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ABUNDANCE OF BOTTLENOSE DOLPHINS, *Tursiops truncatus*, IN THE COASTAL GULF OF MEXICO

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ABSTRACT: The abundance of bottlenose dolphins (*Tursiops truncatus*) for many coastal areas of the United States Gulf of Mexico is poorly known. During spring and fall 1987, we used aircraft and strip transects to estimate bottlenose dolphin abundance within 37 km of the U.S. Gulf shore. Greatest estimated dolphin densities were in the north-central Gulf (spring), northern Florida (fall) and Louisiana study areas (fall) (about 0.30 dolphins / km²). We estimated the coastal U.S. Gulf population of bottlenose dolphins to be 16,892 ± 3,628 (95% CI) and 16,089 ± 3,338 in spring and fall, respectively. Bottlenose dolphins were found throughout the U.S. Gulf waters searched, but herds offshore of Texas were concentrated near passes and Louisiana herds were more common in and near eastern bays. Our estimates are one of the first assessments of the abundance and density of bottlenose dolphins throughout the coastal U.S. Gulf and may provide useful baseline estimates.
[Keywords: *bottlenose dolphins; abundance; Tursiops truncatus*]

Estimates of bottlenose dolphin densities for coastal areas of the United States Gulf of Mexico (U.S. Gulf) have been made using a wide variety of field and analytical techniques over many seasons and years. Most studies of bottlenose dolphin density have been conducted in easily accessible areas, restricted geographic regions or areas heavily used by the live-capture fishery (Leatherwood and Reeves 1982:377, Scott 1984, Shane *et al.* 1986:37).

During the spring and fall of 1987, we conducted aerial surveys to estimate the abundance of schools of red drum (*Sciaenops ocellatus*) in 7 geographic regions in the U.S. Gulf (Lohoefener *et al.* 1988). We collected data for many other marine species, including bottlenose dolphins. Here, we report the seasonal relative abundance and distribution of bottlenose dolphins for each region. From 1983 to 1986, Scott *et al.* (1989) used aerial survey methods to estimate the seasonal abundance of bottlenose dolphins in the U.S. Gulf. Their results, and ours, are the first to assess the abundance and distribution of bottlenose dolphins throughout the coastal U.S. Gulf from single research efforts and are important for several reasons: (1) bottlenose dolphin abundance has not been previously assessed for some Texas, Louisiana and Florida areas; and (2) because of the standardization of field and analytical techniques, the estimates provide more valid comparisons of bottlenose dolphin abundance among regions, habitat types and seasons than comparisons among previous studies.

We project seasonal estimates of bottlenose dolphin abundance for almost the entire coastal U.S. Gulf, which along with the regional estimates, could be used as baseline abundances for a rapidly changing Gulf coastal environment (*e.g.*, continuing oil and gas development, wetland loss, coastal development, increased boat traffic and growing demands of the seafood industry). Additionally, the recent mass mortality of bottlenose dolphins on the U.S. Atlantic coast (Geraci 1988) showed that the size of a bottlenose dolphin population can decrease rapidly. This further illustrates the need to understand the abundance of bottlenose dolphins in broad regions of the U.S. Gulf.

STUDY AREA AND METHODS

Our study area included the coastal waters of the Gulf of Mexico from Key West, Florida to the Rio Grande River, Texas. Coastal waters included all Gulf and estuarine waters within 37 km from the U.S. Gulf shore. This area was divided into 7 study areas: southern Texas, northern Texas, Louisiana, north-central Gulf, northern Florida, central Florida and southern Florida (Figs. 1, 2). The waters between Mobile Bay, Alabama and Cape San Blas, Florida were not surveyed because of military air space restrictions.

Surveys were conducted in each study area during a 21-day period during April through July (spring) and a 21-day period during September through December (fall) in 1987 with 2 exceptions: (1) the Louisiana area was surveyed during a 21-day period twice in the spring and (2) central Florida was surveyed only during a 21-day fall period.

Two observer teams surveyed different study areas simultaneously during each season until all the study areas were covered (Table 1). Each observer team consisted of 2 of the authors. A maximum of 10 replicate (daily) aerial surveys were conducted when conditions were acceptable. Survey transects were flown from about 1000-1500 hours when winds were less than about 20 km/hour and skies were not cloudy. These conditions were considered optimal for sighting red drum schools (R.L. Watters, *pers. comm.*, Clark Seafood Co., Pascagoula, Miss.) and are similar to optimal conditions for sighting dolphins (Scott 1984). Observers flew in a single-engine, overhead-wing aircraft with retractable landing gear (Cessna 172-RG).

