

# Sighting Patterns of Bottlenose Dolphins Observed in the Outer Banks, NC

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## Introduction

Populations of bottlenose dolphins (*Tursiops truncatus*) are distributed commonly in estuarine and coastal waters (Zolman 2002; Wells et al. 1980, Kenney 1990). On the U.S. Atlantic Coast, these populations consist of resident and migratory animals, and seasonal mixing between populations may occur (Urian et al. 2013; Waring et al. 2013). Mixing of stocks can be contributed to the fission-fusion nature of bottlenose dolphin societies. Seasonal residency patterns and mixing suggests populations may have complex ranges (Reynolds et al. 2000).

In order to further examine the population structure of bottlenose dolphins along the Atlantic Coast, the Mid-Atlantic Bottlenose Dolphin Photo-identification Catalog (MABDC) was developed in 1997 through collaboration of individual researchers. The purpose of the MABDC is to serve as a resource to elucidate the stock structure of bottlenose dolphins along the western North Atlantic coast (Urian 2014). The MABDC currently consists of 19 catalogs with 20 contributors and over 11,000 dolphins with photos dating back as far as 1979 (Urian 2014). Bottlenose dolphins that inhabit the Roanoke Sound are considered part of the Northern North Carolina Estuarine System (NNCES) Stock (Rosel et al. 2009; Waring et al. 2013). The NNCES is defined as animals that use the estuarine waters of the Pamlico Sound and nearby coastal waters (up to 1 km from shore) from Beaufort, NC to southern Virginia and the lower Chesapeake Bay during the warmer months. In the cooler months, animals belonging to this stock migrate south to the coastal waters (within 3 km of shore) between the New River and Cape Hatteras, NC (Waring et al. 2013). The bottlenose dolphin population in the Roanoke Sound, NC has been monitored since 1997 (Taylor et al. 2014). The Nags Head Dolphin Watch initiated the study, with dedicated efforts being continued by the Outer Banks Center for Dolphin Research (OBXCDR) in 2008. By using photo-identification, distinguishable individuals are tracked over time to collect information on health and population trends that can contribute to conservation of this stock.

Our objectives in this study were to examine the range of individuals belonging to the NNCES sighted in the Outer Banks, NC. We compared a select sample of the bottlenose dolphins photographed in the Roanoke Sound to the MABDC to determine movement patterns of dolphins between the study area and particular sites along the east coast. In particular, dorsal fin images from Roanoke Sound were matched to Virginia Beach, VA (VA-SB), New Jersey (NJ-JLT), Roanoke Sound, NC (NC-RMD), and Beaufort, NC (NC-NMFS).

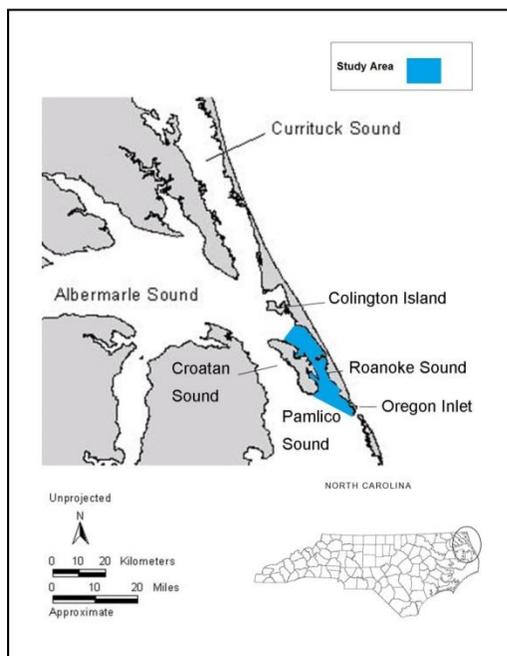
The NC and VA catalogs were chosen for comparison because of the previously documented movement between these areas. For example, on August 1, 2012, a male bottlenose dolphin (NC-OBX 008) stranded in Kill Devil Hills, NC. Using the MABDC, the dorsal fin image was matched to three contributor catalogs with sighting records

from 1993-2011 (Urian 2014), with sightings ranging from Roanoke Sound, to Beaufort, NC and coastal waters off of Oregon Inlet (Urian 2014). A site further north than currently documented for the NNCES (New Jersey) was also chosen for comparison to test the current boundaries of this stock. Dorsal fin photos were compared to NC-RMD catalog to give insight to long-term site fidelity within the select sample.

