

RESIDENCE PATTERNS OF BOTTLENOSE  
DOLPHINS (*TURSIOPS TRUNCATUS*) IN THE  
STONO RIVER ESTUARY, CHARLESTON  
COUNTY, SOUTH CAROLINA, U.S.A.

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ABSTRACT

Residence patterns of inshore bottlenose dolphins (*Tursiops truncatus*) in the Stono River estuary, Charleston County, South Carolina were investigated as part of a larger effort to better understand stock structure of these dolphins along the east coast of the United States. Eighty-seven small-boat surveys for bottlenose dolphins were conducted from October 1994 through January 1996. Dolphins were sighted during all surveys. Approximately 304 h were spent surveying the study area; 64% ( $n = 196$  h) of this time was spent observing and videotaping dolphins. A catalog, containing 112 individually identified dolphins was compiled. Thirty-two percent ( $n = 36$ ) of identified dolphins were sighted once, while 28% ( $n = 31$ ) were sighted five or more times. Nineteen percent ( $n = 21$ ) of identified dolphins were determined to be year-round residents; eight percent ( $n = 9$ ) seasonal residents. The majority (64%,  $n = 72$ ) of identified dolphins were sighted in the study area during a single season or in two consecutive seasons and were classified as transients. This study documents the northernmost known site of a resident bottlenose dolphin community on the east coast of the United States, suggesting a complex bottlenose dolphin stock structure.

Key words: bottlenose dolphin, *Tursiops truncatus*, stock structure, residence, migration, transients, photo-identification, video-identification.

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Bottlenose dolphins are a cosmopolitan species, widely distributed in inshore and coastal waters, as well as past the edge of the continental shelf to the pelagic ocean (Wells *et al.* 1980, Kenney 1990). In the inshore waters of the southeastern United States, bottlenose dolphins are the most commonly encountered cetacean species (Caldwell and Golley 1965).

Dolphins in this region exhibit varying degrees of residence to particular locales, ranging from small localized inshore populations, apparently resident to specific embayments, to larger numbers of apparently migratory coastal dolphins which appear to move latitudinally on a seasonal basis (Wang *et al.* 1994). This seasonal migration was first noted by True (1891) off the coast of Cape Hatteras, North Carolina. Migratory dolphins (hereafter referred to as the coastal migratory stock or CMS) are discontinuously distributed along the east coast: during summer months the CMS ranges from the Florida Keys to approximately Long Island, New York; during winter the CMS range apparently contracts, as dolphins are rarely sighted north of Cape Hatteras, North Carolina (Scott *et al.* 1988).

It was primarily the CMS that was affected by an epizootic during 1987–1988 (Scott *et al.* 1988, Mead and Potter 1995). In fact, it was the spatial and temporal pattern observed in strandings of impacted dolphins that led Scott *et al.* (1988) to first propose their hypothesis of a single CMS. Currently, there is little empirical evidence to support or refute Scott *et al.*'s (1988) hypothesis (Hohn 1997).

The 1987–1988 mass mortality was most likely due to morbilliviral-induced immunosuppression, which left affected dolphins susceptible to an array of opportunistic infections (Lipscomb *et al.* 1994). The stock may have suffered a greater than 50% reduction in size, with more than 750 dolphins stranding between New Jersey and Florida during this event (Scott *et al.* 1988). As a result, the CMS was designated as depleted under the Marine Mammal Protection Act (MMPA) by the National Marine Fisheries Service (NMFS) (58 FR 17789, 6 April 1993). As a consequence of this listing, the MMPA required that a conservation plan be put in place for the CMS.

The current lack of understanding regarding the population structure of east coast bottlenose dolphins makes the planning and/or implementation of such a conservation plan difficult, if not impossible. Obtaining data relevant to the stock structure question is complicated by the inferred presence of multiple, potentially overlapping stocks of coastal bottlenose dolphins (Scott *et al.* 1988, Hohn 1997). These different stocks are distinguishable by residence patterns. A long-standing tenet of bottlenose dolphin research is the species' ecological plasticity, readily evident in the different ranging patterns of various dolphin populations (*e.g.*, Wells 1991).

Baseline data on the size and movements of dolphin stocks have been, or are being, collected at a number of sites along the United States east coast (see Urian and Wells 1996 for a review). Currently though, the degree of overlap and demarcation between putative resident stocks and the CMS is unknown. Other studies have identified year-round resident dolphin communities in the Indian/Banana river complex in Florida (Odell and Asper 1990) and near Hilton Head, South Carolina (Petricig 1995); whereas no year-round resident dolphins were identified near Virginia Beach, Virginia (Barco *et al.* 1999).