Transect directions were north-south or east-west so that transects were

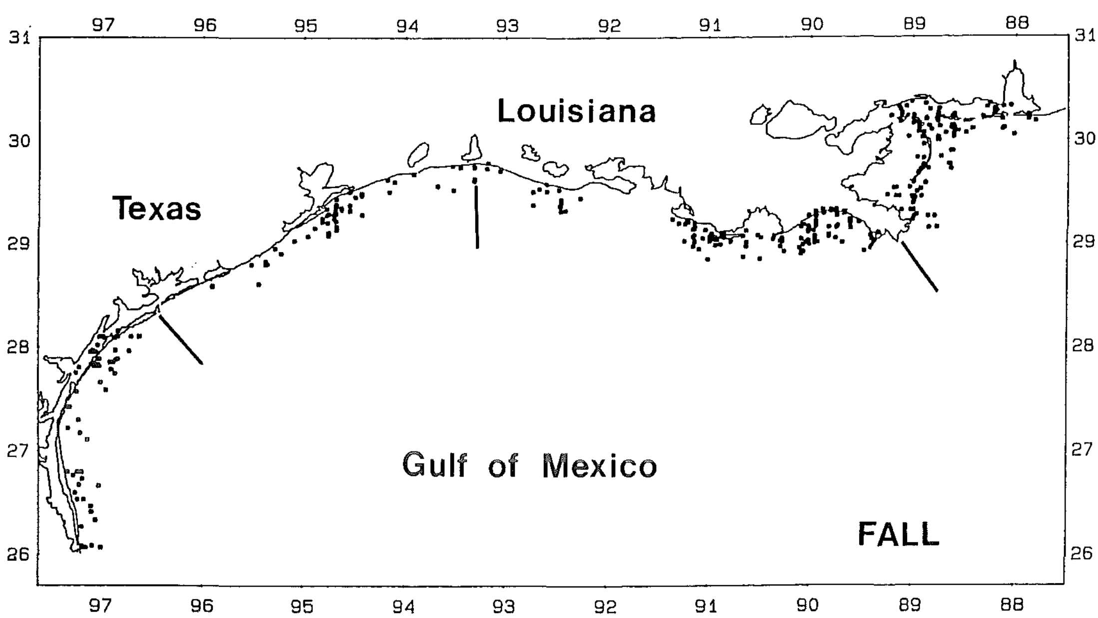

Figure 1. Locations of bottlenose dolphin herds (black squares) sighted in coastal waters of southern Texas, northern Texas, Louisiana and north-central Gulf study areas during fall 1987. Black bars separate the study areas.

Table 1. Mean herd densities ($\hat{D}_h$, herds/km²) and mean herd sizes ($\bar{H}$, dolphins/herd) of bottlenose dolphin herds sighted in 7 Gulf of Mexico study areas during 1987 (R = number of replicate surveys, K = number of herds sighted).

STUDY AREA Habitat month	R	$\hat{D}_h$	$\hat{se}(\hat{D}_h)$	K	$\bar{H}$	$\hat{se}(H)$
SOUTHERN TEXAS						
Inshore						
Apr	8	0.03	0.011	18	8.1	1.36
Sep	6	0.01	0.005	5	5.1	1.58
Gulf						
Apr	8	0.02	0.003	37	9.2	0.91
Sep	6	0.02	0.006	36	5.4	0.72
NORTHERN TEXAS						
Inshore						
May	6	0.01	0.002	2	5.8	3.25
Sep	6	0.02	0.008	9	2.5	0.00
Gulf						
May	7	0.03	0.008	61	7.5	0.58
Sep	7	0.03	0.010	74	4.1	0.40
LOUISIANA						
Inshore						
Apr	8	0.02	0.011	10	7.2	1.75
Jun	6	0.05	0.019	12	5.8	0.98
Oct	5	0.11	0.037	35	6.3	0.74
Gulf						
Apr	9	0.03	0.011	70	5.7	0.48
Jun	8	0.01	0.002	26	5.8	0.84
Oct	7	0.03	0.009	47	4.9	0.55
NORTH-CENTRAL GULF						
Inshore						
May	8	0.06	0.014	45	5.8	0.66
Sep	10	0.03	0.007	32	6.0	0.73
Gulf						
May	8	0.05	0.012	71	7.4	0.60
Sep	10	0.04	0.012	68	7.1	0.63
NORTHERN FLORIDA						
Inshore						
Jun	7	0.01	0.005	5	3.8	1.30
Nov	6	0.05	0.034	9	2.5	0.00
Gulf						
Jun	11	0.02	0.004	73	6.1	0.55
Nov	6	0.06	0.009	98	5.7	0.46
CENTRAL FLORIDA						
Inshore						
Nov	7	0.06	0.021	10	5.1	1.06
Gulf						
Nov	7	0.04	0.006	74	4.5	0.44
SOUTHERN FLORIDA						
Inshore						
Jul	6	0.07	0.034	10	5.8	1.49
Dec	4	0.02	0.012	3	4.7	2.17
Gulf						
Jul	11	0.03	0.004	82	3.8	0.35
Dec	8	0.05	0.009	102	4.6	0.38

