21	6,044	60	2011-2012
Tt Eastern Coastal	1	12,388	0.13	11,110	111	2011-2012
Tt TX BSE stocks *	6	438	varies	274 (28; 107)	2.8 (0.3; 1.1)	Varies
Tt LA BSE stocks *	5	238	varies	195 (0; 129)	2.0 (0; 1.3)	Varies
Tt AL/MS BSE stocks *	4	1355	varies	813 (0; 551)	8.2 (0; 5.6)	Varies
Tt FL BSE stocks *	16	3683	varies	3015(0; 766)	30 (0; 7.7)	Varies
Sf Northern GoM	1	37,611	0.28	29,844	298	2001-2004

* BSE stocks included in each state area are as follows:
1) TX [Laguna Madre; Nueces Bay, Corpus Christi Bay; Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay; Matagorda Bay, Tres Palacios Bay, Lavaca Bay; West Bay; Galveston Bay, East Bay, Trinity Bay];
2) LA [Sabine Lake; Calcasieu Lake; Vermilion Bay, West Cote Blanche Bay, Atchafalaya Bay; Terrebonne Bay, Timbalier Bay; Barataria Bay (Note Sabine Lake is on the border of LA & TX)];
3) AL/MS [Mississippi River Delta; Mississippi Sound, Lake Borgne, Bay Boudreau; Mobile Bay, Bonsecour Bay; Perdido Bay (Note Perdido Bay is on the border of AL & FL)]; and
4) FL [Pensacola Bay, East Bay; Choctawhatchee Bay; St. Andrew Bay; St. Joseph Bay; St. Vincent Sound, Apalachicola Bay, St. George Sound; Apalachee Bay; Waccasassa Bay, Withlacoochee Bay, Crystal Bay; St. Joseph Sound, Clearwater Harbor; Tampa Bay; Sarasota Bay, Little Sarasota Bay; Lemon Bay, Pine Island Sound, Charlotte Harbor, Gasparilla Sound; Caloosahatchee River; Estero Bay; Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay; Whitewater Bay; Florida Keys (Bahia Honda to Key West)].

Table 2. Annual Gulf of Mexico shrimp trawl fishery effort by strata (state area, depth zone and season) as corrected for otter trawls only in hours fished. Percentage of total effort (i.e. including skimmer effort) is presented for depth zone 0 in State Areas 2 and 3. State Areas: 1 = FL, 2 = AL/MS, 3 = LA, 4= TX. Depth Zones: 0 = Inshore, 1 = 0 – 10 fathom (0-18 m); 2 = 10+ fathom (18+ m). Seasons: 1 = Jan – Apr, 2 = May – Aug, 3 = Sept – Dec.

			Otter Trawl Fishery Effort in Hours Fished (% of Total Effort)			
Year	State Area	Depth Zone	Season 1	Season 2	Season 3	Annual Total
2011	1	0	12,009.6	50,296.8	22,118.4	84,424.8
2011	1	1	4,165.7	10,189.7	3,693.6	18,049.0
2011	1	2	42,652.6	50,071.4	28,929.1	121,653.1
2011	2	0	32,352.1 (82.4)	64,914.8 (59.5)	66,557.6 (52.5)	163,824.5
2011	2	1	11,040.2	42,691.0	12,503.3	66,234.5
2011	2	2	16,039.7	37,166.6	18,305.8	71,512.1
2011	3	0	123,512.9 (78.8)	212,118.9 (53.6)	174,501.9 (45.9)	510,133.8
2011	3	1	72,076.8	243,356.2	148,879.2	464,312.2
2011	3	2	59,122.3	186,704.9	98,292.2	344,119.4
2011	4	0	1,507.2	17,208.0	9,960.0	28,675.2
2011	4	1	14,726.9	33,317.5	49,134.2	97,178.6
2011	4	2	78,025.4	121,558.8	220,015.7	419,599.9
2012	1	0	973.7	1,093.7	2,378.4	4,445.8
2012	1	1	2,803.2	5,636.6	1,727.5	10,167.4
2012	1	2	51,389.8	15,818.9	37,198.3	104,407.0
2012	2	0	4,967.0 (82.8)	63,618.6 (68.7)	43,022.1 (31.0)	111,607.8
2012	2	1	8,300.4	52,277.8	29,514.0	90,092.2
2012	2	2	4,025.0	42,269.8	39,739.4	86,034.2
2012	3	0	48,089.7 (78.4)	199,377.7 (52.4)	165,640.0 (42.0)	413,107.4
2012	3	1	86,462.2	338,176.8	215,582.2	640,221.1
2012	3	2	73,821.6	123,547.9	112,324.1	309,693.6
2012	4	0	5,841.8	27,507.1	6,102.2	39,451.2
2012	4	1	32,360.4	60,774.2	54,880.3	148,015.0
2012	4	2	30,789.1	90,550.6	182,149.9	303,489.6
2013	1	0	4,914.2	63,687.8	7,615.9	76,218.0
2013	1	1	3,097.2	9,881.0	1,806.5	14,784.7
2013	1	2	72,643.9	35,030.9	4,868.4	112,543.2
2013	2	0	1,473.8 (76.4)	44,070.9 (60.4)	59,419.8 (55.3)	104,964.5
2013	2	1	1,855.7	41,367.6	22,379.0	65,602.3
2013	2	2	13,159.7	62,743.4	32,859.1	108,762.2
2013	3	0	24,604.3 (79.1)	218,038.3 (50.6)	127,959.1 (45.9)	370,601.6
2013	3	1	30,778.1	278,980.3	144,671.5	454,429.9
2013	3	2	63,735.1	167,721.1	84,287.0	315,743.3
2013	4	0	492.2	18,606.2	12,710.2	31,808.6
2013	4	1	17,423.5	54,809.3	50,101.4	122,334.2
2013	4	2	38,703.1	104,396.9	217,041.4	360,141.4
2014	1	0	5,209.0	8,590.3	126.2	13,925.5
2014	1	1	4,750.8	8,536.3	38.6	13,325.8
2014	1	2	39,362.4	29,857.9	3,674.9	72,895.2
2014	2	0	2,036.5 (79.9)	13,332.7 (39.4)	6,615.8 (27.5)	21,985.0
2014	2	1	3,859.9	35,011.4	26,692.3	65,563.7
2014	2	2	17,569.0	29,887.0	44,775.1	92,231.0
2014	3	0	94,226.9 (87.3)	114,123.0 (39.2)	89,625.0 (41.0)	297,974.8
2014	3	1	111,816.5	281,687.8	221,981.0	615,485.3
2014	3	2	49,339.2	165,082.6	84,285.8	298,707.6
2014	4	0	72,587.3	37,861.7	52,647.8	163,096.8
2014	4	1	74,426.9	36,102.0	57,643.0	168,171.8
2014	4	2	28,482.0	139,583.5	273,937.0	442,002.5

Table 3. Annual Gulf of Mexico shrimp trawl Observer Program effort and percentage of observed to total effort by strata (state area, depth zone and season). State Areas: 1 = FL, 2 = AL/MS, 3 = LA, 4= TX. Depth Zones: 0 = Inshore, 1 = 0 – 10 fathom (0-18 m); 2 = 10+ fathom (18+ m). Seasons: 1 = Jan – Apr, 2 = May – Aug, 3 = Sept – Dec. The two strata in which a marine mammal take was observed are indicated by bold text.

			Otter Trawl Fishery Observed Effort in Hours Fished				Otter Trawl Fishery Percent Observed Effort			
Year	State Area	Depth Zone	Season 1	Season 2	Season 3	Annual Total	Season 1	Season 2	Season 3	Annual Total
2012	1	0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00
2012	1	1	262.2	19.5	0.0	281.7	9.35	0.35	0.00	2.77
2012	1	2	564.2	347.7	409.0	1,320.9	1.10	2.20	1.10	1.27
2012	2	0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00
2012	2	1	150.8	65.6	366.5	582.9	1.82	0.13	1.24	0.65
2012	2	2	58.3	28.3	393.5	480.1	1.45	0.07	0.99	0.56
2012	3	0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00
2012	3	1	342.6	871.9	1,152.6	2,367.1	0.40	0.26	0.53	0.37
2012	3	2	1,606.7	417.4	1,136.4	3,160.5	2.18	0.34	1.01	1.02
2012	4	0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00
2012	4	1	198.5	98.9	359.5	656.9	0.61	0.16	0.66	0.44
2012	4	2	248.4	1,831.4	4,194.4	6,274.2	0.81	2.02	2.30	2.07
2013	1	0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00
2013	1	1	27.4	4.9	0.0	32.3	0.88	0.05	0.00	0.22
2013	1	2	547.5	195.0	139.8	882.3	0.75	0.56	2.87	0.78
2013	2	0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00
2013	2	1	101.3	401.3	105.5	608.1	5.46	0.97	0.47	0.93
2013	2	2	385.8	683.7	85.1	1,154.6	2.93	1.09	0.26	1.06
2013	3	0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00
2013	3	1	566.5	3080.0	736.6	4,383.1	1.84	1.10	0.51	0.96
2013	3	2	1,179.3	**2,704.4**	1,375.5	5,259.2	1.85	1.61	1.63	1.67
2013	4	0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00
2013	4	1	820.0	556.5	378.2	1,754.7	4.71	1.02	0.75	1.43
2013	4	2	372.3	1,196.4	2,900.1	4,468.8	0.96	1.15	1.34	1.24
2014	1	0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00
2014	1	1	443.3	128.8	50.5	622.6	9.33	1.51	130.69	4.67
2014	1	2	769.0	910.3	52.2	1,731.5	1.95	3.05	1.42	2.38
2014	2	0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00
2014	2	1	7.9	619.8	971.5	1,599.2	0.20	1.77	3.64	2.44
2014	2	2	47.2	1,021.4	582.0	1,650.6	0.27	3.42	1.30	1.79
2014	3	0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00
2014	3	1	404.8	1,971.9	2,765.9	5,142.6	0.36	0.70	1.25	0.84
2014	3	2	1,513.5	824.3	523.8	2,861.6	3.07	0.50	0.62	0.96
2014	4	0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00
2014	4	1	1,501.8	387.3	359.3	2,248.4	2.02	1.07	0.62	1.34
2014	4	2	443.3	**851.5**	2,918.3	4,213.1	1.56	0.61	1.07	0.95

Table 4. Gulf of Mexico shrimp trawl fishery strata (by state areas and depth zones) associations with delphinid stocks. Upper panel refers to common bottlenose dolphin, (*T. truncatus*) stocks while lower panel refers to Atlantic spotted dolphin (*S. frontalis*) stock. Inshore depth zone encompasses waters inshore of the COLREGs demarcation lines, nearshore encompasses waters from the COLREGS lines out to 10 fathoms (18 m), and offshore waters are those greater than 10 fathoms (18 m) depth. All bay, sound, and estuary (BSE) bottlenose dolphin stocks within a state are grouped for this comparison since fishery effort is only available at the state area resolution level. There is a mismatch between the boundary of the FL and MS/AL state areas and the boundary of the Northern Coastal (N Coastal) and Eastern Coastal (E Coastal) bottlenose dolphin stocks, with the N Coastal stock boundary extending into FL waters along the panhandle.