The objectives of this study were to use photo-identification techniques to determine residence patterns of bottlenose dolphins in the Stono River estuary (SRE), Charleston County, South Carolina, and to investigate the influence that the variation in selected physical variables had on residence patterns and dolphin density.

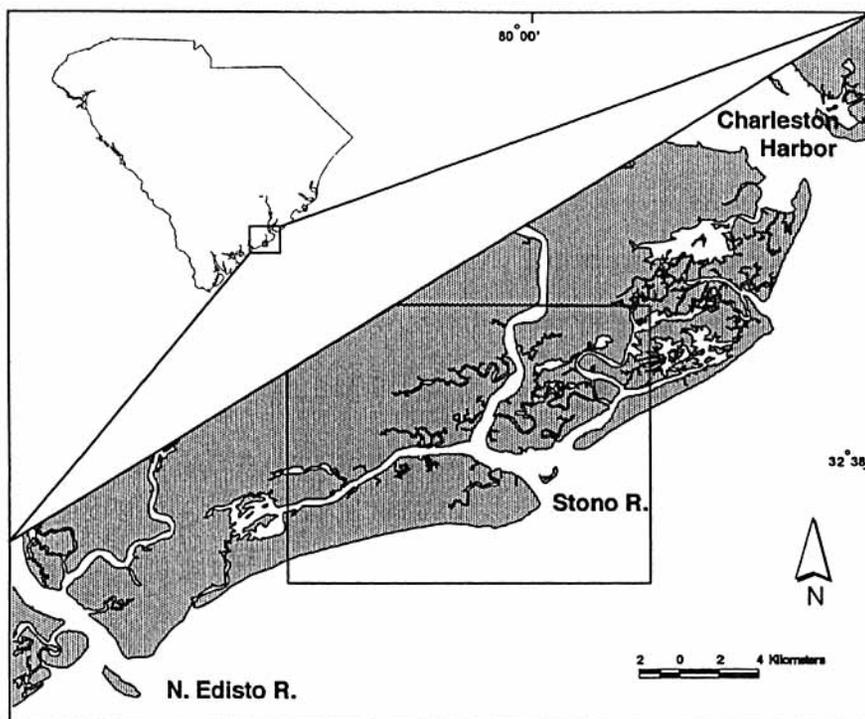


Figure 1. Western coast of Charleston County, South Carolina, including Stono River estuary study area ( $32^{\circ}38'N$ ,  $80^{\circ}01'W$ ) and North Edisto River and Charleston Harbor. Approximate boundaries of study area are indicated on the map by small inset. Study area was arbitrarily delimited based on easily recognizable landmarks and amount of area that could be surveyed in a day's time.

#### METHODS

The Stono River estuary ( $32^{\circ}38'N$ ,  $80^{\circ}01'W$ ) was selected as the study site because of its size, accessibility and regular presence of bottlenose dolphins. The study area covered approximately  $21 \text{ km}^2$  and consisted of the main channels of the Stono, Folly, and Kiawah rivers, as well as many smaller tributaries and a small section of open ocean (Fig. 1). The estuary was a well-mixed, coastal plain salt marsh estuary, characterized by little freshwater input (Day *et al.* 1989). Depth of the study area ranged from 0 to 25 m, with a mean of 4 m. Sea-surface temperatures (SST), recorded during the study period, using a hand-held thermometer, ranged from  $8^{\circ}$  to  $31^{\circ}\text{C}$  with a mean of  $20.4^{\circ}\text{C}$ .

Surveys were conducted year-round, from October 1994 through January 1996. A pilot study was conducted from July through September 1994, prior to the formal study. A 5-m Boston Whaler, equipped with a 55-hp outboard motor, was used to survey the study area. During surveys the boat crew consisted of at least two individuals: a driver/recorder and an observer/videographer; different drivers were used over the course of the study, but the observer/videographer remained constant. The boat was piloted at 8–16 km/h near the center of the river or creek until a dolphin group was sighted. An attempt was made to sample the

entire study area during each survey; a survey was considered complete if approximately 75% of the study area was sampled. On occasion, the 75% limit was not reached; such surveys were considered incomplete. Dolphin images collected during incomplete surveys were used in analyses of residence patterns. Abundance data collected during incomplete surveys were excluded from subsequent analyses.

