COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*): West Bay Stock

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 in the Gulf of Mexico. Until this effort is completed and 31 individual reports are available, some of the basic information presented in this report will also be included in the report: "Northern Gulf of Mexico Bay, Sound and Estuary Stocks".

STOCK DEFINITION AND GEOGRAPHIC RANGE

Common bottlenose dolphins are distributed throughout the bays, sounds, and estuaries (BSE) of the Gulf of Mexico (Mullin 1988). Long-term (year-round, multi-year) residency by at least some individuals has been reported from nearly every estuarine site where photographic identification (photo-ID) or tagging studies have been conducted in the Gulf of Mexico (e.g., Irvine and Wells 1972; Shane 1977; Gruber 1981; Irvine *et al.* 1981; Wells 1986; Wells *et al.* 1987; Scott *et al.* 1990; Shane 1990; Wells 1991; Bräger 1993; Bräger *et al.* 1994; Fertl 1994; Wells *et al.* 1996a,b; Wells *et al.* 1997; Weller 1998; Maze and Würsig 1999; Lynn and Würsig 2002; Wells 2003; Hubard *et al.* 2004; Irwin and Würsig 2004; Shane 2004; Balmer *et al.* 2008; Urian *et al.* 2009; Bassos-Hull *et al.* 2013; Wells *et al.* 2017; Balmer *et al.* 2018). In many cases, residents occur predominantly within estuarine waters, with limited movements through passes to the Gulf of Mexico (Shane 1977; Gruber 1981; Irvine *et al*. 1981; Shane 1990; Maze and Würsig 1999; Lynn and Würsig 2002; Fazioli *et al.* 2006; Bassos-Hull *et al.* 2013; Wells *et al.* 2017). Genetic data also support the presence of discrete BSE stocks (Duffield and Wells 2002; Sellas *et al.* 2005; Rosel *et al.* 2017). Sellas *et al.* (2005) examined population subdivision among dolphins sampled in Sarasota Bay, Tampa Bay, and Charlotte Harbor, Florida; Matagorda Bay, Texas; and the coastal Gulf of Mexico (1–12 km offshore) from just outside Tampa Bay to the south end of Lemon Bay, and found evidence of significant genetic population differentiation among all areas. Genetic data also indicate restricted genetic exchange between and demographic independence of BSE populations and those occurring in adjacent Gulf coastal waters (Sellas *et al.* 2005; Rosel *et al.* 2017). Differences in reproductive seasonality from site to site also suggest genetic-based distinctions among areas (Urian *et al.* 1996). Photo-ID and genetic data from several inshore areas of the southeastern United States also support the existence of resident estuarine animals and differentiation between animals biopsied along the Atlantic coast and those biopsied within estuarine systems at the same latitude (Caldwell 2001; Gubbins 2002; Zolman 2002; Mazzoil *et al.* 2005; Litz 2007; Rosel *et al.* 2009).

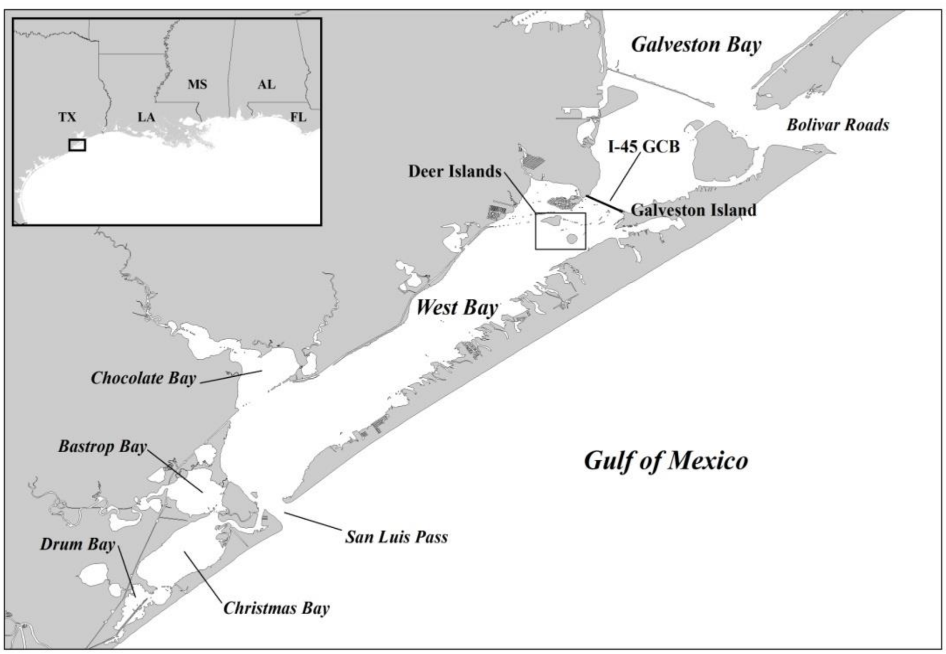

Figure 1. Geographic extent of the West Bay Stock, located within the Galveston Bay Estuary in Texas. I-45 GCB = I-45 Galveston Causeway Bridge.

West Bay, a bay within the Galveston Bay Estuary system, encompasses an area of approximately 180 km^2, and is a narrow, long bay averaging 1.2 m in depth (Diener 1975; Phillips and Rosel 2014; Figure 1). It tends to be more saline than Galveston Bay, with an average salinity of 15 to 32 ppt (Pulich and White 1991; Phillips and Rosel 2014). West Bay is separated from the Gulf of Mexico by Galveston Island, and connected to the Gulf via San Luis Pass in the southwest, and connected to Galveston Bay in the northeast via Bolivar Roads. The Galveston Bay Estuary has been selected as an estuary of national significance by the Environmental Protection Agency National Estuary Program (see http://www.gbep.state.tx.us/). Thus, a comprehensive conservation and management plan has been developed and is being implemented through a partnership of local, state, and federal representatives as well as community stakeholders, to restore and protect the estuary (Lester and Gonzalez 2011).

