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## Extended Movements of Common Bottlenose Dolphins (*Tursiops truncatus*) Along the Northern Gulf of Mexico's Central Coast

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## SHORT PAPERS AND NOTES

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EXTENDED MOVEMENTS OF COMMON BOTTLENOSE DOLPHINS (*TURSIOPS TRUNCATUS*) ALONG THE NORTHERN GULF OF MEXICO'S CENTRAL COAST.—Common bottlenose dolphins (*Tursiops truncatus*) are distributed throughout the bays, sounds, and estuaries (BSEs) and coastal waters of the northern Gulf of Mexico (nGoMx) (Mullin et al., 1990). Along the nGoMx coast, the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) has delineated three coastal stocks, including the Northern Coastal Stock, with boundaries extending from the Mississippi River Delta east to Florida's Big Bend (i.e., 84°W), including waters from shore to the 20-m isobath (Waring et al., 2013). Adjacent to the east–west geographic boundaries of the Northern Coastal Stock, 16 BSE stocks of bottlenose dolphins have also been delineated (Waring et al., 2013). Although extensive research has not been conducted on all 16 of these BSE stocks, several studies (e.g., Conn et al., 2011; Tyson et al., 2011; Bouveroux et al., 2014) have provided valuable information for stock assessment in the nGoMx central coast region (reviewed in Vollmer and Rosel, 2013). For two of these BSE stocks, those of the St. Joseph Bay and Mississippi Sound, photographic-identification (photo-id) surveys have identified long-term (across multiple seasons and years) estuarine residents, in addition to seasonal influxes of dolphins presumed to originate from the Northern Coastal Stock (Hubard et al., 2004; Balmer et al., 2008). Telemetry data from dolphins tagged in St. Joseph Bay demonstrated relatively localized ranging patterns for individuals that were likely members of the St. Joseph Bay BSE stock (Balmer et al., 2008, 2010). However, one female (X09), tagged in April 2005 and tracked through July 2005, traveled more than 100 km west, with the final telemetry location placing her near Destin, FL (Fig. 1a; adapted from Balmer et al., 2008). Although these telemetry data are from only one dolphin, X09's extended movements may have provided some of the first insights into the potential ranging patterns of nGoMx central coast dolphins. Currently, there are no systematic studies investigating individual dolphin movements and overall ranging patterns in this coastal region.

Although the majority of photo-id studies in the nGoMx central region have been focused on

BSE waters, it is possible that members of the Northern Coastal Stock may have been photographed as a result of overlapping ranges into BSE waters. Additionally, comparisons of photo-id catalogs across nGoMx field sites provide an opportunity to compare dolphin sightings and to further refine our understanding of longer-range movements. The goal of this pilot study was to compare photo-id catalogs from the Mississippi Sound and St. Joseph Bay field sites (Fig. 1a) to provide insight into potential extended movements of dolphins along the nGoMx central coast. This pilot study was initiated as a result of a dolphin that was freeze-branded in St. Joseph Bay during a health assessment in 2006 and was subsequently sighted in Mississippi Sound during a photo-id survey in 2015.

On 7 May 2015, a field team based out of NOAA's NMFS Southeast Fisheries Science Center in Pascagoula, MS, surveyed the barrier islands of Mississippi Sound and encountered a group of 14 dolphins approximately 1 km off the northeast corner of Petit Bois Island (Fig. 1b). A dolphin in the group appeared to have a freeze-brand with the number "15" on the right side of its dorsal fin. Dolphins are routinely freeze-branded during capture–release health assessments (e.g., Balmer et al., 2008) or following rehabilitation releases (e.g., Wells et al., 2013) to provide long-term identification of the animal in subsequent sightings and/or stranding. The technique involves applying metal brands, cooled in liquid nitrogen, to the dorsal fin, resulting in depigmentation of the branded tissue, with subsequent white digits appearing within a few days (Scott et al., 1990). In the case of the 7 May sighting, the dolphin's freeze-brand number and dorsal fin markings did not coincide with any dolphin previously captured in Mississippi Sound (Solangi and Dukes, 1983; Mullin, pers. obs.). In collaboration with researchers from NOAA's National Centers for Coastal Ocean Science, the dolphin was verified as "X15," a 198-cm female captured on 17 July 2006 during a health assessment in the southwestern corner of St. Joseph Bay, over 300 km from Mississippi Sound (Fig. 1b). X15 was subsequently sighted in the St. Joseph Bay field site three times across multiple years (25 June 2007, 24 June 2010, and 10 Aug. 2010) (Fig. 1b).