Upon sighting a group of dolphins, the time, group location, approximate number of dolphins, presence and number of calves and/or neonates, presence of individually identifiable dolphins, behavior and physical variables (weather conditions, Beaufort sea state, tidal stage, and air and water temperature) were recorded. Locations were determined using a Magellan GPS 2000. Subsequent changes in physical variables and biological information were recorded as they occurred. The boat was maneuvered towards the group of dolphins and an attempt was made to reliably videotape both sides of each dolphin's dorsal fin and any other distinguishing features.

Dorsal fins were videotaped using a Canon L2 Hi8-mm camcorder, equipped with an  $f/1.4-2.1$ , 43.2–648-mm,  $15\times$  autofocus zoom lens and a  $2\times$  digital magnification feature and Canon Hi8-ME-120 videotapes. Video footage was reviewed in the lab, using a Sony EV-C100 Hi8-mm video cassette recorder. Images of identifiable dorsal fins were digitized using a Micron 586 computer and a Targa 64+ framegrabber board. Digitized images were viewed and manipulated using Jandel Scientific's Mocha Image Analysis Software for Windows, version 1.2.10. Images were then saved on a hard drive and color hard copies were printed using a Hewlett-Packard DeskJet 1200C color laser printer. A video-ID catalog was assembled using these printed hard copies. The video-ID catalog was divided into nine subsections based on the type, location, and/or number of identifying marks. Dolphins encountered, videotaped, and subsequently identified during the pilot study and during incomplete surveys were included in the video-ID catalog.

Residence patterns were examined based on the seasonal presence or absence of individually identifiable dolphins. A survey year was divided into four seasons: fall (October–December), winter (January–March), spring (April–June), and summer (July–September). Dolphins identified in the study area during all four seasons (regardless of year) were defined as residents. Dolphins identified in the study area during the same season in consecutive years but not during intervening seasons were defined as seasonal residents. Dolphins identified in the study area during only one season or in two consecutive seasons were defined as transients.

The seasonal variation in SST and daily photoperiod were recorded to investigate possible correlations with dolphin density and to the movement of seasonal resident and transient dolphins. Density was estimated as the number of dolphins sighted per kilometer surveyed. SST was recorded opportunistically during surveys and a mean SST per survey was calculated. Daily photoperiod for Charleston, South Carolina, was obtained from the National Weather Service.

## RESULTS

During the study (October 1994–January 1996), 74 complete and seven incomplete surveys, totaling approximately 304 h, were conducted. No surveys

were conducted during December 1995. In addition, four surveys were conducted during the pilot study (July–September 1994). Approximately 64% ( $n = 196$  h) of survey time was spent in direct observation of dolphin groups. The number of surveys completed per season ranged from eight (winter 1996, represented by only one month) to 18. Survey effort (measured in survey hours per month) was statistically constant across all seasons: fall 28.1%, winter 25.7%, spring 23.0%, and summer 23.2%.

A total of 898 groups, comprising 1,578 dolphins, was sighted during the study. Over 5,700 fin images were collected from approximately 21 h of videotape. Roughly 11% ( $n = 652$ ) of fin images were of sufficient quality for use in identifying individual dolphins. One hundred and twelve dolphins were identified through video-ID. These 112 dolphins were videotaped a total of 427 times and were sighted between one and 16 times. Thirty-two percent ( $n = 36$ ) of identified dolphins were sighted once. Forty-one percent ( $n = 31$ ) of the remaining dolphins ( $n = 76$ ) were sighted five or more times.

Nearly half (43.8%,  $n = 49$ ) of new dolphin identifications were made during fall of 1994 and 1995; the number of new identifications per season decreased throughout the rest of the study (Fig. 2). The number of new identifications did not vary significantly by season (single factor ANOVA:  $F = 0.575$ ,  $n = 6$ ,  $P > 0.5$ ) or by month (Kruskal-Wallis rank test:  $H = 19.1$ ,  $n = 15$ ,  $P > 0.1$ ). The number of new identifications per month was not significantly correlated with monthly survey effort (Pearson product-moment correlation:  $r_p = -0.066$ ,  $n = 15$ ,  $P > 0.5$ ).

