

Analysing 25 years of bottlenose dolphin (*Tursiops truncatus*) strandings along the Atlantic coast of the USA: do historic records support the coastal migratory stock hypothesis?

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ABSTRACT

Between June 1987 and March 1988, bottlenose dolphins (*Tursiops truncatus* Montagu 1821) along the US Atlantic coast experienced an epizootic. Monthly interquartile ranges of strandings during the epizootic were used to propose the Coastal Migratory Stock (CMS) of bottlenose dolphins (Scott *et al.*, 1988). To date, the hypothesised CMS remains poorly understood. The goal of this study was to use a 25-year database to compare stranding patterns during the epizootic to those before (1972-1986) and after (1989-1997) the event. These comparisons reveal that monthly interquartile ranges during the epizootic are dissimilar to those before and after the event. The frequency distribution of total monthly strandings during the epizootic is also significantly different from those observed outside the event. Seasonal stranding patterns from 1989-1997 suggest more complex movements of dolphins along the US Atlantic coast than those of a single group ranging seasonally from Florida to New Jersey. In winter, for example, when the current model for the CMS predicts dolphin distributions concentrated in central Florida, the highest number of strandings occurred in North Carolina. Thus, these comparative analyses suggest that the pattern observed during the epizootic was anomalous, and not representative of stranding distributions for any other time period of the study. During the 15 years before the epizootic, and the nine years following, there was no clear picture of 'migration' of mortality along the coast. This study demonstrates how long-term, systematic collection of strandings data can be useful in testing hypotheses regarding the complex stock structure of coastal bottlenose dolphins. This knowledge will greatly enhance the ability to conserve and manage these animals as they recover from historic (i.e. directed takes and epizootic) and current sources of mortality.

KEYWORDS: STRANDINGS; BOTTLENOSE DOLPHIN; EPIZOOTIC; STOCK STRUCTURE; DISTRIBUTION; NORTH AMERICA; ATLANTIC OCEAN

INTRODUCTION

Strandings have historically provided one of the most readily available means to study the biology of marine mammals (e.g. Fraser, 1974; Reynolds and Odell, 1991; Malakoff, 2001). Strandings of bottlenose dolphins, *Tursiops truncatus* Montagu (1821), along the US Atlantic coast have been investigated from the late 1800s (True, 1889; 1891) to the late 1900s (Mead and Potter, 1990).

To date strandings data have been used only once in an effort to address bottlenose dolphin stock structure. The spatial and temporal distribution of strandings was described during a 10-month period from June 1987 to March 1988 (Scott *et al.*, 1988), when Atlantic coastal bottlenose dolphins experienced an epizootic (Geraci, 1989) that was later determined to be caused by morbillivirus (Duignan *et al.*, 1996; Schulman *et al.*, 1997). The mortality event, which was marked by elevated stranding rates, began in waters off Virginia, moved north to New Jersey in the summer, and then southward to central Florida in the winter (Fig. 1). Scott *et al.* (1988) used this pattern of elevated strandings, and the known distribution patterns of coastal dolphins north of Cape Hatteras, North Carolina (CeTAP, 1982), to hypothesise 'a single coastal-migratory stock of bottlenose dolphins that ranges seasonally as far north as Long Island, New York and as far south as central Florida'.

During the investigation of the 1987-1988 epizootic, 742 bottlenose dolphin strandings were reported — a ten-fold increase in strandings relative to the three previous years (Scott *et al.*, 1988). Scott *et al.* (1988) used this elevated

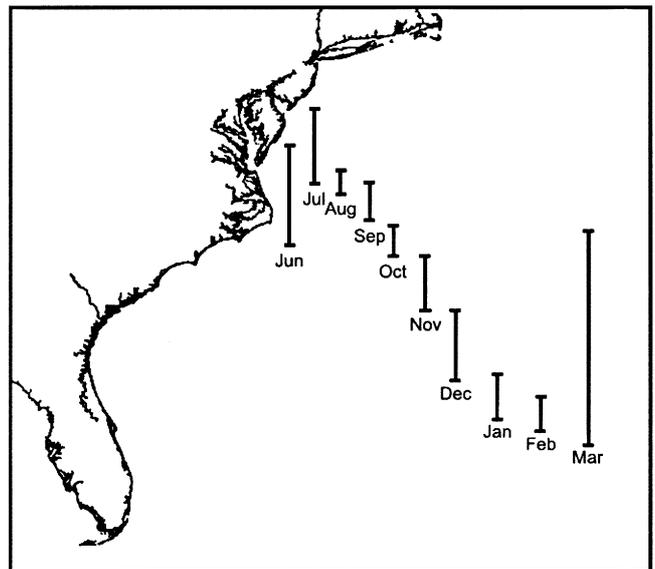


Fig. 1. Monthly interquartile latitudinal ranges of bottlenose dolphin strandings along the US Atlantic coast, June 1987 – March 1988 (from Scott *et al.*, 1988). The interquartiles show a movement of mortality north during the summer of 1987 and south during the autumn and winter.

stranding rate and assumptions regarding the birth and mortality rates of bottlenose dolphins (Hersh *et al.*, 1990), to conclude that the coastal migratory stock (CMS) had been

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reduced by over 50%. This finding led the National Marine Fisheries Service (NMFS) to determine that the CMS had fallen below its optimal sustainable population. Thus, it designated the CMS as depleted under provisions of the US Marine Mammal Protection Act (MMPA), and thereby required that a Conservation Plan be implemented to restore the stock to its pre-epizootic numbers (58 FR 177789, 6 April 1993).