The West Bay Stock was designated in the first stock assessment reports published in 1995 (Blaylock *et al.* 1995) and common bottlenose dolphins are present within the bay. The stock boundaries extend from Drum Bay in the southwest to the I-45 Galveston Causeway Bridge in the northeast and include West Bay, Chocolate Bay, Bastrop Bay, Christmas Bay, Drum Bay, and San Luis Pass (Figure 1). However, Bastrop Bay, Christmas Bay, and Drum Bay are very shallow areas, and dolphins were not sighted there during recent exploratory surveys (Ronje *et al.* 2018). The area between the Deer Islands and the I-45 Galveston Causeway Bridge is being included in the West Bay Stock due to sightings of two animals that were also seen in southern West Bay (Litz *et al.* 2019), but this area may serve as a transition zone between the Galveston Bay/East Bay/Trinity Bay Stock and the West Bay Stock. Additional research may result in a revision to the northeastern boundary. Dolphins of this stock also are seen in nearshore coastal waters adjacent to San Luis Pass, where they may be exposed to additional threats. However, the extent to which they use these waters and whether there may be significant seasonality to that usage is unknown. To date, coastal waters approximately 3 km north and south of San Luis Pass and within 1 km of shore are included in the stock area. This coastal range is based on sightings data from a 2014–2015 photo-ID mark recapture survey (see Population Size). The range in coastal waters may be revised as new studies are conducted. Given the small size and relatively homogeneous habitat of West Bay, it is unlikely this stock contains multiple demographically independent populations, but a directed investigation of this question has never been conducted.

POPULATION SIZE

The best available abundance estimate for the West Bay Stock of common bottlenose dolphins is 37 (CV=0.05; Table 1), which is the result of vessel-based capture-recapture photo-ID surveys conducted during winter 2014 and summer 2015 (Ronje *et al.* 2020).

Earlier Abundance Estimates (>8 years old)

Boat-based photo-ID surveys in 1995 and 1996 conducted in southwestern West Bay, Chocolate Bay, San Luis Pass (SLP) and adjacent Gulf coastal waters outside SLP identified 28 year-round residents that utilized the bays, SLP, and nearshore coastal waters adjacent to SLP. During the summer dolphins were most frequently sighted furthest inland, mainly in Chocolate Bay, whereas during winter, sightings were concentrated near San Luis Pass and adjacent Gulf of Mexico coastal waters. In addition to resident animals, transient animals were sighted in Gulf coastal waters only (Maze and Würsig 1999). Additional boat-based surveys were conducted within the same area during 1997–2001 by Irwin and Würsig (2004) to compare three methods of assessing abundance: 1) counts based on photo-ID data; 2) capture-recapture analysis based on photo-ID data; and 3) line-transect surveys to estimate density using the program DISTANCE (Buckland *et al.* 1993). Photo-ID results based on counts yielded 34 resident animals displaying seasonal variation in their habitat use as described above. Capture-recapture analysis estimates of dolphin abundance in each year in warm months ranged from 28 (95% CI: 26–71) in 1998 to a high of 38 (95% CI: 33–55) in 2000. Line-transect density estimates ranged from 0.94 to 1.01 dolphins/km^2, with a warm-month abundance estimate of 108 dolphins (95% CI: 33-358). Irwin and Würsig (2004) suggested their density estimates were positively biased compared to estimates from other locations because the nonrandom distribution of dolphins in the study area makes the area unsuitable for line-transect surveys.

Recent Surveys and Abundance Estimates

Photo-ID capture-recapture surveys were conducted in two seasons (December 2014 and June 2015) with three surveys per season (Litz *et al.* 2019). The surveys covered the entirety of this stock's range including West Bay, Chocolate Bay, and San Luis Pass. Christmas Bay was surveyed in the summer but not the winter; there were no sightings in this bay. In addition, two 20-km segments of trackline were surveyed in the coastal waters off San Luis Pass (1 km from shore and 2 km from shore) (Litz *et al.* 2019). A Poisson-log normal Mark-Resight model

(McClintock *et al.* 2009) was used to estimate abundance for each season using MARK 8.2 (White and Burnham 1999). Six coastal sightings presumed to contain coastal stock animals (primarily 1–2 sightings of each animal and only in coastal waters) were removed from the analyses (Litz *et al.* 2019). The abundance estimate for winter (December 2014) was 51 dolphins (CV=0.04; 95% CI: 47–56) and the summer (June 2015) estimate was 44 dolphins (CV= 0.03; 95% CI: 43–47), and the mean of the estimates was 48 (CV=0.03; 95% CI: 45–50). The summer and winter estimates were averaged because there were no clear seasonal patterns in sighting distributions (Litz *et al.* 2019; Ronje *et al.* 2018). These estimates were corrected for the proportion of unmarked individuals. Capture probabilities were high for both seasons, and resighting data allowed for the exclusion of sightings of coastal stock animals from the abundance estimate. A key uncertainty is the possibility that coastal stock dolphins were present in estuarine waters and therefore could not be completely excluded from the abundance estimate.