Resident dolphins accounted for 19% ( $n = 21$ ) of all identified dolphins. Nearly one-third (29%,  $n = 6$ ) of residents were presumed to be females, based on repeated close associations with neonates or calves. Beginning in October 1994, initial sightings of residents rose sharply for four months. By January 1995, 90% ( $n = 19$ ) of the 21 residents had been sighted in the study area. Figure 2 shows the discovery curve of identifiable residents, which became asymptotic by March 1995. Resightings of resident dolphins ranged from 4 to 16 times with a mean of 10 resights per dolphin. There was considerable variability in the amount of time between resights of individual residents (Table 1). The variation in time between resights of resident dolphins ranged from 0 to 6 mo with a mean of 1 mo.

Dolphins classified as seasonal residents accounted for 8% ( $n = 9$ ) of identified dolphins and were sighted predominantly during fall/winter or spring/summer of consecutive years. Beginning in October 1994, initial sightings of seasonal residents rose sharply for four months. By January 1995, all seasonal residents had been sighted. The discovery curve of identifiable seasonal residents resembled the discovery curve of resident dolphins, but became asymptotic earlier (January 1995) (Fig. 2). The variation in time between resights of seasonal resident dolphins ranged from 0 to 11 mo with a mean of 4 mo.

Dolphins classified as transients accounted for 64% ( $n = 72$ ) of identified dolphins. Initial sightings of transient dolphins increased steadily throughout the study period. The slope of the discovery curve of identifiable transients remained fairly constant over the course of the study and did not appear to approach an asymptote (Fig. 2). Forty-two dolphins were represented by a sighting during (or sightings confined to) a single season. Fall witnessed the majority of these dolphins (40%,  $n = 17$ ), followed by winter (24%,  $n = 10$ ), spring (19%,  $n = 8$ ), and summer (17%,  $n = 7$ ).

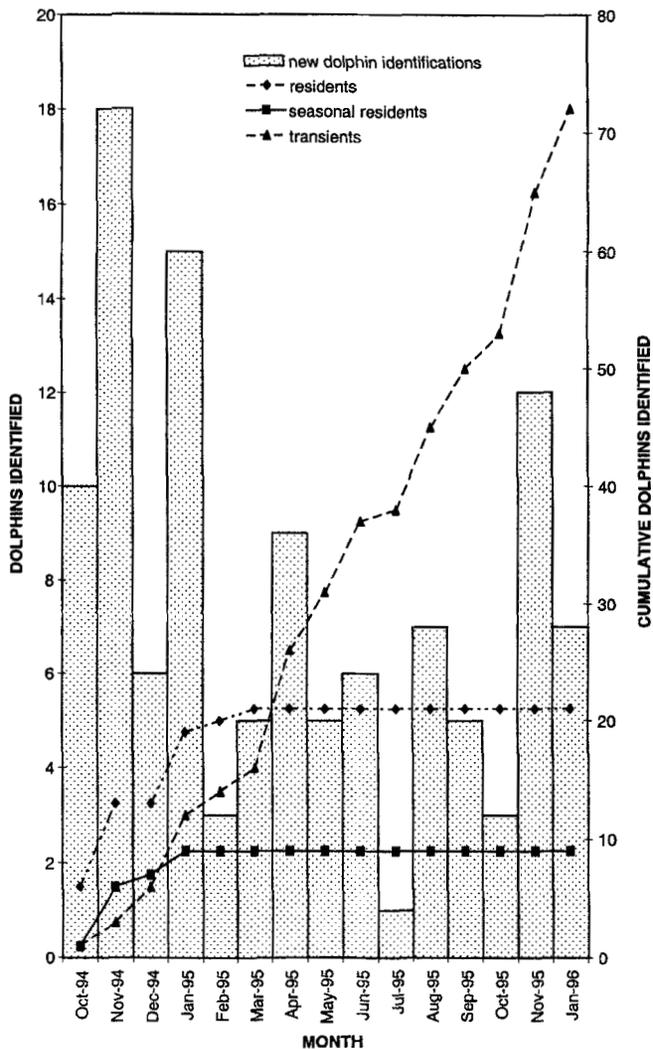


Figure 2. Number of dolphins identified per month and cumulative number of identifiable resident, seasonal resident, and transient dolphins per month (October 1994 through January 1996; no surveys were conducted during December 1995).