Despite the definition proposed for the CMS, its structure, size and distribution remain poorly understood (Hohn, 1997; Barco *et al.*, 1999). A clear definition of bottlenose dolphin stocks along the east coast of the USA is vital, in that the Federal Government manages marine mammals on a stock by stock basis (e.g. Wade and Angliss, 1997). It is likely that the complex of coastal bottlenose dolphins, which inhabits estuarine and coastal waters from New Jersey to Florida, includes permanent residents as well as seasonal migrants (Hohn, 1997). Further, the relationship between the CMS and the recognised inshore form of bottlenose dolphins, i.e. the 'resident coastal population' (58 CFR 17789, 6 April 1993; reviewed by Hohn, 1997), has yet to be resolved. Cooperative, multi-agency, photo-identification efforts (Urian and Wells, 1996), and regional studies (Barco *et al.*, 1999) have demonstrated that individual dolphins exhibit considerable variation in patterns of movement and residency along the coast. Thus, a variety of alternate hypotheses describing the stock structure of coastal bottlenose dolphins are currently being considered (Fig. 2).

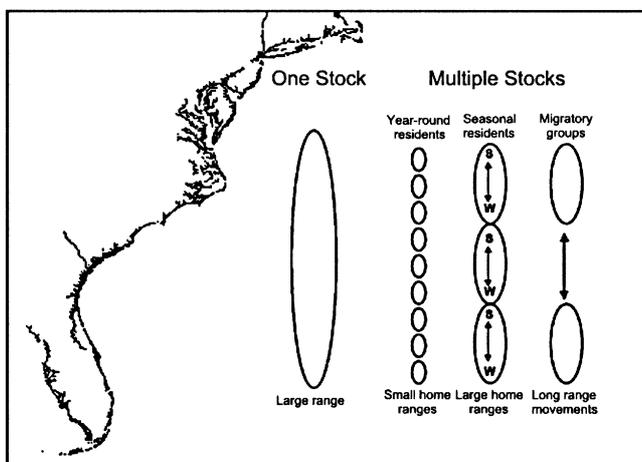


Fig. 2. Illustration of potential stock structures for bottlenose dolphins along the US Atlantic coast (redrawn from Hohn, 1997). Hypotheses include both single stock and multiple stock models (S = summer, W = winter).

The CMS was defined in the absence of any prior knowledge of its size, structure or distribution. Rather, it was defined by the spatial and temporal pattern of strandings which was assumed to represent the seasonal movements of a single group of dolphins along the Atlantic coast. Excluding the epizootic event, the spatial and temporal distribution of bottlenose dolphin strandings along the US Atlantic coast has not yet been described.

The goal of this study was to use a 25-year database (1972-1997) to compare the patterns of strandings observed during the 1987-1988 epizootic to those observed before and after this event to determine whether historical stranding records support the hypothesised CMS.

MATERIALS AND METHODS

Data for this study were taken from the Smithsonian Institution's Cetacean Stranding Database, which contained 4,521 coastal Atlantic bottlenose dolphin records from 1869-1998 (Table 1). These records included sightings, directed commercial takes from shore-based operations in North Carolina and stranding records from Florida to Maine. Stranding records from 1972, the year the national stranding network was established under the Marine Mammal Protection Act, to 1997 were analysed. Only 'strandings' (which eliminated 'sightings' and 'captures' from the original dataset) from the Atlantic coast of Florida (25°N) to New York (41°N), an area that represents the recognised geographic range of coastal Atlantic bottlenose dolphins (Wang *et al.*, 1994), were included in the analysis.

The subset of data used in this study was compared with both published and unpublished stranding records. After duplicate records were removed, the dataset was compared with compiled stranding records from Virginia (1991-1996; Swingle and Barco, 1997), Maryland (1992-1997; Susan Knowles, pers. comm.), South Carolina (1992-1997; Wayne McFee, pers. comm.) and the Southeastern United States Region (1993; Daniel Odell, pers. comm.). The resulting dataset consisted of all Atlantic bottlenose dolphin stranding records from 1972-1997 that contained the date, geographic position, sex and total length (termed 'Level A Data', as defined by Hoffman, 1991) of the stranded specimen.

Strandings were divided into three temporal blocks for analyses: (1) 1972-1986, a period of relatively low stranding response effort before the epizootic; (2) June 1987 – March 1988, the months of the epizootic when stranding response effort was extremely high; and (3) 1989-1997, a period after the epizootic when stranding effort remained high along the Atlantic coast. Although effort varied considerably among temporal blocks, effort within each temporal block was considered to be consistent.