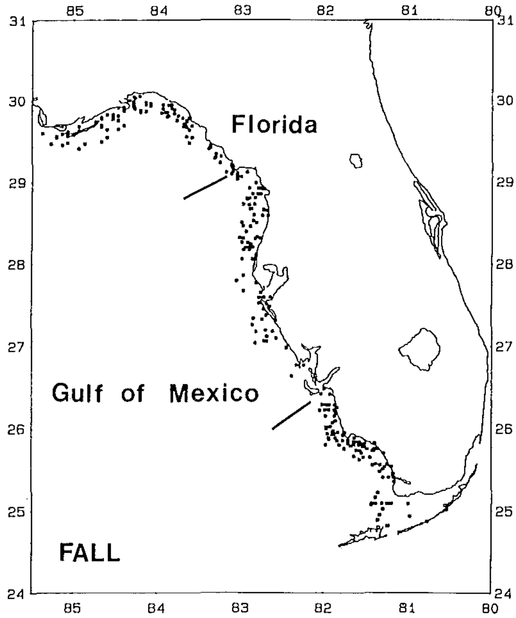

Figure 2. Locations of bottlenose dolphin herds (black squares) sighted in coastal waters of northern, central and southern Florida study areas during fall 1987. Black bars separate study areas.

approximately perpendicular to the mainland. Transects, placed every one-half minute of latitude or longitude, extended into the Gulf from the shore a distance of 15-20 minutes of latitude or longitude (28-37 km) and inshore transects covered bays, marshes, rivers, lagoons and sounds. A random starting transect and random choice of work direction (east or west, north or south) for each study day was chosen. Subsequent transects for each study day were 4 minutes of latitude or longitude apart. Daily survey flights averaged about 4.5 hours and usually consisted of 10-14 transects. Survey altitudes were 305 or 457 m on alternate days. Survey speed was about 167 km/hour airspeed.

Observers watched through opened windows on each side of the aircraft. All dolphin herds in a strip defined by an angle between 21 and 55° on both sides of the transect were counted. (The angle from zero-21° was obstructed by the fuselage.) Unbiased estimates of density using strip transect methods are based on the assumption that all herds within the strips were sighted (Burnham *et al.* 1980). This assumption was violated in this study for several reasons (see discussion). Depending on altitude, the width of the strip on each side of the aircraft was 320 or 480 m. Colored tape on the wing struts, and reference marks on the window frames, insured a consistent viewing angle delineating the 55° strip. Data were recorded on a small portable computer interfaced with a long-range-navigation-C receiver.

When a dolphin herd was sighted in the strip, it was classified in a herd size category: 1-4, 5-12, or >12 adult (non-calf) dolphins. Mean herd size ($\bar{H}$) and variance (var) were calculated for each season and habitat (inshore and Gulf) within each study area following Beyer (1978): $\bar{H} = \Sigma(f_j m_j)/\Sigma f_j$ and

$$\hat{\text{var}}(H) = \frac{\Sigma f_j \ [\Sigma(f_j m_j^2)] - [\Sigma(f_j m_j)]^2}{\Sigma f_j\,(\Sigma f_j - 1)},$$

where f_j was the number of herds within each herd size category (j) and m_j was the midpoint of the herd size category (2.5, 8.5 or 16). We assumed the frequency distribution of herd sizes was symmetrically distributed within each herd size category (*i.e.*, the midpoint was equal to the arithmetic mean within each category; see discussion).

