

COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*): Northern Gulf of Mexico Bay, Sound, and Estuary Stocks

NOTE – NMFS is in the process of writing individual stock assessment reports for each of the 31 bay, sound and estuary stocks of common bottlenose dolphins that are included in this report. Until this effort is completed and this report is replaced by 31 individual reports, basic information for all individual bay, sound and estuary stocks will remain in this report: “Northern Gulf of Mexico Bay, Sound and Estuary Stocks”. To date, four stocks have individual reports completed (Barataria Bay Estuarine System; Mississippi Sound, Lake Borgne, Bay Boudreau; Choctawhatchee Bay; St. Joseph Bay) and the remaining 27 stocks are assessed in this report.

STOCK DEFINITION AND GEOGRAPHIC RANGE

Common bottlenose dolphins are distributed throughout the bays, sound and estuaries of the Gulf of Mexico (Mullin 1988). The identification of biologically-meaningful “stocks” of bottlenose dolphins in these waters is complicated by the high degree of behavioral variability exhibited by this species (Shane *et al.* 1986; Wells and Scott 1999; Wells 2003), and by the lack of requisite information for much of the region.

Distinct stocks are delineated in each of 31 areas of contiguous, enclosed or semi-enclosed bodies of water adjacent to the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico; Table 1; Figure 1). The genesis of the delineation of these stocks was work initiated in the 1970s in Sarasota Bay, Florida (Irvine *et al.* 1981), and in bays in Texas (Shane 1977; Gruber 1981). These studies documented year-round residency of individual bottlenose dolphins in estuarine waters. As a result, the expectation of year-round resident populations was extended to bay, sound and estuary (BSE) waters across the northern Gulf of Mexico when the first stock assessment reports were established in 1995. Since these early studies, long-term (year-round, multi-year) residency has been reported from nearly every site where photographic identification (photo-ID) or tagging studies have been conducted in the Gulf of Mexico. In Texas, long-term resident dolphins have been reported in the Matagorda-Espiritu Santo Bay area (Gruber 1981; Lynn and Würsig 2002), Aransas Pass (Shane 1977; Weller 1998), San Luis Pass (Maze and Würsig 1999; Irwin and Würsig 2004), and Galveston Bay (Bräger 1993; Bräger *et al.* 1994; Fertl 1994). In Louisiana, Miller (2003) concluded the bottlenose dolphin population in the Barataria Basin was relatively closed. Hubard *et al.* (2004) reported sightings of dolphins in Mississippi Sound that were known from tagging efforts there 12–15 years prior. In Florida, long-term residency has been reported from Tampa Bay (Wells 1986; Wells *et al.* 1996b; Urian *et al.* 2009), Sarasota Bay (Irvine and Wells 1972; Irvine *et al.* 1981; Wells 1986; 1991; 2003; 2014; Wells *et al.* 1987; Scott *et al.* 1990; Wells 1991; 2003), Lemon Bay (Wells *et al.* 1996a; Bassos-Hull *et al.* 2013), Charlotte Harbor/Pine Island Sound (Shane 1990; Wells *et al.* 1996a; Wells *et al.* 1997; Shane 2004; Bassos-Hull *et al.* 2013) and Gasparilla Sound (Bassos-Hull *et al.* 2013). In Sarasota Bay, which has the longest research history, at least 5 concurrent generations of identifiable residents have been identified, including some of those first identified in 1970 (Wells 2014). Maximum immigration and emigration rates of about 2–3% have been estimated (Wells and Scott 1990).

Genetic data also support the concept of relatively discrete BSE stocks. Analyses of mitochondrial DNA haplotype distributions indicate the existence of clinal variations along the Gulf of Mexico coastline (Duffield and Wells 2002). Differences in reproductive seasonality from site to site also suggest genetic-based distinctions between communities (Urian *et al.* 1996). Mitochondrial DNA analyses suggest finer-scale structural levels as well. For example, dolphins in Matagorda Bay, Texas, appear to be a localized population, and differences in haplotype frequencies distinguish among adjacent communities in Tampa Bay, Sarasota Bay and Charlotte Harbor/Pine Island Sound, along the central west coast of Florida (Duffield and Wells 1991; 2002). Additionally, Sellas *et al.* (2005) examined population subdivision among dolphins sampled in Sarasota Bay, Tampa Bay, Charlotte Harbor, Matagorda Bay, and the coastal Gulf of Mexico (1–12 km offshore) from just outside Tampa Bay to the southern end of Lemon Bay, and found evidence of significant population structure among all areas on the basis of both mitochondrial DNA control region sequence data and 9 nuclear microsatellite loci. The Sellas *et al.* (2005) findings support the separate identification of BSE populations from those occurring in adjacent Gulf coastal waters.

In many cases, residents occur primarily in BSE waters, with limited movements through passes to the Gulf of Mexico (Shane 1977; 1990; Gruber 1981; Irvine *et al.* 1981; Maze and Würsig 1999; Lynn and Würsig 2002; Fazioli *et al.* 2006). These habitat use patterns are reflected in the ecology of the dolphins in some areas; for

example, residents of Sarasota Bay, Florida, lacked squid in their diet, unlike non-resident dolphins stranded on nearby Gulf beaches (Barros and Wells 1998). However, in some areas year-round residents may co-occur with non-resident dolphins. For example, about 14–17% of group sightings involving resident Sarasota Bay dolphins include at least 1 non-resident as well (Wells *et al.* 1987; Fazioli *et al.* 2006). Mixing of inshore residents and non-residents has been seen at San Luis Pass, Texas (Maze and Würsig 1999), Cedar Keys, Florida (Quintana-Rizzo and Wells 2001), and Pine Island Sound, Florida (Shane 2004). Non-residents exhibit a variety of movement patterns, ranging from apparent nomadism recorded as transience to a given area, to apparent seasonal or non-seasonal migrations. Passes, especially the mouths of the larger estuaries, serve as mixing areas. For example, dolphins from several different areas were documented at the mouth of Tampa Bay, Florida (Wells 1986), and most of the dolphins identified in the mouths of Galveston Bay and Aransas Pass, Texas, were considered transients (Henningsen 1991; Bräger 1993; Weller 1998).

Seasonal movements of dolphins into and out of some of the bays, sounds and estuaries have also been documented. In Sarasota Bay, Florida, and San Luis Pass, Texas, residents have been documented moving into Gulf coastal waters in fall/winter, and returning inshore in spring/summer (Irvine *et al.* 1981; Maze and Würsig 1999). Fall/winter increases in abundance have been noted for Tampa Bay (Scott *et al.* 1989) and are thought to occur in Matagorda Bay (Gruber 1981; Lynn and Würsig 2002) and Aransas Pass (Shane 1977; Weller 1998). Spring/summer increases in abundance occur in Mississippi Sound (Hubard *et al.* 2004) and are thought to occur in Galveston Bay (Henningsen 1991; Bräger 1993; Fertl 1994).

Spring and fall increases in abundance have been reported for St. Joseph Bay, Florida. Mark-recapture abundance estimates were highest in spring and fall and lowest in summer and winter (Table 1; Balmer *et al.* 2008). Individuals with low site-fidelity indices were sighted more often in spring and fall, whereas individuals sighted during summer and winter displayed higher site-fidelity indices. In conjunction with health assessments, 23 dolphins were radio tagged during April 2005 and July 2006. Dolphins tagged in spring 2005 displayed variable utilization areas and variable site fidelity patterns. In contrast, during summer 2006 the majority of radio tagged individuals displayed similar utilization areas and moderate to high site-fidelity patterns. The results of the studies suggest that during summer and winter St. Joseph Bay hosts dolphins that spend most of their time within this region, and these may represent a resident community. In spring and fall, St. Joseph Bay is visited by dolphins that range outside of this area (Balmer *et al.* 2008).

The current BSE stocks are delineated as described in Table 1. There are some estuarine areas that are not currently part of any stock's range. Many of these are areas that dolphins cannot readily access. For example, the marshlands between Galveston Bay and Sabine Lake and between Sabine Lake and Calcasieu Lake are fronted by long, sandy beaches that prohibit dolphins from entering the marshes. The region between the Calcasieu Lake and Vermilion Bay/Atchafalaya Bay stocks has some access, but these marshes are predominantly freshwater rather than saltwater marshes, making them unsuitable for long-term survival of a viable population of bottlenose dolphins. In other regions, there is insufficient estuarine habitat to harbor a demographically independent population, for instance between the Matagorda Bay and West Bay Stocks in Texas, and/or sufficient isolation of the estuarine habitat from coastal waters. The regions between the south end of the Estero Bay Stock area to just south of Naples and between Little Sarasota Bay and Lemon Bay are highly developed and contain little appropriate habitat. South of Naples to San Marco Island and Gullivan Bay is also not currently covered in a stock boundary. This region may reasonably contain bottlenose dolphins, but the relationship of any dolphins in this region to other BSE stocks is unknown. They may be members of the Gullivan to Chokoloskee Bay stock as there is passage behind San Marco Island that would allow dolphins to move north. The regions between Apalachee Bay and Cedar Key/Waccasassa Bay, between Crystal Bay and St. Joseph Sound and between Chokoloskee Bay and Whitewater Bay are comprised of thin strips of marshland with no barriers to adjacent coastal waters. Further work is necessary to determine whether year-round resident dolphins use these thin marshes or whether dolphins in these areas are members of the coastal stock that use the fringing marshland as well. Finally, the region between the eastern border of the Barataria Bay Stock and the Mississippi Delta Stock to the east may harbor dolphins, but the area is small and work is necessary to determine whether any dolphins utilizing this habitat come from an adjacent BSE stock.

As more information becomes available, combination or division of these stocks, or alterations to stock boundaries, may be warranted. Recent research based on photo-ID data collected by Bassos-Hull *et al.* (2013) recommended combining B21, Lemon Bay, with B22–23, Gasparilla Sound, Charlotte Harbor, Pine Island Sound. Therefore, these stocks have been combined (see Table 1). However, it should be noted this change was made in the absence of genetic data and could be revised again in the future when genetic data are available. Additionally, a number of geographically and socially distinct subgroupings of dolphins in regions such as Tampa Bay, Charlotte Harbor, Pine Island Sound, Aransas Pass and Matagorda Bay have been identified, but the importance of these distinctions to stock designations remains undetermined (Shane 1977; Gruber 1981; Wells *et al.* 1996a; 1996b;

1997; Lynn and Würsig 2002; Urian 2002). For Tampa Bay, Urian *et al.* (2009) described 5 discrete communities (including the adjacent Sarasota Bay community) that differed in their social interactions and ranging patterns. Structure was found despite a lack of physiographic barriers to movement within this large, open embayment. Urian *et al.* (2009) further suggested that fine-scale structure may be a common element among bottlenose dolphins in the southeastern U.S. and recommended that management should account for fine-scale structure that exists within current stock designations.