Ronje *et al.* (2020) combined the West Bay survey data published by Litz *et al.* (2019) with data from two other study sites, Sabine Lake and Galveston Bay, into a single photo-ID catalog to compare inter-bay movements and incorporated results from that comparison when estimating abundance for each bay. As a part of this broader study, Ronje *et al.* (2020) also re-scored fin distinctiveness for the West Bay catalog of Litz *et al.* (2019) for consistency across study site catalogs, excluded dolphins that were sighted in more than one study site from analyses, and also used only on-effort sightings. Data were analyzed in MARK 9.0 (White and Burnham 1999) using the closed capture Huggins' p and c conditional likelihood approach and each season was analyzed independently. Using the selective dataset that included animals sighted only in coastal waters if sighted in both summer and winter seasons, and that removed animals sighted in more than one study site, (see Ronje *et al.* 2020), estimates for West Bay were 38 (CV=0.10; 95% CI: 29–47) in winter and 37 in summer (CV=0.02; CI: 33–40), and the mean of the estimates was 37 (CV=0.05). The summer and winter estimates were averaged because there were no clear seasonal patterns (Litz *et al.* 2019; Ronje *et al.* 2020). These estimates were corrected for the proportion of unmarked individuals (see Ronje *et al.* 2020).

The best estimate for the West Bay Stock is considered to be the average of the winter 2014 and summer 2015 estimates, 37 (CV=0.05; Table 1), as presented by Ronje *et al.* (2020). This is the most conservative estimate because it excluded animals sighted in more than one study area.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for this stock of common bottlenose dolphins is 37 (CV=0.05). The minimum population estimate for the West Bay Stock is 35 common bottlenose dolphins (Table 1).

Current Population Trend

A population trend analysis has not been conducted for this stock. Older abundance estimates exist but data need to be examined for comparability to the 2014–2015 estimate.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations likely do 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 the minimum population size, one-half the maximum productivity rate, and a recovery factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997; Wade 1998). The minimum population size of the West Bay Stock of common bottlenose dolphins is 35. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.4 because the CV of the shrimp trawl mortality estimate for Texas BSE stocks is greater than 0.8 (Wade and Angliss 1997). PBR for this stock of common bottlenose dolphins is 0.3 (Table 1).

Table 1. Best and minimum abundance estimates for the West Bay Stock of common bottlenose dolphins with Maximum Productivity Rate (Rmax), Recovery Factor (Fr) and PBR.

Nest	Nest CV	Nmin	Fr	Rmax	PBR
37	0.05	35	0.4	0.04	0.3

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the West Bay Stock of common bottlenose dolphins during 2015–2019 is unknown. Across all Texas BSE stocks, the total annual estimated mortality for the shrimp trawl fishery was 0.4 (CV=1.62), but the portion of this attributed to the West Bay Stock is unknown (see Shrimp Trawl section). There were no recorded fishery-related mortalities or serious injuries during 2015–2019 based on strandings and at-sea observations. In addition, there were no recorded mortalities or serious injuries during 2015–2019 due to other human-caused sources. Therefore, the total mean annual human-caused mortality and serious injury for this stock during 2015–2019 was 0 (Table 2). However, the true value is likely non-zero because 1) not all fisheries that could interact with this stock are observed and/or observer coverage is very low, 2) stranding data are used as an indicator of fishery-related interactions and not all dead animals are recovered by the stranding network (Peltier *et al*. 2012; Wells *et al*. 2015), 3) cause of death is not (or cannot be) routinely determined for stranded carcasses, 4) the estimate of fishery-related interactions includes an actual count of verified fishery-caused deaths and serious injuries and should be considered a minimum (NMFS 2016), and 5) the estimate does not include shrimp trawl bycatch (see Shrimp Trawl section).

Fishery Information

There are three commercial fisheries that interact, or that potentially could interact, with this stock. These include one Category II fishery (Southeastern U.S. Atlantic, Gulf of Mexico shrimp trawl) and two Category III fisheries (Gulf of Mexico blue crab trap/pot; and Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line)). Detailed fishery information is presented in Appendix III.

Note: Animals reported in the sections to follow were ascribed to a stock or stocks of origin following methods described in Maze-Foley et al. (2019). These include strandings, observed takes (through an observer program), fisherman self-reported takes (through the Marine Mammal Authorization Program), research takes, and opportunistic at-sea observations.

Shrimp Trawl

Between 1997 and 2019, 13 common bottlenose dolphins and nine unidentified dolphins, which could have been either common bottlenose dolphins or Atlantic spotted dolphins, became entangled in the net, lazy line, turtle excluder device, or tickler chain gear in observed trips of the commercial shrimp trawl fishery in the Gulf of Mexico (Soldevilla *et al.* 2021). All dolphin bycatch interactions resulted in mortalities except for one unidentified dolphin that was released alive without serious injury in 2009 (Maze-Foley and Garrison 2016). Soldevilla *et al.* (2015; 2016; 2021) provided mortality estimates calculated from analysis of shrimp fishery effort data and NMFS's Observer Program bycatch data. Mandated observer program coverage does not extend into BSE waters, therefore time-area stratified bycatch rates were extrapolated into inshore waters to estimate a five-year unweighted mean mortality estimate for 2015–2019 based on inshore fishing effort (Soldevilla *et al.* 2021). Because the spatial resolution at which fishery effort is modeled is aggregated at the state level (e.g., Nance *et al.* 2008), the mortality estimate covers inshore waters of Texas from Galveston Bay, East Bay, Trinity Bay south to Laguna Madre. The mean annual mortality estimate for Texas BSE stocks for the years 2015–2019 was 0.4 (CV=1.62; Soldevilla *et al.* 2021). Limitations and biases of annual bycatch mortality estimates are described in detail in Soldevilla *et al.* (2015; 2016; 2021).