The residence patterns of some identifiable dolphins (9%,  $n = 10$ ) could not be classified based on predefined criteria. The residence patterns of a majority of these dolphins (80%,  $n = 8$ ) most closely resembled residents, but could not be classified as such due to a lack of sightings during a single season. An example will serve to illustrate this pattern: dolphin 7008 was initially sighted during fall 1994 and was subsequently sighted during winter 1994 and summer, fall, and winter of 1995. 7008's sighting pattern is similar to that of resident dolphins except for a lack of sightings during spring 1995. The remaining two unclassifiable dolphins were both sighted twice, once each during the winter and summer of 1995.

Table 1. Total number of resights of identified resident dolphins during the study period. A number in a cell represents the number of resights of the dolphin that month. Blank cells indicate that the dolphin was not resighted during that month (no surveys were conducted during December 1995).

	1994			1995										1996	
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Jan
FLOP					1		1			1				2	
TIP				1	1		1			1	1		1		
COMA				1		2			3		3			2	1
BLUE	1		1				1	1	2			2	2	1	3
BACK		2			1		1		1		1		1	1	
CRES		1		1			1	1	1		1			1	
PAL	2						1	1	1		4	2	2		2
HINO		1	1			1	1		1			3	1		
TOPO1				1		1			1		1			1	
TOPO2						1	1		4		1		1		
SVEN				1					1	1				1	
LAG		1	1	2	1		4	1		1		2	1		2
FLAG	2	1	2					2	1			2	1	3	1
NOLO		2		1			1		2	1	1		1	1	
HALF					2				1		1			1	2
SLOT		1	1	1			5	1		1		3	1		1
STAR		1		1					1		1				
5003	1		1			2	2		2	1	1	2		2	
8008				2					1		2		1		1
10000	1	1				1	1		2		2	1			1
11034				1	1	1	2	1	1		1		1	1	4

Density values were log-transformed to meet assumptions of normality. Dolphin density (measured as number of dolphins sighted/km surveyed) varied significantly between seasons over the course of the study (ANOVA  $F = 4.97$ ,  $df = 3$ ,  $P < 0.005$ ) (Fig. 3). Density was significantly greater during the fall than during winter or spring ( $P < 0.01$ ,  $P < 0.05$ , respectively). Dolphin density during the fall was also greater than density during the summer, but the difference was not statistically significant ( $P > 0.5$ ).

A multiple linear regression was conducted to investigate the relationship between dolphin density (measured as dolphins sighted/km surveyed) and monthly mean temperature and photoperiod. The overall regression model was significant ( $F_{2,12} = 9.083$ ,  $n = 15$ ,  $P < 0.005$ ), with coefficients for temperature ( $P < 0.01$ ) and photoperiod ( $P < 0.005$ ) both highly significant.

#### DISCUSSION

Resight data defined a small community of year-round resident dolphins in the Stono River estuary. Bottlenose dolphins were reported previously as being present year round (Caldwell *et al.* 1971), but year round residence in South Carolina waters by specific individual dolphins had not been established. The study area (32°38'N, 80°01'W) currently represents the northernmost identified site of a resident bottlenose dolphin community on the United States east coast.