Herd density for each daily replicate survey (i) within a study area, season, and habitat was calculated as: $\hat{D}_i = n_i/2l_i w$, where n was the number of dolphin herds observed, l the transect length, and w the half strip width (320 or 480 m). The overall mean herd density ($\hat{D}_h$) was estimated from R replicate surveys following Burnham *et al.* (1980) as: $\hat{D}_h = \Sigma(l_i\hat{D}_i)/\Sigma l_i$, $i = 1, 2, 3 \ldots R$. Variance of herd density was estimated as:

$$\hat{\text{var}}(\hat{D}_h) = \frac{\Sigma[l_i(\hat{D}_i - \hat{D}_h)^2]}{\Sigma l_i(R - 1)}.$$

Dolphin density ($\hat{D}_d$) was calculated as: $\hat{D}_d = \bar{H}\,\hat{D}_h$. The variance of $\hat{D}_d$ was estimated using Goodman's (1960) estimator of the variance of products:

$$\hat{\text{var}}(\hat{D}_d) = \hat{D}_h^2\,\hat{\text{se}}(H)^2 + \bar{H}^2\,\hat{\text{se}}(\hat{D}_h)^2 - \hat{\text{se}}(H)^2\,\hat{\text{se}}(\hat{D}_h)^2$$

where the standard errors (se) were estimated as follows: $\hat{\text{se}}(H) = (\hat{\text{var}}(H)/K)^{1/2}$ where $K = \Sigma f_j$, $\hat{\text{se}}(\hat{D}_h) = \hat{\text{var}}(\hat{D}_h)^{1/2}$, and $\hat{\text{se}}(\hat{D}_d) = \hat{\text{var}}(\hat{D}_d)^{1/2}$. The population estimate ($\hat{N}$) within an area (A) and habitat each season was estimated as: $\hat{N} = \hat{D}_d\,A$, and $\hat{\text{se}}(\hat{N}) = [A^2\hat{\text{var}}(\hat{D}_d)]^{1/2}$. We estimated the approximate 95% confidence interval as $\hat{N} \pm 2\hat{\text{se}}(\hat{N})$.

The estimated areas of Florida and Texas inshore waters were as defined by Diener (1975) and McNulty *et al.* (1972). Louisiana and the north-central Gulf inshore areas were measured using a planimeter and nautical charts. Gulf areas were estimated from nautical charts using a planimeter and the mean transect length/study area.

RESULTS

Estimated mean herd sizes ranged from 2.5-9.2 dolphins. Inshore and Gulf mean herd sizes from both Texas study areas apparently declined spring to fall. Otherwise, there were no apparent differences between inshore-Gulf and spring-fall or among study-area mean herd sizes. Densities of inshore herds ranged from 0.01-0.11 herds/km². Densities of Gulf herds ranged from 0.01-0.06 herds/km² (Table 1).

The greatest spring densities of inshore bottlenose dolphins (north-central Gulf, southern Florida) were nearly 10 times larger than the smallest spring inshore densities (northern Texas, northern Florida). The spring density of Gulf bottlenose dolphins in the north-central Gulf was at least 3 times larger than those in the Louisiana, northern Florida and southern Florida study areas (Table 2).

In the fall, estimates of bottlenose dolphin density in inshore Louisiana were 2-16 times greater than estimates in the other inshore study areas. In the fall, Gulf densities from the north-central Gulf and northern Florida areas were about twice as large, except for southern Florida, as those from all other study areas.

When spring inshore and Gulf densities of bottlenose dolphins were combined, the overall density for each study area was: north-central Gulf, 0.33 dolphins/km²; southern Texas, 0.22; southern Florida, 0.20; northern Texas, 0.18; Louisiana, 0.13 and 0.16; and northern Florida, 0.11. The combined fall densities were: northern Florida, 0.32; Louisiana, 0.27; central Florida, 0.19; southern Florida, 0.18; north-central Gulf, 0.20; southern Texas, 0.11; and northern Texas, 0.11.