Blue Crab Trap/Pot

During 2015–2019, there were no documented interactions between commercial blue crab trap/pot gear and the West Bay Stock. There is no observer coverage of crab trap/pot fisheries in the Gulf of Mexico, so it is not possible to quantify total mortality.

Hook and Line (Rod and Reel)

During 2015–2019, there were no documented interactions between hook and line gear and the West Bay Stock

(NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 25 August 2020; Table 2). The most recent take occurred in 2014. It is not possible to estimate the total number of interactions with hook and line gear because there is no observer program in the Gulf of Mexico.

Other Mortality

NOAA's Office of Law Enforcement has been investigating increased reports from along the northern Gulf of Mexico coast of violence against common bottlenose dolphins, including shootings via guns and bows and arrows, pipe bombs and cherry bombs, and stabbings (Vail 2016). From recent cases that have been prosecuted, it has been shown that fishermen become frustrated and retaliate against dolphins for removing bait or catch, or depredating, their fishing gear. To date there are no records of acts of intentional harm for this stock area.

Depredation of fishing catch and/or bait is a growing problem in Gulf of Mexico coastal and estuary waters and globally, and can lead to serious injury or mortality via ingestion of or entanglement in gear (e.g., Zollett and Read 2006; Read 2008; Powell and Wells 2011; Vail 2016), as well as changes in dolphin activity patterns, such as decreases in natural foraging (Powell and Wells 2011). It has been suggested that provisioning, or the illegal feeding, of wild common bottlenose dolphins, may encourage depredation because provisioning conditions dolphins to approach humans and vessels, where they then may prey on bait and catches (Vail 2016). Such conditioning subsequently increases risks of injury and mortality (Christiansen *et al.* 2016). Provisioning has been documented in the literature in Florida and Texas (Bryant 1994; Samuels and Bejder 2004; Cunningham-Smith *et al.* 2006; Powell and Wells 2011). To date there are no records within the literature of provisioning for this stock area.

All mortalities and serious injuries from known sources for the West Bay Stock are summarized in Table 2.

Table 2. Summary of the incidental mortality and serious injury of common bottlenose dolphins (Tursiops truncatus) of the West Bay Stock. For the shrimp trawl fishery, the bycatch mortality for the West Bay Stock alone cannot be quantified at this time because mortality estimates encompass all estuarine waters of Texas pooled (see Shrimp Trawl section). The remaining fisheries do not have an ongoing, federal observer program, so counts of mortality and serious injury were based on stranding data, at-sea observations, or fisherman self-reported takes via the Marine Mammal Authorization Program (MMAP). For strandings, at-sea counts, and fisherman self-reported takes, the number reported is a minimum because not all strandings, at-sea cases, or gear interactions are detected. See the Annual Human-Caused Mortality and Serious Injury section for biases and limitations of mortality estimates, and the Strandings section for limitations of stranding data. NA = not applicable.

Fishery	**Years**	**Data Type**	**Mean Annual Estimated Mortality and Serious Injury Based on Observer Data**	**5-year Minimum Count Based on Stranding, At-Sea, and/or MMAP Data**
Shrimp Trawl	2015–2019	Observer Data	Undetermined for this stock but may be non-zero (see Shrimp Trawl section)	NA
Atlantic Blue Crab Trap/Pot	2015–2019	Stranding Data and At-Sea Observations	NA	0
Hook and Line	2015–2019	Stranding Data and At-Sea Observations	NA	0
Mean Annual Mortality due to commercial fisheries (2015–2019)			**0**	
Research Takes (5-year Count)			0	

Other Takes (5-year Count)	0
Mean Annual Mortality due to research and other takes (2015–2019)	**0**
Minimum Total Mean Annual Human-Caused Mortality and Serious Injury (2015–2019)	**0**

Strandings

During 2015–2019, six common bottlenose dolphins were reported stranded within the West Bay area (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 25 August 2020). No evidence of human interaction (HI) was detected for four strandings, and for the remaining two strandings, it could not be determined if there was evidence of human interaction.

The assignment of animals to a single stock is impossible in some regions where stocks overlap, especially in nearshore coastal waters (Maze-Foley *et al.* 2019). Of the six strandings ascribed to the West Bay Stock, three were ascribed solely to this stock. It is likely, therefore, that the counts in Table 3 include some animals from the Western Coastal Stock and thereby overestimate the number of strandings for the West Bay Stock; those strandings that could not be definitively ascribed to the West Bay Stock were also included in the counts for the Western Coastal Stock as appropriate. Stranded carcasses are not routinely identified to either the offshore or coastal morphotype of common bottlenose dolphin, therefore it is possible that some of the reported strandings were of the offshore form, though that number is likely to be low (Byrd *et al.* 2014).

There are a number of other difficulties associated with the interpretation of stranding data. Stranding data 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; Carretta *et al.* 2016). 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.