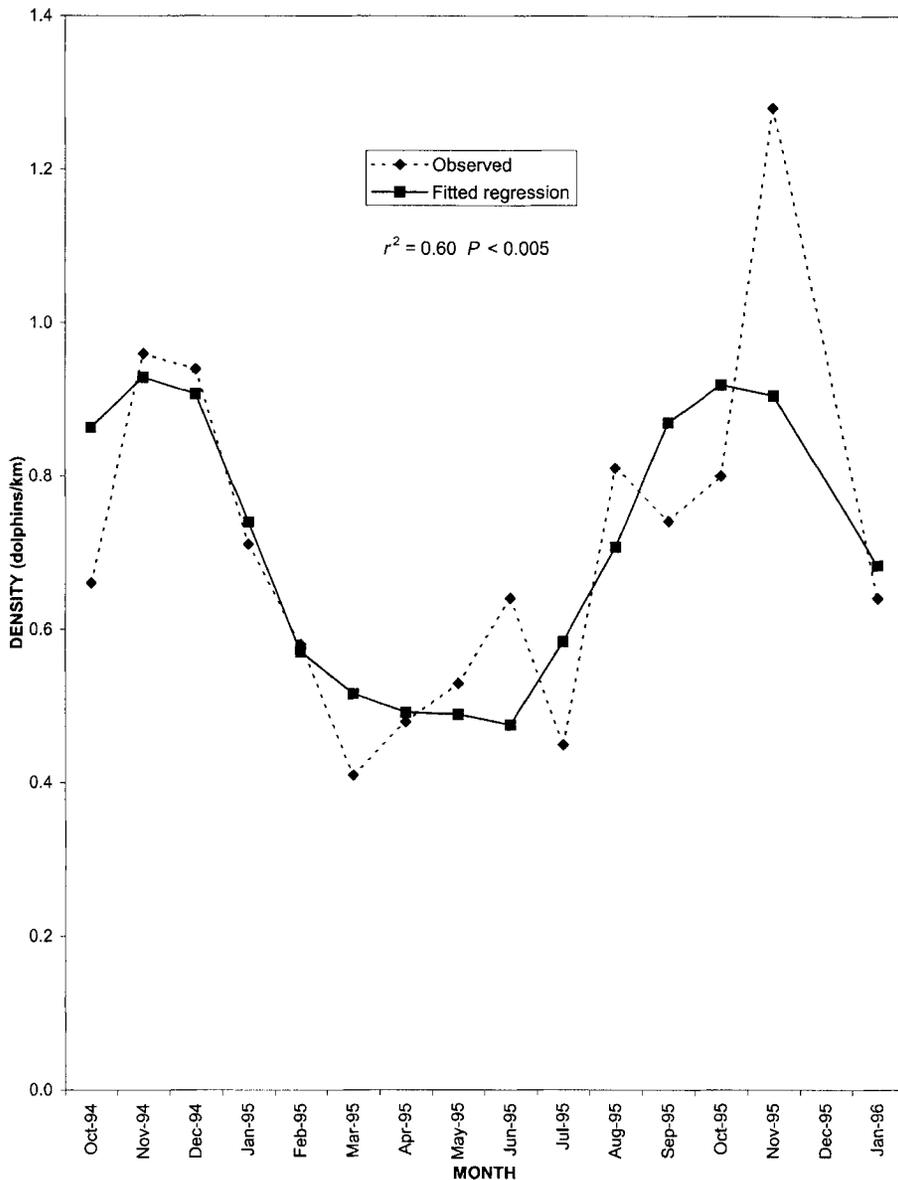


Figure 3. Observed monthly variation in mean dolphin density (dolphins/km) and fitted regression (estimated density =  $2.49 + 0.035 \cdot \text{temperature} - 0.210 \cdot \text{photoperiod}$ ).

Previous work has shown that coastal bottlenose dolphins can reside year-round at high latitudes: In the northern hemisphere, the Moray Firth, Scotland (*ca.* 57°N), is home to approximately 73 resident dolphins (Wilson 1995). Between October 1990 and November 1993, at least 13 bottlenose dolphins were continually present in Monterey Bay, California (*ca.* 36°N) (Feinholz 1996). In the southern hemisphere, at Golfo San José, Argentina (*ca.* 42°S), at least five

dolphins were resident for 21 mo between August 1974 and March 1976 (Würsig and Würsig 1977). Williams *et al.* (1993) studied a small population of approximately 62 resident dolphins in Doubtful Sound, New Zealand (*ca.* 45°S), between the summers of 1990 and 1992.

Large individual home ranges, extending beyond the limits of the study area, may explain the apparent variation in time between resights of resident dolphins. Caldwell (1955) and Essapian (1962) presented evidence for such large dolphin home ranges along Florida's west coast and along the coast of Georgia and South Carolina, respectively. It is unlikely that an individual's home range would coincide with the arbitrarily selected boundaries of the study area (Davis 1953). Gruber (1981) invoked the idea of large home ranges to account for the sporadic resight records of certain dolphins near Pass Cavallo, Matagorda Bay, Texas. Other researchers have documented dolphins covering large distances (30–45 km) in relatively short time spans (12–24 h) (Cockcroft *et al.* 1990, Mate *et al.* 1995). The likelihood that the study area completely overlapped an individual dolphin's home range is small. It is more probable that individual dolphins spent varying amounts of time within the study area and it was this fact that accounted for the variability in time between resights of resident dolphins.