In southern Florida the total numbers of bottlenose dolphins (inshore plus Gulf) were about the same for spring and fall. However, the inshore abundance in spring was about 2 times the Gulf abundance. In the fall study, this pattern was reversed. In the other study areas, there was no evidence of a seasonal relationship in abundance between the inshore and Gulf habitats. By area, spring to fall patterns were not apparent in observed bottlenose dolphin abundance. Total numbers of bottlenose dolphins, from spring to fall, decreased by as much as 50% in some areas (southern Texas, northern Texas, and north-central Gulf) and increased by 100% or more in other areas (Louisiana and northern Florida).

Estimated total number of coastal bottlenose dolphins (± 95% CI) from Key West to Brownsville (without the central Florida area) were as follows: spring, 16,892 ± 3,628 dolphins (5,746 inshore and 11,146 Gulf); and fall, 16,089 ± 3,338 (4,935 inshore and 11,154 Gulf). The fall

Table 2. Bottlenose dolphin densities ($\hat{D}_d$, dolphins /km²) and the estimated number of dolphins ($\hat{N}$) in 7 Gulf of Mexico study areas surveyed during 1987 (A = area in km²).

STUDY AREA Habitat month	$\hat{D}_d$	$\hat{se}(\hat{D}_d)$	A	$\hat{N}$	±95% CI
SOUTHERN TEXAS					
Inshore					
Apr	0.28	0.102	1,569	435	320
Sep	0.04	0.026	1,569	70	83
Gulf					
Apr	0.20	0.033	7,696	1,570	512
Sep	0.12	0.037	7,696	916	575
NORTHERN TEXAS					
Inshore					
May	0.04	0.025	3,764	153	191
Sep	0.04	0.021	3,764	166	160
Gulf					
May	0.23	0.063	9,894	2,310	1,253
Sep	0.14	0.043	9,894	1,370	851
LOUISIANA					
Inshore					
Apr	0.11	0.080	4,262	500	682
Jun	0.30	0.120	4,262	1,232	1,030
Oct	0.67	0.243	4,262	2,869	2,068
Gulf					
Apr	0.17	0.062	14,158	2,440	1,758
Jun	0.08	0.018	14,158	1,187	502
Oct	0.14	0.045	14,158	2,027	1,268
NORTH-CENTRAL GULF					
Inshore					
May	0.37	0.092	8,472	3,141	1,564
Sep	0.16	0.046	8,472	1,325	773
Gulf					
May	0.38	0.094	7,802	2,931	1,466
Sep	0.30	0.089	7,802	2,340	1,386
NORTHERN FLORIDA					
Inshore					
Jun	0.04	0.024	1,113	48	53
Nov	0.13	0.086	1,113	141	190
Gulf					
Jun	0.12	0.026	7,888	965	415
Nov	0.34	0.059	7,888	2,729	930
CENTRAL FLORIDA					
Inshore					
Nov	0.32	0.123	1,948	621	479
Gulf					
Nov	0.16	0.030	8,856	1,415	544
SOUTHERN FLORIDA					
Inshore					
Jul	0.38	0.214	3,893	1,469	1,665
Dec	0.09	0.065	3,893	364	504
Gulf					
Jul	0.11	0.019	8,100	930	315
Dec	0.22	0.044	8,100	1,772	708

estimate (with central Florida) was 18,125 ± 3,700 dolphins (5,556 inshore and 12,569 Gulf).

Locations of herd sightings (Figs. 1, 2) indicated that bottlenose dolphins occurred throughout each study area but in different patterns of concentration. Spring and fall distributions of herds were generally similar. Dolphins offshore of Texas appeared to aggregate near passes (*e.g.*, Aransas Pass, Galveston Bay inlet). Offshore of Louisiana, bottlenose dolphin herds seemed to concentrate in the east where there are many bays and bayous, rather than in the west, where there is an unbroken beach. In the fall, bottlenose dolphin herds were notably absent in and near Atchafalaya and Vermillion bays. Bottlenose dolphin herds in the north-central Gulf and Florida study areas seemed to be ubiquitous. Far fewer herds were observed in Florida Bay in the fall than in the spring.