	TX	LA	MS/AL	FL
Inshore	TX BSEs	LA BSEs	MS/AL BSEs	FL BSEs
Nearshore	W Coastal	W Coastal	N Coastal	E Coastal
Offshore	Shelf	Shelf	Shelf	Shelf
Inshore	-	-	-	-
Nearshore	*S. frontalis*	*S. frontalis*	*S. frontalis*	*S. frontalis*
Offshore	*S. frontalis*	*S. frontalis*	*S. frontalis*	*S. frontalis*

Table 5. Marine mammal bycatch incidents as reported by the Gulf of Mexico shrimp trawl Observer Program on the Protected Species Capture Report (Appendix C). All incidents, except one, occurred on ships towing 4 nets. The February 07, 2010 incident occurred on a ship towing only 2 nets.

Date	Time	Longitude	Latitude	Water Depth (ft.)	Species ID	Entanglement Gear	Release Condition
12/07/2001	0:30	-88.1372	30.1356	58	Marine Mammal	TED Net	Decomposed
03/26/2002	19:12	-82.3950	25.9656	85.6	Marine Mammal	Net	Unknown
03/05/2003	11:50	-88.1431	30.2378	23	Bottlenose Dolphin	Lazy Line	Fresh Dead
09/04/2004	19:54	-93.9992	28.3461	172	Marine Mammal	Lazy Line	Not Given
03/09/2006	18:20	-91.7431	28.1339	286	Marine Mammal	TED Net	Decomposed
03/27/2007	7:10	-82.4486	26.7056	57	Marine Mammal	TED Net	Not Given
12/28/2007	19:46	-91.5792	29.1717	23	Bottlenose Dolphin	Lazy Line	Fresh Dead
02/03/2008	0:56	-96.5528	26.2244	180	Dolphin Carcass	Tickler chain	Decomposed
12/02/2008	7:35	-97.1256	26.8603	90	Bottlenose Dolphin	Lazy Line	Fresh Dead
05/13/2009	15:56	-97.1939	27.4258	60	Dolphin	Lazy Line	Alive[o]
02/07/2010	19:02	-90.1167	29.1228	25.4	Bottlenose Dolphin	Net	Fresh Dead
11/22/2011	7:35	-96.8731	26.4844	n/a*	Bottlenose Dolphin	Lazy Line	Fresh Dead
08/31/2013	15:15	-91.9711	28.1753	240	Bottlenose Dolphin	Line from net to tickler chain	Dead
08/23/2014	6:52	-95.1039	28.4906	100	Bottlenose Dolphin	Dropline/Floatline	Dead

* Based on trip and tow information from other observer forms and Lat/Long, this entanglement occurred in > 60 ft. (>10 fathom) waters.

[o] This animal was released alive with no apparent injury, and therefore was not included in bycatch mortality estimation. Comments indicated: "The dolphin was tangled in the lazy line; the line was cut. The dolphin appeared in good condition, alive, and with no noticeable injuries."

Table 6. Unweighted five-year mean of annual stock bycatch mortality estimates for 2012, 2013, and 2014 by stratification method and species classification scenario for unidentified dolphins. Coefficients of variation (CV) of the standard error were estimated using standard bootstrap methods, and 95% confidence intervals (CI) were estimated using bias corrected and accelerated bootstrap methods. Annual bycatch mortality estimates for 2012-2014 are included in Appendix D. Species codes: Ud are unidentified dolphins, Tt are bottlenose dolphins (*T. truncatus*), and Sf are Atlantic spotted dolphins (*S. frontalis*). Stratification methods (2-areas, and 4-areas refer to stratification of bycatch rate estimation). The models thought to be the most appropriate for the stock assessment reports, as described in the text, are indicated with bold type.

		2012			2013			2014		
		2008-2012 Mean	CV	95% CI	2009-2013 Mean	CV	95% CI	2010-2014 Mean	CV	95% CI
2-area										
Ud=Tt	Tt Shelf	46	0.4	16 - 93	49	0.4	17 - 95	50	0.4	18 - 96
	Tt W Coastal	68	0.5	15 - 167	60	0.6	13 - 168	56	0.6	12 - 145
	Tt N Coastal	9.5	0.7	2.3 - 35	7.8	0.9	1.6 - 37	5.1	0.7	1.0 - 17
	Tt E Coastal	1.8	1.3	0 - 13	1.7	1.4	0 - 14	1.3	1.4	0 - 13
	Tt TX BSE	3.0	0.8	0.7 - 13	2.7	0.9	0.6 - 13	6.3	1.5	1.4 - 63
	Tt LA BSE	62	0.7	11 - 194	56	0.8	8.6 - 201	45	0.9	11 - 206
	Tt AL/MS BSE	18	0.7	2.2 - 56	17	0.8	1.6 - 58	13	1.1	0.8 - 66
	Tt FL BSE	3.3	1.5	0 - 26	3.4	1.5	0 - 26	2.4	1.6	0 - 26
	Sf	0	-	0 - 0	0	-	0 - 0	0	-	0 - 0
Ud=Sf	Tt Shelf	20	0.7	0 - 56	22	0.6	0 - 60	25	0.6	0 - 64
	Tt W Coastal	52	0.6	0 - 144	45	0.7	4.9 - 147	42	0.7	4.4 - 124
	Tt N Coastal	6.9	0.8	1.0 - 27	5.9	1.0	0.5 - 28	3.8	0.9	0.4 - 16
	Tt E Coastal	0	-	0 - 0	0	-	0 - 0	0	-	0 - 0
	Tt TX BSE	1.9	0.8	0.3 - 8	1.7	0.9	0.1 - 8	5.0	1.7	0.9 - 63
	Tt LA BSE	52	0.8	5.5 - 183	47	0.9	4.7 - 191	38	1.0	6.1 - 199
	Tt AL/MS BSE	13	0.9	0.6 - 51	12	1.0	0.3 - 53	9.6	1.3	0.5 - 60
	Tt FL BSE	0	-	0 - 0	0	-	0 - 0	0	-	0 - 0
	Sf	48	0.5	12 - 116	45	0.5	13 - 115	41	0.5	11 - 103
4-area										
Ud=Tt	Tt Shelf	**54**	**0.4**	**18 - 115**	**57**	**0.4**	**20 - 116**	**57**	**0.4**	**21 - 115**
	Tt W Coastal	**61**	**0.9**	**0 - 238**	**55**	**1.0**	**0 - 257**	**51**	**1.0**	**0 - 216**
	Tt N Coastal	**20**	**0.9**	**0 - 93**	**17**	**1.0**	**0 - 94**	**11**	**0.8**	**0 - 38**
	Tt E Coastal	**1.8**	**1.3**	**0 - 13**	**1.7**	**1.4**	**0 - 13**	**1.3**	**1.4**	**0 - 13**
	Tt TX BSE	**0**	**-**	**0 - 0**	**0**	**-**	**0 - 0**	**0**	**-**	**0 - 0**
	Tt LA BSE	**85**	**1.2**	**0 - 511**	**76**	**1.4**	**0 - 557**	**61**	**1.4**	**6.8 - 572**
	Tt AL/MS BSE	**38**	**0.8**	**0 - 142**	**35**	**0.9**	**0 - 149**	**27**	**1.1**	**0 - 150**
	Tt FL BSE	**3.3**	**1.5**	**0 - 26**	**3.4**	**1.4**	**0 - 26**	**2.4**	**1.6**	**0 - 25**
	Sf	0	-	0 - 0	0	-	0 - 0	0	-	0 - 0
Ud=Sf	Tt Shelf	28	0.7	0 - 78	30	0.6	0 - 79	32	0.6	0 - 85
	Tt W Coastal	61	0.9	0 - 238	55	1.0	0 - 257	51	1.0	0 - 216
	Tt N Coastal	9.1	1.0	0 - 38	8.2	1.1	0 - 38	5.6	1.1	0 - 28
	Tt E Coastal	0	-	0 - 0	0	-	0 - 0	0	-	0 - 0
	Tt TX BSE	0	-	0 - 0	0	-	0 - 0	0	-	0 - 0
	Tt LA BSE	85	1.2	0 - 511	76	1.4	0 - 557	61	1.4	6.8 - 572
	Tt AL/MS BSE	17	1.2	0 - 97	16	1.3	0 - 98	13	1.6	0 - 110
	Tt FL BSE	0	-	0 - 0	0	-	0 - 0	0	-	0 - 0
	Sf	**39**	**0.5**	**11 - 95**	**37**	**0.5**	**11 - 95**	**31**	**0.5**	**10 - 78**