## Methods

The Outer Banks study area encompassed the entirety of Roanoke Sound, approximately 41 square miles from the northern tip of Roanoke Island south to Oregon Inlet (Figure 1). Roanoke Sound separates Nags Head, NC from Roanoke Island and is frequently used for boating, recreation, and fishing. The sound is comprised of mainly shallow seagrass and sandbars as well as dredged channel areas.

Figure 1: Roanoke Sound Study Area



From April through October 2012, monthly dedicated transect surveys were conducted from a 16' outboard vessel in Roanoke Sound. Transect lines were created in MapSource and uploaded to a hand-held GPS for use in the field. Upon sighting a group of dolphins, the transect location was marked on the GPS and dolphins were approached for photographs. Standard photo-identification techniques were used for photographing dorsal fins. Sighting data, including GPS location, group size estimates, activity state, and environmental variables were recorded for each sighting. A sighting lasted until one of three events occurred: dorsal fin photographs were obtained for each individual, the maximum time of one hour for a sighting was reached, or dolphins were lost/exhibited avoidance behaviors. Based upon the General Authorization permit under

which surveys were conducted, one hour represented the maximum time for a sighting. Upon ending each sighting, the vessel returned to the marked location on the transect line and the survey resumed. A complete survey covered the entire transect route.

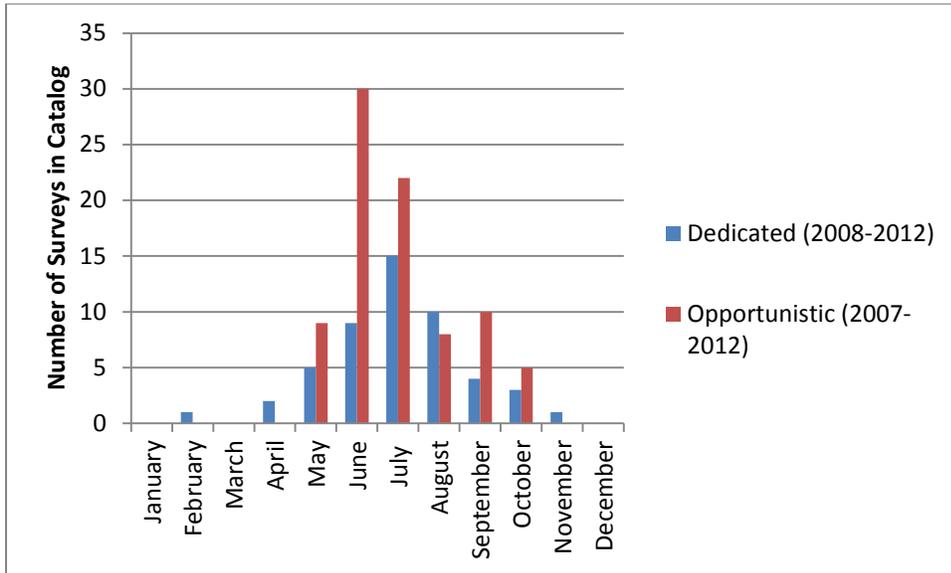
FinBase (Adams et al. 2006) was used for processing photo-identification data. All dorsal fin images were sorted, graded for photo quality, and matched to the OBXCDR photo-identification catalog. The OBXCDR catalog spanned from October 2007-October 2012, and consisted of dedicated and opportunistic sightings in Roanoke Sound and the surrounding estuarine waters. All matches were verified by a second researcher. Sighting data was entered into FinBase and linked to corresponding fin images. All data was sent to Kim Urian, DUML, for incorporation into the MABDC. Poor quality images and low/not distinct fins were excluded from this analysis.

An analysis of residency patterns, using the long-term OBXCDR catalog, was conducted to distinguish seasonal residents from transients within this dataset. Seasons were described as follows: Spring (April and May), Summer (June, July, August), and Fall (September and October). Seasonal residency was defined as individuals sighted in the study area across years during one or more seasons. Transients were defined as individuals sighted in the study area during only one season (Zolman 2002).