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	2001	B
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	C
B30	Mississippi River Delta	332	0.93	170	1.7	2011–12	D
B02–05, 29, 31	Mississippi Sound, Lake Borgne, Bay Boudreau†	901	0.63	551	5.6	2012	D
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	UNK ^c	UND ^c	2007	E
B10	St. Andrew Bay	124	0.57	UNK	UND	1993	A
B11	St. Joseph Bay†	152	0.08	UNK ^c	UND ^c	2007	F
B12–13	St. Vincent Sound, Apalachicola Bay, St. George Sound	439	0.14	UNK	UND	2007	G
B14–15	Apalachee Bay	491	0.39	UNK	UND	1993	A
B16	Waccasassa Bay, Withlacoochee Bay, Crystal Bay	UNK	-	UNK	UND		
B17	St. Joseph Sound, Clearwater Harbor	UNK	-	UNK	UND		
B32–34	Tampa Bay	UNK	-	UNK	UND		
B20, 35	Sarasota Bay, Little Sarasota Bay	158	0.27	126	1.3	2015	H
B21–23	Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay	826	0.09	UNK	UND	2006	I
B36	Caloosahatchee River	0 ^{ab}	-		UND	1985	J
B24	Estero Bay	UNK	-	UNK	UND		
B25	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay	UNK	-	UNK	UND		
B27	Whitewater Bay	UNK	-	UNK	UND		
B28	Florida Keys (Bahia Honda to Key	UNK	-	UNK	UND		

West)
References: A – Blaylock and Hoggard 1994; B – Irwin and Würsig 2004; C – Miller 2003; D – Garrison 2017; E – Conn <i>et al.</i> 2011; F – Balmer <i>et al.</i> 2008; G – Tyson <i>et al.</i> 2011; H – Tyson and Wells 2016; I – Bassos-Hull <i>et al.</i> 2013; J – Scott <i>et al.</i> 1989
Notes:
^a During earlier surveys (Scott <i>et al.</i> 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 The individual SAR for this stock has not been updated yet to reflect this change.
[†] An individual stock assessment report is available for this stock.

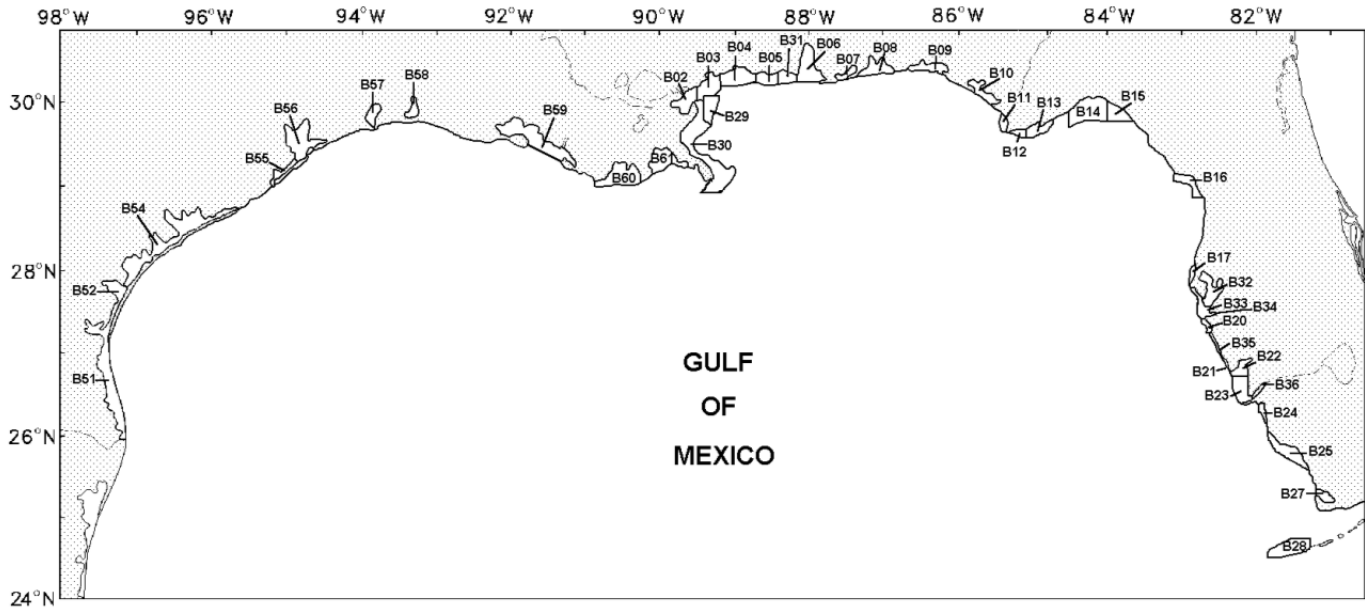


Figure 1. Northern Gulf of Mexico bays, sounds and estuaries. Each of the alpha-numerically designated blocks corresponds to one of the NMFS Southeast Fisheries Science Center logistical aerial survey areas listed in Table 1. The common bottlenose dolphins inhabiting each bay, sound or estuary are considered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

POPULATION SIZE

Population size estimates for most of the stocks are greater than 8 years old and therefore the current population sizes for all but 3 of these stocks are considered unknown (Wade and Angliss 1997). However, a capture-mark-recapture population size estimate for 2015 is available for Sarasota Bay, Little Sarasota Bay (Tyson and Wells 2016). Recent aerial survey line-transect population size estimates are available for Mississippi River Delta and Mississippi Sound, Lake Borgne, Bay Boudreau (Garrison 2017; Table 1). Population size estimates for many stocks were generated from preliminary analyses of line-transect data collected during aerial surveys conducted in September–October 1992 in Texas and Louisiana and in September–October 1993 in Louisiana, Mississippi, Alabama and the Florida Panhandle (Blaylock and Hoggard 1994; Table 1). Standard line-transect perpendicular sighting distance analytical methods (Buckland *et al.* 1993) and the computer program DISTANCE (Laake *et al.* 1993) were used.

Minimum Population Estimate

The population sizes for all but 3 stocks are currently unknown and the minimum population estimates are given for those 3 stocks in Table 1. The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The minimum population estimate was calculated for each block from the estimated population size and its associated coefficient of variation.

Current Population Trend

The data are insufficient to determine population trends for most of the Gulf of Mexico BSE common bottlenose dolphin stocks.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for these stocks. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate and a recovery factor (Wade and Angliss 1997). The recovery factor is 0.5 because these stocks are of unknown status. PBR is undetermined for all but 3 stocks because the population size estimates are more than 8 years old. PBR for those stocks with population size estimates less than 8 years old is given in Table 1.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for these stocks during 2010–2014 is unknown because these stocks interact with unobserved fisheries (see below). Five-year unweighted mean mortality estimates for 2007–2011 for the commercial shrimp trawl fishery were calculated at the state level (see Shrimp Trawl section below).

Fishery Information

The commercial fisheries that interact, or that potentially could interact, with these stocks in the Gulf of Mexico are the Category II Southeastern U.S. Atlantic, Gulf of Mexico shrimp trawl; Gulf of Mexico menhaden purse seine; Southeastern U.S. Atlantic, Gulf of Mexico stone crab trap/pot; and Gulf of Mexico gillnet fisheries; and the Category III Gulf of Mexico blue crab trap/pot; Florida spiny lobster trap/pot; and Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line) fisheries (Appendix III).

In the following sections the number of documented interactions of common bottlenose dolphins with each of these fisheries during 2010–2014 is reported. The likely stock(s) of origin for each interaction has been inferred based on the location of the interaction and distribution of the fishery.

Shrimp Trawl

During 2010–2014, there were no documented mortalities or serious injuries of common bottlenose dolphins from Gulf of Mexico BSE stocks by commercial shrimp trawls because observer coverage of this fishery does not include BSE waters. Between 1997 and 2011, 5 common bottlenose dolphins and 7 unidentified dolphins, which could have been either common bottlenose dolphins or Atlantic spotted dolphins, became entangled in the lazy line, turtle excluder device or tickler chain gear in the commercial shrimp trawl fishery in the Gulf of Mexico. All dolphin bycatch interactions resulted in mortalities except for 1 unidentified dolphin that was released alive in 2009. Soldevilla *et al.* (2015) provided mortality estimates calculated from analysis of shrimp fishery effort data and NMFS's Observer Program bycatch data. Observer program coverage does not extend into BSE waters; time-area stratified bycatch rates were extrapolated into inshore waters to estimate bycatch mortalities from inshore fishing effort. Annual mortality estimates were calculated for the years 1997–2011 from stratified annual fishery effort and bycatch rates, and a 5-year unweighted mean mortality estimate for 2007–2011 was calculated for Gulf of Mexico dolphin stocks. The 4-area (Texas, Louisiana, Mississippi/Alabama, Florida) stratification method was chosen because it best approximates how fisheries operate (Soldevilla *et al.* 2015). The BSE stock mortality estimates were aggregated at the state level as this was the spatial resolution at which fishery effort is modeled (e.g., Nance *et al.* 2008). The mean annual mortality estimates for the BSE stocks were as follows: Texas BSE (from Galveston Bay, East Bay, Trinity Bay south to Laguna Madre): 0; Louisiana BSE (from Sabine Lake east to Barataria Bay): 88 (CV=1.01); Mississippi/Alabama BSE (from Mississippi River Delta east to Mobile Bay, Bonsecour Bay): 41 (CV=0.67); and Florida BSE (from Perdido Bay east and south to the Florida Keys): 3.4 (CV=0.99). These estimates do not include skimmer trawl effort, which may represent up to 50% of shrimp fishery effort in Louisiana, Alabama, and Mississippi inshore waters, because observer program coverage of skimmer trawls is limited. Limitations and biases of annual bycatch mortality estimates are described in detail in Soldevilla *et al.* (2015).

One mortality (2009) and 1 live release without serious injury (2012) occurred in Alabama bays during non-

commercial shrimp trawling (see "Other Mortality" below for details).