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FIGURES

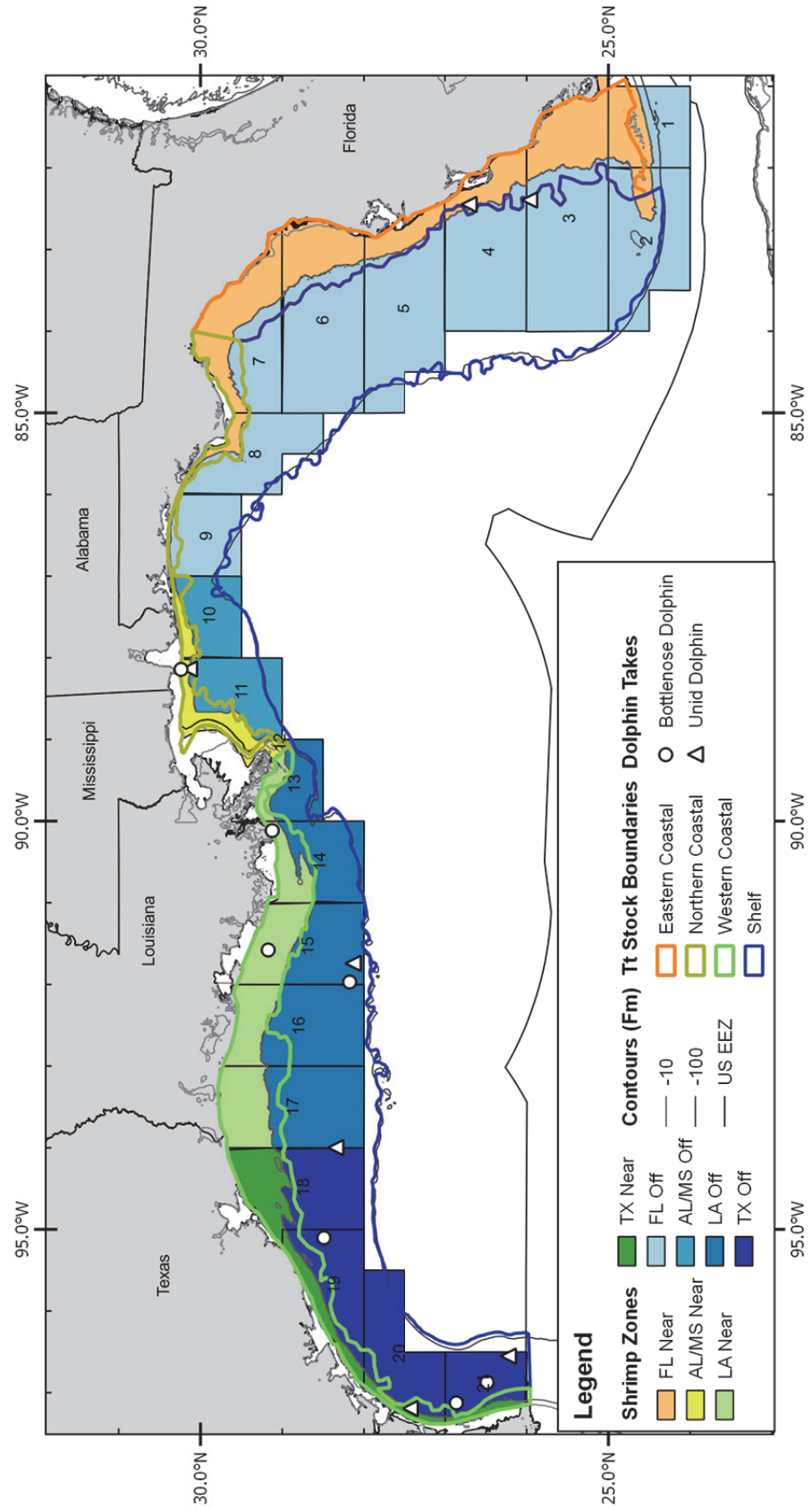


Figure 1. Gulf of Mexico shrimp trawl fishery statistical zones, state area and depth boundaries, shelf and coastal bottlenose dolphin stock boundaries, and observed dolphin take locations. Shrimp fishery statistical zones described by Patella (1975) include 21 statistical areas and 9 depth zones based on isobaths in 10 fathom intervals. Statistical areas are grouped into coarser resolution state areas, and nearshore and offshore (>10 Fm) depth zones, as indicated by color groupings. Coastal and shelf bottlenose dolphin stock boundaries are indicated by colored out lines. Locations of marine mammal entanglements observed by the NMFS Gulf of Mexico shrimp otter trawl fishery Observer Program from 1997 to 2014 are overlaid. Bycaught dolphins were identified as bottlenose dolphin (*T. truncatus*) or remained unidentified and may be bottlenose dolphins or Atlantic spotted dolphins (*S. frontalis*). Bathymetry is indicated by 10 and 100 Fm (18.3 and 182.9 m) isobaths.

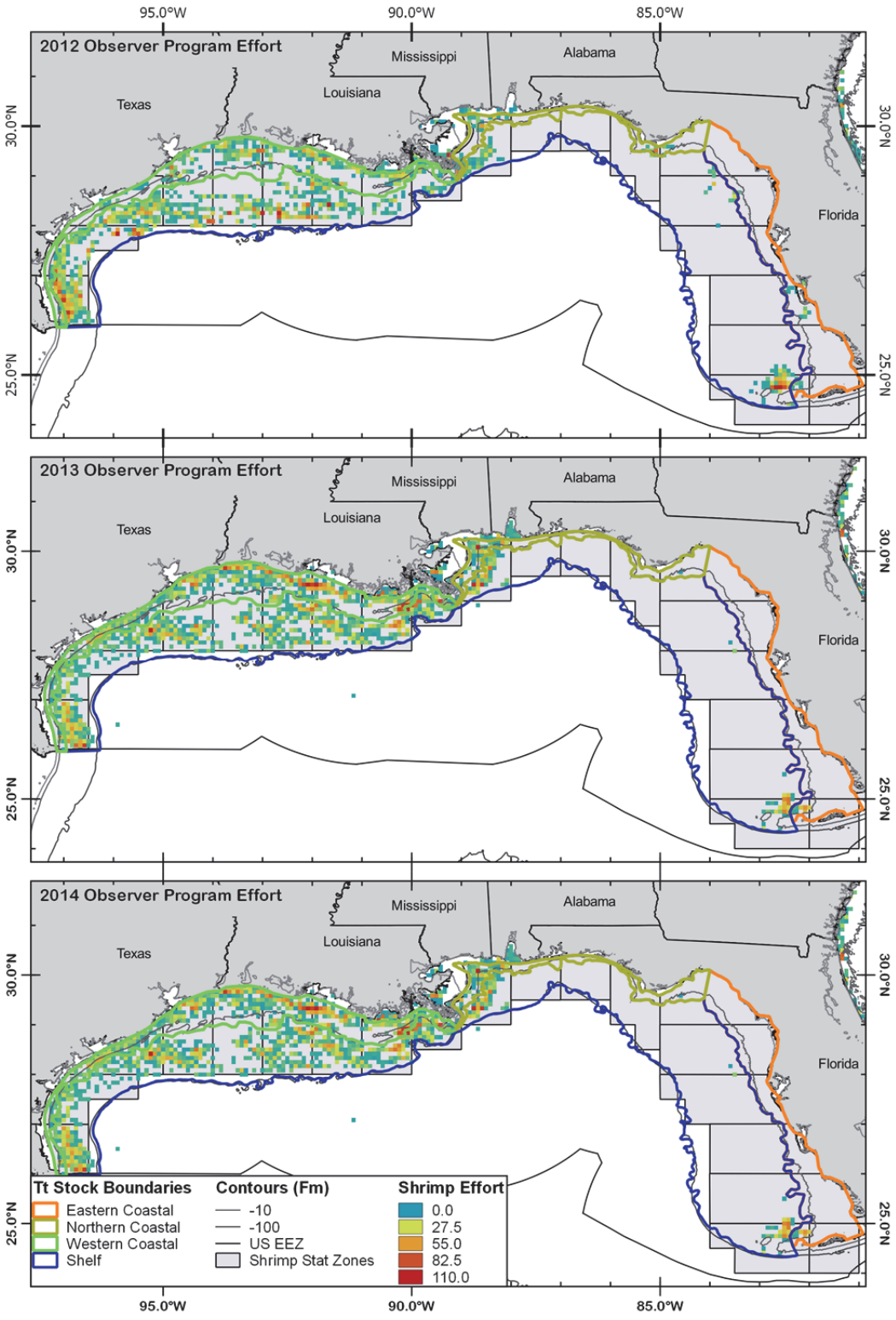


Figure 2. Distribution of fishing effort (hours actively fished) by year for the NMFS Gulf of Mexico shrimp otter trawl fishery Observer Program. Shrimp effort is gridded in 5 arc minute intervals. Gulf of Mexico shrimp trawl fishery statistical zones and shelf and coastal bottlenose dolphin (Tt) stock boundaries are indicated. Bathymetry is indicated by 10 and 100 Fm (18.3 and 182.9 m) isobaths.

