

Seasonal Exchange of Bottlenose Dolphins Between Roanoke Sound and Beaufort, North Carolina

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Introduction

Bottlenose dolphins (*Tursiops truncatus*) are commonly found around the world in both offshore and inshore areas of tropical and temperate waters. These areas include the eastern coastline of the United States in the western North Atlantic (NOAA 2015). Many of these dolphins exhibit seasonal migratory patterns while other dolphins may demonstrate different residency patterns. These patterns include long-term and permanent residency, short-term seasonal residency, or are migratory (Toth et al. 2011). Differing patterns of site fidelity among individual dolphins may be in response to foraging, searching for nursery areas, water temperature, and protection from predators (Miller et al. 2013). The migratory patterns of some dolphins make it difficult to develop management decisions regarding the protection and monitoring of this species. A better understanding of the movements and behaviors of bottlenose dolphins in the western North Atlantic is imperative to protect and manage this species.

Groups of dolphins of the same species that occupy the same general area and interbreed are defined as “stocks” (NOAA 2015). The Northern North Carolina Estuarine System Stock (NNCESS) is defined as bottlenose dolphins that occupy the waters within and connecting to the Pamlico Sound and the surrounding estuarine system of North-Eastern North Carolina (Hayes et al. 2017). This stock is estimated to be approximately 823 dolphins (Gorgone et al. 2014), some of which remain in the Pamlico estuarine system during warm months while others use near-shore coastal waters to travel from the Chesapeake Bay to the north and south to Beaufort, North Carolina. During cold-water months, many members of the stock leave the estuaries and travel in coastal waters while others remain in the estuaries and sounds (Hayes et al. 2017).

The NNCESS stock, specifically dolphins in the Roanoke Sound, has been monitored through photo-identification methods by the Nags Head Dolphin Watch and the Outer Banks Center for Dolphin Research (OBXCDR) since 2008 (Taylor et al. 2020). Boat-based surveys are conducted to collect photographic data on the unique markings and shapes of dorsal fins. Other data including GPS coordinates, weather conditions, water salinity and temperature, and notes on dolphin behavior are also recorded to get a better understanding of dolphin movement patterns, ecology, and behavior in the area.

The photos collected in the surveys are contributed to an online database known as the Mid-Atlantic Bottlenose Dolphin Catalog (MABDC). This catalog was created to assess the structure of the bottlenose dolphin stocks along the Atlantic coast (Urian et al. 1999). This catalog includes photographic data from the OBXCDR of the Roanoke Sound contributed by Jessica Taylor and from the North Carolina Maritime Museum (NCMM) in Beaufort, NC by Keith Rittmaster. The goal of this study is to examine seasonal exchange between these two

locations using a subset of frequently seen dolphins in the Roanoke Sound. Similar studies have been done in the past comparing photos between the Roanoke Sound and Beaufort (Mason and Taylor 2016; Taylor et al. 2011). This updated comparison will allow for better management decisions and understanding of the Northern North Carolina Estuarine System Stock.

Methods

Study Area

This study was conducted in the Roanoke Sound on the Outer Banks, North Carolina (*Figure 1*). The Roanoke Sound is part of the Albemarle-Pamlico estuarine system and spans approximately 41 square miles. The study area lies between Roanoke Island and Nags Head, with the southern tip at Oregon Inlet, which opens to the North-Western Atlantic Ocean. The average depth of the Roanoke Sound is approximately 3.5 feet with the exception of the 8-12' man-made channel dredged through the sound for boat navigation. The seagrass beds within the sound create great habitat for soniferous (sound-producing) fish, providing the main source of food for bottlenose dolphins. Its shallow waters are home to many water-based recreational activities including commercial and recreational fishing.



Figure 1. Roanoke Sound Study Area and surrounding water bodies

Data Collection and Processing

Data was collected in the Roanoke Sound study area through both dedicated surveys and opportunistic dolphin watches by OBXCDR. The dedicated surveys were collected under General Authorization Permits LOC-13416 and LOC-17988 and span from 2008-2016 with most

surveys taken between May and October. The dolphin watch data was also collected in this same time span.

Dedicated surveys were conducted on a 16' or 17' outboard vessel throughout the study area, dependent on weather conditions. A transect route was created in 2011 with the MapSource program and uploaded to a GPS unit that was taken on each survey to ensure the study area was thoroughly covered. Once dolphins were sighted on the survey, they were slowly approached to prevent the disturbance of their natural behaviors. Data was then collected including time and date, the estimated group size of the sighting, observed behaviors of the dolphins, GPS coordinates of the beginning and end of the sighting, and environmental conditions. These conditions included cloud coverage, visibility and sightability, air temperature, wind speed and direction, water salinity, and water temperature. Photographic data of the dolphins was also collected in order to identify each individual dorsal fin.