The West Bay Stock has likely been affected by five common bottlenose dolphin die-offs or Unusual Mortality Events (UMEs). 1) From January through May 1990, a total of 344 common 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 in the northern Gulf of Mexico. 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). One stranding occurred within West Bay and 25 others occurred along the ocean side of Galveston Island, some in the vicinity of West Bay, but the stock origin of those animals is unknown (Phillips and Rosel 2014). 2) In 1993–1994, a UME of common 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 common bottlenose dolphins were found dead on Texas beaches, of which 67 occurred in a single 10-day period. One stranding occurred within West Bay, and 51 others occurred along the ocean side of Galveston Island and may or may not have involved this stock (Phillips and Rosel 2014). 3) During February and March of 2007 a UME was declared for northeast Texas and western Louisiana involving 64 common bottlenose dolphins and two unidentified dolphins. Decomposition prevented conclusive analyses on most carcasses (Litz *et al.* 2014). Eighteen animals stranded along the ocean side of Galveston Island in the vicinity of West Bay, but the stock origin of the animals is unknown (Phillips and Rosel 2014). 4) During February and March of 2008 a UME was declared in Texas involving 111 common bottlenose dolphin strandings (plus strandings of one unidentified dolphin and one melon-headed whale, *Peponocephala electra*). Most of the animals recovered were in a decomposed state and a direct cause of the mortalities 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). Two strandings occurred within West Bay and 35 others occurred along the Gulf side of Galveston Island in the vicinity of West Bay, but the stock origin of the animals is unknown (Phillips and Rosel 2014). 5) A UME occurred from November 2011 to March 2012 across five Texas counties and included 126 common bottlenose dolphin strandings.

The strandings were coincident with harmful algal blooms of *Karenia brevis* and *Dinophysis sp.* The cause of the bottlenose dolphin UME was determined to be due to biotoxin exposure from brevetoxin and okadaic acid. The additional supporting evidence of fish kills and other species die-offs linked to brevetoxin during the same time and space made a strong case that the harmful algal blooms impacted the dolphins. Three animals from the West Bay Stock were considered to be part of the UME, and an additional 37 strandings occurred along the Gulf side of Galveston Island in the vicinity of West Bay, but the stock origin of the animals is unknown (Phillips and Rosel 2014).

Table 3. Common bottlenose dolphin strandings occurring in the West Bay Stock area from 2015 to 2019, including the number of strandings for which evidence of human interaction (HI) was detected and number of strandings for which it could not be determined (CBD) if there was evidence of HI. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 25 August 2020). Please note HI does not necessarily mean the interaction caused the animal's death.

Stock	Category	2015	2016	2017	2018	2019	Total
West Bay Stock	Total Stranded	0	2	0	3	1	6
	Human Interaction						
	---Yes	0	0	0	0	0	0
	---No	0	1	0	2	1	4
	---CBD	0	1	0	1	0	2

HABITAT ISSUES

The estuarine habitat occupied by this stock is adjacent to the highly populated and industrial areas of Houston and Galveston, Texas. The five coastal counties surrounding the Galveston Bay Estuary, which includes West Bay, have a population exceeding 5.4 million people as of January 1, 2018 (TDC 2019). This has been an area of continuous economic growth and development over most of the previous 50 years, with much of this growth attributed to the discovery of oil and the construction of the Houston Ship Channel (Lester and Gonzalez 2011).

There are over 3000 oil and natural gas production platforms in the five counties surrounding Galveston and West Bays, including pipelines for the transport of these products and many refining facilities (Lester and Gonzalez 2011). While most of the platforms are placed on the surrounding land in the West Bay area, several platforms reside in Chocolate Bay and the confluence of Chocolate Bay and West Bay (Lester and Gonzalez 2011). No major oil spills have occurred within West Bay itself, however, repeated spills, from minor to serious in nature, have occurred in the waters of Galveston Bay or in coastal waters off Galveston Island (see Phillips and Rosel 2014 for a summary). A recent oil spill in 2014, referred to as the Texas City Y incident, involved a vessel collision in Galveston Bay near Texas City and the subsequent release of approximately 168,000 gallons of intermediate fuel oil. Through the National Resource Damage Assessment (NRDA) process, impacts of this spill are currently being evaluated and will include impacts to common bottlenose dolphins of the West Bay Stock (NOAA DAARP 2018). No information is currently available on potential impacts to the West Bay Stock. In addition to being known as an area of oil and gas production, the area surrounding Galveston and West Bays produces more than 50% of all chemical products manufactured in the U.S. (Henningsen and Würsig 1991; Lester and Gonzalez 2011).

According to an agricultural census for 2007, over 7,700 farms consisting of >540,000 acres of cropland, were located within the five coastal counties surrounding the Galveston Bay Estuary (Lester and Gonzalez 2011). Raising of livestock is also common in this area. Agricultural impacts on West Bay include the introduction of pesticides, herbicides, and nutrients from crop management, as well as fecal coliform bacteria resulting from livestock waste (Lester and Gonzalez 2011). Due to high levels of fecal coliform bacteria, half of the Galveston Bay Estuary is provisionally or permanently closed to the harvesting of shellfish. Chocolate Bay and Bastrop Bay have been rated as "moderate" for bacterial contamination levels, and West Bay has been rated "good" with fewer than 10% of sampled sites exceeding threshold levels for coliform bacteria (Lester and Gonzalez 2011).