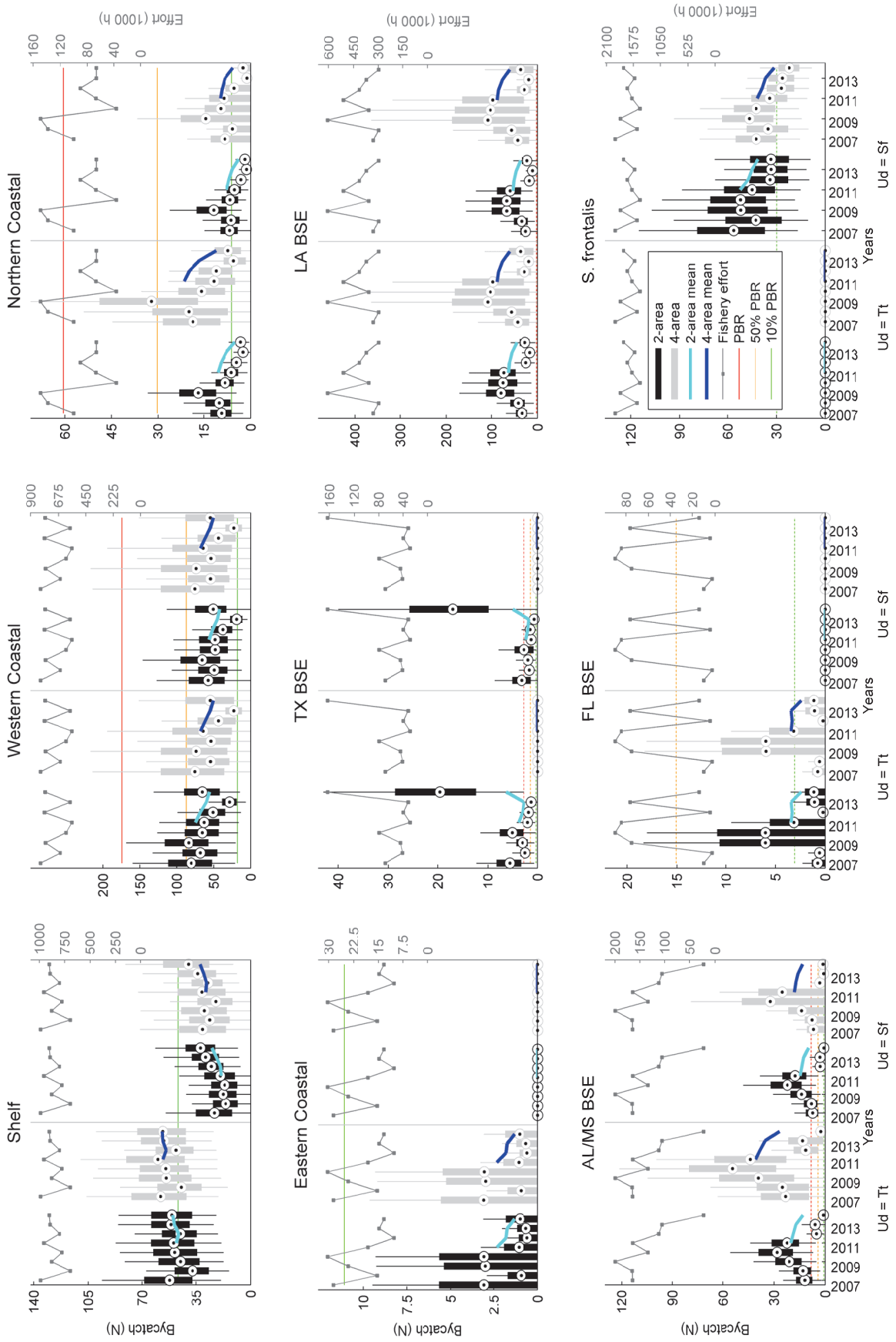

Shelf
Western Coastal
Northern Coastal
Eastern Coastal
TX BSE
LA BSE
AL/MS BSE
FL BSE
S. frontalis
Bycatch (N)
Effort (1000 h)
Years
Ud = Tt
Ud = Sf
2-area
4-area
2-area mean
4-area mean
Fishery effort
PBR
50% PBR
10% PBR

Figure 3. Trends in estimated bycatch mortality for each stock by stratification method (2-area and 4-area) and under two species identification scenarios from 2007 to 2014. Estimates are presented for 8 stock groups of bottlenose dolphins (Shelf (S), Western Coastal (WC), Northern Coastal (NC), Eastern Coastal (EC), TX BSE (TX), LA BSE (LA), AL/MS BSE (AL/MS), and FL BSE (FL),) and for one stock of Atlantic spotted dolphins (Sf). The two species identification scenarios represent best and worst case scenarios for each species, in which all unidentified takes are assigned to either species. Bycatch mortality for each method is represented by box and whisker plots which indicate the median (circle), 25 – 75% quartiles (box), and 95% CIs (whiskers). The 5-year average estimates for 2011 to 2014 are overlaid in cyan and blue for the 2-area and 4-area methods, respectively. Best available data on Potential Biological Removal (PBR) is shown for reference (green = 10% PBR, orange = 50% PBR, red = PBR), but estimates for all bottlenose dolphin Bay, Sound and Estuary (BSE) stocks and the Atlantic spotted dolphin stock are uncertain due to the age (>8 years) of the last abundance estimates. PBR values for BSE stocks represent the aggregate PBR for all stocks within each state area. Total annual fishery effort aggregated over strata that match stock ranges are plotted as thousands of hours fished for each method.

APPENDICES

APPENDIX A. Northern Gulf of Mexico bottlenose dolphin Bay, Sound, and Estuary (BSE) stocks abundance table and map reproduced from Waring et al. (2016).

Table 1. Most recent common bottlenose dolphin abundance (N_{BEST}), coefficient of variation (CV) and minimum population estimate (N_{MIN}) in northern Gulf of Mexico bays, sounds and estuaries. Because they are based on data collected more than 8 years ago, most estimates are considered unknown or undetermined for management purposes. Blocks refer to aerial survey blocks illustrated in Figure 1. PBR – Potential Biological Removal; UNK – unknown; UND – undetermined.

Blocks	Gulf of Mexico Estuary	N_{BEST}	CV	N_{MIN}	PBR	Year	Reference
B51	Laguna Madre	80	1.57	UNK	UND	1992	A
B52	Nueces Bay, Corpus Christi Bay	58	0.61	UNK	UND	1992	A
B50	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay	55	0.82	UNK	UND	1992	A
B54	Matagorda Bay, Tres Palacios Bay, Lavaca Bay	61	0.45	UNK	UND	1992	A
B55	West Bay	32	0.15	UNK	UND	2000	E
B56	Galveston Bay, East Bay, Trinity Bay	152	0.43	UNK	UND	1992	A
B57	Sabine Lake	0[a]	-		UND	1992	A
B58	Calcasieu Lake	0[a]	-		UND	1992	A
B59	Vermilion Bay, West Cote Blanche Bay, Atchafalaya Bay	0[a]	-		UND	1992	A
B60	Terrebonne Bay, Timbalier Bay	100	0.53	UNK	UND	1993	A
B61	Barataria Bay	138	0.08	UNK	UND	2001	D
B30	Mississippi River Delta	332	0.93	170	1.7	2011-12	J
B02-05, 29, 31	Mississippi Sound, Lake Borgne, Bay Boudreau	901	0.63	551	5.6	2012	J
B06	Mobile Bay, Bonsecour Bay	122	0.34	UNK	UND	1993	A
B07	Perdido Bay	0[a]	-		UND	1993	A
B08	Pensacola Bay, East Bay	33	0.80	UNK	UND	1993	A
B09	Choctawhatchee Bay	179	0.04	173	1.7	2007	H
B10	St. Andrew Bay	124	0.57	UNK	UND	1993	A
B11	St. Joseph Bay	152	0.08	142	1.4	2007	F
B12-13	St. Vincent Sound, Apalachicola Bay, St. George Sound	439	0.14	390	3.9	2007-08	G
B14-15	Apalachee Bay	491	0.39	UNK	UND	1993	A
B16	Waccasassa Bay, Withlacoochee Bay, Crystal Bay	100	0.85	UNK	UND	1994	A
B17	St. Joseph Sound, Clearwater Harbor	37	1.06	UNK	UND	1994	A
B32-34	Tampa Bay	559	0.24	UNK	UND	1994	A
B20, 35	Sarasota Bay, Little Sarasota Bay	160	na[c]	160	1.6	2007	B
B21-23	Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay	826	0.09	UNK	UND	2006	I
B36	Caloosahatchee River	0[a,b]	-		UND	1985	C
B24	Estero Bay	104	0.67	UNK	UND	1994	A
B25	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay	208	0.46	UNK	UND	1994	A
B27	Whitewater Bay	242	0.37	UNK	UND	1994	A
B28	Florida Keys (Bahia Honda to Key West)	29	1.00	UNK	UND	1994	A

References: A – Blaylock and Hoggard 1994; B – Wells 2009; C – Scott *et al.* 1989; D – Miller 2003; E – Irwin and Würsig 2004; F – Balmer *et al.* 2008; G – Tyson *et al.* 2011; H – Conn *et al.* 2011; I - Bassos-Hull *et al.* 2013; J - NMFS unpublished data

Notes:

[a] During earlier surveys (Scott *et al.* 1989), the range of seasonal abundances was as follows: B57, 0-2 (CV=0.38); B58, 0-6 (0.34); B59, 0-0; B30, 0-182 (0.14); B07, 0-0; B21, 0-15 (0.43); and B36, 0-0.

[b] Block not surveyed during surveys reported in Blaylock and Hoggard (1994).

[c] No CV because N_{BEST} was a direct count of known individuals.

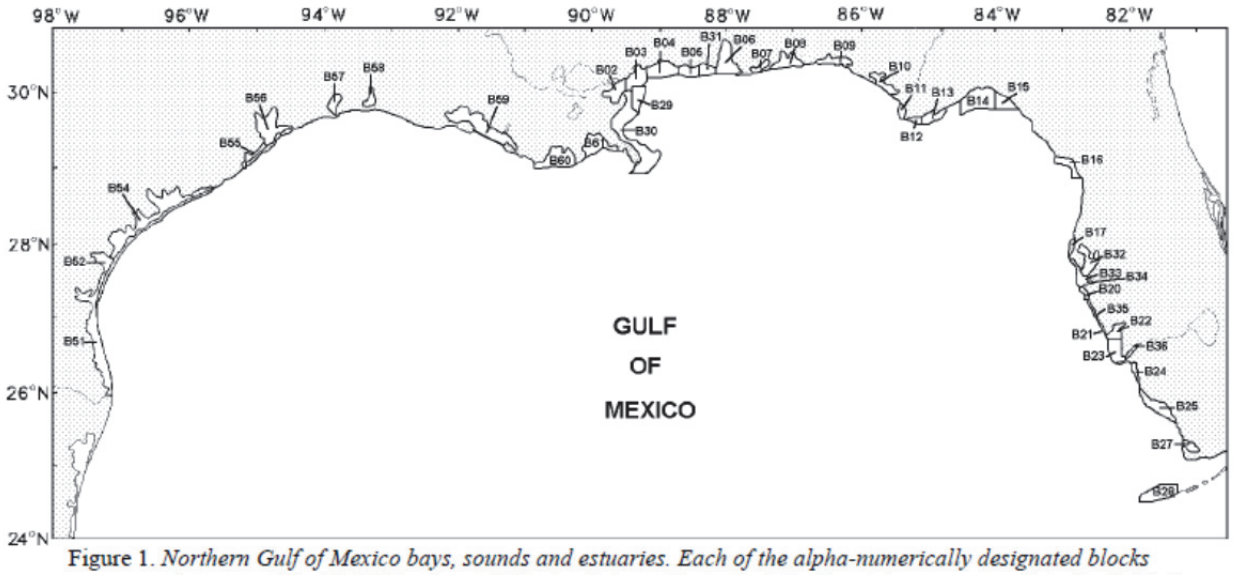


Figure 1. *Northern Gulf of Mexico bays, sounds and estuaries. Each of the alpha-numerically designated blocks corresponds to one of the NMFS Southeast Fisheries Science Center logistical aerial survey areas listed in Table 1. The common bottlenose dolphins inhabiting each bay, sound or estuary are considered to comprise a unique stock for purposes of this assessment.*

APPENDIX B. Trawl gear configuration reproduced from Scott-Denton et al. (2012)