The opportunistic data was collected with the Nags Head Dolphin Watch using two pontoon boats that were 30 and 36 ft. When dolphins were spotted, photographic data was collected for identification as well as the same data recorded on the dedicated surveys. However, the dolphin watches did not follow a predetermined route like the dedicated surveys.

The images and sighting data collected on both types of surveys were processed through a program called FinBase (Adams et al. 2006). After a survey, the photos were sorted and cropped to show the dorsal fins. The cropped images were entered into FinBase to be graded for quality and matched to the OBXCDR catalog. Another individual would verify the photo matches and new fins to minimize error. The images in the updated catalog would then be sent for inclusion in the MABDC.

Matching Methods

For this study, a sample of dolphins was selected from the OBXCDR catalog within the MABDC in order to be matched to the NCMM catalog. This sample was selected by choosing dolphins that were frequently sighted (>10 ; $n=25$) within the catalog, with the exception of one dolphin with 9 sightings (Little Scoop), who was chosen because he is the independent calf of another frequently sighted female dolphin (Double Scoop). For each individual in the sample, the number of sightings in the OBX catalog, an alias if given, number of years and seasons they have been sighted, and the sex, if determined, was recorded. Of the 25 dolphins in the sample, 17 dolphins were previously compared to the NCMM catalog in 2016 (Mason and Taylor 2016), but no matches were found. In this matching study, the current sample was matched to the NCMM catalog which contains 5646 images of dorsal fins sighted in Beaufort, NC. *Table 1* compares the year span and size of the OBXCDR and Beaufort catalogs. Due to the large catalog size, the NCMM was filtered during the matching process using characteristics such as sex and age if known, and dorsal fin features including freezebrands, mutilations, fin shape, and notches on trailing and leading edges of fins. This allowed for more efficient matching using the selected sample.

Table 1: MABDC catalogs used for matching process

Catalog	Year Span	# of Individuals	# of Images	Study Location
OBXCDR	2007 - 2017	894	1105	Roanoke Sound, NC
NCMM	1985 - 2019	3950	5646	Beaufort, NC

Methods of Analysis (update after analysis is done)

The matching results are analyzed by calculating the percentage of the OBXCDR sample that found a match in the NCMM catalog ((# of dolphins matched/25) * 100). The percentage of matched dolphins from this sample can also be compared to the percentage matched by Mason in 2016 to assess how many matches were found since the NCMM catalog was updated.

Results

Table 2 shows the sample and demographics from the OBXCDR catalog in the MABDC that was used to match to the NCMM catalog. Of the 25 dolphins in the sample, four had verified matches in the NCMM catalog (NCMM ID of match provided in far-right column). The four matches had varying numbers of years sighted, indicating that there was no correlation between finding a match and how often the dolphin was sighted in the Roanoke Sound.

Table 2: Results of total sample from OBX catalog matched to NCMM catalog

OBXCDR Catalog ID	Alias	Sex	# Years Sighted	Match (M)/No Match (NM)	NCMM ID
37		Unknown	8	NM	-
52	Lorna	F	8	NM	-
54		Unknown	4	NM	-
63	Lisa Caroline	F	7	NM	-
89	Stitch	M	9	NM	-
104	Easy	Unknown	7	NM	-
130	Double Scoop	F	7	NM	-
135	92	M	8	M	2039a
168		Unknown	6	NM	-
221		Unknown	4	NM	-
225		Unknown	5	NM	-
237	Emma	F	6	NM	-
240	Kerner	Unknown	2	M	0336a
246	Rocky	F	6	NM	-
249		Unknown	6	NM	-
358		Unknown	5	M	5010a
364	FB457	F	8	NM	-
541	Mo	M	6	NM	-
561	Cola	M	6	M	2655a
648	Nick	Unknown	4	NM	-
702	Jack	Unknown	6	NM	-
818		Unknown	3	NM	-

822		Unknown	6	NM	-
965	Wendy	F	4	NM	-
1289	Little Scoop	Unknown	4	NM	-

Figure 2 shows the percentage of the sample (n=25) matched (16%) and unmatched (84%). Figure 3 is a graph of the sex of the four dolphins with a match in the NCMM catalog—two were males and two were unknown. Since there were no verified female dolphins found in both catalogs there is a possibility that gender influenced their travel patterns, however, the small sample size makes it difficult to determine a trend.