Anecdotal evidence supports the assumption that the SRe was part of a larger range for at least some dolphins. On 14 February 1994, during preliminary field work, "Mutt," a seasonally resident dolphin, was identified alone near the mouth of the North Edisto River (Fig. 1). On 10 November 1994, and again on 22 November 1995, Mutt was videotaped within the study area. After the study, on 5 August 1996, Mutt was observed traveling northeast in southern Charleston Harbor in a group of approximately 12 dolphins (Fig. 1). Mutt's sighting record covered a linear distance of 35 km and stretched beyond the limits of the study area to the southwest and northeast.

"Flop," a resident dolphin, was first identified on 22 July 1994, during the pilot study, in the lower Stono River. Later that day, Flop was observed traveling east in southwestern Charleston Harbor (Fig. 1).<sup>2</sup> Flop was next sighted in northwestern Charleston Harbor on 27 January 1995 (Fig. 1). Flop was subsequently recorded five times in the Stono estuary during the remainder of the study period. In February 1996, after the study concluded, Flop was again sighted in southwestern Charleston Harbor (Fig. 1). Flop's sighting record covered a linear distance of 20 km and stretched beyond the limits of the study area to the northeast. Since the conclusion of the study, a number of dolphins, both residents and non-residents, have been observed and video-identified in both Charleston Harbor and the North Edisto River, in addition to the SRe.

Alternatively, the observed variation in time between resights of resident dolphins could have been due to methodological factors. Resident dolphins could have been present year-round in the study area and not been encountered during a survey, not videotaped, videotaped inadequately (precluding identification), or videotaped well, but subsequently not recognized during video analyses. One (or more) of these considerations could account for some or all of the temporal variation in resights of resident dolphins. These same factors could also have played a role in misidentifying resident dolphins as seasonal residents or transients.

<sup>2</sup> Personal communication (memo) from Wayne McFee, NOAA/NOS, 219 Ft. Johnson, Charleston, South Carolina 29412, U.S.A., 23 July 1994.

Large individual home ranges could also account for the inability to define the residence patterns of 10 of the 112 identified dolphins. The majority of the 10 dolphins could not be classified as residents due to a lack of sightings during a single season. These dolphins may have been residents with a large home range that only partially overlapped the SRe, which resulted in them spending relatively little time in the study area. Ballance (1992) estimated ranges of 25–65 km and recorded a mean of 30 d between resights of identified dolphins in the northern Gulf of California.

Potential ecological and methodological considerations aside, video-ID and dolphin density data indicated that the resident dolphin community in the SRe was supplemented by an influx of “new” dolphins beginning in early fall. Dolphin density was greater during fall than during all other seasons, while new dolphin identifications peaked during fall in both 1994 and 1995 (Fig. 2). Twelve new dolphins were identified during November 1995, the third highest monthly total observed notwithstanding that it was the fourteenth month of the study. Coastal bottlenose dolphins leave the coastal waters of Virginia in mid-October and are generally absent by mid-November (Swingle 1994, Barco *et al.* 1999). Davis (1988) found that dolphins were least likely to be observed by fishermen during winter months near Cape Lookout, North Carolina.

A majority of these “new” dolphins were identified only once or twice within the study area and were therefore classified as transients. The sighting records of these transient dolphins indicated that they spent little time in the SRe but, rather, appeared to “pass” through the study area. Some “new” dolphins however were resighted during the same season(s) in consecutive years and were classified as seasonal residents. These seasonal residents were usually observed in the study area during fall/winter or spring/summer, but not during the intervening seasons. It is assumed that putative seasonal residents migrated elsewhere during those times they were not sighted in the SRe. Caldwell and Caldwell (1972) hypothesized that coastal bottlenose dolphins may utilize two or more seasonal home ranges, connected to one another by “traveling ranges.”

However, the sighting records of both transients and seasonal residents may have been misleading due to ecological and/or methodological considerations. A dolphin classified as a transient or seasonal resident might have been a resident that simply utilized the SRe less than other residents. Alternatively, the study area could have been located at the edge of a resident dolphin’s home range. Either pattern of utilization would decrease the probability of that dolphin being sighted and identified and lead to an erroneous conclusion regarding that individual’s residence status. Near Sarasota, Florida, the home ranges of male dolphins were much larger than those of females and dependent calves; consequently, males range more widely and are thus less available to be identified in any one part of their home range (Wells 1991). Similar sex-specific ranging patterns could likewise affect sightability of resident dolphins, particularly males, in the SRe. Interestingly, of the 21 identified resident dolphins, nearly one-third were preliminarily identified as females based on repeated associations with neonates or calves.