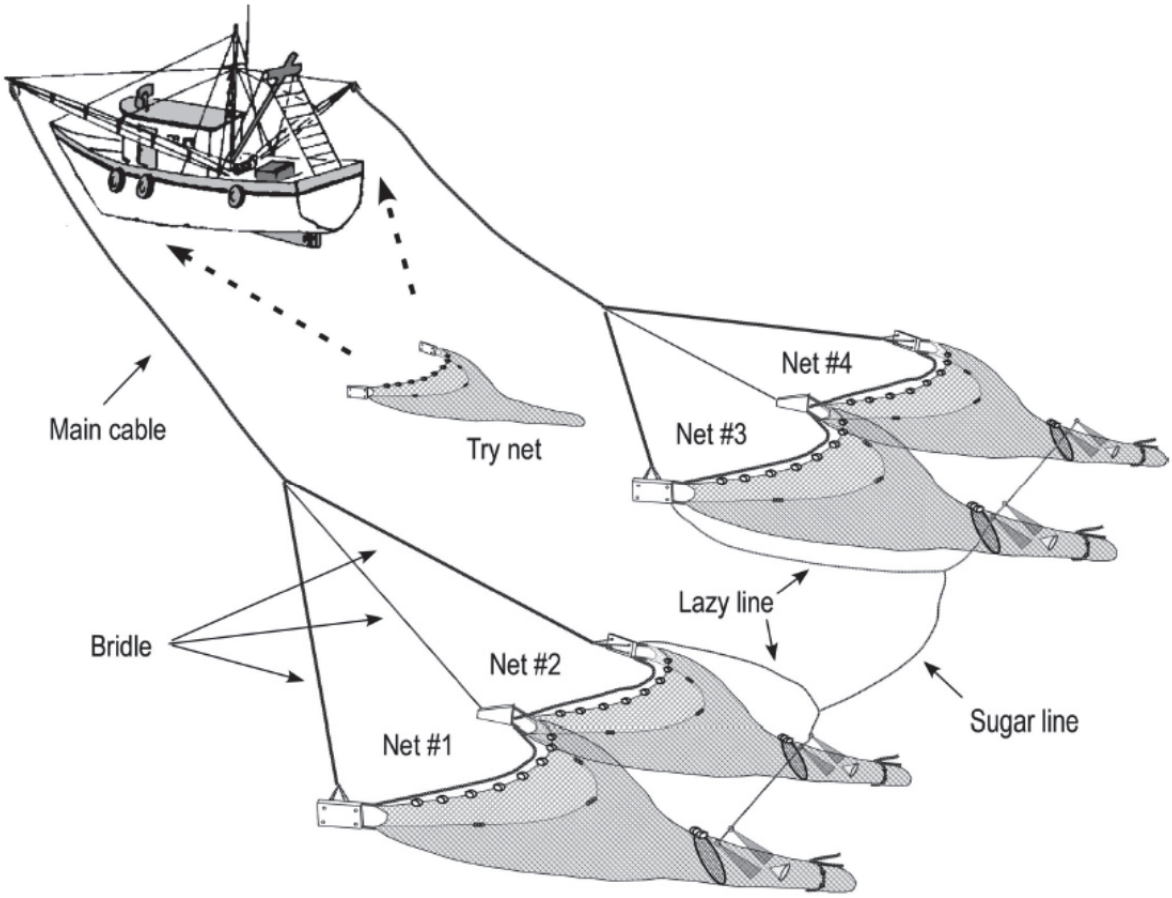


Figure 2.—Typical gear configuration for U.S. southeastern shrimp vessels equipped with four nets.

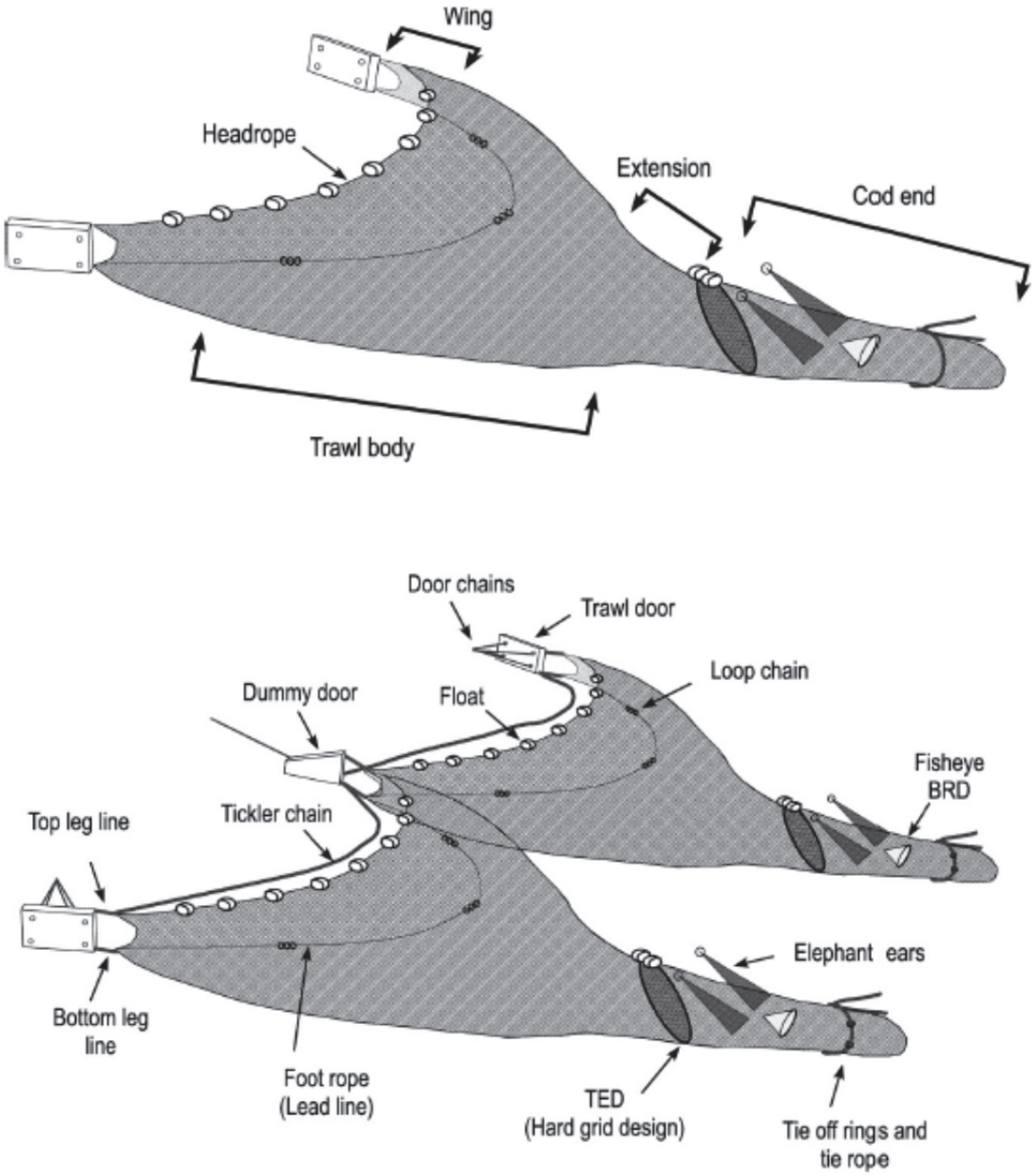


Figure 3.—Typical gear components for U.S. southeastern shrimp vessels.

APPENDIX C. Observer Program bycatch forms. The Sawfish, Sturgeon, Marine Mammals, and Birds form was used from 1997 to 2010, and the Marine Mammal Life history form was used from 2011 to 2014.

SAWFISH, STURGEON, MARINE MAMMALS, BIRDS

PROTECTED RESOURCES CAPTURE REPORT

REPORT WITH IN 24 HOURS OF CAPTURE 1_10

Trip Number ☐☐☐☐☐☐ MO DY YR ___/___/___ Set/Tow ☐☐☐ ☐ Station ☐ Non-Station ☐ Captured ☐ Sighted Specimen # By Trip ☐☐☐

Check type of specimen captured and reference species (if known) in space provided:

☐ Sawfish ☐ Sturgeon _____ ☐ Marine Mammal ☐ Birds _____

Vessel ☐☐☐ Observer ☐☐☐ State ☐☐ Time (24 hr) ☐☐:☐☐ Water Depth (ft.) ☐☐☐.☐ Photos Y/N ☐ Number ☐☐

LATITUDE ☐☐ deg ☐☐ min ☐☐ sec LONGITUDE ☐☐ deg ☐☐ min ☐☐ sec

Gear Type: ☐ Longline ☐ Gill Net ☐ Trawl ☐ Bandit Reel ☐ Handline ☐ Jug ☐ Fish Trap ☐ Spear Fishing

Gear Depth: ☐ Surface ☐ Midwater ☐ Bottom ☐ Other _____

Net Position ☐ Net Type Animal Captured In: ☐ Try Net ☐ Standard Net Net Modifications: ☐ TED ☐ TED/BRD ☐ BRD ☐ None ☐ Unknown

IF GEAR IS A FORM OF HOOK AND LINE, COMPLETE THIS SECTION, AS APPLICABLE:

Hook Type: ☐ "J" ☐ Circle ☐ other (describe)_____ SIZE ☐☐ /0

Manufacturer/Style No. _____ DEGREE OFFSET ☐☐°

Bait: ☐ Squid ☐ Mackerel ☐ Sardine ☐ Unknown ☐ Other (describe) _____

Was hook removed from this animal? Y / N / Unknown / Not Applicable

Was animal entangled in gear? At capture? Y / N / Unknown At Release? Y / N / Unknown

How much gear (linear feet) was left on the animal when released? ☐☐☐.☐ ft. (estimated/measured)

TARGET SPECIES: List all targeted species for this set using genus species format.

_____ _____ _____ _____

DIMENSIONS (cm):

Estimated total length: ☐☐.☐ ft. Estimated length of saw: ☐☐.☐ ft.