Figure 2: Percentage of OBX catalog sample matched to NCMM catalog

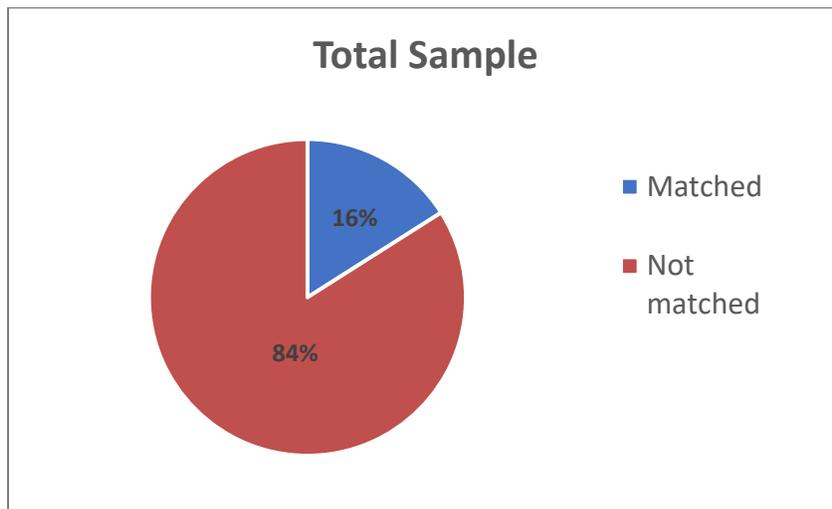
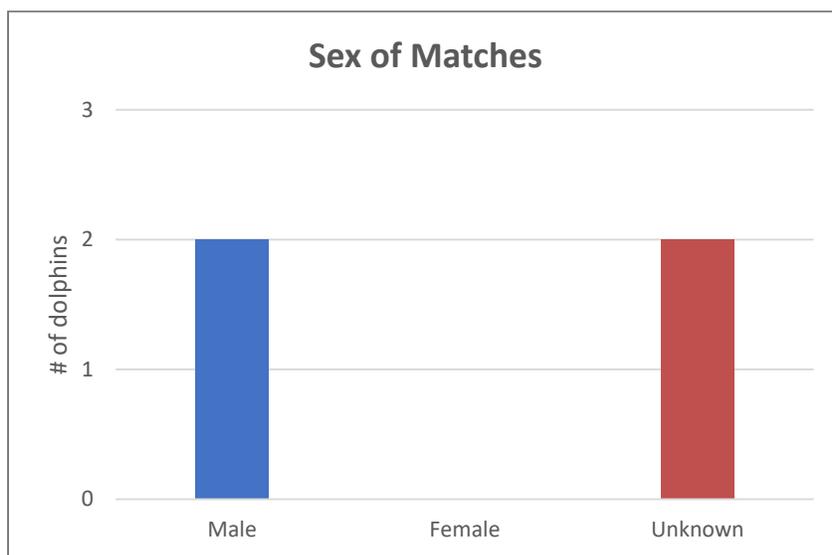


Figure 3: Sex of dolphins matched to NCMM catalog (n=4)



Discussion

The previous study comparing dolphins in the Roanoke Sound to those in Beaufort in 2016 by Elizabeth Mason had a total sample size of 59 dolphins from the OBXCDR catalog, and had 31 matches in the NCMM catalog (52.54% matched). 17 of the 25 dolphins in this year's sample were also included in Mason's sample; none of which were matched to the NCMM catalog in 2016. Of the four dolphins matched in this study, three were of those included in the 2016 sample. These matches were found in this study due to the update of the NCMM catalog in 2020. The percentage of matches found by Mason was significantly higher than the 16% found in this study. This could possibly be explained by less-frequent dedicated surveys occurring in recent years and therefore less photos added to the updated catalog. The lower percentage could also be due to a smaller sample size than Mason's study.

The updated comparisons between the OBXCDR and NCMM catalogs are important to understanding bottlenose dolphin populations and their movement patterns along eastern North Carolina. Increased knowledge of the location of dolphin stocks and timing of movements will help improve management efforts of bottlenose dolphins and will help minimize impacts of events that may impact their populations. Further research could be done by focusing on common paired relationships between dolphins and tracking where and when they travel together to different areas to better understand the stock structure. The study areas could also be expanded to produce a better outline of travel patterns along the east coast. A clearer picture of dolphin stocks will greatly improve their conservation and protection in the future.

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