As a consequence of the unexpected Mississippi Sound sighting of X15, a pilot study was initiated to compare Mississippi Sound and St. Joseph Bay

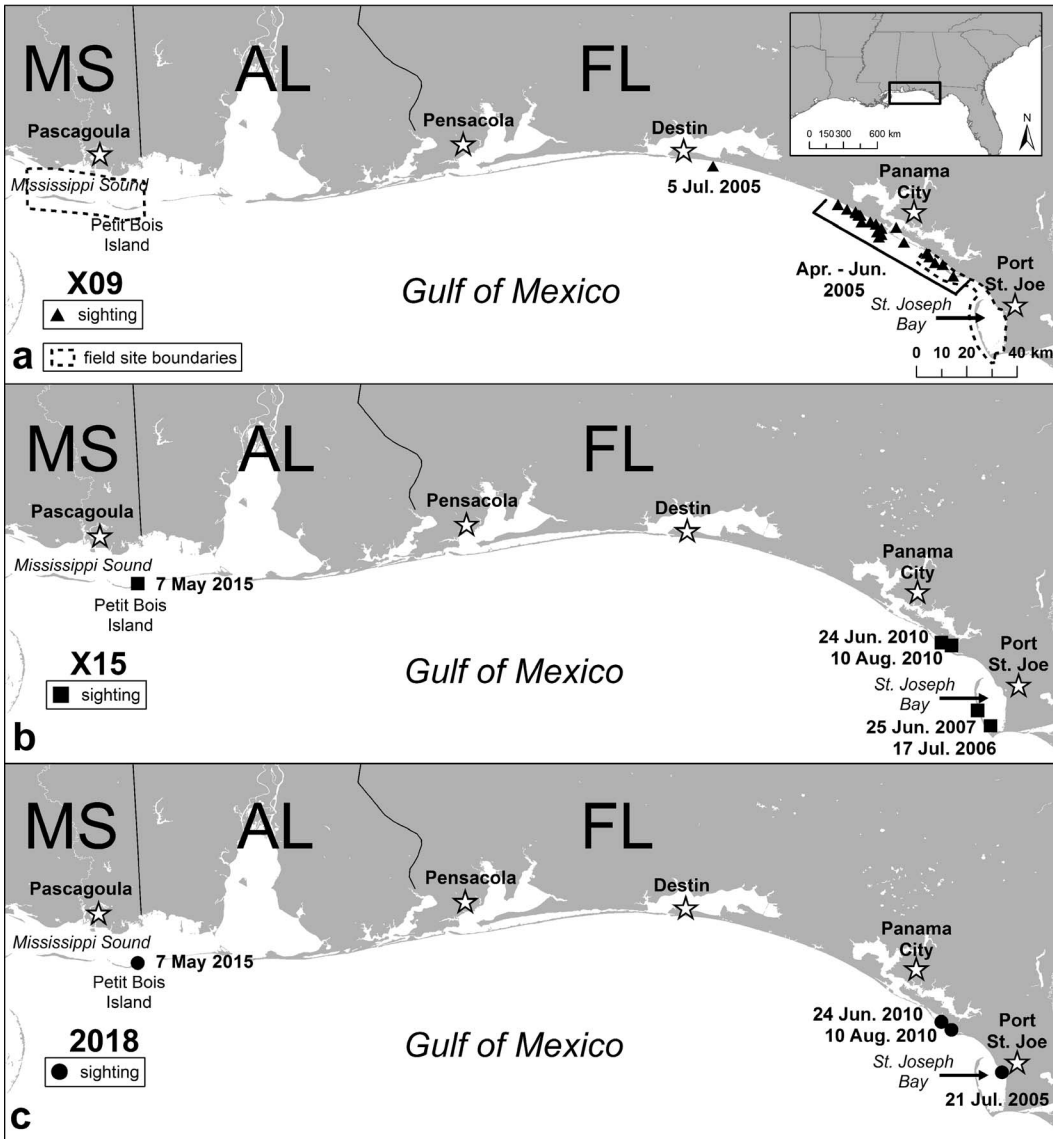


Fig. 1. Extended movements of three bottlenose dolphins along the northern Gulf of Mexico (nGoMx) central coast: (a) X09, (b) X15, and (c) 2018.

photo-id catalogs and to identify additional dolphins with ranging patterns comparable to that of X15. Two different Mississippi Sound photo-id catalogs were used [1995–2008 (Hubard et al., 2004), and 2010–14 (Mullin, pers. obs.)], composed of 1,307 and 2,158 individuals, respectively, and were compared to the St. Joseph Bay photo-id catalog from 2004 through 2013 (Balmer et al., 2008; Balmer, pers. obs.), with 690 individuals. Comparisons of all individuals across both field sites would have required a large amount of time and resources, which were currently unavailable. To reduce the total number of comparisons, dorsal fin distinctiveness was used

to identify a subset of individuals for cross-catalog comparisons. Prior to a dolphin being included in its respective photo-id catalog, it received a dorsal fin distinctiveness classification agreed upon by two investigators: D1 indicating “very distinctive,” D2, “moderately distinctive,” and D3, “not distinctive” (Urian et al., 1999). For this pilot study, individuals with only a D1 classification were compared between the St. Joseph Bay (N = 131) and Mississippi Sound (N = 317 and N = 328) catalogs by two independent researchers.

The photo-id catalogs that were used are maintained in FinBase (Adams et al., 2006), a Microsoft Access (Microsoft Corporation, Red-

mond, WA) database that includes images and associated data for dolphins sighted in a given field site. For each dolphin, FinBase also identifies associates, which are other cataloged dolphins that have been sighted with the respective individual. In addition to the D1 catalog searches, all of X15's associates in the 7 May 2015 Mississippi Sound sighting and in the three post-health assessment sightings in St. Joseph Bay were compared. All associates were also compared to the other field site's catalog(s) (e.g., an associate of X15 sighted in Mississippi