Total Length: ☐☐☐.☐ cm (if boated)

TAG ID NUMBERS:

_____ _____ _____ _____

RELEASE INFORMATION: TIME (24hr) ☐☐:☐☐ DATE ___/___/___ MO DY YR

LATITUDE ☐☐ deg ☐☐ min ☐☐ sec LONGITUDE ☐☐ deg ☐☐ min ☐☐ sec

FINAL DISPOSITION: ☐ Discarded Dead/Unresponsive Carcass ☐ Released Alive ☐ Unknown (explain)

ADDITIONAL COMMENTS: (list all biological samples collected):

MARINE MAMMAL LIFE HISTORY FORM
CAPTURE INFORMATION

6_11

Trip Number ____ MO/ DY/ YR ____ Set/Tow ____ ☐ Station ☐ Non-Station ☐ Capture ☐ Sighted Specimen # by Trip ____ Time (24 hr) ____ Water Depth (ft.) ____

GEAR TYPE: ☐ Longline ☐ Gillnet ☐ Trawl ☐ Hook and Line

GEAR DEPTH: ☐ Surface (pelagic) ☐ Midwater ☐ Bottom ☐ Other ____

LATITUDE ☐☐ deg ☐☐ min ☐☐ sec LONGITUDE ☐☐ deg ☐☐ min ☐☐ sec

SPECIES IDENTIFICATION: Photos Taken? Y / N Number of photo taken ____

☐ Pilot whale ☐ Bottlenose dolphin ☐ Pantropical spotted dolphin ☐ Risso's dolphin ☐ Common dolphin

☐ Striped dolphin ☐ Atlantic spotted dolphin ☐ Unid. Marine mammal ☐ Other ____

Diagnostic features: ____

Confidence Level of Species ID: ☐ Good ☐ Fair ☐ Poor

IF HOOK AND LINE GEAR USED, COMPLETE AS APPLICABLE: Hook Type: ☐ "J" ☐ Circle ☐ Other (describe) ____

Hook Size ____/0 Manufacturer/Style No. ____ Degree Offset ____°

BAIT: ☐ Squid ☐ Mackerel ☐ Sardine ☐ Unknown Other (describe) ____

HOOKING OF MARINE MAMMAL: Was animal hooked? ☐ Yes ☐ No ☐ Unknown (If no, skip to next section)

Hook Location **Internal:** ☐ In Mouth? ☐ Yes ☐ No Mouth Location? ☐ Upper ☐ Lower ☐ Side Swallowed? ☐ Yes ☐ No Hook Visable? ☐ Visible to insertion point ☐ Partial hook ☐ Not visible

External: ☐ ☐ Front Flipper ☐ Dorsal fin ☐ Body ☐ Head/Neck ☐ Tail ☐ Other ____

Was hook removed from animal? ☐ Yes ☐ No ☐ Unknown

If No, was line cut? ☐ Yes ☐ No

If Yes, how much line was left trailing? ____ feet

ENTANGLEMENT OF MARINE MAMMAL: Was animal entangled? ☐ Yes ☐ No ☐ Unknown

Entanglement Location (check all that apply) ☐ Front Flipper ☐ Head/Neck ☐ Tail ☐ Body ☐ Mouth ☐ Other ____

Gear involved: ☐ Hook ☐ Mainline ☐ Gangion ☐ Dropline/Floatline ☐ Float

Was gear removed from animal? ☐ Yes ☐ No ☐ Partial ☐ Unknown

Amount of gear left on animal ____ feet Were loops cut? ☐ Yes ☐ No ☐ Unknown

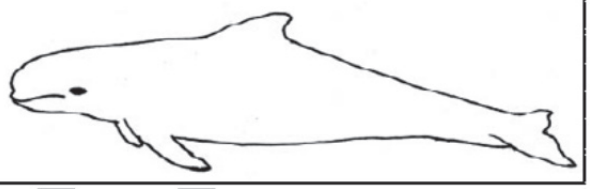
DESCRIPTION OF RELEASE PROCEDURE ____

CONDITION OF MARINE MAMMAL UPON RELEASE

☐ Alive, swam away normally ☐ Alive, swam abnormally ☐ Dead

Description of animal's behavior upon release ____

SKETCH OF ANIMAL SHOWING WHERE GEAR WAS HOOKED OR ENTANGLED ON BODY



PRESENCE OF OTHER MARINE MAMMALS AT TIME OF CAPTURE:

Were other marine mammals present at time of capture? ☐ Yes ☐ Didn't look ☐ Looked but did not see

Number of other marine mammals present (record all three) ____ MIN ____ MAX ____ BEST GUESS

Same species as animal captured? ☐ Yes ☐ No Species ID if different ____

Approximate distance from vessel (in yards) ____

Were actions taken by vessel to deter or avoid marine mammals? ☐ Yes ☐ No ☐ Unknown

Describe actions taken ____

Biopsy Sample Taken? ☐ Yes ☐ No ☐ Unsuccessful If yes, itemize samples: ____

TAGS Tagged before release? ☐ Yes ☐ No Tag number: ____ Tag Type: ____ Metal (1) / Plastic (2)

Position of tag: ☐ Left flipper ☐ Right flipper ☐ Dorsal fin ☐ Tail

APPENDIX D

1. Gulf of Mexico shrimp otter trawl fishery effort, Observer Program effort, marine mammal takes, and marine mammal bycatch rates for the 2-area stratified method of bycatch rate estimation for 2011 to 2014. Species codes: Ud are unidentified dolphins, Tt are bottlenose dolphins (*T. truncatus*), and Sf are Atlantic spotted dolphins (*S. frontalis*). State areas are Florida (FL), Alabama/Mississippi (AL/MS), Louisiana (LA), and Texas (TX). Fishery effort is presented for the estimation year only, while OP effort, marine mammal takes, and marine mammal bycatch rates represent the aggregate from 1997 to the estimation year.

			Fishery Effort		OP Effort (since 1997)		Marine Mammal Takes			Marine Mammal Bycatch Rate (Takes per 1000 Hours)		
Area	Season	Depth Zone	Hours Fished	Est. Trips	Hours Fished	Trips	Sf Ud=Sf	Tt Ud=Sf	Tt Ud=Tt	Sf Ud=Sf	Tt Ud=Sf	Tt Ud=Tt
2011 Fishery Effort and 1997-2011 Bycatch Rates												
Eastern	1	In	12,010	222	3,735	69	1	0	1	0.268	0	0.268
Eastern	1	Near	4,166	77	3,735	69	1	0	1	0.268	0	0.268
Eastern	1	Off	42,653	402	8,494	80	1	0	1	0.118	0	0.118
Eastern	2	In	50,297	1,642	827	27	0	0	0	0	0	0
Eastern	2	Near	10,190	333	827	27	0	0	0	0	0	0
Eastern	2	Off	50,071	691	2,462	34	0	0	0	0	0	0
Eastern	3	In	22,118	1,790	185	15	0	0	0	0	0	0
Eastern	3	Near	3,694	299	185	15	0	0	0	0	0	0
Eastern	3	Off	28,929	263	2,755	25	0	0	0	0	0	0
Western	1	In	157,372	2,044	4,929	64	0	2	2	0	0.406	0.406
Western	1	Near	97,844	1,271	4,929	64	0	2	2	0	0.406	0.406
Western	1	Off	153,187	842	19,828	109	2	0	2	0.101	0	0.101
Western	2	In	294,242	3,423	14,526	169	0	0	0	0	0	0
Western	2	Near	319,365	3,716	14,526	169	0	0	0	0	0	0
Western	2	Off	345,430	2,400	32,246	224	0	0	0	0	0	0
Western	3	In	251,020	2,269	13,495	122	1	1	2	0.074	0.074	0.148
Western	3	Near	210,517	1,903	13,495	122	1	1	2	0.074	0.074	0.148
Western	3	Off	336,614	2,139	33,678	214	1	2	3	0.030	0.059	0.089
2012 Fishery Effort and 1997-2014 Bycatch Rates												
Eastern	1	In	974	19	4,484	88	1	0	1	0.223	0	0.223
Eastern	1	Near	2,803	55	4,484	88	1	0	1	0.223	0	0.223
Eastern	1	Off	51,390	493	10,419	97	1	0	1	0.096	0	0.096
Eastern	2	In	1,094	36	987	33	0	0	0	0	0	0
Eastern	2	Near	5,637	185	987	33	0	0	0	0	0	0
Eastern	2	Off	15,819	208	3,936	44	0	0	0	0	0	0
Eastern	3	In	2,378	192	236	18	0	0	0	0	0	0
Eastern	3	Near	1,728	140	236	18	0	0	0	0	0	0
Eastern	3	Off	37,198	339	3,377	34	0	0	0	0	0	0
Western	1	In	58,899	739	9,124	100	0	2	2	0	0.219	0.219
Western	1	Near	127,123	1,594	9,124	100	0	2	2	0	0.219	0.219
Western	1	Off	108,636	578	25,829	141	2	0	2	0.077	0	0.077
Western	2	In	290,503	3,392	23,184	235	0	0	0	0	0	0
Western	2	Near	451,229	5,268	23,184	235	0	0	0	0	0	0
Western	2	Off	256,368	1,775	42,211	292	0	2	2	0	0.047	0.047
Western	3	In	214,764	1,925	21,049	173	1	1	2	0.048	0.048	0.095
Western	3	Near	299,976	2,688	21,049	173	1	1	2	0.048	0.048	0.095
Western	3	Off	334,213	2,038	48,418	290	1	2	3	0.021	0.041	0.062
2013 Fishery Effort and 1997-2014 Bycatch Rates												
Eastern	1	In	4,914	99	4,484	88	1	0	1	0.223	0	0.223
Eastern	1	Near	3,097	62	4,484	88	1	0	1	0.223	0	0.223
Eastern	1	Off	72,644	678	10,419	97	1	0	1	0.096	0	0.096
Eastern	2	In	63,688	2,153	987	33	0	0	0	0	0	0
Eastern	2	Near	9,881	334	987	33	0	0	0	0	0	0
Eastern	2	Off	35,031	453	3,936	44	0	0	0	0	0	0
Eastern	3	In	7,616	616	236	18	0	0	0	0	0	0
Eastern	3	Near	1,806	146	236	18	0	0	0	0	0	0
Eastern	3	Off	4,868	45	3,377	34	0	0	0	0	0	0