Scott *et al.* (1988) used interquartiles to visualise the pattern of bottlenose dolphin strandings during the 1987-1988 epizootic. To permit direct comparison with Scott *et al.* (1988), latitudinal interquartiles for the months of June-March for each of the three temporal blocks defined above were generated (JMPIN 3.2.1, SAS Institute, Inc., NC). The interquartile plots for these three time blocks were compared to determine if the pattern observed during the epizootic (Scott *et al.*, 1988) was similar to that observed before and after the event.

An interquartile graphically represents only 50% of the data, including 25% of the observations above (in this case, north) and below (south) the median latitude for strandings. Whereas interquartiles represent normally distributed data well, they may misrepresent more complex distributions. To date, the distribution of bottlenose dolphin strandings along the Atlantic coast is not known for any time period. Therefore, total strandings, by month and by degree latitude, during the 1987-1988 epizootic were plotted. To compare these patterns with those before and after the epizootic, monthly strandings for 1972-1986 and for 1989-1997 were plotted and the frequency distributions compared using a chi-square analysis. All strandings from 1972-1997, and from 1989-1997 (the longest temporal block with consistently high effort), were also plotted by degree latitude to describe the overall pattern of strandings along the US Atlantic coast. A chi-square frequency distribution analysis was used to test whether the latitudinal distribution of strandings from the epizootic was similar to those during the other time periods. To examine the stranding data for

seasonal distribution patterns, the 1989-1997 data were plotted by degree latitude for each season (winter = December, January, February; spring = March, April, May; summer = June, July, August; autumn = September, October, November).

To test whether stranding distributions were simply a function of the amount of coastline per degree latitude, a linear regression analysis was performed to investigate the correlation between amount of coastline per degree latitude and number of strandings within that area. This analysis was performed on the stranding data from 1989-1997. To determine the amount of coastline in each degree of latitude, each degree was selected separately from a shape file of the US Atlantic coast using ArcView GIS 3.1 (ESRI Inc. California, USA), and the cumulative length of all polylines within that area was calculated.

RESULTS

The edited dataset for the years 1972-1997 contained a total of 3,763 Atlantic bottlenose dolphin stranding records, 3,358 of which were within the geographical range of the study and contained complete date, geographic position and total body length data (Table 1).

Table 1

Edits to original Smithsonian Institution's Cetacean Stranding Database used in this study.

Total unedited bottlenose dolphin records	4521
Total stranding records, 1972-1997	3783
Total edited records	3358
1972-1986	786
1987-1988	706
June 1987-March 1988 (epizootic)	667
Total strandings investigated	645
Total strandings with biological data	575
1989-1997	1819

From June 1987 to March 1988, the Smithsonian Institution recorded 667 stranded bottlenose dolphins along the US Atlantic coast, 75 less than the 742 dolphin strandings reported in Scott *et al.* (1988). Included among the 667 records were 22 reports of dolphin strandings with no accompanying data of any kind (no date, location, or biological data), which consisted of accounts from the public that were not investigated by a stranding response team. Thus, those 22 records were removed from the dataset leaving a total of 645. Of the 645 records, only the 575 that contained date, geographic position and total length data and were used in the interquartile analysis.

The monthly interquartiles for the 1987-1988 epizootic generated from this dataset (Fig. 3) are qualitatively similar (see Fig. 1) to those of Scott *et al.* (1988). In contrast, interquartiles for 1972-1986 and 1989-1997 are dissimilar to those of the epizootic event (Fig. 3). Except for the month of March, interquartile ranges before and after the epizootic encompass a larger geographic range than during the 1987-1988 event. The interquartile ranges for July and August during the epizootic do not overlap those before or after the event. During the epizootic, interquartiles were shifted north from June to September and south from December to February. Additionally, despite differing levels of stranding response, the 1972-1986 and 1989-1997 patterns are more similar to each other than either is to the

pattern observed during the epizootic. To ensure that patterns observed for these time blocks were representative of any given year, individual years were arbitrarily chosen and their interquartiles mapped (data not shown). None of these years showed interquartile patterns similar to those observed during the epizootic.

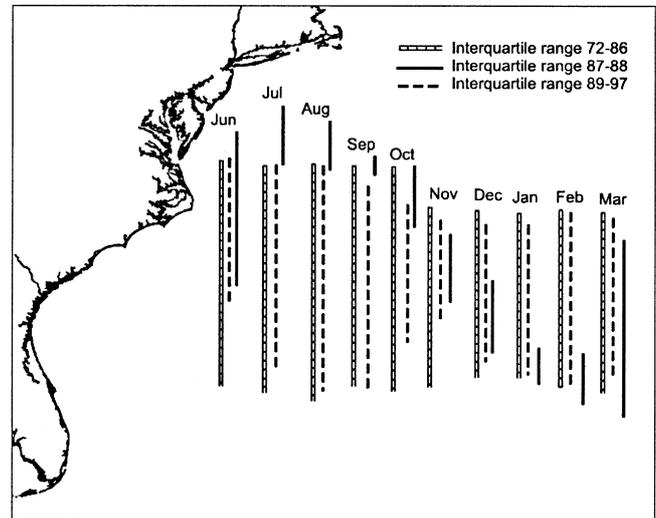


Fig. 3. Monthly latitudinal interquartile ranges (June through March) for bottlenose dolphin strandings from 1972-1986, 1987-1988 and 1989-1997.