Sound was compared to individuals in the St. Joseph Bay catalog). To reduce the total number of comparisons for this search, the location of each associate's predominant dorsal fin feature (e.g., upper portion of the dorsal fin) was determined. FinBase can sort catalog individuals by specific dorsal fin features or "attributes." Dolphins in the other field sites' catalog(s) with the same attributes as each associate were compared to the respective associate.

The D1 comparisons between the St. Joseph Bay and two Mississippi Sound photo-id catalogs yielded no matches. However, in searching associates of X15 between the two field sites, one confirmed match was determined. St. Joseph Bay catalog identification (cat. ID) number 2018 was identified as an associate of X15 sighted with a calf in Mississippi Sound on 7 May 2015. Cat. ID 2018 is not currently in either Mississippi Sound photo-id catalog; however, she has been sighted three times in St. Joseph Bay (21 July 2005, 24 June 2010, and 10 Aug. 2010), twice (24 June 2010 and 10 Aug. 2010) with X15 (Fig. 1c). In comparing X15's associates to cataloged individuals with similar attributes, cat. ID 2018 was also identified, but no other matches were determined. Cat. ID 2018's associates from the St. Joseph Bay sightings were compared to individuals with the same attributes in the Mississippi Sound catalogs, and no matches were identified.

The low number of matches between the St. Joseph Bay and Mississippi Sound catalogs may indicate that the number of Northern Coastal Stock dolphins in these catalogs is very small. In the St. Joseph Bay and Mississippi Sound field sites, coastal surveys were conducted. However, the limited duration and geographic scope of these surveys may not be representative of all dolphins using the coastal waters adjacent to these field sites. There may also be additional Northern Coastal Stock dolphins in the St. Joseph Bay and Mississippi Sound catalogs but these individuals may have more limited ranging patterns. Future surveys, specifically focused on the coastal waters, are essential to better our understanding of the number of coastal dol-

phins in these regions and overlap with dolphins in BSE waters.