Menhaden Purse Seine

During 2010–2014, there were 2 mortalities and 1 animal released alive without serious injury documented within BSE waters involving the menhaden purse seine fishery. All 3 interactions occurred within the waters of the Mississippi Sound, Lake Borgne, Bay Boudreau Stock (also reported in that SAR).

There is currently no observer program for the Gulf of Mexico menhaden purse seine fishery; however, recent incidental takes have been reported via two sources. First, during 2011, a pilot observer program operated from May through September, and observers documented 3 dolphins trapped within purse seine nets. All 3 were released alive without serious injury (Maze-Foley and Garrison 2016a). Two of the 3 dolphins were trapped within a single purse seine within waters of the Western Coastal Stock. The third animal was trapped in waters of the Mississippi Sound, Lake Borgne, Bay Boudreau Stock. Second, through the Marine Mammal Authorization Program (MMAP), there have been 13 self-reported incidental takes (all mortalities) of common bottlenose dolphins in northern Gulf of Mexico coastal and estuarine waters by the menhaden purse seine fishery during 2000–2014. Specific self-reported takes under the MMAP likely involving BSE stocks are as follows: 2 dolphins were reported taken in a single purse seine during 2012 in Mississippi Sound (Mississippi Sound, Lake Borgne, Bay Boudreau Stock); 1 take of a single bottlenose dolphin was reported in Louisiana waters during 2004 that likely belonged to the Mississippi River Delta Stock; 1 take of a single unidentified dolphin reported during 2002 likely belonged to the Mississippi Sound, Lake Borgne, Bay Boudreau Stock; 1 take of a single bottlenose dolphin was reported in Louisiana waters during 2001 that likely belonged to Mississippi River Delta Stock or Northern Coastal Stock; during 2000, 1 take of a single bottlenose dolphin was reported in Louisiana waters that likely belonged to Mississippi River Delta Stock or Northern Coastal Stock; and also in 2000, 3 bottlenose dolphins were reported taken in a single purse seine in Mississippi waters that likely belonged to Mississippi Sound, Lake Borgne, Bay Boudreau Stock.

Without an ongoing observer program, it is not possible to obtain statistically reliable information for this fishery on the incidental take and mortality rates, and the stocks from which bottlenose dolphins are being taken.

Blue Crab, Stone Crab and Florida Spiny Lobster Trap/Pot

During 2010–2014 there were 4 documented interactions with trap/pot fisheries and BSE stocks. During 2013, 1 animal was disentangled and released alive from Florida spiny lobster trap/pot gear (it could not be determined if the animal was seriously injured following mitigation (disentanglement) efforts; the initial determination (pre-mitigation) was seriously injured [Maze-Foley and Garrison 2016c]). This animal likely belonged to the Florida Keys Stock. During 2011, 1 mortality occurred and 1 live animal was disentangled and released (it could not be determined if the animal was seriously injured [Maze-Foley and Garrison 2016a]). The BSE stocks involved were likely Waccasassa Bay, Withlacoochee Bay, Crystal Bay and Galveston Bay, East Bay, Trinity Bay, respectively. In 2010, a calf likely belonging to the Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay Stock was disentangled by stranding network personnel from a crab trap line wrapped around its peduncle. The animal swam away with no obvious injuries, but was considered seriously injured because it is unknown whether it was reunited with its mother (Maze-Foley and Garrison 2016a). The specific fishery could not be identified for the trap/pot gear involved in the 2011 and 2010 interactions. All mortalities and animals released alive were included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015) and are included in the stranding totals in Table 1. Because there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab traps/pots.

Gillnet

No marine mammal mortalities associated with gillnet fisheries have been reported or observed in recent years, but stranding data suggest that gillnet and marine mammal interactions do occur, causing mortality and serious injury. During 2010–2014, a total of 12 entanglements in research-related gillnets were reported in BSE stocks: 8 dolphins in Texas, 2 in Louisiana and 2 in Florida. Three of the 12 entanglements resulted in mortalities, and 1 in a serious injury (see "Other Mortality" below for details on recent and historical research-related entanglements).

There has been no observer coverage of this fishery in federal waters. Beginning in November 2012, NMFS began placing observers on commercial vessels in the coastal waters of Alabama, Mississippi and Louisiana (state waters only). No takes have been observed to date (Mathers *et al.* 2016). In 1995, a Florida state constitutional amendment banned gillnets and large nets from bays, sounds, estuaries and other inshore waters. Commercial and recreational gillnet fishing is also prohibited in Texas state waters.

Hook and Line (Rod and Reel)

During 2010–2014 there were 29 documented interactions (entanglements or ingestions) with hook and line gear and BSE stocks—20 mortalities and 9 live animals for which disentanglement efforts were made. Available evidence from stranding data was examined for the 20 mortalities. For 12 of these mortalities, evidence suggested the hook and line gear interaction contributed to the cause of death. For 4 mortalities, evidence suggested the hook and line gear interaction was incidental and was not a contributing factor to cause of death. For 4 mortalities, it could not be determined if the hook and line gear interaction contributed to cause of death. Attempts were made to disentangle 9 live animals from hook and line gear, 2 of which were considered seriously injured by the gear based on observations during mitigation (disentanglement) efforts. Four live animals were considered seriously injured by the gear prior to mitigation efforts, but based on observations during mitigations, they were considered not seriously injured post-mitigation. For the remaining 3 live animals, it could not be determined if the animals were seriously injured (Maze Foley and Garrison 2016a,b,c,d). In summary, the evidence available from stranding data suggested that at least 12 mortalities and 2 serious injuries to animals from BSE stocks were a result of interactions with rod and reel hook and line gear.

Interactions by year with hook and line gear were as follows: During 2010 there were 3 mortalities, and 1 live animal was disentangled and released, considered seriously injured (Maze-Foley and Garrison 2016a). During 2011, there were 2 mortalities, and 2 live animals were disentangled from hook and line gear. One of the live animals was considered seriously injured, and 1 was not seriously injured (Maze-Foley and Garrison 2016a). During 2012 there were 8 mortalities, and 2 live animals were disentangled from hook and line gear (1 considered not seriously injured, 1 could not be determined if it was seriously injured) (Maze-Foley and Garrison 2016b). During 2013 there were 3 mortalities and 3 live animals disentangled from hook and line gear. One of the live animals was considered not seriously injured and for the other 2, it could not be determined whether they were seriously injured (Maze-Foley and Garrison 2016c). Finally, during 2014 there were 4 mortalities and 1 live animal disentangled from hook and line gear considered not seriously injured (Maze-Foley and Garrison 2016d).

The mortalities and serious injuries likely involved animals from the following BSE stocks: Pensacola Bay, East Bay; Waccasassa Bay, Withlacoochee Bay, Crystal Bay; Tampa Bay; Sarasota Bay, Little Sarasota Bay; Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay; Caloosahatchee River; Estero Bay; Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay; Galveston Bay, East Bay, Trinity Bay; West Bay; Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay; and Neuces Bay, Corpus Christi Bay.

All mortalities and live entanglements were included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015) and are included in the stranding totals presented in Table 1. It should be noted that, in general, it cannot be determined if rod and reel hook and line gear originated from a commercial (i.e., charter boat and headboat) or recreational angler because the gear type used by both sources is typically the same. Also, it is not possible to estimate the total number of interactions with hook and line gear because there is no systematic observer program.

Strandings

A total of 564 common bottlenose dolphins were found stranded within bays, sounds and estuaries of the northern Gulf of Mexico from 2010 through 2014 (Table 2; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015). It could not be determined if there was evidence of human interaction for 452 of these strandings. For 27 dolphins, no evidence of human interaction was detected. Evidence of human interactions was detected for 85 of these dolphins. Human interactions were from numerous sources, including 29 entanglements with hook and line gear, 4 entanglements with trap/pot gear, 12 incidental takes in research gillnet gear, 1 stabbing with a screwdriver, 2 animals shot by arrow and 1 with gunshot, 1 entanglement in a non-commercial shrimp trawl, 1 entanglement in research longline gear, 2 strandings with visible, external oil, and 1 entrapment between oil booms (see Table 1). Strandings with evidence of fishery-related interactions are reported above in the respective gear sections. Bottlenose dolphins are known to become entangled in, or ingest recreational and commercial fishing gear (Wells and Scott 1994; Gorzelany 1998; Wells *et al.* 1998, 2008), and some are struck by vessels (Wells and Scott 1997; Wells *et al.* 2008).

There are a number of difficulties associated with the interpretation of stranding data. Except in rare cases, such as Sarasota Bay, Florida, where residency can be determined, it is possible that some or all of the stranded dolphins may have been from a nearby coastal stock. However, the proportion of stranded dolphins belonging to another stock cannot be determined because of the difficulty of determining from where the stranded carcasses originated. Stranding data probably underestimate the extent of human and fishery-related mortality and serious injury because not all of the dolphins that die or are seriously injured in human interactions wash ashore, or, if they do, they are not all recovered (Peltier *et al.* 2012; Wells *et al.* 2015). Additionally, not all carcasses will show evidence of human

interaction, entanglement or other fishery-related interaction due to decomposition, scavenger damage, etc. (Byrd *et al.* 2014). Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interaction.

