

Association Patterns of Seasonally Resident Bottlenose Dolphins (*Tursiops truncatus*) at adjacent North Carolina Study Sites

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Abstract

Although bottlenose dolphins live in fission-fusion societies, stable associations have been documented in several populations. One of the most stable association patterns is the male pair bond; this bond has yet to be documented in migratory dolphin populations. In North Carolina, a seasonally resident group of bottlenose dolphins are monitored via photo-identification by two research groups at separate study sites. During the summer, individuals are monitored in the Nags Head area and during the winter, the same individuals are observed in Beaufort waters. Since 1997, stable associations have been documented in both study areas between presumed adult males. We present a preliminary description of these associations at each seasonal study site and a comparison of these association patterns to those demonstrated by known male pairs in other study areas. Photographic records of six dolphins that exhibit pair associations were collected from each study site to quantify association patterns. A half-weight coefficient of association (COA = $2J/(a+b)$) was calculated for each pair at each study site. The COA analysis revealed strong associations for all three pairs year-round (0.57 – 0.95). The strength of pair bond associations between these North Carolina dolphins are comparable to those observed in Sarasota, Florida and Shark Bay, Australia. These preliminary observations lead us to question whether social associations documented over time may be used to determine male gender in the field. As social strategies may influence reproductive behavior and survivorship, further understanding of these associations may provide insight into conservation measures and management.

Introduction

- Bottlenose dolphins live in fission-fusion societies where group membership and composition are highly variable (Connor et al. 2000); however, stable sex-specific associations have been documented in several populations throughout the world (Smolker et al. 1992; Wells et al. 1987).
- The male pair bond is one of the most stable types of sex-specific associations (Wells et al. 1987; Connor et al. 1992). The bond formed between two adult males is long-lasting and serves both ecological and reproductive purposes (Wells 1991; Owen et al. 2002).
- Since 1997, seasonally resident bottlenose dolphins have been monitored at their apparent migratory endpoints (Nags Head in May-October, Beaufort in November-April) via photo-identification. This has offered a unique opportunity to study the behavior of migratory dolphins year-round.
- Long-term associations between the same presumed adult males have been described in both study areas suggesting the first observations of stable male pair bonds in a migratory population.

Objectives

The objectives of this preliminary study were to:

- Quantify the nature of these associations at each seasonal study site
- Compare these associations to those demonstrated by known male pairs in Sarasota, Florida and Shark Bay, Australia

Study Areas

- The Nags Head study site was approximately 120 km² and encompassed estuarine waters in the Roanoke Sound from Oregon Inlet north to Colington Harbor, as well as the northern Pamlico Sound, eastern Croatan Sound, and southern Albemarle Sound (Figure 1).
- The Beaufort study site was approximately 150 km² of nearshore coastal and estuarine waters between Cape Lookout and Core Creek near Beaufort, Carteret County, NC (Figure 1).



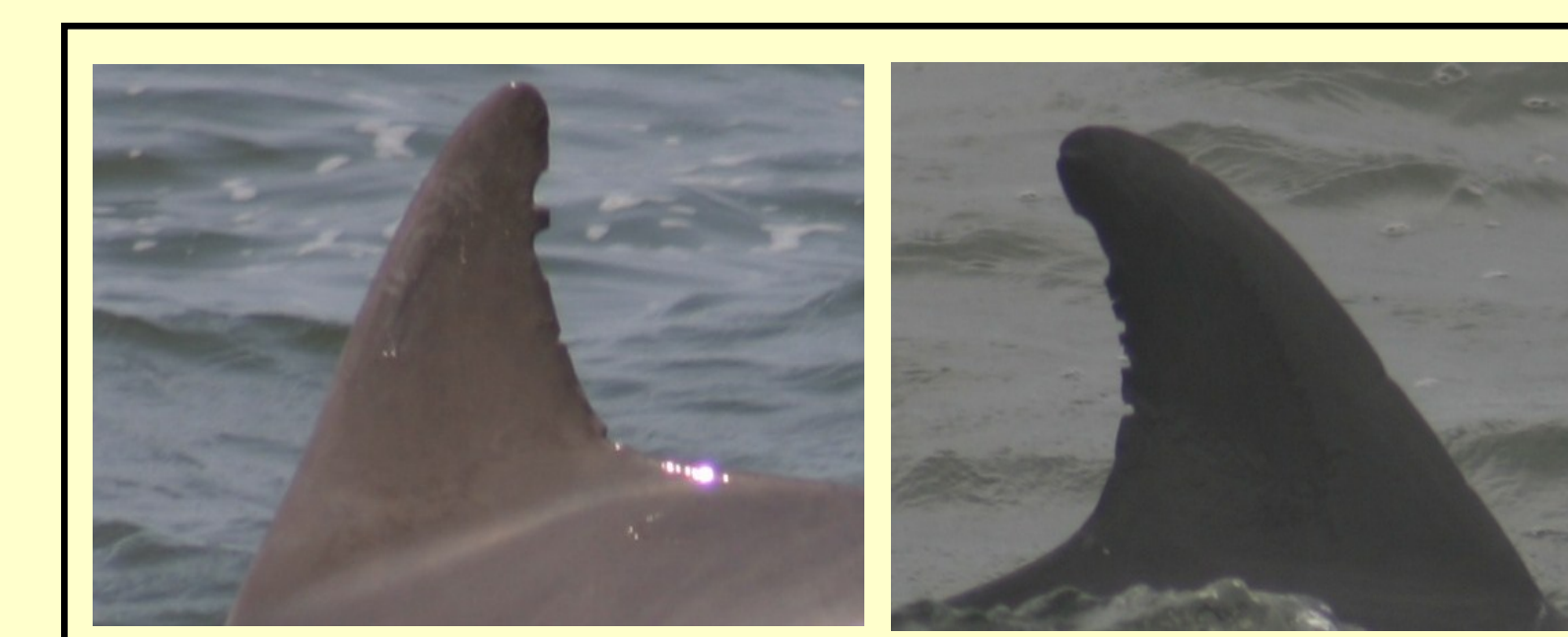
“Onion”
(NCMM #26/ NH #7)