In addition to discharge from the petroleum and chemical refineries and facilities and agricultural sources and sewage, West Bay receives additional pollution from stormwater runoff and shipping traffic (Jackson *et al.* 1998; Santschi *et al.* 2001; Lester and Gonzalez 2011; Phillips and Rosel 2014). Analysis of sediment samples from Galveston and West Bays in 2009 and 2010 indicated low concentrations of heavy metals. However, in 2000, two sediment samples from West Bay exceeded safety thresholds for PCBs (lindane and chlordane) (Lester and Gonzalez 2011; Phillips and Rosel 2014). Heavy metal and chemical concentrations in sediments and fish tissues have historically been of concern, and advisories about seafood consumption have often been issued. For example, currently an advisory exists regarding catfish consumption in West Bay and Chocolate Bay due to concerns about dioxins and PCBs (TPWD 2020). Mercury concentrations from samples of blue crab, oysters, and finfish are typically below those considered to be of human health concern, however the second highest concentration of mercury within the Galveston Bay Estuary was measured in a sample of sheepshead collected in West Bay in 1999 (Lester and Gonzalez 2011; Phillips and Rosel 2014). Organic contaminants and trace metals have been monitored in oysters, and the resulting concentration of PCBs has typically surpassed the level for sub-lethal effects (Jackson *et al.* 1998; Phillips and Rosel 2014). The concentrations of lead found in oysters from West Bay and Back Bay (adjacent to West Bay, on the other side of the I-45 Galveston Causeway Bridge) have been higher than those reported from other sampling sites within the Galveston Bay Estuary (Jiann and Presley 1997). Polynuclear aromatic hydrocarbon (PAH) levels in Galveston Bay are higher than national levels and indicate contamination by petroleum products, industrial activities, and urban run-off (Qian *et al.* 2001; Phillips and Rosel 2014). Concentrations of chlorinated hydrocarbons and metals were examined in conjunction with an anomalous mortality event of common bottlenose dolphins in Texas bays (although not West Bay) in 1990 and found to be relatively low in most; however, some had concentrations at levels of possible toxicological concern (Varanasi *et al.* 1992).

Harmful algal blooms and low dissolved oxygen are habitat issues leading to fish kills almost annually in the summers for Galveston and West Bays (McInnes and Quigg 2010). For example, a fish kill occurred in 2005 near Galveston Island due to low dissolved oxygen and a cyanobacteria bloom, killing over 10,000 Gulf menhaden (Phillips and Rosel 2014). In August 2012, a bloom occurred killing approximately one million fish in Galveston and West Bays. Another *K. brevis* bloom occurred along the Texas coast during September 2011–January 2012 resulting in the temporary closure of all shellfish beds in Texas and fish kills in Galveston Bay (Phillips and Rosel 2014). Earlier algal blooms affecting West Bay and resulting in shellfish bed closures occurred in 1972, 1976, 1986, 1996, and 2000 (Magaña *et al.* 2003; Phillips and Rosel 2014). For the 2011–2012 UME mentioned above (Strandings section), the strandings were coincident with a large harmful algal bloom of *K. brevis*. The definitive cause of that event has not been determined, but the algal bloom could have contributed to the mortality event.

Loss of wetland habitat and seagrass beds, and fragmentation of these habitats, within West Bay is another important issue (Lester and Gonzalez 2011; Phillips and Rosel 2014). West Bay has suffered significant loss of wetland habitat since the 1950s, much through the conversion of wetlands to cropland. Subsidence is another leading cause of wetland loss, exacerbated by the removal of petroleum and groundwater in the area (Lester and Gonzalez 2011; Phillips and Rosel 2014). Seagrass beds have been lost due to a complex interaction of causes including shoreline development, dredging, subsidence, boat traffic, and severe storms (Lester and Gonzalez 2011). Conservation partners and resource managers have invested in habitat restoration efforts within West Bay and have begun to restore acres of intertidal marsh and seagrasses (Lester and Gonzalez 2011; Phillips and Rosel 2014).

Finally, West Bay and Galveston Bay experienced significant storm surge during Hurricane Ike in 2008. As a result, discussion and planning for improved coastal barriers to protect the region from storm surge is in the works. Part of this plan includes ecosystem restoration projects and possible construction of flood gates within the West Bay area (U.S. Army Corps of Engineers 2020).

STATUS OF STOCK

Common bottlenose dolphins are not listed as threatened or endangered under the Endangered Species Act, and the West Bay Stock is not a strategic stock under the MMPA. The total fishery-related mortality and serious injury for this stock is unknown. The minimum estimate of fishery-related mortality and serious injury is less than 10% of the calculated PBR, but there is insufficient information (see Annual Human-Caused Mortality and Serious Injury section) available to determine whether the total human-caused fishery-related mortality and serious injury is insignificant and approaching a zero mortality and serious injury rate. The status of this stock relative to optimum sustainable population is unknown and there are insufficient data to determine population trends for this stock.

Although this stock does not meet the criteria to qualify as strategic, NMFS has concerns regarding this stock due to the small stock size and the inability to determine the total human-caused mortality and serious injury.

REFERENCES CITED

Balmer, B.C., T. McDonald, F. Hornsby, J. Adams, J. Allen, A. Barleycorn, P. Clarke, C. Cush, A. Honaker, K. McHugh, T. Speakman, R. Wells and L. Schwacke. 2018. Long-term trends in a northern Gulf of Mexico