Since 1990, there have been 13 bottlenose dolphin die-offs or Unusual Mortality Events (UMEs) in the northern Gulf of Mexico (Litz *et al.* 2014; <http://www.nmfs.noaa.gov/pr/health/mmume/events.html>, accessed 11 January 2016). 1) From January through May 1990, a total of 344 bottlenose dolphins stranded in the northern Gulf of Mexico. Overall this represented a two-fold increase in the prior maximum recorded number of strandings for the same period, but in some locations (i.e., Alabama) strandings were 10 times the average number. The cause of the 1990 mortality event could not be determined (Hansen 1992), however, morbillivirus may have contributed to this event (Litz *et al.* 2014). 2) A UME was declared for Sarasota Bay, Florida, in 1991 involving 31 bottlenose dolphins. The cause was not determined, but it is believed biotoxins may have contributed to this event (Litz *et al.* 2014). 3) In March and April 1992, 119 bottlenose dolphins stranded in Texas - about 9 times the average number. The cause of this event was not determined, but low salinity due to record rainfall combined with pesticide runoff and exposure to morbillivirus were suggested as potential contributing factors (Duignan *et al.* 1996; Colbert *et al.* 1999; Litz *et al.* 2014). 4) In 1993–1994 a UME of bottlenose dolphins caused by morbillivirus started in the Florida Panhandle and spread west with most of the mortalities occurring in Texas (Lipscomb 1993; Lipscomb *et al.* 1994; Litz *et al.* 2014). From February through April 1994, 236 bottlenose dolphins were found dead on Texas beaches, of which 67 occurred in a single 10-day period. 5) In 1996 a UME was declared for bottlenose dolphins in Mississippi when 31 bottlenose dolphins stranded during November and December. The cause was not determined, but a *Karenia brevis* (red tide) bloom was suspected to be responsible (Litz *et al.* 2014). 6) Between August 1999 and May 2000, 150 bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle (additional strandings included 3 Atlantic spotted dolphins, *Stenella frontalis*, 1 Risso's dolphin, *Grampus griseus*, 2 Blainville's beaked whales, *Mesoplodon densirostris*, and 4 unidentified dolphins. Brevetoxin was determined to be the cause of this event (Twiner *et al.* 2012; Litz *et al.* 2014). 7) In March and April 2004, in another Florida Panhandle UME attributed to *K. brevis* blooms, 105 bottlenose dolphins and 2 unidentified dolphins stranded dead (Litz *et al.* 2014). Although there was no indication of a *K. brevis* bloom at the time, high levels of brevetoxin were found in the stomach contents of the stranded dolphins (Flewelling *et al.* 2005; Twiner *et al.* 2012). 8) In 2005, a particularly destructive red tide (*K. brevis*) bloom occurred off central west Florida. Manatee, sea turtle, bird and fish mortalities were reported in the area in early 2005 and a manatee UME had been declared. Dolphin mortalities began to rise above the historical averages by late July 2005, continued to increase through October 2005, and were then declared to be part of a multi-species UME. The multi-species UME extended into 2006, and ended in November 2006. In total, 190 dolphins were involved, primarily bottlenose dolphins (plus strandings of 1 Atlantic spotted dolphin, *S. frontalis*, and 23 unidentified dolphins). The evidence suggests a red tide bloom contributed to the cause of this event (Litz *et al.* 2014). 9) A separate UME was declared in the Florida Panhandle after elevated numbers of dolphin strandings occurred in association with a *K. brevis* bloom in September 2005. Dolphin strandings remained elevated through the spring of 2006 and brevetoxin was again detected in the tissues of most of the stranded dolphins and determined to be the cause of the event (Twiner *et al.* 2012; Litz *et al.* 2014). Between September 2005 and April 2006 when the event was officially declared over, a total of 88 bottlenose dolphin strandings occurred (plus strandings of 5 unidentified dolphins). 10) During February and March of 2007 an event was declared for northeast Texas and western Louisiana involving 64 bottlenose dolphins and 2 unidentified dolphins. Decomposition prevented conclusive analyses on most carcasses (Litz *et al.* 2014). 11) During February and March of 2008 an additional event was declared in Texas involving 111 bottlenose dolphin strandings (plus strandings of 1 unidentified dolphin and 1 melon-headed whale, *Peponocephala electra*). Most of the animals recovered were in a decomposed state. The investigation is closed and a direct cause could not be identified. However, there were numerous, co-occurring harmful algal bloom toxins detected during the time period of this UME which may have contributed to the mortalities (Fire *et al.* 2011). 12) A UME was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010 and ending 31 July 2014 (Litz *et al.* 2014; http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico.htm, accessed 1 June 2016). The UME began a few months prior to the *Deepwater Horizon* (DWH) oil spill, however most of the strandings prior to May 2010 were in Lake Pontchartrain, Louisiana, and western Mississippi and were likely a result of low salinity and cold temperatures (Venn Watson *et al.* 2015a). The largest increase in strandings (compared to historical data) occurred after May 2010 following the DWH spill, and strandings were focused in areas exposed to DWH oil. Investigations to date have determined that the DWH oil spill is the primary underlying cause of the elevated stranding numbers in the northern Gulf of Mexico after the spill (e.g., Schwacke *et al.* 2014; Venn-Watson *et al.* 2015b). 13) A UME occurred from November 2011 to March 2012 across 5 Texas counties and included 126 bottlenose dolphin strandings. The strandings were coincident with a harmful algal bloom of *K. brevis*, but researchers have not

determined that was the cause of the event. During 2011, 6 animals from BSE stocks were considered to be part of the UME; during 2012, 24 animals.

Table 2. Common bottlenose dolphin strandings occurring in bays, sounds and estuaries in the northern Gulf of Mexico from 2010 to 2014, as well as number of strandings for which evidence of human interaction was detected and number of strandings for which it could not be determined (CBD) if there was evidence of human interaction. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 15 June 2015). Please note human interaction does not necessarily mean the interaction caused the animal's death. Please also note that this table does not include strandings from Barataria Bay Estuarine System; Mississippi Sound, Lake Borgne, Bay Boudreau; Choctawhatchee Bay; or St. Joseph Bay.

Stock	Category	2010	2011	2012	2013	2014	Total
Bay, Sound and Estuary	Total Stranded	96 ^a	106 ^b	124 ^c	131 ^d	107 ^e	564
	Human Interaction						
	---Yes	15 ^f	13 ^g	23 ^h	22 ⁱ	12 ^j	85
	---No	7	6	4	4	6	27
	---CBD	74	87	97	105	89	452

^a This total includes animals that are part of the Northern Gulf of Mexico UME.

^b This total includes animals that are part of the Northern Gulf of Mexico UME, and also includes 6 animals that were part of the 2011–2012 UME in Texas.

^c This total includes animals that are part of the Northern Gulf of Mexico UME, and also includes 24 animals that were part of the 2011–2012 UME in Texas.

^d This total includes animals that are part of the Northern Gulf of Mexico UME.

^e This total includes animals that are part of the Northern Gulf of Mexico UME.

^f Includes 4 entanglement interactions with hook and line gear (3 mortalities and 1 animal released alive seriously injured); 1 entanglement interaction with unidentified trap/pot gear (released alive seriously injured); 2 entanglement interactions with research gillnet gear (1 released alive without serious injury, 1 released alive that could not be determined if seriously injured or not); 1 live release without serious injury following entrapment between oil booms (animal was initially seriously injured, but due to mitigation efforts, was released without serious injury); 1 animal visibly oiled (mortality); and 1 entanglement interaction with unknown gear (released alive without serious injury [animal was initially seriously injured, but due to mitigation efforts, was released without serious injury]).

^g Includes 4 entanglement interactions with hook and line gear (2 mortalities, 1 animal released alive seriously injured, 1 released alive without serious injury [this animal was initially seriously injured, but due to mitigation efforts, was released without serious injury]); 2 entanglement interactions with research gillnet gear (1 mortality, 1 released alive without serious injury); 2 entanglement interactions with trap/pot gear (1 mortality, 1 released alive that could not be determined if seriously injured or not); and 1 animal visibly oiled (mortality).

^h Includes 10 entanglement interactions with hook and line gear (8 mortalities, 1 released alive without serious injury [animal was initially seriously injured, but due to mitigation efforts, was released without serious injury], 1 released alive that could not be determined if seriously injured or not); 4 entanglement interactions with research gillnet gear (1 released alive seriously injured, 3 released alive without serious injury); 1 entanglement in a non-commercial shrimp trawl net (released alive without serious injury); 1 stabbing (mortality); and 1 entanglement interaction with unknown fishing gear (released alive without serious injury [animal was initially seriously injured, but due to mitigation efforts, was released without serious injury]).

ⁱ Includes 6 entanglement interactions with hook and line gear (3 mortalities, 1 animal released alive without serious injury [animal was initially seriously injured, but due to mitigation efforts, was released without serious injury], 2 animals released alive that could not be determined if seriously injured or not); 4 entanglement interactions with research gillnet gear (2 mortalities, 1 animal released alive without serious injury, 1 animal released alive that could not be determined if seriously injured or not); 1 interaction with Florida spiny lobster trap/pot gear (released alive, could not be determined if seriously injured or not [this animal was initially seriously injured, but mitigation efforts were made]); 1 interaction with research longline gear (released alive, seriously injured); and 1 animal that was gunshot (mortality).

^j Includes 5 entanglement interactions with hook and line gear (4 mortalities, 1 released alive without serious injury [animal was initially seriously injured, but due to mitigation efforts, was released without serious injury]) and 2 animals shot by arrow (mortalities).

Other Mortality

There were 3 live dolphins included in the stranding database during 2010–2014 that were entangled in unidentified fishing gear or unidentified gear. One animal was seriously injured in 2013 in the Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay Stock area (Maze-Foley and Garrison 2016c). Two animals were initially considered seriously injured, but following mitigation efforts, were released alive without serious injury in 2010 (Sarasota Bay, Little Sarasota Bay Stock) and 2012 (Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay Stock) (Maze-Foley and Garrison 2016a,b). In addition, during 2012 in Alabama (Perdido Bay Stock), a dolphin was disentangled from a shrimp trawling net being used in a local ecotour. The animal was considered not seriously injured (Maze-Foley and Garrison 2016b), and was also included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015).

In addition to animals included in the stranding database, during 2010–2014, there were 20 at-sea observations in BSE stock areas of common bottlenose dolphins entangled in fishing gear or unidentified gear (hook and line, crab trap/pot and unidentified gear/line/rope). In 8 of these cases the animals were seriously injured, in 1 case the animal was not seriously injured, and for the remaining 11 cases, it could not be determined (CBD) if the animals were seriously injured (Maze-Foley and Garrison 2016a,b,c,d; see Table 3).

Table 3. At-sea observations of common bottlenose dolphins entangled in fishing gear or unidentified gear during 2010–2014, including the serious injury determination (mortality, serious injury, not a serious injury, or could not be determined (CBD) if seriously injured) and stock to which each animal likely belonged based on sighting location. Further details can be found in Maze-Foley and Garrison (2016a,b,c,d).		
Year	Determination	Stock
2010	Serious injury	Mobile Bay, Bonsecour Bay
2010	CBD	Terrebonne, Timbalier Bay
2011	Serious injury	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2011	Serious injury	Pensacola Bay, East Bay
2011	CBD	Tampa Bay
2012	Serious injury	Caloosahatchee River
2012	Serious injury	Sarasota Bay, Little Sarasota Bay
2012	CBD	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay
2012	CBD	Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay
2012	CBD	Tampa Bay
2013	Serious injury	Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay
2013	Serious injury	Estero Bay
2013	Not serious	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay
2013	CBD	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2013	CBD	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2013	CBD	Tampa Bay
2013	CBD	Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay
2014	Serious injury	St. Joseph Sound, Clearwater Harbor
2014	CBD	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay
2014	CBD	St. Andrew Bay

Common bottlenose dolphins are also known to interact with research-fishery gear. During 2010–2014, a dolphin was seriously injured during a research longline survey (Maze-Foley and Garrison 2016c; see Table 4) and 12 dolphins were entangled in research-related gillnets—in Texas (8), Louisiana (2) and Florida (2). Three of the 12 entanglements resulted in mortalities; 1 entanglement resulted in a serious injury; 6 entanglements were released alive without serious injury; and for 2 entanglements, it could not be determined if the animals were seriously injured (Maze-Foley and Garrison 2016a,b,c,d; see Table 4). All of the interactions with research gear were included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished

data, accessed 15 June 2015).