Strandings during the epizootic event were distributed bi-modally, both by month and by degree latitude (Fig. 4). Strandings increased from June to August, tapered off through November, then increased again through January off the north-central Florida coast. Peak strandings occurred during August and at 36°N (Virginia Beach, Virginia); minimum numbers of strandings occurred in November and at 33°N (Cape Romain, South Carolina).

The frequency distribution of total monthly strandings observed during the epizootic was significantly different than the pattern observed during 1972-1986 ($p < 0.0001$) and during 1989-1997 ($p < 0.0001$) (Fig. 5). Monthly stranding patterns from 1972-1986 and 1989-1997 do not display the bi-modal distribution observed during the epizootic.

A latitudinal histogram of all strandings from 1972-1997 ($n = 3,358$) displayed a complex multimodal distribution with peaks from 34°N-36°N (Outer Banks of North Carolina to Virginia Beach, Virginia) and at 28°N (Cape Canaveral, Florida) (Fig. 6). Minimum numbers of strandings occurred at the northern and southern limits of the range and at the central latitudes of 33°N (near Cape Romain, South Carolina) and 31°N (near Brunswick, Georgia).

From 1989-1997, strandings ($n = 1,855$) plotted by degree latitude exhibited similar patterns to those for the entire dataset with peaks from 34°N-36°N and at 28°N (Fig. 7). Minimum numbers of strandings occurred at the northern and southern limits, and at 33°N and 31°N. A frequency distribution analysis of the latitudinal pattern of strandings from 1989-1997 was significantly different ($p < 0.0001$) than the pattern observed during the epizootic event (see Fig. 4C).

Seasonal patterns of strandings from 1989-1997 are complex (Fig. 8). In winter, few strandings occur north of 35°N (Cape Hatteras, North Carolina), a position with the largest number of strandings in that season. Irrespective of season, stranding numbers are always highest between

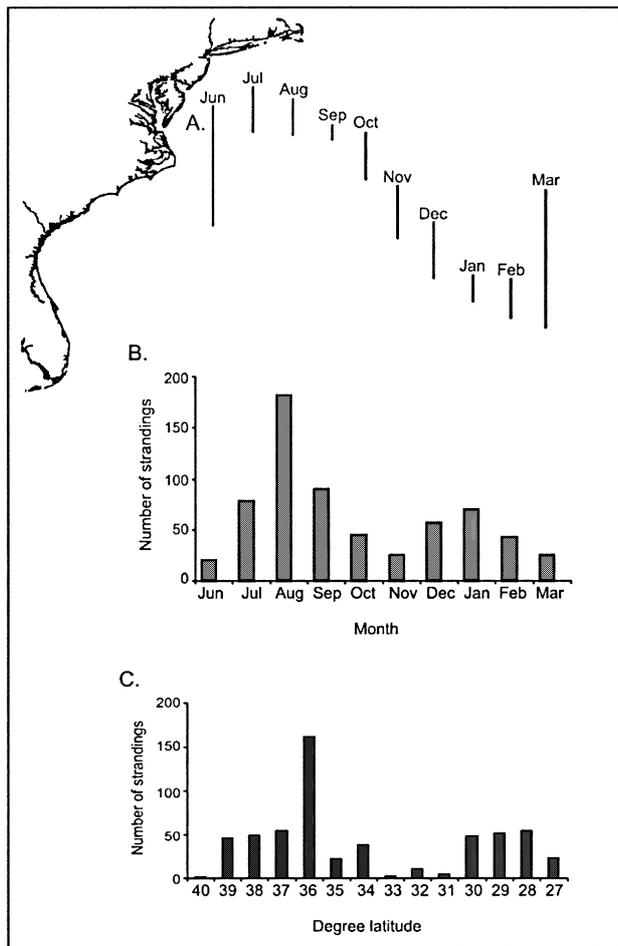


Fig. 4. Bottlenose dolphin stranding patterns during the 1987-1988 epizootic. (A) Monthly latitudinal interquartile ranges of bottlenose dolphin strandings from this study. (B) Histogram of monthly bottlenose dolphin strandings from June 1987-March 1988. (C) Latitudinal histogram of strandings from June 1987 - March 1988.

34°N-36°N, and at 28°N. Between these latitudes, minimum numbers of strandings occur at 31°N or 33°N (winter, spring and summer), and at 29°N in autumn.