common bottlenose dolphin (*Tursiops truncatus*) population in the wake of the *Deepwater Horizon* oil spill. J. Cetacean Res. Manage. 18:1–9.
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.
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., J.W. Hain, L.J. Hansen, D.L. Palka and G.T. Waring. 1995. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments. NOAA Tech. Memo. NMFS-SEFSC-363. 211 pp.
Bräger, S. 1993. Diurnal and seasonal behavior patterns of bottlenose dolphins (*Tursiops truncatus*). Mar. Mamm. Sci. 9(4):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.
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):1–23.
Caldwell, M. 2001. Social and genetic structure of bottlenose dolphin (*Tursiops truncatus*) in Jacksonville, Florida. Ph.D. dissertation from University of Miami. 143 pp.
Carretta, J.V., K. Danil, S.J. Chivers, D.W. Weller, D.S. Janiger, M. Berman-Kowalewski, K.M. Hernandez, J.T. Harvey, R.C. Dunkin, D.R. Casper, S. Stoudt, M. Flannery, K. Wilkinson, J. Huggins and D.M. Lambourn. 2016. Recovery rates of bottlenose dolphin (*Tursiops truncatus*) carcasses estimated from stranding and survival rate data. Mar. Mamm. Sci. 32(1):349–362.
Christiansen, F., K.A. McHugh, L. Bejder, E.M. Siegal, D. Lusseau, E. Berens McCabe, G. Lovewell and R.S. Wells. 2016. Food provisioning increases the risk of injury and mortality in a long-lived marine top predator. Royal Society Open Science 3:160560.
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.
Diener, R.A. 1975. Cooperative Gulf of Mexico estuarine inventory and study-Texas: area description. NOAA Tech. Rep., NMFS CIRC-393, Seattle, Washington, USA. 134 pp.
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.
Fazioli, K.L., S. Hofmann 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.
Gruber, J.A. 1981. Ecology of the Atlantic bottlenosed dolphin (*Tursiops truncatus*) in the Pass Cavallo area of Matagorda Bay, Texas. M.Sc. Thesis from Texas A&M University, College Station. 182 pp.
Gubbins, C. 2002. Association patterns of resident bottlenose dolphins (*Tursiops truncatus*) in a South Carolina estuary. Aquat. Mamm. 28(1):24–31.

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.

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(2):299–310.

Irvine, B. and R.S. Wells. 1972. Results of attempts to tag Atlantic bottlenosed dolphins (*Tursiops truncatus*). Cetology 13:1–5.

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(4): 671–688.

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.

Jackson, T.J., T.L. Wade, J.L. Sericano, J.M. Brooks, J.M. Wong, B. Garcia-Romero and T.J. McDonald. 1998. Galveston Bay: temporal changes in the concentrations of trace organic contaminants in national status and trends oysters (1986-1994). Estuaries 21(4):718–730.

Jiann, K.T. and B.J. Presley. 1997. Variations in trace metal concentrations in American oysters (*Crassostrea virginica*) collected from Galveston Bay, Texas. Estuaries 20(4):710–724.

Lester, L.J. and L.A. Gonzalez, eds. 2011. The state of the bay: a characterization of the Galveston Bay Ecosystem, Third Edition. Texas Commission on Environmental Quality, Galveston Bay Estuary Program, Houston, Texas, 356 pp. Available from: http://galvbaydata.org/www.galvbaydata.org/StateoftheBay/tabid/1846/Default.html

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. 2007. Social structure, genetic structure, and persistent organohalogen pollutants in bottlenose dolphins (*Tursiops truncatus*) in Biscayne Bay, Florida. Ph.D. dissertation from University of Miami. 140 pp.

Litz, J.A., M.A. Baran, S.R. Bowen-Stevens, R.H. Carmichael, K.M. Colegrove, L.P. Garrison, S.E. Fire, E.M. Fougeres, 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(2):161–175.

Litz, J.A., E.L. Ronje, H.R. Whitehead and L.P. Garrison. 2019. Updated abundance estimate for common bottlenose dolphins (*Tursiops truncatus*) inhabiting West Bay, Texas. Aquatic Conserv.: Mar. Freshw. Ecosyst. 2019:1–12.

Lynn, S.K. and B. Würsig. 2002. Summer movement patterns of bottlenose dolphins in a Texas bay. G. Mex. Sci. 20(1):25–37.

Magaña, H.A., C. Contreras and T.A. Villareal. 2003. A historical assessment of *Karenia brevis* in the western Gulf of Mexico. Harmful Algae 2(3):163–171.

Maze, K.S. and B. Würsig. 1999. Bottlenose dolphins of San Luis Pass, Texas: Occurrence patterns, site fidelity, and habitat use. Aquat. Mamm. 25(2):91–103.

Maze-Foley, K. and L.P. Garrison. 2016. 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.

Maze-Foley, K., B.L. Byrd, S.C. Horstman and J.R. Powell. 2019. Analysis of stranding data to support estimates of mortality and serious injury in common bottlenose dolphin (*Tursiops truncatus truncatus*) stock assessments for the Atlantic Ocean and Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-742. 42 pp. Available from: https://repository.library.noaa.gov/view/noaa/23151

Mazzoil, M., S.D. McCulloch and R.H. Defran. 2005. Observations on the site fidelity of bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida. Fla. Sci. 68(4):217–226.

McClintock, B.T., G.C. White, M.F. Antolin and D.W. Tripp. 2009. Estimating abundance using mark-resight when sampling is with replacement or the number of marked individuals is unknown. Biometerics. 65:237–246.