The extended, short-term (X09) and long-term (X15 and 2018) movements of individual dolphins along the nGoMx central coast suggest that at least some individuals range widely within the Northern Coastal Stock boundaries as currently defined. Although the range of movement for the stock cannot be generalized from only three dolphins, additional support for the current coastal delineations comes from the study by Balmer et al. (2008) that identified seasonal influxes of dolphins into the St. Joseph Bay region during spring and fall. This study hypothesized that these increases in abundance were a result of members of the Northern Coastal Stock entering BSE waters. X09's telemetry data built upon this hypothesis by suggesting that coastal animals sighted, and in X09's case tagged, in the St. Joseph Bay region in the spring may have a westward movement out of the region along the coast during the summer (Fig. 1a). However, the sighting histories of X15 and 2018 showed a different ranging pattern than that of X09. Both of these dolphins were sighted during the summer (June, July, and/or Aug.) across multiple years in the St. Joseph Bay region and in the spring (May) in Mississippi Sound (Fig. 1b,c). Based upon the different ranging patterns of these few individuals, seasonal movements of central coast nGoMx dolphins are unclear. Animals may also be shifting their ranging patterns for short or extended periods based on factors that are currently unknown, and our understanding of seasonality in the nGoMx central region needs further refinement. Future research investigating cues that may trigger coastal dolphin movements, such as environmental or prey-based parameters, would provide insight into seasonal movements (or lack thereof) along the nGoMx central coast.

Recent studies have recommended integrating multiple techniques (e.g., photo-id and telemetry, in addition to genetics) to better identify marine mammal stock boundaries and define management units (Balmer et al., 2014; Sveegaard et al., 2015). Systematic line-transect and/or mark-recapture photo-id surveys could be employed to determine abundance and ranging patterns of the Northern Coastal Stock and to identify environmental parameters (e.g., water temperature, salinity, and depth) that may influence this stock's movements. The Gulf of Mexico Dolphin Identification System (GoMDIS) is a tool to compare individual project-submitted photo-id catalogs (Cush and Wells, 2015); collaborators can then share data of interest between among themselves in an effort to enhance our knowledge of nGoMx dolphin movements. Recent studies on larger

cetaceans [e.g., false killer whales (*Pseudorca crassidens*) and killer whales (*Orcinus orca*)] have used satellite-linked tags that were remotely attached to the dorsal fin with subdermal anchors (i.e., LIMPET tags) (Andrews et al., 2008; Baird et al., 2010). Although similar attachment designs have been deployed on smaller cetaceans (Baird et al., 2014), development of a less invasive, satellite-linked tag that could be remotely deployed on bottlenose dolphins would reduce the costs and risks associated with capturing individuals and provide insight into coastal dolphins' movements and range overlap with BSE stocks in the nGoMx.

Determining movement patterns and interactions among different dolphin stocks is essential to improving stock delineations (e.g., Balmer et al., 2008), identifying habitat use (e.g., Wilson et al., 2013), and assessing the impacts of anthropogenic stressors (e.g., Balmer et al., 2011). Along the western North Atlantic, two morbillivirus outbreaks (1986–88 and 2013–15) have resulted in thousands of bottlenose dolphin deaths (Scott et al., 1988; NMFS, unpubl. data), and the disease prevalence and the epidemiological impacts within a given stock are currently unknown. Movement pattern data are crucial to determining the geographic range of disease outbreaks and how diseases are spread among stocks. In the nGoMx, three large-scale mass mortality events between 1999 and 2006 occurred as a result of brevetoxin exposure (Twiner et al., 2012). Currently, it is unknown if the Northern Coastal Stock and/or BSE stocks were affected by these mortality events. Long-term photo-id studies and collaborations among field sites to determine nGoMx movement patterns are necessary to identify which stocks are affected by anthropogenic stressors and the geographic scope of future mass mortality events.

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