A linear regression was performed to test whether the observed latitudinal frequency distributions of strandings were correlated with the amount of coastline in each degree of latitude. There was no significant correlation ($R^2 = 0.08$, $p = 0.25$) found between number of strandings and amount of coastline per degree of latitude.

DISCUSSION

The pattern of bottlenose dolphin strandings observed during the 1987-1988 epizootic, as represented by latitudinal interquartile ranges, was used to define the Coastal Migratory Stock (Scott *et al.*, 1988). These interquartiles, which represented a total of 742 strandings, showed a movement of mortality along the northern mid-Atlantic coast in July 1987. Mortality was concentrated off the coast of Virginia in August 1987 and continued southward in a stepwise fashion until concentrating again in north-central Florida in February 1988. When viewed in the context of the epizootic alone, these interquartiles show clear evidence of 'migrating' mortality northward in the summer and southward in the winter (Scott *et al.*, 1988) (Fig. 1 and Fig. 4A). The pattern of interquartiles generated in this study for

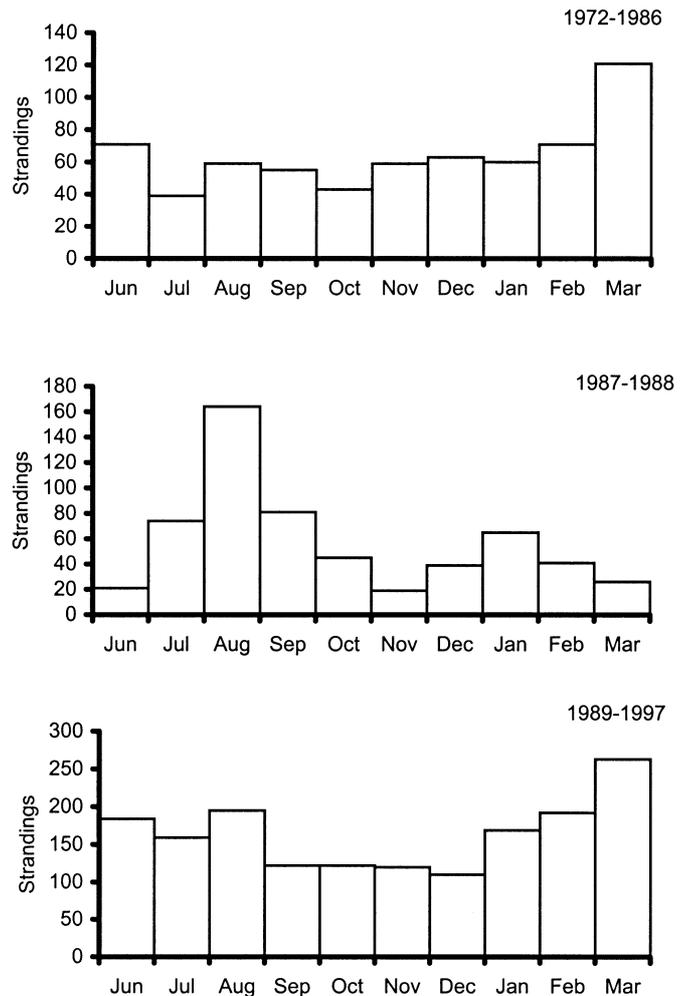


Fig. 5. Monthly histograms of bottlenose dolphin strandings before, during and after the epizootic (note that the y-axis scales differ for each time period).

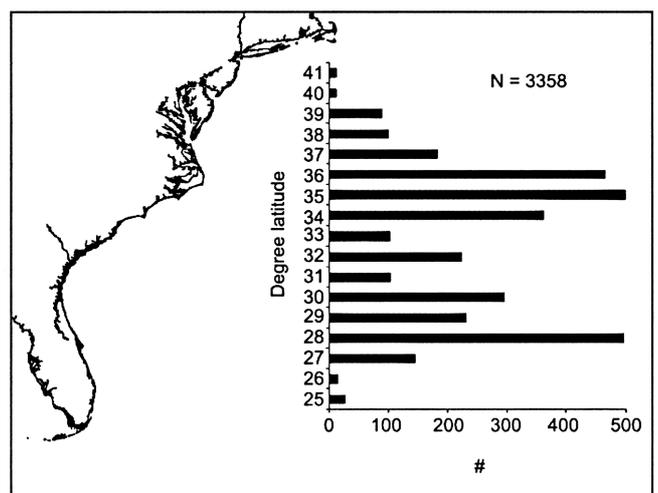


Fig. 6. Histogram of bottlenose dolphin strandings along the US Atlantic coast by degree of latitude, 1972-1997. The histogram is aligned relative to the coast line.

the epizootic, although based upon only 575 dolphin strandings, showed a similar seasonal movement of mortality along the coast.