All good quality distinctive fins from the 2012 dataset were matched to the Virginia Beach, VA, New Jersey, and Beaufort, NC catalogs within the MABDC. To examine site fidelity to the study area over time, 2012 good quality distinctive fins were also compared to the MABDC Nags Head catalog (1997). Each potential match was verified by the curator (Kim Urian), a second OBXCDR researcher, and the regional catalog contributor.

A descriptive summary table was created for each individual matched, including gender (if known), original sighting date in the OBX, number of total OBX sightings, OBX residency status, and lesion presence. Gender was determined as follows: if an individual was sighted 3 or more times consistently with a dependent calf, this individual was assumed to be a female. If an individual was sighted 3 times or more consistently with another adult, this individual was assumed to be part of a male pair. Original sighting date and number of sightings was extracted from the OBXCDR Catalog, which included a combination of dedicated and opportunistic surveys. Greatest survey effort occurred during the summer months (Figure 2). Residency status and lesion presence was determined by Taylor et al. 2014.

Figure 2: OBXCDR Catalog Field Effort



We calculated the percent of dolphins from the OBX catalog matched to another study site. For these dolphins, we calculated the percent matched to each of the MABDC catalogs (Virginia Beach, VA, NJ, Nags Head, NC, and Beaufort, NC). We examined the sighting histories of all dolphins in the sample as well as residents, based upon the analysis of residency patterns conducted by Taylor et al. (2014). We determined the sighting patterns, by season, for all matched dolphins.

## Results

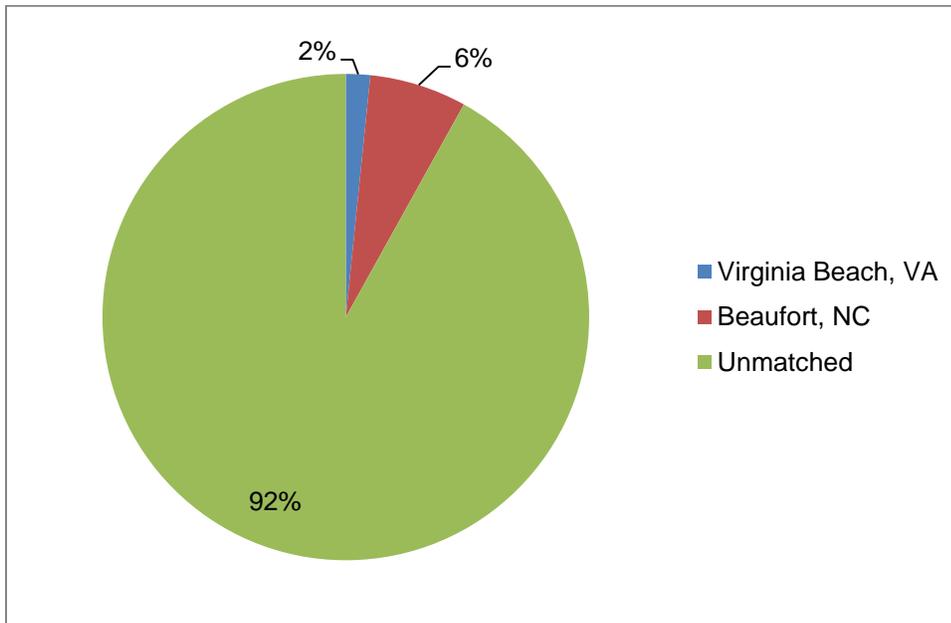
From April through October 2012, seven complete surveys were conducted with a total of 25 sightings. Sixty-two distinctive individuals with good quality photos were identified and matched to the OBX catalog. These individuals were subsequently compared to the Virginia Beach, VA, Long Beach Island/Ocean City, NJ, Nags Head, NC, and Beaufort, NC catalogs using the MABDC (Table 1).