“Butterfly/
Pinchers”
(NCMM #217/ NH #8)



“Bud”
(NCMM #1142/ NH #9)

“Mo”
(NCMM #618/ NH #1)



“Rake”
(NCMM #287/ NH #112)

“92”
(NCMM #2039/ NH #135)

Methods

- Photo-identification data were collected via small boat surveys and opportunistic sightings as part of long-term studies, summers in the Nags Head area during 2007-2008 and year-round in Beaufort from January 1990– December 2009.
- Standard photo-identification techniques were used for photographing dorsal fins at both study sites (Wursig and Wursig 1977).
- We used FinBase (Nags Head) (Adams et al. 2006) and an MS Access database (Beaufort) to examine sighting trends, resight histories, and associations of individual dolphins.
- Photographic records of 3 dolphin pairs that exhibit long-term associations were collected from each study site to quantify association patterns. Each individual selected is a presumed male and observed in both study areas. Sighting records for each individual date back to at least 1998 at each study site; individuals are assumed to be males based upon being known adults and never being seen with a calf.
- Associations were quantified using the half-weight coefficient of association: COA = $2J/(a+b)$ (Schaller 1972). In this formula, J represents the number of sightings with both dolphin A and B in the same group, a is the total numbers of sightings of dolphin A, and b is the total number of sightings of dolphin B. Based on this formula, coefficients may range from 0.0 for a pair that is never seen together to 1.0 for a pair that is always seen together. A COA was calculated for each pair to measure the strength of their associations at each study site.

Results

- These three dolphin pairs were seen together year-round and at both ends of their migratory endpoints (Figures 2-4).

	Beaufort		Nags Head	
Dolphin ID	# times seen	# times seen together	# times seen	# times seen together
"Onion"	120	102	12	11
"Butterfly/ Pinchers"	102		11	
"Bud"	90	82	12	10
"Mo"	94		11	
"Rake"	8	8	15	13
"92"	20		15	