DISCUSSION

We consider our relative estimates of bottlenose dolphin abundance to be minimum estimates for several reasons. The assumption that all dolphin herds were observed in the strip from 21-55° was almost certainly violated. In dolphin studies that used line transect methods (Gates 1979, Burnham *et al.* 1980), the number of dolphin herds sighted decreased as perpendicular distance from the transect (path of the aircraft) increased (Leatherwood *et al.* 1978, Barham *et al.* 1980, Dohl *et al.* 1986). We collected the dolphin data knowing the shortcomings of strip transect methods (Burnham and Anderson 1984). However, collecting perpendicular distance data on other species would have detracted from our primary objective of searching for red drum schools.

Leatherwood *et al.* (1982) tested the effects of altitude on estimates of bottlenose dolphin density in Florida. They tested altitudes of 164, 246, 328 and 410 m and reported the greatest estimated density at 246 m. Since our surveys were conducted at higher altitudes (305 or 457 m), our estimates may have been negatively biased.

Bottlenose dolphin herds are usually small (Leatherwood and Reeves 1982) and we certainly missed some herds because they were submerged. Only dolphins in herds with more than 15 individuals were probably not submerged simultaneously (Holt and Cologne 1987). The mean herd sizes we observed were <10 adult bottlenose dolphins.

Many factors cause additional negative bias in strip transects. The only factors we could reasonably control (by deciding whether to survey) were sea state, visibility and cloud cover. We surveyed within the most stringent range of acceptable conditions that could be repeated and allowed enough days for adequate samples. Glare, water turbidity and dolphin behavior may have negatively biased our estimates.

When we estimated mean herd sizes, we assumed that the herd size frequency distribution for each size category was symmetrically distributed. In studies where herds were circled and counted, frequency distributions of bottlenose dolphin herd sizes were skewed toward smaller herd sizes (Leatherwood *et al.* 1978, Barham *et al.* 1980, Mullin 1988). This may have positively biased our mean herd size estimates. We believe, however, that any positive bias was minimized or negated for several reasons. Our estimates of mean herd size were similar to or smaller than those from other studies (Leatherwood and Reeves 1982). Experience has shown us that when a dolphin herd is circled and counted for several minutes, more dolphins are usually counted (never less) than when counts are made (as they were

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here) without circling. Results were similar when we compared the mean herd sizes from Mullin's (1988) herd size data (508 herds) using the midpoint formula and the arithmetic mean formula; 6.9 and 8.1 dolphins/herd, respectively.

To what extent differences and similarities between our results and other studies (Table 3) were due to factors such as survey methods, analytical techniques, time periods, seasons, or areas surveyed is unknown. For example, Scott *et al.* (1989) used a twin-engine aircraft with track-line visibility, line transect methods and a survey speed of 223 km/hour for their surveys. Their inshore study areas were similar to ours. However, their Gulf estimates which we used for comparisons were for study areas that extended offshore to about the 20 m isobath, whereas, our Gulf study areas usually terminated over more shallow waters.

Dolphin densities from other studies in inshore southern Texas were generally larger than our estimates. We included Laguna Madre, where we sighted few bottlenose dolphin herds, whereas most other researchers have reported densities for only the more northern bays. Bottlenose dolphins were concentrated around Aransas Pass in our study where Shane (1980) reported high bottlenose dolphin densities. Because it is the site of the largest bottlenose dolphin live-capture fishery (Reeves and Leatherwood 1984), many density estimates exist for the inshore north-central Gulf. Because of slower survey speeds and a more efficient sighting platform, estimates from small boats studies by Lohoefener *et al.* (1990) were probably less negatively biased than those from aerial survey. The largest estimate of inshore abundance from central Florida was from a small study area (Sarasota Bay).

Table 3. Bottlenose dolphin densities ($\hat{D}_d$, dolphins /km²) from studies in major regions in the U.S. Gulf of Mexico. Two values are the range of seasonal point estimates.