Table 1. MABDC Catalogs Used for Matching

Catalog Name	Contributor/Affiliation	Study Area	Catalog Size	Dates of Catalog
NC-OBX	Jessica Taylor/Outer Banks Center for Dolphin Research	Roanoke Sound	918	2007-2012
NJ-JLT	Jackie Toth Brown/Rutgers University	Long Beach Island/Ocean City, NJ	306	2003-2005
VA-SB	Sue Barco/ Virginia Aquarium	Virginia Beach, VA	399	1989-1998

NC-RMD	Rich Mallon- Day/Nags Head Dolphin Watch	Roanoke Sound, NC	150	1997-1998
NC-NMFS	Annie Gorgone/ NMFS Beaufort Lab	Beaufort, NC	370	2001-ongoing

Figure 3: Matches to MABDC Study Sites

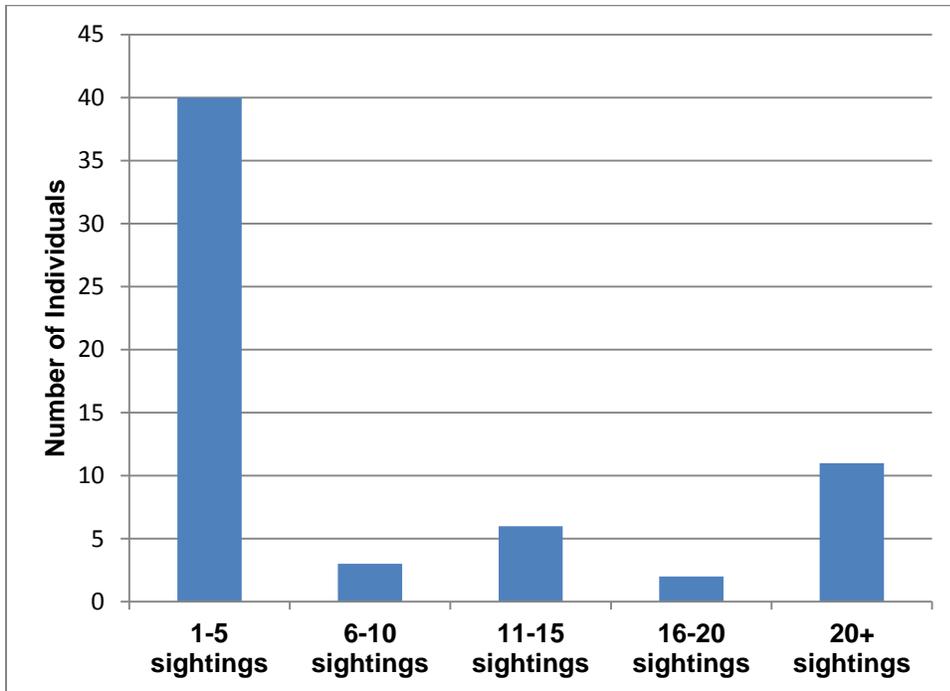


Approximately 8% (N=5) of the OBX 2012 dolphins were matched to another study site. Of these individuals, 6% (N=4) were matched to Beaufort, NC (NC-NMFS) and 2% (N=1) were matched to Virginia Beach, VA (VA-SB) (Figure 3). Approximately 75% (N=3) of the dolphins matched to Beaufort, NC were defined as seasonal residents in the study area. There was not enough data available to determine residency status of the dolphin matched neither to VA Beach nor for the fourth dolphin matched to Beaufort, NC. No matches were made to the New Jersey catalog (NJ-JLT). Of the dolphins that were matched to other study sites, no individuals were matched to more than one site. Ninety-two percent of the sample (N=57) was unmatched.

Matching to the NC-RMD catalog of Nags Head provided insight into long-term site fidelity within the Outer Banks, NC. Approximately 14.5% (N=9) of the sample was matched to the NC-RMD catalog, indicating that these individuals have been observed in Roanoke Sound since 1997. Of these individuals, 33% (N=3) were matched to another study site. One individual (OBX 831) was matched to the Virginia Beach, VA catalog while 2 individuals (OBX 317 and 318) were matched to the Beaufort, NC (NC-NMFS) catalog. OBX 831 was observed in the Outer Banks once during the summer of

2011 and once during the fall of 2012. OBX 317 and 318 have been observed in the Outer Banks on multiple occasions during the summer and fall since 2008.