Interestingly, this interquartile pattern is not observed for bottlenose dolphin strandings before or after the epizootic event. During the previous 15-year and subsequent nine-year

periods, there is no clear picture of 'migration' of mortality along the coast. The northern limits of the interquartiles do move south during the winter months, although they never advance farther than the central Outer Banks of North Carolina. The southern limits of the pre- and post-epizootic interquartiles are almost always farther south than those observed in 1987-1988. Similarly, no single year investigated showed interquartile patterns similar to those observed during the epizootic. Thus, the comparative interquartile analysis suggests that the pattern observed during the 1987-1988 epizootic was anomalous, and not representative of stranding distributions along the coast for any other time period.

However, interquartiles only illustrate 50% of the complete stranding dataset (25% above and below the median). In addition, as the median so heavily weights the

latitudinal placement of the interquartile, a concentration of mortality, as witnessed during the epizootic (Fig. 4), influences both its range and placement along the coast. Interquartiles also offer no information about the distribution pattern (e.g. uni- vs multi-modal) or the magnitude of strandings. These patterns can only be investigated by graphically representing the total stranding database.

During the 1987-1988 epizootic, both monthly and latitudinal distributions of strandings were bi-modal. Strandings peaked in August 1987, near Virginia Beach, Virginia, and again in January 1988, off central Florida. It is noteworthy that the centre of the November interquartile (and therefore the latitudinal median of all strandings during that month) is at 33°N, a latitudinal minimum for all bottlenose dolphin strandings in this study (Fig. 6). This distribution pattern of mortality is significantly different from those observed before and after the epizootic event. A minimum number of strandings occurred in November 1987, at Cape Romain, South Carolina (Fig. 4B and C). The monthly (Fig. 5) and latitudinal distributions of total strandings (1972-1997) and of strandings from 1989-1997 were more complex, with peaks occurring at the Outer Banks of North Carolina to Virginia Beach, Virginia, and at Cape Canaveral, Florida (Figs 6 and 7). Between these latitudes, minimum strandings occurred at 33°N, followed closely by 31°N. These distribution patterns are significantly different from the pattern observed during the epizootic event. Neither the interquartile pattern nor the monthly and latitudinal distribution patterns of strandings during the 1987-1988 epizootic are similar to those observed during the 15 years prior to and the nine years after the event; the migration of mortality illustrated by the 1987-1988 interquartiles does not typify mortality patterns for any other period of time investigated in this study.

From 1989-1997, seasonal stranding patterns (Fig. 8) also do not show a distribution that is consistent with the CMS

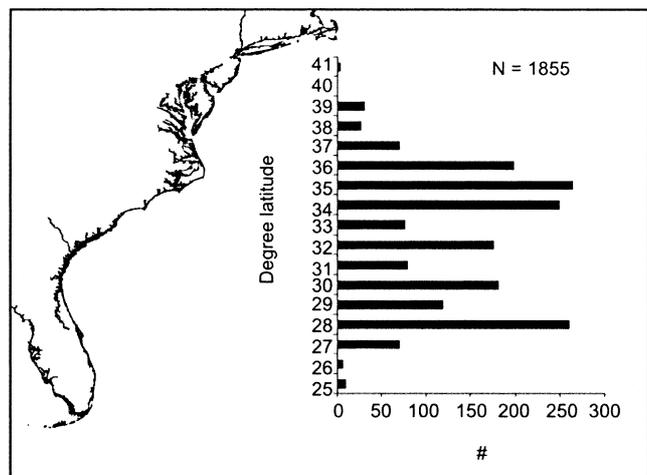


Fig. 7. Histogram of bottlenose dolphin strandings along the US Atlantic coast by degree of latitude, 1989-1997.