Table 4. Research-related takes of common bottlenose dolphins during 2010–2014, including the serious injury determination for each animal (mortality, serious injury, not a serious injury, or could not be determined (CBD) if seriously injured) and stock to which each animal likely belonged based on location of the interaction. All of these interactions were included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015). Further details on injury determinations can be found in Maze-Foley and Garrison (2016a,b,c,d).

Year	Gear Type	Determination	Stock
2013	Longline	Serious injury	Mobile Bay, Bonsecour Bay
2010	Gillnet	Not serious	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2010	Gillnet	CBD	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2011	Gillnet	Mortality	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2011	Gillnet	Not serious	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2012	Gillnet	Serious injury	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2012	Gillnet	Not serious	Neuces Bay, Corpus Christi Bay
2012	Gillnet	Not serious	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2012	Gillnet	Not serious	Laguna Madre
2013	Gillnet	Not serious	Mississippi River Delta
2013	Gillnet	Mortality	Mississippi River Delta
2013	Gillnet	Mortality	Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay
2013	Gillnet	CBD	Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay

The problem of dolphin depredation of fishing gear is increasing in Gulf of Mexico coastal and estuary waters. There was a recent case within BSE waters of a shrimp fisherman illegally taking a common bottlenose dolphin in Mississippi Sound (Mississippi Sound, Lake Borgne, Bay Boudreau Stock) during summer 2012. In December 2013 the fisherman was convicted under the MMPA for knowingly shooting a dolphin with a shotgun while shrimping.

In addition to the above case where it was confirmed the fisherman retaliated against depredation by dolphins, there have been several other documented shootings of BSE common bottlenose dolphins in recent years, both by arrows and guns. During 2014 in Cow Bayou, Texas (Sabine Lake Stock), a dolphin was shot with a compound bow resulting in mortality. In 2014 near Orange Beach, Alabama (Perdido Bay Stock), a dolphin was shot with a hunting arrow. In the arrow cases, there was no evidence the acts were committed due to dolphin depredation of fishing gear. In 2014 within Choctawhatchee Bay, Florida (Choctawhatchee Bay Stock), a pregnant bottlenose dolphin was found dead with a bullet lodged in its lung. Necropsy results indicated the dolphin died of the gunshot wound. Two individual bottlenose dolphins were shot with buckshot-like ammunition in Louisiana waters: 1 in 2014 within Barataria Bay (Barataria Bay Stock), and 1 in 2013 in a canal off Terrebonne Bay (Terrebonne Bay, Timbalier Bay Stock). In 2013 in Mississippi Sound, a dolphin was found with a bullet lodged in its lung. Necropsy results indicated the bullet had been there for several months and likely was not the cause of death. In the gunshot cases, it is unknown whether the animals were shot due to depredation of fishing gear, but it is possible one or more of these acts was related to depredation. All of these shootings were included in the stranding database and in Table 2. During 2012 a dolphin was observed swimming in Perdido Bay with a screwdriver protruding from its melon and was found dead the next day. This stabbing was included in the stranding database and in Table 2.

Illegal feeding or provisioning of wild bottlenose dolphins has been documented in Florida, particularly near Panama City Beach in the Panhandle (Samuels and Bejder 2004) and in and near Sarasota Bay (Cunningham-Smith *et al.* 2006; Powell and Wells 2011), and also in Texas near Corpus Christi (Bryant 1994). Feeding wild dolphins is defined under the MMPA as a form of ‘take’ because it can alter their natural behavior and increase their risk of injury or death. Nevertheless, a high rate of provisioning was observed near Panama City Beach in 1998 (Samuels

and Bejder 2004), and provisioning has been observed south of Sarasota Bay since 1990 (Cunningham-Smith *et al.* 2006; Powell and Wells 2011). There are emerging questions regarding potential linkages between provisioning and depredation of recreational fishing gear and associated entanglement and ingestion of gear, which is increasing through much of Florida. During 2006, at least 2% of the long-term resident dolphins of Sarasota Bay died from ingestion of recreational fishing gear (Powell and Wells 2011).

Swimming with wild bottlenose dolphins has also been documented in Florida in Key West (Samuels and Engleby 2007) and near Panama City Beach (Samuels and Bejder 2004). Near Panama City Beach, Samuels and Bejder (2004) concluded that dolphins were amenable to swimmers due to illegal provisioning. Swimming with wild dolphins may cause harassment, and harassment is illegal under the MMPA.

As noted previously, bottlenose dolphins are known to be struck by vessels (Wells and Scott 1997; Wells *et al.* 2008). During 2010–2014, 19 stranded bottlenose dolphins (of 564 total strandings) showed signs of a boat collision (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015). It is possible some of the instances were post-mortem collisions. In addition to vessel collisions, the presence of vessels may also impact bottlenose dolphin behavior in bays, sounds and estuaries. Nowacek *et al.* (2001) reported that boats pass within 100 m of each bottlenose dolphin in Sarasota Bay once every 6 minutes on average, leading to changes in dive patterns and group cohesion. Buckstaff (2004) noted changes in communication patterns of Sarasota Bay dolphins when boats approached. Miller *et al.* (2008) investigated the immediate responses of bottlenose dolphins to “high-speed personal watercraft” (i.e., boats) in Mississippi Sound. They found an immediate impact on dolphin behavior demonstrated by an increase in traveling behavior and dive duration, and a decrease in feeding behavior for non-traveling groups. The findings suggested dolphins attempted to avoid high-speed personal watercraft. It is unclear whether repeated short-term effects will result in long-term consequences like reduced health and viability of dolphins. Further studies are needed to determine the impacts throughout the Gulf of Mexico.

As part of its annual coastal dredging program, the Army Corps of Engineers conducts sea turtle relocation trawling during hopper dredging as a protective measure for marine turtles. No interactions have been documented during the most recent 5 years, 2010–2014, that fall within BSE stocks in this report; however, 1 interaction occurred within the boundaries of the Mississippi Sound, Lake Borgne, Bay Boudreau Stock (please see that SAR for details). In earlier years, 5 interactions, including 4 mortalities (2003, 2005, 2006, 2007), were documented in the Gulf of Mexico involving bottlenose dolphins and relocation trawling activities. It is likely that 2 of these animals belonged to BSE stocks (2003, 2006).

There have been documented mortalities of common bottlenose dolphins during health-assessment research projects in the Gulf of Mexico, but none have occurred during the most recent 5 years, 2010–2014. Historically, 1 mortality occurred within Sarasota Bay in 2002, and 1 mortality occurred in St. Joseph Bay in 2006.

Some of the BSE communities were the focus of a live-capture fishery for bottlenose dolphins which supplied dolphins to the U.S. Navy and to oceanaria for research and public display for more than 2 decades (Reeves and Leatherwood 1984; Scott 1990). Between 1973 and 1988, 533 bottlenose dolphins were removed from Southeastern U.S. waters (Scott 1990). The impact of these removals on the stocks is unknown. In 1989, the Alliance of Marine Mammal Parks and Aquariums declared a self-imposed moratorium on the capture of bottlenose dolphins in the Gulf of Mexico (Corkeron 2009).

HABITAT ISSUES

The DWH MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500 m deep, exploded on 20 April 2010. The rig sank, and over 87 days up to ~4.9 million barrels of oil were discharged from the wellhead until it was capped on 15 July 2010 (McNutt *et al.* 2012). During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns (Buist *et al.* 1999; NOAA 2011). The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

A substantial number of beaches and wetlands along the Louisiana coast experienced heavy or moderate oiling (OSAT-2 2011; Michel *et al.* 2013). The heaviest oiling in Louisiana occurred west of the Mississippi River on the Mississippi Delta and in Barataria and Terrebonne Bays, and to the east of the river on the Chandeleur Islands. Some heavy to moderate oiling occurred on Alabama and Florida beaches, with the heaviest stretch occurring from Dauphin Island, Alabama, to Gulf Breeze, Florida. Light to trace oil was reported along the majority of Mississippi's mainland coast, from Gulf Breeze to Panama City, Florida, and outside of Atchafalaya and Vermilion Bays in western Louisiana. Heavy to light oiling occurred on Mississippi's barrier islands (Michel *et al.* 2013). Thus, it is

likely that some BSE stocks were exposed to oil. Dolphins were observed with tar balls attached to them and seen swimming through oil slicks close to shore and inland bays. The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; Helm *et al.* 2015). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; Helm *et al.* 2015).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, continental shelf, coastal and estuarine marine mammals. The research is ongoing. For coastal and estuarine dolphins, the NOAA-led efforts include: active surveillance to detect stranded animals in remote locations; aerial surveys to document the distribution, abundance, species and exposure relative to oil from the DWH spill; assessment of sublethal and chronic health impacts on coastal and estuarine bottlenose dolphins in Barataria Bay, Louisiana, Mississippi Sound, and a reference site in Sarasota Bay, Florida; and assessment of injuries to dolphin stocks in Barataria Bay and Chandeleur Sound, Louisiana, Mississippi Sound, and as a reference site, St. Joseph Bay, Florida.

The nearshore habitat occupied by many of these stocks is adjacent to areas of high human population, and in some bays, such as Mobile Bay in Alabama and Galveston Bay in Texas, is highly industrialized. The area surrounding Galveston Bay, for example, has a coastal population of over 3 million people. More than 50% of all chemical products manufactured in the U.S. are produced there, and 17% of the oil produced in the Gulf of Mexico is refined there (Henningsen and Würsig 1991). Many of the enclosed bays in Texas are surrounded by agricultural lands which receive periodic pesticide applications.