STUDY AREA Study	Inshore $\hat{D}_d$	Gulf $\hat{D}_d$
SOUTHERN TEXAS		
Barham *et al.* (1980)	0.75	
Shane (1980)	1.50-5.10	
Thompson (1982)	0.13-0.36	
Leatherwood & Reeves (1983)	1.02	0.31
Fritts *et al.* (1983)		0.21
Scott *et al.* (1989)	0.01-0.20	0.02-0.10
This study	0.04-0.28	0.12-0.20
NORTHERN TEXAS		
Scott *et al.* (1989)	0.01-0.06	0.02-0.18
This study	0.04	0.14-0.23
LOUISIANA		
Leatherwood *et al.* (1978)		0.09
Fritts *et al.* (1983)		0.27
Scott *et al.* (1989)	0.00-0.14	0.02-0.15
This study	0.11-0.67	0.08-0.17
NORTH-CENTRAL GULF		
Leatherwood *et al.* (1978)	0.09-0.14	
Thompson (1982)	0.08-0.13	
Lohoefener (1987)	0.27-1.38	
Mullin (1988)	0.16-0.43	0.41-0.58
Scott *et al.* (1989)	0.06-0.17	0.08-0.17
This study	0.16-0.37	0.30-0.38
NORTHERN FLORIDA		
Odell and Reynolds (1980)		0.12
Thompson (1982)	0.06-0.09	
Scott *et al.* (1989)	0.03-0.10	0.11-0.27
This study	0.04-0.13	0.12-0.34
CENTRAL FLORIDA		
Odell and Reynolds (1980)		0.06
Irvine *et al.* (1981)	1.30	
Scott *et al.* (1989)	0.12-0.18	0.09-0.15
This study	0.32	0.16
SOUTHERN FLORIDA		
Fritts *et al.* (1983)		0.18
Scott *et al.* (1989)	0.13-0.25	0.13-0.19
This study	0.09-0.38	0.11-0.22

Fewer estimates of bottlenose dolphin abundance have been made for Gulf waters (Table 3). The surveys of Fritts *et al.* (1983) extended well beyond coastal waters to the outer continental shelf. Their surveys included only small portions (<20%) of our southern Texas, Louisiana and southern Florida study areas as did the Louisiana Gulf survey by Leatherwood *et al.* (1978). Fritts *et al.* (1983) found bottlenose dolphins generally restricted to water depths <50 m and estimated average densities for this area. Thus comparisons between their results and ours may be reasonable. (About 7% of our southern Texas area was >50 m.) Odell and Reynolds' (1980) coverage of central and northern Florida was similar to ours and their estimates were based on an annual survey effort. Leatherwood and Reeves (1983) also reported a September estimate of Gulf bottlenose dolphin density in southern Texas.

There was not a consistent pattern between spring and fall estimates of bottlenose dolphin abundance for each study area, some increased while others declined. The estimated total number of bottlenose dolphins in the coastal U.S. Gulf remained similar between seasons (about 16,000 dolphins). The large difference between our spring and fall estimates of dolphin abundance in most study areas was probably due, at least in part, to the small sample sizes (7-10 survey days/season). However, the similarity of the total number of U.S. Gulf bottlenose dolphins each season can probably be attributed to the large sample created by combining all areas.

Little is known about the seasonal movement patterns of bottlenose dolphins. Investigators have reported seasonal differences in the abundance of bottlenose dolphins in small or physiographically similar study areas near Argentina (Würsig 1978), Texas (Shane 1980) and Mississippi (Lohoefener *et al.* 1990). Mullin (1988) reported the seasonal abundance of bottlenose dolphins was similar except during the summer in a large (2,500 km^2) north-central Gulf study area. Some bottlenose dolphins are apparently year-round residents with local home ranges (Caldwell 1955, Würsig 1978, Shane 1980, Wells *et al.* 1987) but others may be migratory or have large home ranges (Würsig 1978). Würsig and Würsig (1977) reported 6 bottlenose dolphins near Argentina at least 300 km from where they were first sighted. If Gulf bottlenose dolphins migrate, it is not known if they migrate along shore, coastal to offshore, or both. Some U.S. Atlantic coast bottlenose dolphins may move along shore south in the winter and then return north in warmer weather (Mead 1975). No along-shore migration routes could reasonably account for our spring to fall abundance patterns. If bottlenose dolphins migrate offshore, their seasonal patterns would have to be regionally different to account for our results. Fritts *et al.* (1983) studied bottlenose dolphins to the edge of their apparent offshore distribution. They found evidence of an offshore shift in distribution only during winter in their Louisiana study area. U.S. Gulf bottlenose dolphins are thought to make only local seasonal movements (Shane *et al.* 1986) and not make extensive migrations. However, not enough is known at this point to preclude migratory activities as an explanation for at least some of our results.

The estimates of bottlenose dolphin abundance reported here were negatively biased. Because our estimates should be minimums, if future studies using similar or improved methodologies reported lesser densities, the status of U.S. Gulf bottlenose dolphins would be cause for concern.

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