McInnes, A.S. and A. Quigg. 2010. Near-annual fish kills in small embayments: casual vs. causal factors. J. Coastal Res. 26(5):957–966.
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.
NMFS. 2016. Guidelines for preparing stock assessment reports pursuant to the 1994 amendments to the MMPA. NMFS Instruction 02-204-01, February 22, 2016. Available from: http://www.nmfs.noaa.gov/op/pds/index.html
NOAA DAARP (Damage Assessment, Remediation, and Restoration Program). Accessed 11 January 2018. Available at: https://darrp.noaa.gov/oil-spills/texas-city-y
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. Indicators 18:278–290.
Phillips N.M. and P.E. Rosel. 2014. A method for prioritizing research on common bottlenose dolphin stocks through evaluating threats and data availability: development and application to bay, sound and estuary stocks in Texas. NOAA Tech. Memo. NMFS-SEFSC-665, 146 pp.
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.
Pulich, W.M. and W.A. White. 1991. Decline of submerged vegetation in the Galveston Bay system: chronology and relationships to physical processes. J. Coastal Res. 7(4):1125–1138.
Qian, Y., T.L. Wade, and J.L. Sericano. 2001. Sources and bioavailability of polynuclear aromatic hydrocarbons in Galveston Bay, Texas. Estuaries 24(6):817–827.
Read, A.J. 2008. The looming crisis: Interactions between marine mammals and fisheries. J. Mammal. 89(3):541–548.
Ronje, E., H.R. Whitehead, S. Piwetz and K.D. Mullin. 2018. Field summary for common bottlenose dolphin surveys on the Texas, Gulf of Mexico Coast, 2014-2016. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2018-02, 31 pp. Available from: https://grunt.sefsc.noaa.gov/P_QryLDS/download/PRB96_PRBD-2018-02_C.pdf?id=LDS
Ronje, E.I., H.R. Whitehead, K. Barry, S. Piwetz, J. Struve, V. Lecours, L.P. Garrison, R.S. Wells and K.D. Mullin. 2020. Abundance and occurrence of common bottlenose dolphins (*Tursiops truncatus*) in three estuaries of the northwestern Gulf of Mexico. Gulf and Caribbean Research 31:18–34.
Rosel, P.E., L. Hansen and A.A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: Common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Mol. Ecol. 18(24):5030–5045.
Rosel, P.E., L.A. Wilcox, C. Sinclair, T.R. Speakman, M.C. Tumlin, J.A. Litz and E.S. Zolman. 2017. Genetic assignment to stock of stranded bottlenose dolphins in southeastern Louisiana after the *Deepwater Horizon* oil spill. Endang. Species Res. 33:221–234.
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(1):69–77.
Santschi, P.H., B.J. Presley, T.L. Wade, B. Garcia-Romero and M. Baskaran. 2001. Historical contamination of PAHs, PCBs, DDTs and heavy metals in Mississippi River Delta, Galveston Bay and Tampa Bay sediment cores. Mar. Environ. Res. 52(1):51–79.
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 from 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.
Smith, J.W., E.A. Hall, N.A. McNeill and W.B. O'Bier. 2002. The distribution of purse-seine sets and catches in the Gulf menhaden fishery in the northern Gulf of Mexico, 1994–98. G. Mex. Sci. 20(1):12–24.
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.
Soldevilla, M.S., L.P. Garrison, E. Scott-Denton and R.A. Hart. 2016. Estimated bycatch mortality of marine mammals in the Gulf of Mexico shrimp otter trawl fishery during 2012 to 2014. NOAA Tech. Memo. NMFS-SEFSC-697. 47 pp.
Soldevilla, M.S., L.P. Garrison, E. Scott-Denton and J. Primrose. 2021. Estimated bycatch mortality of marine mammals in the Gulf of Mexico shrimp otter trawl fishery during 2015 to 2019. NOAA Tech. Memo. NMFS-SEFSC-749. 78 pp.
TDC. 2019. Estimates of the total populations of counties and places in Texas for July 1, 2017 and January 1, 2018. Produced by: The Population Estimates and Projections Program, Texas Demographic Center, The University of Texas at San Antonio. Available from: https://demographics.texas.gov/Resources/TPEPP/Estimates/2017/2017_txpopest_county.pdf
TPWD. 2020. Fish consumption bans and advisories. Accessed 25 November 2020. Available from: https://tpwd.texas.gov/regulations/outdoor-annual/fishing/general-rules-regulations/fish-consumption-bans-and-advisories
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(2):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(3):619–638.
U.S. Army Corps of Engineers. 2020. Coastal Texas Protection and Restoration Feasibility Study. Coastal Texas Study. Draft Report. October 2020. Available from: https://www.swg.usace.army.mil/Business-With-Us/Planning-Environmental-Branch/Documents-for-Public-Review/
Vail, C.S. 2016. An overview of increasing incidents of bottlenose dolphin harassment in the Gulf of Mexico and possible solutions. Front. Mar. Sci. 3:110.
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.
Wade, P.R. 1998. Calculating limits to the allowable human-caused mortality of cetaceans and pinnipeds. Mar. Mamm. Sci. 14(1):1–37.
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. Available from: https://repository.library.noaa.gov/view/noaa/15963
Weller, D.W. 1998. Global and regional variation in the biology and behavior of bottlenose dolphins. Ph.D. Thesis from 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., 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., 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 Center Contribution No. 40-WCNF601958. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Wells, R.S., L.H. Schwacke, T.K. Rowles, B.C. Balmer, E. Zolman, T. Speakman, F.I. Townsend, M.C. Tumlin, A. Barleycorn and K.A. Wilkinson. 2017. Ranging patterns of common bottlenose dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana, following the *Deepwater Horizon* oil spill. Endanger. Spec. Res. 33:159–180.

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., 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.

White, G.C. and K.P. Burnham. 1999. Program MARK: Survival estimation from populations of marked individuals. Bird Study 46:120–139.

Zollett, E.A. and A.J. Read. 2006. Depredation of catch by bottlenose dolphins (*Tursiops truncatus*) in the Florida king mackerel (*Scomberomorus cavalla*) troll fishery. U.S. Fish. Bull. 104(3):343–349.

Zolman, E.S. 2002. Residence patterns of bottlenose dolphins (*Tursiops truncatus*) in the Stono River estuary, Charleston County, South Carolina, U.S.A. Mar. Mamm. Sci. 18(4):879–892.