Concentrations of chlorinated hydrocarbons and metals were examined in conjunction with an anomalous mortality event of bottlenose dolphins in Texas bays in 1990 and found to be relatively low in most; however, some had concentrations at levels of possible toxicological concern (Varanasi *et al.* 1992). No studies to date have determined the amount, if any, of indirect human-induced mortality resulting from pollution or habitat degradation.

Analyses of organochlorine concentrations in the tissues of bottlenose dolphins in Sarasota Bay, Florida, have found that the concentrations in male dolphins exceeded toxic threshold values that may result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002). Studies of contaminant concentrations relative to life history parameters showed higher levels of mortality in first-born offspring, and higher contaminant concentrations in these calves and in primiparous females (Wells *et al.* 2005). While there are no direct measurements of adverse effects of pollutants on estuary dolphins, the exposure to environmental pollutants and subsequent effects on population health are areas of concern and active research.

STATUS OF STOCKS

The status of these stocks relative to OSP is unknown and this species is not listed as threatened or endangered under the Endangered Species Act. The occurrence of 13 Unusual Mortality Events (UMEs) among common bottlenose dolphins along the northern Gulf of Mexico coast since 1990 (Litz *et al.* 2014; <http://www.nmfs.noaa.gov/pr/health/mmume/events.html>, accessed 11 January 2016) is cause for concern. Notably, stock areas in Louisiana, Mississippi, Alabama and the western Florida panhandle have been impacted by a UME of unprecedented size and duration (began 1 February 2010, and as of December 2015, the event is under consideration for closure). However, the effects of the mortality events on stock abundance have not yet been determined, in large part because it has not been possible to assign mortalities to specific stocks due to a lack of empirical information on stock identification.

Human-caused mortality and serious injury for each of these stocks is not known. Considering the evidence from stranding data (Table 2) and the low PBRs for stocks with recent abundance estimates, the total fishery-related mortality and serious injury likely exceeds 10% of the total known PBR or previous PBR, and therefore, it is probably not insignificant and not approaching the zero mortality and serious injury rate. NMFS considers each of these stocks to be strategic because most of the stock sizes are currently unknown, but likely small and relatively few mortalities and serious injuries would exceed PBR.

REFERENCES CITED

- Balmer, B.C., R.S. Wells, S.M. Nowacek, D.P. Nowacek, L.H. Schwacke, W.A. McLellan, F.S. Scharf, T.K. Rowles, L.J. Hansen, T.R. Spradlin and D.A. Pabst. 2008. Seasonal abundance and distribution patterns of common bottlenose dolphins (*Tursiops truncatus*) near St. Joseph Bay, Florida, USA. *J. Cetacean Res. Manage.* 10(2): 157-167.
- Barlow, J., S.L. Swartz, T.C. Eagle and P.R. Wade. 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6, 73 pp.
- Barros, N.B. and R.S. Wells. 1998. Prey and feeding patterns of resident bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. *J. Mamm.* 79(3): 1045-1059.
- Bassos-Hull, K., R.M. Perrtree, C.C. Shepard, S. Schilling, A.A. Barleycorn, J.B. Allen, B.C. Balmer, W.E. Pine and R.S. Wells. 2013. Long-term site fidelity and seasonal abundance estimates of common bottlenose dolphins (*Tursiops truncatus*) along the southwest coast of Florida and responses to natural perturbations. *J. Cetacean Res. Manage.* 13(1): 19-30.
- Blaylock, R.A. and W. Hoggard. 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Tech. Memo. NMFS-SEFSC-356, 10 pp.
- Bräger, S. 1993. Diurnal and seasonal behavior patterns of bottlenose dolphins (*Tursiops truncatus*). *Mar. Mamm. Sci.* 9: 434-440.
- Bräger, S., B. Würsig, A. Acevedo and T. Henningsen. 1994. Association patterns of bottlenose dolphins (*Tursiops truncatus*) in Galveston Bay, Texas. *J. Mamm.* 75(2): 431-437.
- Bryant, L. 1994. Report to Congress on results of feeding wild dolphins: 1989-1994. National Marine Fisheries Service, Office of Protected Resources, 23 pp.
- Buckland, S.T., D.R. Andersen, K.P. Burnham and J.L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman and Hall, New York. 446 pp.
- Buckstaff, K.C. 2004. Effects of watercraft noise on the acoustic behavior of bottlenose dolphins, *Tursiops truncatus*, in Sarasota Bay, Florida. *Mar. Mamm. Sci.* 20: 709-725.
- Buist, I., J. McCourt, S. Potter, S. Ross and K. Trudel. 1999. In situ burning. *Pure. Appl. Chem.* 71(1): 43-65.
- Byrd, B.L., A.A. Hohn, G.N. Lovewell, K.M. Altman, S.G. Barco, A. Friedlaender, C.A. Harms, W.A. McLellan, K.T. Moore, P.E. Rosel and V.G. Thayer. 2014. Strandings illustrate marine mammal biodiversity and human impacts off the coast of North Carolina, USA. *Fish. Bull.* 112: 1-23.
- Colbert, A.A., G.I. Scott, M.H. Fulton, E.F. Wirth, J.W. Daugomah, P.B. Key, E.D. Strozier and S.B. Galloway. 1999. Investigation of unusual mortalities of bottlenose dolphins along the mid-Texas coastal bay ecosystem during 1992. NOAA Tech. Rpt. 147, 23 pp. Available from: <http://spo.nmfs.noaa.gov/tr147.pdf>
- Conn, P.B., A.M. Gorgone, A.R. Jugovich, B.L. Byrd and L.J. Hansen. 2011. Accounting for transients when estimating abundance of bottlenose dolphins in Choctawhatchee Bay, Florida. *J. Wildl. Manage.* 75(3): 569-579.
- Corkeron, P. 2009. Captivity. Pages 183-188 in: W.F. Perrin, B. Würsig, J.G. M. Thewissen (eds) *The encyclopedia of marine mammals*. Academic Press, San Diego, CA.
- Cunningham-Smith, P., D.E. Colbert, R.S. Wells and T. Speakman. 2006. Evaluation of human interactions with a wild bottlenose dolphin (*Tursiops truncatus*) near Sarasota Bay, Florida, and efforts to curtail the interactions. *Aquat. Mamm.* 32(3): 346-356.
- Duffield, D.A. and R.S. Wells. 1991. The combined application of chromosome, protein and molecular data for the investigation of social unit structure and dynamics in *Tursiops truncatus*. Pages 155-169 in: A.R. Hoelzel (ed.), *Genetic Ecology of Whales and Dolphins*. Rep. Int. Whal. Comm., Cambridge, U.K. Special Issue 13.
- Duffield, D.A. and R.S. Wells. 2002. The molecular profile of a resident community of bottlenose dolphins, *Tursiops truncatus*. Pages 3-11 in: C.J. Pfeiffer (ed.), *Cell and Molecular Biology of Marine Mammals*. Krieger Publishing, Melbourne, FL.
- Duignan, P.J., C. House, D.K. Odell, R.S. Wells, L.J. Hansen, M.T. Walsh, D.J. St. Aubin, B.K. Rima, J.R. Geraci. 1996. Morbillivirus infection in bottlenose dolphins: Evidence for recurrent epizootics in the western Atlantic and Gulf of Mexico. *Mar. Mamm. Sci.* 12(4) 499-515.
- Fazioli, K.L., S. Hoffman and R.S. Wells. 2006. Use of Gulf of Mexico coastal waters by distinct assemblages of bottlenose dolphins (*Tursiops truncatus*). *Aquat. Mamm.* 32(2): 212-222.
- Fertl, D.C. 1994. Occurrence patterns and behavior of bottlenose dolphins (*Tursiops truncatus*) in the Galveston Ship Channel. *Texas J. Sci.* 46: 299-317.
- Fire, S.E., Z. Wang, M. Byrd, H.R. Whitehead, J. Paternoster and S.L. Morton. 2011. Co-occurrence of multiple