Figure 2: Sighting histories at each North Carolina study site

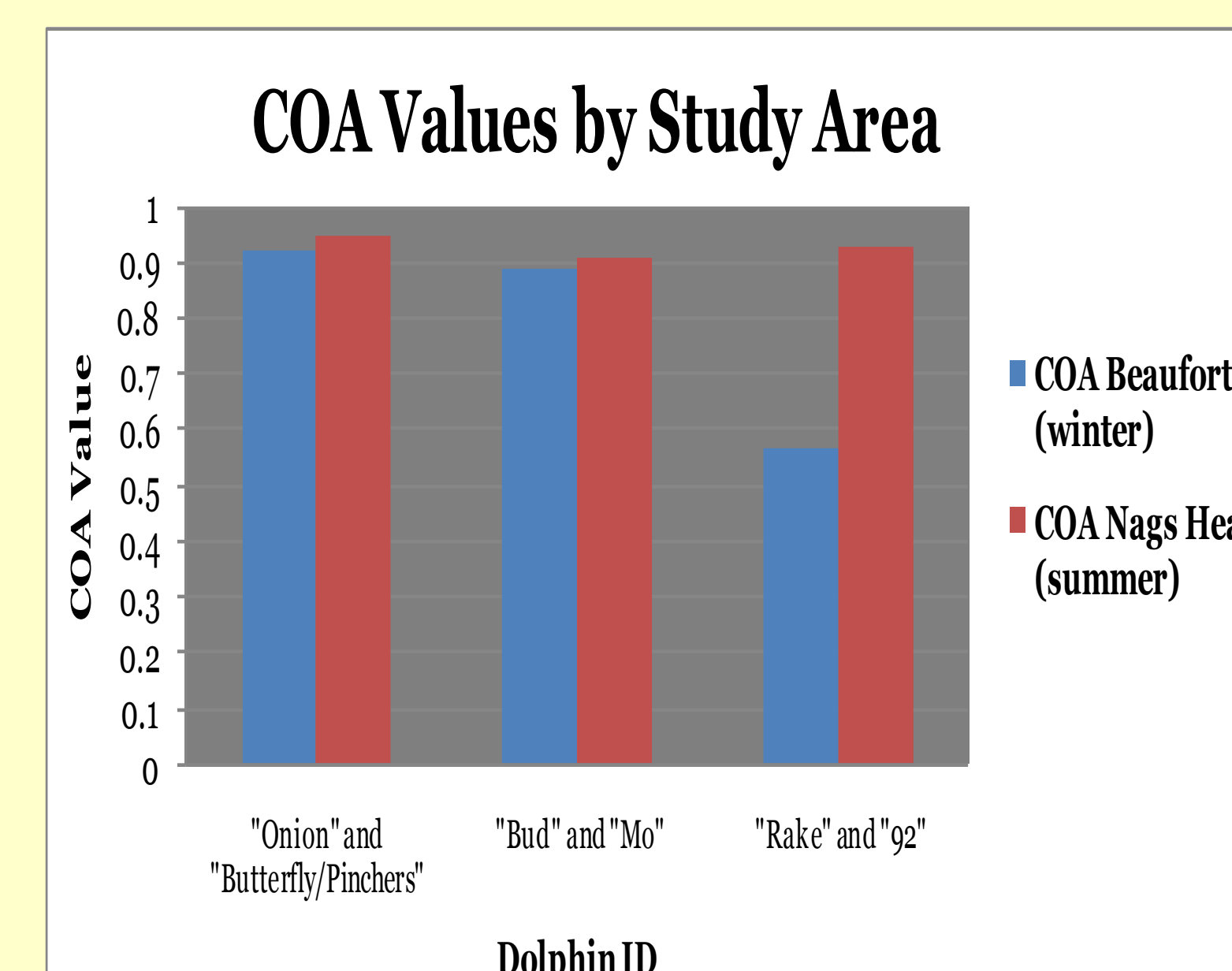


Figure 3: COA values by study area

Study Area	COA Ranges
North Carolina (present study)	0.57 – 0.95
Sarasota, FL (Wells et al. 1987; Wells 2003)	0.80- 0.96
Shark Bay, Western Australia (Connor et al. 1992; Connor et al. 1999)	0.70 – 1.0*

Figure 4: Comparison of male pair COA values.
* Values reflect first-order alliances.

Discussion

- Wells (2003) defined males as paired if their COA remains 0.8 or greater over time. The COA for only one pair in this study (“Rake” and “92” in Beaufort) was lower than 0.8. This pair may be younger in age than the other two pairs (R. Mallon-Day, pers. comm.). If these males were sub-adults during their earlier sightings, their COA may have been affected as the association between two males strengthens upon reaching sexual maturity (Wells et al. 1987; Wells 2003). In addition, a lower number of sightings of this pair may have affected the COA value.
- Two of the three male pairs had been the subjects of a previous association analysis in Beaufort, NC. Bowles and Rittmaster (1998) had found the COAs between “Onion” and “Butterfly/Pinchers” and “Bud” and “Mo” to be 0.89 and 0.77, respectively, indicating that these pairs have remained stable over time.
- This preliminary study suggests the potential to use associations for determining male gender in the field, especially in areas where waters are murky. Currently, male sex determination in the field may occur by direct observation of an erection, the size of the gap between the genital and anal slits, the absence of mammary glands, or a combination of these observations (Connor et al. 1992). Female sex may be determined by indirect means, such as an individual that is sighted consistently with a calf may be determined to be a female. Perhaps behavioral patterns may be used to identify males as well.
- Male pairs in Sarasota, FL exhibit greater ranges than unpaired males (Owen et al. 2002) and are likely vectors of genetic exchange with adjacent communities (Wells 1991; Wells 2003). The presence of male pair bonds in this seasonally resident community may imply genetic exchange is occurring with other adjacent communities.
- Future studies will focus on more detailed observations of male pair associations using focal follows, increasing our sighting dataset size, and constructing dendrograms to further analyze association patterns.