There did appear to be an actual difference in resighting intervals between resident and seasonal resident dolphins however. The range in the time between resights of resident dolphins was substantially smaller than that of seasonal resident dolphins (0–6 mo opposed to 0–11 mo, respectively). Even more telling, there was a statistically significant difference ( $t$ -test  $P < 0.005$ ) between the

mean amount of time between resights of resident ( $\bar{X} = 1$  mo) and seasonal resident ( $\bar{X} = 4$  mo) dolphins.

If the CMS ranges from northern Florida to New Jersey, as hypothesized by Scott *et al.* (1988), then it is possible that seasonal resident and transient dolphins in the SRe represent a portion of this stock. Monthly dolphin densities in the SRe were lowest from mid-February to mid-March. Between mid-April and mid-May, dolphins began to reappear off Virginia Beach, Virginia (Swingle 1994, Barco *et al.* 1999). Near Cape Lookout, North Carolina, dolphins were most likely to be observed during summer months (Davis 1988). Conceivably, the northern reappearance of the CMS is due to a northward movement of dolphins, including seasonal resident and transient dolphins from the SRe. Coastal bottlenose dolphins elsewhere have been documented making similar long distance movements (Würsig and Würsig 1977, Würsig 1978, Shane 1980, Gruber 1981, Wells *et al.* 1990).

The "cue" for the seasonal migration of dolphins to and from the SRe is unknown. Previous work has shown that migrations by bottlenose dolphins are more pronounced where temperature and prey abundance fluctuate seasonally (Bräger *et al.* 1994). In the present study, it is presumed that the timing of seasonal movements by dolphins was influenced, either directly or indirectly (*e.g.*, prey movements), by fluctuations in one or more physical variables. Changes in water temperature have been suggested as possible migratory cues for the CMS (Mead and Potter 1990). Similarly, water temperature was negatively correlated with dolphin abundance near Cape Henry, Virginia, (Barco *et al.* 1999). A similar finding resulted from the current study, where a significant relationship was found between dolphin density and mean monthly SST and photoperiod. This finding indicated a possible cause/effect relationship between environmental variables and the seasonal migration of the CMS.

The results of this study have shown the SRe to be the northernmost site of a known resident community of bottlenose dolphin along the east coast of the United States. The estuary also appears to function as a "wintering ground" or "way-station" for seasonal resident and transient dolphins. The relationship between resident, seasonal resident, and transient dolphins requires further study. The depleted listing for the CMS made no mention of resident populations of bottlenose dolphins. This omission was based on the mortality pattern observed during the 1987–1988 mass mortality and on the lack of observed impact(s) on the resident dolphin stock in the Indian and Banana river complex on Florida's east coast (Wang *et al.* 1994). It is possible that more northerly resident stocks were affected by the epizootic but impacts were not assessable due to a lack of baseline data. Based on this study's findings, there is a need for further research into the role that this estuary plays in the lives of resident, seasonal resident, and transient dolphins. Dolphin critical habitat needs to be identified, evaluated, and protected in order to maximize the recovery rate of the migratory stock and to prevent possible localized depletions or extirpations of resident populations.

The current study provides baseline data in case of future epizootics and will enable researchers to investigate interactions between dolphins with different residence patterns. Continued work in the SRe, when combined with genetic studies, will serve to clarify the stock discreteness of coastal bottlenose dolphins. Such knowledge, when combined with information from similar studies elsewhere along the Atlantic coast, will impact future management decisions regarding the stock(s). If each coastal stock is a discrete entity or interbreeds at very

low levels, then each will necessarily have to be managed separately. Conversely, if the migratory stock(s) serves as a "genetic vector," maintaining homogeneity between coastal bottlenose dolphins, then the population could be managed as a single unit. Collaborative efforts between east coast research efforts, coordinated through the mid-Atlantic bottlenose dolphin catalog (see Urian *et al.* 1999 for a review), will serve to delineate stocks, clarify movements between study sites, and identify migratory routes and endpoints.

Continued research in the SRE, and expansion into adjacent areas to the north-east and southwest, will also provide a foundation for future studies. Knowing the residence status of individual dolphins will enhance information collected during remote-biopsy, telemetry, and live-capture/release studies and will aid in the interpretation of biological and ecological information gained from them. Furthermore, characterization of the study area and the dolphins that utilize it will provide a context in which to monitor future environmental change (both natural as well as anthropogenic) and dolphin responses to such change.

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