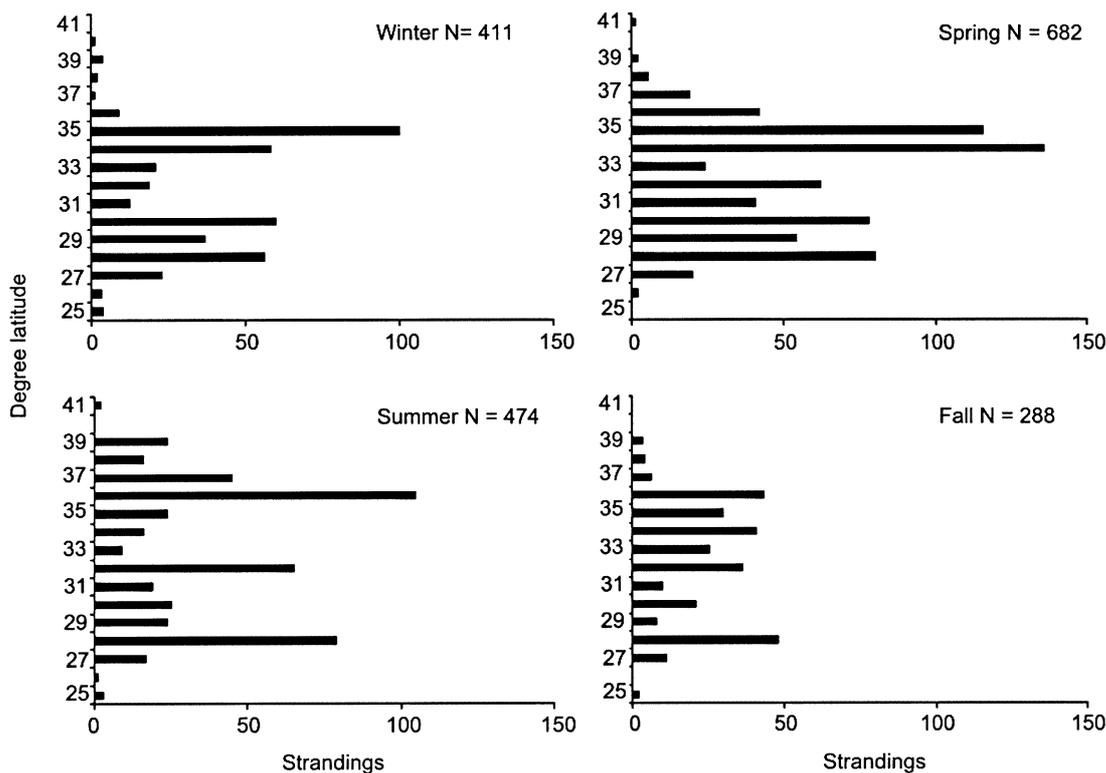


Fig. 8. Latitudinal histograms of bottlenose dolphin strandings for each season, for 1989-1997. Each season displays a complex distribution of strandings.

model of a stock of dolphins migrating north in summer and south in winter from New Jersey to Florida. In winter, for example, when the current model for the CMS predicts dolphin distribution concentrated in central Florida, the highest number of strandings occurred in North Carolina. In all seasons, the minimum number of strandings generally occurred at either 33°N or 31°N (although from 1989-1997 in autumn the minimum was at 29°N). These data suggest more complex movement patterns along the US Atlantic coast than that of a single group ranging seasonally from Florida to New Jersey.

Scott *et al.* (1988) reported that 742 dolphins were investigated during the epizootic. In conducting the analyses described here, only 667 stranding records for this time period were found to exist in the Smithsonian Institution's Cetacean Stranding Database. Of these, 22 records had no associated data of any kind, suggesting that the maximum number of dolphin carcasses investigated was 645. The discrepancy between the number of strandings reported during the 1987-1988 epizootic and the number taken from the same database for this study 12 years later may be explained by the continued editing and reassessment of the Smithsonian Institution's Cetacean Stranding Database.

Implicit in the analysis of the 1987-1988 epizootic was an assumption that spatial and temporal patterns of strandings represented seasonal movements of dolphins. Although this assumption may appear reasonable, especially given the extraordinary magnitude of the event, it is important to note that many factors may contribute to the distribution of carcasses along the coast. Stranding patterns may represent either real movement patterns of dolphins, and/or some combination of differential mortality rates, oceanographic currents that occur along the coast, or differential stranding response effort along the coast.

For example, the interquartile and distributional histograms of strandings may suggest a more complex stock structure or distributional pattern than that of a single coastal migratory stock. The seasonal histograms (Fig. 8) do suggest latitudinal movements of dolphins north of Cape Hatteras, North Carolina. These data support aerial (Kenney, 1990) and boat-based (Barco *et al.*, 1999) survey studies. In addition to this north-south movement pattern of coastal bottlenose dolphins north of Cape Hatteras, other factors may be contributing to the observed distributional patterns. These patterns may also represent dolphins moving seasonally between estuarine and coastal waters. Boat-based surveys conducted in Beaufort, North Carolina suggest that some dolphins spend summer months inhabiting estuaries and tidal rivers, and winter months in near-shore ocean waters (Rittmaster and Thayer, 1994). Dolphins stranding on ocean-facing beaches have a greater chance of being observed and recovered than those in estuarine areas. Stranding patterns are also influenced by mortalities of offshore bottlenose dolphins (Mead and Potter, 1995). The seasonal distribution patterns of offshore bottlenose dolphins have, to date, only been described from Cape Hatteras, North Carolina northward to Cape Cod, Massachusetts (Kenney, 1990). Offshore dolphins are known to range near the continental shelf and Gulf Stream current (Kenney, 1990), both of which are in close proximity to the coast near Cape Hatteras, North Carolina. Also, resident populations of bottlenose dolphins are known to exist along the US Atlantic coast (Petricig, 1995; Zolman, 1996) and contribute unknown numbers to the strandings database.

Another bias to the distributional patterns of strandings may come from differential mortality factors that may occur spatially or temporally. Entanglement in fishing gear is the

most common source of anthropogenic mortality for small cetaceans (Perrin *et al.*, 1994; Forney *et al.*, 1999; Hill and DeMaster, 1999; Read and Murray, 2000; Friedlaender *et al.*, 2001). The distribution and frequency of strandings may be influenced in areas where there is increased fishing effort (see Friedlaender *et al.*, 2001). The standardisation of protocols evaluating human-induced mortality as a cause of death (Haley and Read, 1993; Read and Murray, 2000) on all carcasses will enhance our understanding of the magnitude of this mortality factor in the stranding record.