Area	Season	Depth Zone	Fishery Effort		OP Effort (since 1997)		Marine Mammal Takes			Marine Mammal Bycatch Rate (Takes per 1000 Hours)		
			Hours Fished	Est. Trips	Hours Fished	Trips	Sf Ud=Sf	Tt Ud=Sf	Tt Ud=Tt	Sf Ud=Sf	Tt Ud=Sf	Tt Ud=Tt
Western	1	In	26,570	304	9,124	100	0	2	2	0	0.219	0.219
Western	1	Near	50,057	572	9,124	100	0	2	2	0	0.219	0.219
Western	1	Off	115,598	602	25,829	141	2	0	2	0.077	0	0.077
Western	2	In	280,715	2,861	23,184	235	0	0	0	0	0	0
Western	2	Near	375,157	3,824	23,184	235	0	0	0	0	0	0
Western	2	Off	334,861	2,307	42,211	292	0	2	2	0	0.047	0.047
Western	3	In	200,089	1,851	21,049	173	1	1	2	0.048	0.048	0.095
Western	3	Near	217,152	2,009	21,049	173	1	1	2	0.048	0.048	0.095
Western	3	Off	334,188	2,057	48,418	290	1	2	3	0.021	0.041	0.062
2014 Fishery Effort and 1997-2014 Bycatch Rates												
Eastern	1	In	5,209	102	4,484	88	1	0	1	0.223	0	0.223
Eastern	1	Near	4,751	93	4,484	88	1	0	1	0.223	0	0.223
Eastern	1	Off	39,362	366	10,419	97	1	0	1	0.096	0	0.096
Eastern	2	In	8,590	287	987	33	0	0	0	0	0	0
Eastern	2	Near	8,536	286	987	33	0	0	0	0	0	0
Eastern	2	Off	29,858	334	3,936	44	0	0	0	0	0	0
Eastern	3	In	126	10	236	18	0	0	0	0	0	0
Eastern	3	Near	39	3	236	18	0	0	0	0	0	0
Eastern	3	Off	3,675	37	3,377	34	0	0	0	0	0	0
Western	1	In	168,851	1,851	9,124	100	0	2	2	0	0.219	0.219
Western	1	Near	190,103	2,084	9,124	100	0	2	2	0	0.219	0.219
Western	1	Off	95,390	521	25,829	141	2	0	2	0.077	0	0.077
Western	2	In	165,317	1,676	23,184	235	0	0	0	0	0	0
Western	2	Near	352,801	3,576	23,184	235	0	0	0	0	0	0
Western	2	Off	334,553	2,314	42,211	292	0	2	2	0	0.047	0.047
Western	3	In	148,889	1,224	21,049	173	1	1	2	0.048	0.048	0.095
Western	3	Near	306,316	2,518	21,049	173	1	1	2	0.048	0.048	0.095
Western	3	Off	402,998	2,414	48,418	290	1	2	3	0.021	0.041	0.062

2. Gulf of Mexico shrimp fishery effort, Observer Program effort, marine mammal takes, and marine mammal bycatch rates for the 4-area stratified method of bycatch rate estimation for 2011 to 2014. Species codes: Ud are unidentified dolphins, Tt are bottlenose dolphins (*T. truncatus*), and Sf are Atlantic spotted dolphins (*S. frontalis*). State areas are Florida (FL), Alabama/Mississippi (AL/MS), Louisiana (LA), and Texas (TX). Fishery effort is presented for the estimation year only, while OP effort, marine mammal takes, and marine mammal bycatch rates represent the aggregate from 1997 to the estimation year.

			Fishery Effort		OP Effort (since 1997)		Marine Mammal Takes			Marine Mammal Bycatch Rate (Takes per 1000 Hours)		
Area	Season	Depth Zone	Hours Fished	Est. Trips	Hours Fished	Trips	Sf Ud=Sf	Tt Ud=Sf	Tt Ud=Tt	Sf Ud=Sf	Tt Ud=Sf	Tt Ud=Tt
2011 Fishery Effort and 1997-2011 Bycatch Rates												
FL	1	In	12,010	222	3,735	69	1	0	1	0.268	0	0.268
FL	1	Near	4,166	77	3,735	69	1	0	1	0.268	0	0.268
FL	1	Off	42,653	402	8,494	80	1	0	1	0.118	0	0.118
FL	2	In	50,297	1,642	827	27	0	0	0	0	0	0
FL	2	Near	10,190	333	827	27	0	0	0	0	0	0
FL	2	Off	50,071	691	2,462	34	0	0	0	0	0	0
FL	3	In	22,118	1,790	185	15	0	0	0	0	0	0
FL	3	Near	3,694	299	185	15	0	0	0	0	0	0
FL	3	Off	28,929	263	2,755	25	0	0	0	0	0	0
AL/MS	1	In	32,352	653	1,239	25	0	1	1	0	0.807	0.807
AL/MS	1	Near	11,040	223	1,239	25	0	1	1	0	0.807	0.807
AL/MS	1	Off	16,040	152	3,790	36	0	0	0	0	0	0
AL/MS	2	In	64,915	1,280	2,535	50	0	0	0	0	0	0
AL/MS	2	Near	42,691	842	2,535	50	0	0	0	0	0	0
AL/MS	2	Off	37,167	417	6,153	69	0	0	0	0	0	0
AL/MS	3	In	66,558	1,053	3,223	51	1	0	1	0.310	0	0.310
AL/MS	3	Near	12,503	198	3,223	51	1	0	1	0.310	0	0.310
AL/MS	3	Off	18,306	260	4,934	70	0	0	0	0	0	0
LA	1	In	123,513	2,337	1,585	30	0	1	1	0	0.631	0.631
LA	1	Near	72,077	1,364	1,585	30	0	1	1	0	0.631	0.631
LA	1	Off	59,122	347	10,043	59	1	0	1	0.100	0	0.100
LA	2	In	212,119	1,503	9,033	64	0	0	0	0	0	0
LA	2	Near	243,356	1,724	9,033	64	0	0	0	0	0	0
LA	2	Off	186,705	2,073	8,647	96	0	0	0	0	0	0
LA	3	In	174,502	1,827	6,783	71	0	1	1	0	0.147	0.147
LA	3	Near	148,879	1,558	6,783	71	0	1	1	0	0.147	0.147
LA	3	Off	98,292	825	15,004	126	1	0	1	0.067	0	0.067
TX	1	In	1,507	11	2,104	15	0	0	0	0	0	0
TX	1	Near	14,727	105	2,104	15	0	0	0	0	0	0
TX	1	Off	78,025	677	5,996	52	1	0	1	0.167	0	0.167
TX	2	In	17,208	437	2,953	75	0	0	0	0	0	0
TX	2	Near	33,318	846	2,953	75	0	0	0	0	0	0
TX	2	Off	121,559	940	17,457	135	0	0	0	0	0	0
TX	3	In	9,960	85	3,504	30	0	0	0	0	0	0
TX	3	Near	49,134	421	3,504	30	0	0	0	0	0	0
TX	3	Off	220,016	1,762	13,737	110	0	2	2	0	0.146	0.146
2012 Fishery Effort and 1997-2014 Bycatch Rates												
FL	1	In	974	19	4,484	88	1	0	1	0.223	0	0.223
FL	1	Near	2,803	55	4,484	88	1	0	1	0.223	0	0.223
FL	1	Off	51,390	493	10,419	97	1	0	1	0.096	0	0.096
FL	2	In	1,094	36	987	33	0	0	0	0	0	0
FL	2	Near	5,637	185	987	33	0	0	0	0	0	0
FL	2	Off	15,819	208	3,936	44	0	0	0	0	0	0
FL	3	In	2,378	192	236	18	0	0	0	0	0	0
FL	3	Near	1,728	140	236	18	0	0	0	0	0	0
FL	3	Off	37,198	339	3,377	34	0	0	0	0	0	0
AL/MS	1	In	4,967	99	1,511	30	0	1	1	0	0.662	0.662
AL/MS	1	Near	8,300	166	1,511	30	0	1	1	0	0.662	0.662