Figure 4: Number of Sightings of Individuals for Total Sample 2007-2012



The majority of individuals in the OBX 2012 sample (64%; N=40) were sighted between 1 and 5 times through the OBXCDR research program (Figure 4), suggesting a transient nature to most dolphins observed in this area. However, approximately 18% of the sample (N=11) were sighted on more than 20 different occasions, indicating some long-term site fidelity may exist. When residency patterns were examined, approximately 40% of the 2012 sample (N=25) were classified as seasonal residents to the study area. Most seasonal residents (79%; N=19) were sighted more than 10 times through the OBXCDR research program (Figure 5). These sightings occurred across years during the months of May through October.

Figure 5: Total Number of Sightings for Residents

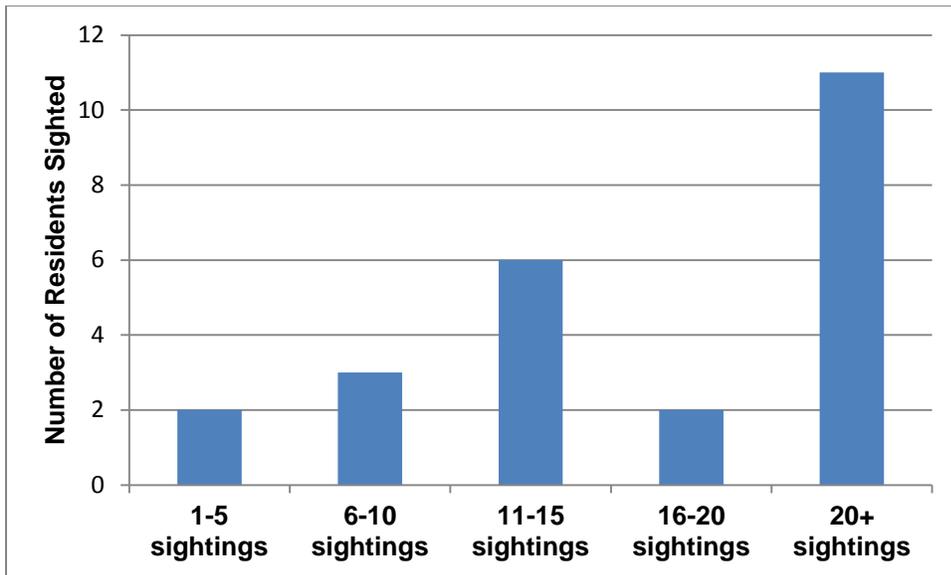
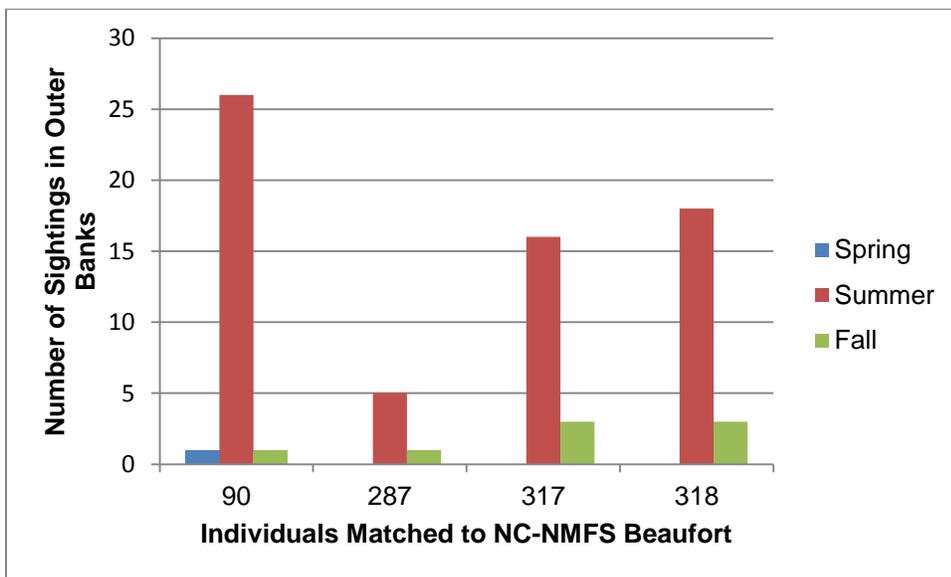
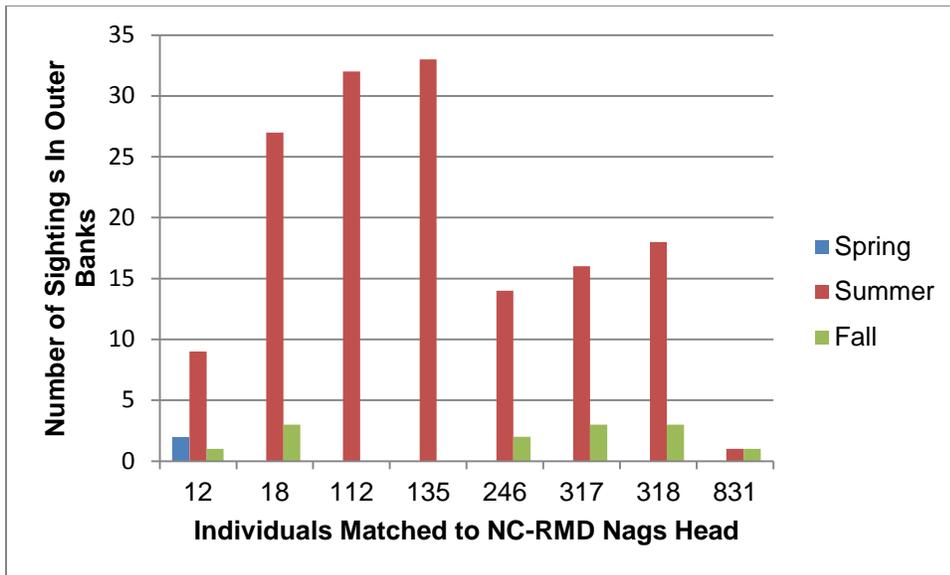