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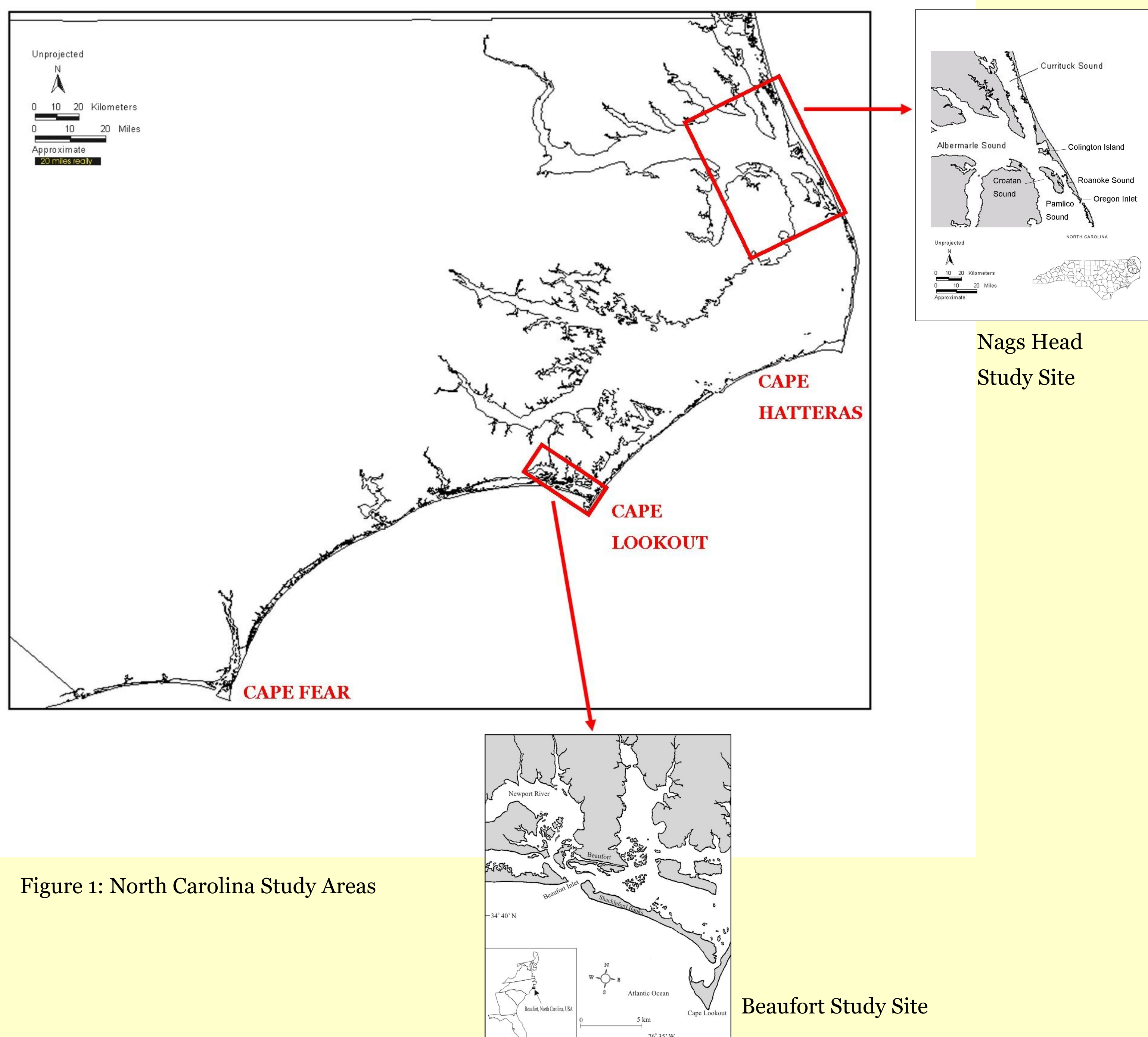


Figure 1: North Carolina Study Areas