Oceanographic and current patterns may also influence the observed frequency and distribution of strandings. Oceanographic features in certain coastal areas may either enhance or diminish the likelihood that a dead dolphin will strand on a beach. The slope and composition of a beach could greatly affect whether or not a dead dolphin would become beach-cast. Similarly, small and large-scale current patterns may confound the assumption that where a dolphin strands reflects where that dolphin died. A better understanding of these factors would be valuable in interpreting stranding patterns.

The final caveat to the distributions described from the stranding database is that of effort. Although the time blocks used in this study represent relatively consistent stranding response effort across years and throughout the entire Atlantic coast, it is likely that local effort can vary. There are areas along the coast that have been monitored consistently because long-term stranding programmes do exist, but other areas have not been monitored, usually because of accessibility. Areas with poor coverage and monitoring would be under-represented in the stranding record.

Historically, collection effort of beach-cast carcasses can be seen in the yearly contributions to the Smithsonian Institution's Cetacean Stranding Database from 1869-1997 (Fig. 9). Before 1972, the year of the enactment of the Marine Mammal Protection Act and the formalisation of stranding networks, contributions to the database came largely from collection efforts made on the Outer Banks of North Carolina during the time of a directed drive-fishery for coastal bottlenose dolphins (True, 1889; 1891). True recorded as many as 90 dolphins killed per day. This fishery operated from 1797-1920, and Mitchell (1975) estimated the cumulative catch of this fishery from 1885-1890 at 13,748 to 17,000 animals. This cumulative catch estimate has been mistakenly presented as a population estimate for coastal bottlenose dolphins up to the middle 1990s (e.g. Waring *et al.*, 1996)

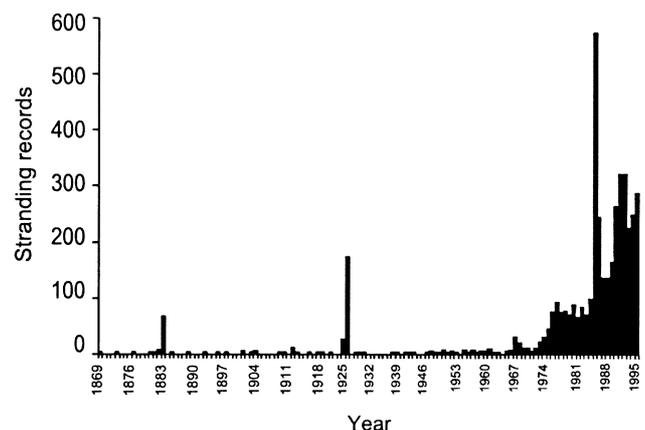


Fig. 9. Yearly records from the Smithsonian Institution's Cetacean Stranding Database, 1869-1997 ($n = 4,259$).

This study demonstrates how a long-term, systematic collection of strandings data can be useful in helping to understand the stock structure of coastal bottlenose dolphins. Such data can help formulate testable hypotheses regarding stock structure and provide information on long-term levels of mortality. However, the study has also shown that strandings data must be treated with proper caution when used to formulate hypotheses.

It is not clear from Level A strandings data (species, date, location, field number, sex, total body length) what combination of resident and migratory animals make up the stock complex of coastal bottlenose dolphins along the US Atlantic coast (e.g. Hohn, 1997). Genetic and morphometric analyses of stranded specimens might help to place individual animals into stocks, thus allowing a more detailed analysis of the stranding patterns (and therefore movement patterns) of specific stocks. The addition of genetic and morphometric sampling to basic stranding protocols would greatly enhance these efforts. Continued integration of stranding patterns, photo-ID efforts (e.g. Urian and Wells, 1996), telemetry and genetic analysis (with samples provided from stranded carcasses) will enhance our understanding of stock structure of coastal bottlenose dolphins along the US Atlantic coast.

Using the best available information at the time, Scott *et al.* (1988) concluded that the 1987-1988 epizootic 'primarily affected the coastal migratory stock of animals that ranges between Florida and New Jersey'. The results of this study do not support this hypothesis. The comparative interquartile analysis of stranding data suggests that the pattern observed during the 1987-1988 epizootic was anomalous, and not representative of stranding distributions along the coast for any other time period. Monthly and latitudinal frequency distributions of strandings before and after the epizootic are not similar to those observed during the event, and raise the question of how representative these stranding patterns are of a single stock of dolphins. Stranding patterns also suggest that coastal bottlenose dolphins do not form a single, discrete stock along the US Atlantic coast. This study demonstrates how long-term, systematic collection of strandings data can be useful in testing hypotheses regarding the complex stock structure of coastal bottlenose dolphins. This knowledge will greatly enhance our abilities to conserve and manage these animals as they recover from historic (i.e. directed takes and epizootic) and current sources of mortality.

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