Area	Season	Depth Zone	Fishery Effort		OP Effort (since 1997)		Marine Mammal Takes			Marine Mammal Bycatch Rate (Takes per 1000 Hours)		
			Hours Fished	Est. Trips	Hours Fished	Trips	Sf Ud=Sf	Tt Ud=Sf	Tt Ud=Tt	Sf Ud=Sf	Tt Ud=Sf	Tt Ud=Tt
AL/MS	1	Off	4,025	41	4,293	43	0	0	0	0	0	0
AL/MS	2	In	63,619	1,272	3,738	69	0	0	0	0	0	0
AL/MS	2	Near	52,278	1,045	3,738	69	0	0	0	0	0	0
AL/MS	2	Off	42,270	479	7,948	90	0	0	0	0	0	0
AL/MS	3	In	43,022	671	4,678	65	1	0	1	0.214	0	0.214
AL/MS	3	Near	29,514	460	4,678	65	1	0	1	0.214	0	0.214
AL/MS	3	Off	39,739	570	6,044	86	0	0	0	0	0	0
LA	1	In	48,090	873	2,913	54	0	1	1	0	0.343	0.343
LA	1	Near	86,462	1,570	2,913	54	0	1	1	0	0.343	0.343
LA	1	Off	73,822	411	14,447	81	1	0	1	0.069	0	0.069
LA	2	In	199,378	1,427	15,384	105	0	0	0	0	0	0
LA	2	Near	338,177	2,420	15,384	105	0	0	0	0	0	0
LA	2	Off	123,548	1,386	12,779	128	0	1	1	0	0.078	0.078
LA	3	In	165,640	1,662	11,669	101	0	1	1	0	0.086	0.086
LA	3	Near	215,582	2,163	11,669	101	0	1	1	0	0.086	0.086
LA	3	Off	112,324	946	18,100	157	1	0	1	0.055	0	0.055
TX	1	In	5,842	40	4,699	33	0	0	0	0	0	0
TX	1	Near	32,360	222	4,699	33	0	0	0	0	0	0
TX	1	Off	30,789	266	7,089	64	1	0	1	0.141	0	0.141
TX	2	In	27,507	728	4,058	95	0	0	0	0	0	0
TX	2	Near	60,774	1,609	4,058	95	0	0	0	0	0	0
TX	2	Off	90,551	691	21,490	164	0	1	1	0	0.047	0.047
TX	3	In	6,102	55	4,719	52	0	0	0	0	0	0
TX	3	Near	54,880	499	4,719	52	0	0	0	0	0	0
TX	3	Off	182,150	1,294	24,270	159	0	2	2	0	0.082	0.082
2013 Fishery Effort and 1997-2014 Bycatch Rates												
FL	1	In	4,914	99	4,484	88	1	0	1	0.223	0	0.223
FL	1	Near	3,097	62	4,484	88	1	0	1	0.223	0	0.223
FL	1	Off	72,644	678	10,419	97	1	0	1	0.096	0	0.096
FL	2	In	63,688	2,153	987	33	0	0	0	0	0	0
FL	2	Near	9,881	334	987	33	0	0	0	0	0	0
FL	2	Off	35,031	453	3,936	44	0	0	0	0	0	0
FL	3	In	7,616	616	236	18	0	0	0	0	0	0
FL	3	Near	1,806	146	236	18	0	0	0	0	0	0
FL	3	Off	4,868	45	3,377	34	0	0	0	0	0	0
AL/MS	1	In	1,474	28	1,511	30	0	1	1	0	0.662	0.662
AL/MS	1	Near	1,856	36	1,511	30	0	1	1	0	0.662	0.662
AL/MS	1	Off	13,160	127	4,293	43	0	0	0	0	0	0
AL/MS	2	In	44,071	875	3,738	69	0	0	0	0	0	0
AL/MS	2	Near	41,368	821	3,738	69	0	0	0	0	0	0
AL/MS	2	Off	62,743	725	7,948	90	0	0	0	0	0	0
AL/MS	3	In	59,420	949	4,678	65	1	0	1	0.214	0	0.214
AL/MS	3	Near	22,379	357	4,678	65	1	0	1	0.214	0	0.214
AL/MS	3	Off	32,859	482	6,044	86	0	0	0	0	0	0
LA	1	In	24,604	423	2,913	54	0	1	1	0	0.343	0.343
LA	1	Near	30,778	529	2,913	54	0	1	1	0	0.343	0.343
LA	1	Off	63,735	345	14,447	81	1	0	1	0.069	0	0.069
LA	2	In	218,038	1,371	15,384	105	0	0	0	0	0	0
LA	2	Near	278,980	1,754	15,384	105	0	0	0	0	0	0
LA	2	Off	167,721	1,701	12,779	128	0	1	1	0	0.078	0.078
LA	3	In	127,959	1,306	11,669	101	0	1	1	0	0.086	0.086
LA	3	Near	144,672	1,477	11,669	101	0	1	1	0	0.086	0.086
LA	3	Off	84,287	724	18,100	157	1	0	1	0.055	0	0.055
TX	1	In	492	3	4,699	33	0	0	0	0	0	0
TX	1	Near	17,424	121	4,699	33	0	0	0	0	0	0
TX	1	Off	38,703	327	7,089	64	1	0	1	0.141	0	0.141
TX	2	In	18,606	457	4,058	95	0	0	0	0	0	0
TX	2	Near	54,809	1,346	4,058	95	0	0	0	0	0	0

Area	Season	Depth Zone	Fishery Effort		OP Effort (since 1997)		Marine Mammal Takes			Marine Mammal Bycatch Rate (Takes per 1000 Hours)		
			Hours Fished	Est. Trips	Hours Fished	Trips	Sf Ud=Sf	Tt Ud=Sf	Tt Ud=Tt	Sf Ud=Sf	Tt Ud=Sf	Tt Ud=Tt
TX	2	Off	104,397	800	21,490	164	0	1	1	0	0.047	0.047
TX	3	In	12,710	131	4,719	52	0	0	0	0	0	0
TX	3	Near	50,101	517	4,719	52	0	0	0	0	0	0
TX	3	Off	217,041	1,519	24,270	159	0	2	2	0	0.082	0.082
2014 Fishery Effort and 1997-2014 Bycatch Rates												
FL	1	In	5,209	102	4,484	88	1	0	1	0.223	0	0.223
FL	1	Near	4,751	93	4,484	88	1	0	1	0.223	0	0.223
FL	1	Off	39,362	366	10,419	97	1	0	1	0.096	0	0.096
FL	2	In	8,590	287	987	33	0	0	0	0	0	0
FL	2	Near	8,536	286	987	33	0	0	0	0	0	0
FL	2	Off	29,858	334	3,936	44	0	0	0	0	0	0
FL	3	In	126	10	236	18	0	0	0	0	0	0
FL	3	Near	39	3	236	18	0	0	0	0	0	0
FL	3	Off	3,675	37	3,377	34	0	0	0	0	0	0
AL/MS	1	In	2,037	40	1,511	30	0	1	1	0	0.662	0.662
AL/MS	1	Near	3,860	77	1,511	30	0	1	1	0	0.662	0.662
AL/MS	1	Off	17,569	176	4,293	43	0	0	0	0	0	0
AL/MS	2	In	13,333	246	3,738	69	0	0	0	0	0	0
AL/MS	2	Near	35,011	646	3,738	69	0	0	0	0	0	0
AL/MS	2	Off	29,887	338	7,948	90	0	0	0	0	0	0
AL/MS	3	In	6,616	92	4,678	65	1	0	1	0.214	0	0.214
AL/MS	3	Near	26,692	371	4,678	65	1	0	1	0.214	0	0.214
AL/MS	3	Off	44,775	637	6,044	86	0	0	0	0	0	0
LA	1	In	94,227	1,747	2,913	54	0	1	1	0	0.343	0.343
LA	1	Near	111,816	2,073	2,913	54	0	1	1	0	0.343	0.343
LA	1	Off	49,339	277	14,447	81	1	0	1	0.069	0	0.069
LA	2	In	114,123	779	15,384	105	0	0	0	0	0	0
LA	2	Near	281,688	1,923	15,384	105	0	0	0	0	0	0
LA	2	Off	165,083	1,654	12,779	128	0	1	1	0	0.078	0.078
LA	3	In	89,625	776	11,669	101	0	1	1	0	0.086	0.086
LA	3	Near	221,981	1,921	11,669	101	0	1	1	0	0.086	0.086
LA	3	Off	84,286	731	18,100	157	1	0	1	0.055	0	0.055
TX	1	In	72,587	510	4,699	33	0	0	0	0	0	0
TX	1	Near	74,427	523	4,699	33	0	0	0	0	0	0
TX	1	Off	28,482	257	7,089	64	1	0	1	0.141	0	0.141
TX	2	In	37,862	886	4,058	95	0	0	0	0	0	0
TX	2	Near	36,102	845	4,058	95	0	0	0	0	0	0
TX	2	Off	139,584	1,065	21,490	164	0	1	1	0	0.047	0.047
TX	3	In	52,648	580	4,719	52	0	0	0	0	0	0
TX	3	Near	57,643	635	4,719	52	0	0	0	0	0	0
TX	3	Off	273,937	1,795	24,270	159	0	2	2	0	0.082	0.082

3. Total annual bycatch mortalities and CV of standard error of bottlenose dolphin (Tt) and Atlantic spotted dolphin (Sf) stocks for the 2-area and 4-area stratified methods of bycatch rate estimation. The top panels for each stratification scenario present results for the species scenario in which all unidentified dolphins are assigned to bottlenose dolphins (Ud=Tt), while the lower panel presents results for the species scenario in which all unidentified dolphins are assigned to spotted dolphins (Ud=Sf). The models thought to be the most appropriate for the stock assessment reports, as described in the text, are indicated with bold type.

		Tt Shelf		Tt W Coastal		Tt N Coastal		Tt E Coastal		Tt TX BSE		Tt LA BSE		Tt AL/MS BSE		Tt FL BSE		Sf	
		Bycatch	CV	Bycatch	CV	Bycatch	CV	Bycatch	CV	Bycatch	CV	Bycatch	CV	Bycatch	CV	Bycatch	CV	Bycatch	CV
2 -area																			
Ud=Tt	2011	50	0.42	65	0.51	6.3	0.55	1.1	1.00	2.1	0.56	76	0.53	23	0.52	3.2	1.00	0	-
	2012	46	0.36	52	0.51	4.6	0.52	0.6	1.01	1.9	0.55	26	0.52	5.2	0.59	0.2	1.01	0	-
	2013	52	0.36	29	0.53	2.5	0.61	0.7	0.98	1.3	0.66	18	0.54	6.0	0.68	1.1	0.98	0	-
	2014	52	0.38	67	0.52	3.4	0.58	1.1	1.01	21	0.58	29	0.55	1.1	0.52	1.2	1.01	0	-
Ud=Sf	2011	20	0.71	50	0.59	5.4	0.62	0	-	1.3	0.65	63	0.61	18	0.60	0	-	47	0.48
	2012	26	0.50	39	0.58	3.2	0.60	0	-	1.6	0.62	18	0.59	3.1	0.70	0	-	35	0.51
	2013	30	0.50	20	0.61	1.5	0.76	0	-	0.7	0.87	11	0.64	3.1	0.92	0	-	34	0.46
	2014	32	0.50	54	0.60	2.1	0.68	0	-	18	0.64	25	0.63	0.8	0.60	0	-	35	0.52
4 -area																			
Ud=Tt	2011	**63**	**0.44**	**67**	**0.95**	**13**	**0.66**	**1.1**	**1.00**	**0**	**-**	**104**	**1.02**	**47**	**0.65**	**3.2**	**1.00**	0	-
	2012	**49**	**0.37**	**48**	**0.79**	**12**	**0.68**	**0.6**	**1.01**	**0**	**-**	**31**	**0.76**	**12**	**0.80**	**0.2**	**1.01**	0	-
	2013	**57**	**0.38**	**23**	**0.74**	**6.0**	**0.83**	**0.7**	**1.01**	**0**	**-**	**19**	**0.74**	**14**	**0.95**	**1.1**	**1.01**	0	-
	2014	**58**	**0.40**	**57**	**0.84**	**8.3**	**0.74**	**1.1**	**0.98**	**0**	**-**	**40**	**0.94**	**2.8**	**0.66**	**1.2**	**0.98**	0	-
Ud=Sf	2011	32	0.70	67	0.95	8.9	0.83	0	-	0	-	104	1.02	26	0.83	0	-	**35**	**0.47**
	2012	29	0.52	48	0.79	5.5	0.86	0	-	0	-	31	0.76	3.3	0.86	0	-	**28**	**0.44**
	2013	36	0.52	23	0.74	1.2	0.88	0	-	0	-	19	0.74	1.0	0.88	0	-	**27**	**0.43**
	2014	42	0.52	57	0.84	2.6	0.86	0	-	0	-	40	0.94	1.3	0.86	0	-	**23**	**0.43**