- classes of harmful algal toxins in bottlenose dolphins (*Tursiops truncatus*) stranding during an unusual mortality event in Texas, USA. *Harmful Algae* 10(3): 330-336.
- Flewelling, L.J., J.P. Naar, J.P. Abbott, D.G. Baden, N.B. Barros, G.D. Bossart, M.D. Bottein, D.G. Hammond, E.M. Haubold, C.A. Heil, M.S. Henry, H.M. Jacocks, T.A. Leighfield, R.H. Pierce, T.D. Pitchford, S.A. Rommel, P.S. Scott, K.A. Steidinger, E.W. Truby, F.M. Van Dolah and J.H. Landsberg. 2005. Red tides and marine mammal mortalities: Unexpected brevetoxin vectors may account for deaths long after or remote from an algal bloom. *Nature* 435: 755-756.
- Garrison, L.P. 2017. Abundance of coastal and continental shelf stocks of bottlenose dolphins in the northern Gulf of Mexico: 2011-2012. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2017-04, 34 pp.
- Geraci, J.R. 1990. Physiologic and toxic effects on cetaceans. Pages 167-197 in: J.R. Geraci and D.J. St. Aubin (eds.) *Sea mammals and oil: Confronting the risks*. Academic Press, New York. 259 pp.
- Gorzelany, J.F. 1998. Unusual deaths of two free-ranging Atlantic bottlenose dolphins (*Tursiops truncatus*) related to ingestion of recreational fishing gear. *Mar. Mamm. Sci.* 14(3): 614-617.
- Gruber, J.A. 1981. Ecology of the Atlantic bottlenosed dolphin (*Tursiops truncatus*) in the Pass Cavallo area of Matagorda Bay, Texas. M. Sc. thesis. Texas A&M University, College Station. 182 pp.
- Hansen, L.J. (ed.) 1992. Report on investigation of 1990 Gulf of Mexico bottlenose dolphin strandings. NOAA-NMFS-SEFSC Contribution MIA-92/93-21. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.
- Helm, R.C., D.P. Costa, T.D. DeBruyn, T.J. O'Shea, R.S. Wells and T.M. Williams. 2015. Overview of effects of oil spills on marine mammals. Pages 455-475 in: M. Fingas (ed.) *Handbook of oil spill science and technology*, First edition. John Wiley & Sons, Inc., Hoboken, New Jersey. 728 pp.
- Henningsen, T. 1991. Zur Verbreitung und Ökologie des Großen Tümmlers (*Tursiops truncatus*) in Galveston, Texas. Diplom thesis. Christian-Albrechts-Universität, Kiel, Germany. 80 pp.
- Henningsen, T. and B. Würsig. 1991. Bottle-nosed dolphins in Galveston Bay, Texas: Numbers and activities. *European research on cetaceans – 5. Proceedings of the Fifth Annual Conference of the European Cetacean Society*, Sandefjord, Norway, Cambridge, UK, 21-23 February, 1991. 36-38 pp.
- Hubard, C.W., K. Maze-Foley, K.D. Mullin and W.W. Schroeder. 2004. Seasonal abundance and site fidelity of bottlenose dolphins (*Tursiops truncatus*) in Mississippi Sound. *Aquat. Mamm.* 30: 299-310.
- Irvine, A.B., M.D. Scott, R.S. Wells and J.H. Kaufmann. 1981. Movements and activities of the Atlantic bottlenose dolphin, *Tursiops truncatus*, near Sarasota, Florida. *Fish. Bull.* 79: 671-688.
- Irvine, B. and R.S. Wells. 1972. Results of attempts to tag Atlantic bottlenose dolphins (*Tursiops truncatus*). *Cetology* 13(1-5).
- Irwin, L.J. and B. Würsig. 2004. A small resident community of bottlenose dolphins, *Tursiops truncatus*, in Texas: Monitoring recommendations. *G. Mex. Sci.* 22(1): 13-21.
- Laake, J.L., S.T. Buckland, D.R. Anderson and K.P. Burnham. 1993. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins. 72 pp.
- Lehr, B., S. Bristol and A. Possolo, eds. 2010. Oil budget calculator: Deepwater Horizon. Technical documentation. Prepared by the Federal Interagency Solutions Group, Oil Budget Calculator Science and Engineering Team for the National Incident Command. Available from: http://www.restorethegulf.gov/sites/default/files/documents/pdf/OilBudgetCalc_Full_HQ-Print_111110.pdf
- Lipscomb, T.P. 1993. Some answers to questions about morbillivirus. Pages 4-5 in: R.A. Blaylock, B. Mase and D.K. Odell (eds.), *Strandings*. SEFSC Miami Laboratory, Miami, Florida. Vol. 2, No. 3.
- Lipscomb, T.P., S. Kennedy, D. Moffet and B.K. Ford. 1994. Morbilliviral disease in an Atlantic bottlenose dolphin (*Tursiops truncatus*) from the Gulf of Mexico. *J. Wildl. Dis.* 30(4): 572-576.
- Litz, J.A., M.A. Baran, S.R. Bowen-Stevens, R.H. Carmichael, K.M. Colegrove, L.P. Garrison, S.E. Fire, E.M. Fougères, R. Hardy, S. Holmes, W. Jones, B.E. Mase-Guthrie, D.K. Odell, P.E. Rosel, J.T. Saliki, D.K. Shannon, S.F. Shippee, S.M. Smith, E.M. Stratton, M.C. Tumlin, H.R. Whitehead, G.A.J. Worthy and T.K. Rowles. 2014. Review of historical unusual mortality events (UMEs) in the Gulf of Mexico (1990–2009): Providing context for the complex and long-lasting northern Gulf of Mexico cetacean UME. *Dis. Aquat. Organ.* 112: 161-175.
- Lynn, S.K. and B. Würsig. 2002. Summer movement patterns of bottlenose dolphins in a Texas bay. *G. Mex. Sci.* 20(1): 25-37.
- Mathers, A.N., B.M. Deacy and J.K. Carlson. 2016. Characterization of catch and bycatch in the state gillnet fisheries of Alabama, Mississippi, and Louisiana, 2012-2015. NOAA Tech. Memo. NMFS-SEFSC-691, 35 pp.

- Maze, K.S. and B. Würsig. 1999. Bottlenose dolphins of San Luis Pass, Texas: Occurrence patterns, site fidelity, and habitat use. *Aquat. Mamm.* 25: 91-103.
- Maze-Foley, K. and L.P. Garrison. 2016a. Serious injury determinations for small cetaceans off the southeast U.S. coast, 2007-2011. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2016-04, 16 pp. Available from: https://www.sefsc.noaa.gov/P_QryLDS/download/PRB85_PRBD-2016-04.pdf?id=LDS
- Maze-Foley, K. and L.P. Garrison. 2016b. Serious injury determinations for small cetaceans off the southeast U.S. coast, 2012. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2016-05, 12 pp. Available from: https://www.sefsc.noaa.gov/P_QryLDS/download/PRB86_PRBD-2016-05.pdf?id=LDS
- Maze-Foley, K. and L.P. Garrison. 2016c. Serious injury determinations for small cetaceans off the southeast U.S. coast, 2013. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2016-06, 12 pp. Available from: https://www.sefsc.noaa.gov/P_QryLDS/download/PRB87_PRBD-2016-06.pdf?id=LDS
- Maze-Foley, K. and L.P. Garrison. 2016d. Serious injury determinations for small cetaceans off the southeast U.S. coast, 2014. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2016-07, 11 pp. Available from: https://www.sefsc.noaa.gov/P_QryLDS/download/PRB88_PRBD-2016-07.pdf?id=LDS
- McNutt, M.K., R. Camilli, T.J. Crone, G.D. Guthrie, P.A. Hsieh, T.B. Ryerson, O. Savas and F. Shaffer. 2012. Review of flow rate estimates of the *Deepwater Horizon* oil spill. *P. Natl. Acad. Sci. USA* 109 (50): 20260-20267.
- Michel, J., E.H. Owens, S. Zengel, A. Graham, Z. Nixon, T. Allard, W. Holton, P.D. Reimer, A. Lamarche, M. White, N. Rutherford, C. Childs, G. Mauseth, G. Challenger and E. Taylor. 2013. Extent and degree of shoreline oiling: *Deepwater Horizon* oil spill, Gulf of Mexico, USA. *PLOS ONE* 8(6): e65087.
- Miller, C. 2003. Abundance trends and environmental habitat usage patterns of bottlenose dolphins (*Tursiops truncatus*) in lower Barataria and Caminada Bays, Louisiana. Ph.D. thesis. Louisiana State University, Baton Rouge. 125 pp.
- Miller, L.J., M. Solangi and S.A. Kuczaj, II. 2008. Immediate response of Atlantic bottlenose dolphins to high-speed personal watercraft in the Mississippi Sound. *J. Mar. Biol. Assoc. U.K.* 88(6): 1139-1143.
- Mullin, K.D. 1988. Comparative seasonal abundance and ecology of bottlenose dolphins (*Tursiops truncatus*) in three habitats of the north-central Gulf of Mexico. Ph.D. thesis. Mississippi State University, Starkville. 135 pp.
- Nance, J., W. Keithly, Jr., C. Caillouet, Jr., J. Cole, W. Gaidry, B. Gallaway, W. Griffin, R. Hart and M. Travis. 2008. Estimation of effort, maximum sustainable yield, and maximum economic yield in the shrimp fishery of the Gulf of Mexico. NOAA Tech. Memo. NMFS-SEFSC-570. 71 pp.
- NOAA. 2011. Public scoping for preparation of a programmatic environmental impact statement for the Deepwater Horizon BP Oil Spill. Available from: <http://www.gulfspillrestoration.noaa.gov/wp-content/uploads/2011/04/Public-DWH-PEIS-Scoping-Review-Document1.pdf>
- Nowacek, S.M., R.S. Wells and A.R. Solow. 2001. Short-term effects of boat traffic on bottlenose dolphins, *Tursiops truncatus*, in Sarasota Bay, Florida. *Mar. Mamm. Sci.* 17(4): 673-688.
- Operational Science Advisory Team (OSAT). 2010. Summary report for sub-sea and sub-surface oil and dispersant detection: Sampling and monitoring. Prepared for P. F. Zukunft, RADM, U.S. Coast Guard, Federal On-Scene Coordinator, Deepwater Horizon MC252, December 17, 2010. Available from: http://www.restorethegulf.gov/sites/default/files/documents/pdf/OSAT_Report_FINAL_17DEC.pdf
- Operational Science Advisory Team (OSAT-2). 2011. Summary report for fate and effects of remnant oil remaining in the beach environment. Annex B: Spatial oil distribution. Available from: <http://www.restorethegulf.gov/release/2011/03/01/osat-2-fate-and-effects-oil-beaches>
- Peltier, H., W. Dabin, P. Daniel, O. Van Canneyt, G. Dorémus, M. Huon and V. Ridoux. 2012. The significance of stranding data as indicators of cetacean populations at sea: modelling the drift of cetacean carcasses. *Ecol. Indic.* 18: 278-290.
- Powell, J.R. and R.S. Wells. 2011. Recreational fishing depredation and associated behaviors involving common bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. *Mar. Mamm. Sci.* 27(1): 111-129.
- Quintana-Rizzo, E. and R.S. Wells. 2001. Resighting and association patterns of bottlenose dolphins (*Tursiops truncatus*) in the Cedar Keys, Florida: Insights into social organization. *Can. J. Zool.* 79: 447-456.
- Reeves, R.R. and S. Leatherwood. 1984. Live-capture fisheries for cetaceans in USA and Canadian waters, 1973-1982. *Rep. Int. Whal. Comm.* 34: 497-507.