Figure 6: OBXCDR Sightings Patterns of Individuals Matched to NC-NMFS



Individuals matched to the NC-NMFS catalog (N=4) were observed mainly during the summer season in the Outer Banks (Figure 6), although effort was greatest during this season as well (Figure 2). Total number of sightings for each individual ranged from 6 (#287) to 28 (#90) (Figure 6). Only one individual (#90) was observed during the spring season.

Figure 7: OBXCDR Sightings Patterns of Individuals Matched to 1997 Nags Head, NC



Individuals matched to the NC-RMD catalog were mainly observed in the Outer Banks during the summer months (Figure 7), although greatest effort occurred during this time (Figure 2). Effort was slightly greater during the fall (Figure 2), yet only one individual was observed during the spring season. Total number of sightings for each individual ranged from 1 (#831) to 33 (#135).

## Discussion

The objectives of this preliminary study were to examine the ranges of individuals belonging to the NNCES stock sighted in the Outer Banks, NC. The study sites which individuals were matched (8%; N=5) fall within the boundary limits of the NNCES stock. The comparison of the OBX 2012 sample to New Jersey (NJ-JLT) contained no matched individuals, which was expected since the lower Chesapeake Bay is thought to be the upper boundary of this stock (Waring et al. 2013). These results support the documented range of the NNCES stock.

Matches to the NC-RMD catalog indicate the existence of individual long-term site fidelity to the Outer Banks. As 1/3 of these individuals were also sighted in Beaufort, NC and Virginia Beach, VA, it is likely that these movement patterns are stable over time. Individuals matched to NC-NMFS (Figure 6) and NC-RMD (Figure 7) catalogs were mainly observed multiple times in the Outer Banks during the summer months, supporting the importance of Roanoke Sound as summer habitat for members of the NNCES stock. Previously documented sighting patterns of bottlenose dolphins observed in Roanoke Sound (Taylor et al. 2011; Urian 2014) also support the long-term importance of this area, especially during the summer. With continued effort, additional

support for the existence of seasonal site fidelity of dolphins in this area will likely be found.

Future goals will focus on increasing survey effort in the Outer Banks and matching to other catalogs within a 100-mile radius. Effort should be more standardized as well to prevent possible skewing of seasonal results. This study also emphasizes the importance of including updated catalogs within the MABDC. Some of the MABDC catalogs used for comparison had not been updated in several years; many more matches to these catalogs may exist than indicated by this study. Matching to outdated catalogs may result in lower numbers of matches due to fins changing over time and becoming unrecognizable. New or younger dolphins would also not be documented by older catalogs and matching to these individuals would not be possible.

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