- Samuels, A. and L. Bejder. 2004. Chronic interactions between humans and free-ranging bottlenose dolphins near Panama City Beach, Florida, USA. *J. Cetacean Res. Manage.* 6: 69-77.
- Samuels, A. and L. Engleby. 2007. Evaluating impacts of tourism on free-ranging bottlenose dolphins near Key West, Florida. Final Technical Report, PWD Proposal # 2003-18. Available from: Dolphin Ecology Project, 727 11th Avenue South, St. Petersburg, FL 33701.
- Schwacke, L.H., E.O. Voit, L.J. Hansen, R.S. Wells, G.B. Mitchum, A.A. Hohn and P.A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. *Environ. Toxicol. Chem.* 21(12): 2752-2764.
- Schwacke, L.H., C.R. Smith, F.I. Townsend, R.S. Wells, L.B. Hart, B.C. Balmer, T.K. Collier, S. De Guise, M.M. Fry, L.J. Guillette, S.V. Lamb, S.M. Lane, W.E. McFee, N.J. Place, M.C. Tumlin, G.M. Ylitalo, E.S. Zolman and T.K. Rowles. 2014. Health of bottlenose dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana following the *Deepwater Horizon* oil spill. *Environ. Sci. Technol.* 48(1): 93-103.
- Scott, G.P. 1990. Management-oriented research on bottlenose dolphins in the Southeast Fisheries Center. Pages 623-639 in: S. Leatherwood and R.R. Reeves, (eds.) *The bottlenose dolphin*. Academic Press, San Diego, CA.
- Scott, G.P., D.M. Burn, L.J. Hansen and R.E. Owen. 1989. Estimates of bottlenose dolphin abundance in the Gulf of Mexico from regional aerial surveys. CRD 88/89-07. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.
- Scott, M.D., R.S. Wells and A.B. Irvine. 1990. A long-term study of bottlenose dolphins on the west coast of Florida. Pages 235-244 in: S. Leatherwood and R.R. Reeves (eds.), *The bottlenose dolphin*. Academic Press, San Diego, CA.
- Sellas, A.B., R.S. Wells and P.E. Rosel. 2005. Mitochondrial and nuclear DNA analyses reveal fine scale geographic structure in bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico. *Conserv. Genet.* 6(5): 715-728.
- Shane, S.H. 1977. The population biology of the Atlantic bottlenose dolphin, *Tursiops truncatus*, in the Aransas Pass area of Texas. M. Sc. thesis. Texas A&M University, College Station. 238 pp.
- Shane, S.H. 1990. Behavior and ecology of the bottlenose dolphin at Sanibel Island, Florida. Pages 245-265 in: S. Leatherwood and R.R. Reeves (eds.), *The bottlenose dolphin*. Academic Press, San Diego, CA.
- Shane, S.H. 2004. Residence patterns, group characteristics, and association patterns of bottlenose dolphins near Sanibel Island, Florida. *G. Mex. Sci.* 22(1): 1-12.
- Shane, S.H., R.S. Wells and B. Würsig. 1986. Ecology, behavior, and social organization of the bottlenose dolphin: A review. *Mar. Mamm. Sci.* 2(1): 34-63.
- Soldevilla, M.S., L.P. Garrison, E. Scott-Denton and J.M. Nance. 2015. Estimation of marine mammal bycatch mortality in the Gulf of Mexico shrimp otter trawl fishery. NOAA Tech. Memo. NMFS-SEFSC-672, 70 pp.
- Twiner, M.J., L.J. Flewelling, S.E. Fire, S.R. Bowen-Stevens, J.K. Gaydos, C.K. Johnson, J.H. Landsberg, T.A. Leighfield, B. Mase-Guthrie, L. Schwacke, F.M. Van Dolah, Z. Wang and T.K. Rowles. 2012. Comparative analysis of three brevetoxin-associated bottlenose dolphin (*Tursiops truncatus*) mortality events in the Florida panhandle region (USA). *PLOS ONE* 7(8). 19 pp.
- Tyson, R.B. and R.S. Wells. 2016. Sarasota Bay/Little Sarasota Bay bottlenose dolphin abundance estimates: 2015. Prepared for National Marine Fisheries Service, northern Gulf of Mexico bay, sound, and estuary bottlenose dolphin stock blocks B20 and B35, combined. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2016-02, 21 pp. Available from: https://www.sefsc.noaa.gov/P_QryLDS/download/PRB84_PRBD-2016-02.pdf?id=LDS
- Tyson, R.B., S.M. Nowacek and D.P. Nowacek. 2011. Community structure and abundance of bottlenose dolphins *Tursiops truncatus* in coastal waters of the northeast Gulf of Mexico. *Mar. Ecol. Prog. Ser.* 438: 253-265.
- Urian, K.W. 2002. Community structure of bottlenose dolphins (*Tursiops truncatus*) in Tampa Bay, Florida, USA. M. Sc. thesis. University of North Carolina, Wilmington. 26 pp.
- Urian, K.W., D.A. Duffield, A.J. Read, R.S. Wells and D.D. Shell. 1996. Seasonality of reproduction in bottlenose dolphins, *Tursiops truncatus*. *J. Mamm.* 77: 394-403.
- Urian, K.W., S. Hofmann, R.S. Wells and A.J. Read. 2009. Fine-scale population structure of bottlenose dolphins (*Tursiops truncatus*) in Tampa Bay, Florida. *Mar. Mamm. Sci.* 25(9): 619-638.
- Varanasi, U., K.L. Tilbury, D.W. Brown, M.M. Krahn, C.A. Wigren, R.C. Clark and S.L. Chan. 1992. Chemical contaminants in bottlenose dolphins stranded along the Gulf of Mexico during 1990. Pages 56-86 in: L.J. Hansen (ed.), *Report on investigation of 1990 Gulf of Mexico bottlenose dolphin strandings*. Southeast Fisheries Science Center Contribution MIA-92/93-21.

- Venn-Watson, S., L. Garrison, J. Litz, E. Fougères, B. Mase, G. Rappucci, E. Stratton, R. Carmichael, D. Odell, D. Shannon, S. Shippee, S. Smith, L. Staggs, M. Tumlin, H. Whitehead and T. Rowles. 2015a. Demographic clusters identified within the northern Gulf of Mexico common bottlenose dolphin (*Tursiops truncatus*) Unusual Mortality Event: January 2010 - June 2013. PLoS ONE 10(2): e0117248.
- Venn-Watson, S., K.M. Colegrove, J. Litz, M. Kinsel, K. Terio, J. Saliki, S. Fire, R. Carmichael, C. Chevis, W. Hatchett, J. Pitchford, M. Tumlin, C. Field, S. Smith, R. Ewing, D. Fauquier, G. Lovewell, H. Whitehead, D. Rotstein, W. McFee, E. Fougères and T. Rowles. 2015b. Adrenal gland and lung lesions in Gulf of Mexico common bottlenose dolphins (*Tursiops truncatus*) found dead following the Deepwater Horizon Oil Spill. PLoS ONE 10(5): e0126538.
- Wade, P.R. and R.P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.
- Weller, D.W. 1998. Global and regional variation in the biology and behavior of bottlenose dolphins. Ph.D. thesis. Texas A&M University, College Station. 142 pp.
- Wells, R.S. 1986. Population structure of bottlenose dolphins: Behavioral studies along the central west coast of Florida. Contract report to NMFS, SEFSC. Contract No. 45-WCNF-5-00366. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149. 58 pp.
- Wells, R.S. 1991. The role of long-term study in understanding the social structure of a bottlenose dolphin community. Pages 199-225 in: K. Pryor and K.S. Norris (eds.), Dolphin societies: Discoveries and puzzles. University of California Press, Berkeley.
- Wells, R.S. 2003. Dolphin social complexity: Lessons from long-term study and life history. Pages 32-56 in: F.B.M. de Waal and P.L. Tyack (eds.), Animal social complexity: Intelligence, culture, and individualized societies. Harvard University Press, Cambridge, MA.
- Wells, R. S. 2014. Social structure and life history of bottlenose dolphins near Sarasota Bay, Florida: Insights from four decades and five generations. Pages 149-172 in: J. Yamagiwa and L. Karczmarski (eds.), Primates and Cetaceans: Field Research and Conservation of Complex Mammalian Societies. Primatology Monographs. Springer Japan, Tokyo.
- Wells, R.S., J.B. Allen, G. Lovewell, J. Gorzelany, R.E. DeLynn, D.A. Fauquier and N.B. Barros. 2015. Carcass-recovery rates for resident bottlenose dolphins in Sarasota Bay, Florida. Mar. Mamm. Sci. 31(1): 355-368.
- Wells, R.S., J.B. Allen, S. Hoffman, K. Bassos-Hull, D.A. Fauquier, N.B. Barros, R.E. DeLynn, G. Sutton, V. Socha and M.D. Scott. 2008. Consequences of injuries on survival and reproduction of common bottlenose dolphins (*Tursiops truncatus*) along the west coast of Florida. Mar. Mamm. Sci. 24: 774-794.
- Wells, R.S., M.K. Bassos, K.W. Urian, W.J. Carr and M.D. Scott. 1996a. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Charlotte Harbor, Florida: 1990-1994. NOAA Tech. Memo. NMFS-SEFSC-384, 36 pp.
- Wells, R.S., M.K. Bassos, K.W. Urian, S.H. Shane, E.C.G. Owen, C.F. Weiss, W.J. Carr and M.D. Scott. 1997. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Pine Island Sound, Florida: 1996. Contract report to National Marine Fisheries Service, Southeast Fisheries Science Center Contribution No. 40-WCNF601958. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.
- Wells, R.S., S. Hofmann and T.L. Moors. 1998. Entanglement and mortality of bottlenose dolphins, *Tursiops truncatus*, in recreational fishing gear in Florida. Fish. Bull. 96(3): 647-650.
- Wells, R.S. and M.D. Scott. 1990. Estimating bottlenose dolphin population parameters from individual identification and capture-release techniques. Pages 407-415 in: P.S. Hammond, S.A. Mizroch and G.P. Donovan (eds.), Individual recognition of cetaceans: Use of photo-identification and other techniques to estimate population parameters. Rep. Int. Whal. Comm., Cambridge, U.K. Special Issue 12.
- Wells, R.S. and M.D. Scott. 1994. Incidence of gear entanglement for resident inshore bottlenose dolphins near Sarasota, Florida. Page 629 in: W.F. Perrin, G.P. Donovan and J. Barlow (eds.), Gillnets and cetaceans. Rep. Int. Whal. Comm. Special Issue 15.
- Wells, R.S. and M.D. Scott. 1997. Seasonal incidence of boat strikes on bottlenose dolphins near Sarasota, Florida. Mar. Mamm. Sci. 13(3): 475-480.
- Wells, R.S. and M.D. Scott. 1999. Bottlenose dolphins. Pages 137-182 in: S.H. Ridgway and R. Harrison (eds.), Handbook of marine mammals. Vol. 6: The second book of dolphins and the porpoises. Academic Press, San Diego, CA.
- Wells, R.S., M.D. Scott and A.B. Irvine. 1987. The social structure of free ranging bottlenose dolphins. Pages 247-305 in: H. Genoways (ed.), Current Mammalogy, Vol. 1. Plenum Press, New York.
- Wells, R.S., V. Tornero, A. Borrell, A. Aguilar, T.K. Rowles, H.L. Rhinehart, S. Hofmann, W.M. Jarman, A.A.

- Hohn and J.C. Sweeney. 2005. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. *Sci. Total Environ.* 349: 106-119.
- Wells, R.S., K.W. Urian, A.J. Read, M.K. Bassos, W.J. Carr and M.D. Scott. 1996b. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Tampa Bay, Florida: 1988-1993. NOAA Tech. Memo. NMFS-SEFSC-385, 25 pp.