

# Evaluating movement patterns of common bottlenose dolphins using cookiecutter shark bite wounds in the Mississippi Sound

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## ABSTRACT

Common bottlenose dolphin stocks are delineated by location endpoints and depth contours. These boundaries reflect the best understanding of stock spatial distribution at the time of delineation, but may need adjustment over time for appropriate management and conservation of the species. Natural interactions between bottlenose dolphins and species with restricted ranges can provide insights into spatial habitat use. As cookiecutter sharks are a deepwater species, and estuarine bottlenose dolphin stocks are considered to be restricted to shallower waters, their habitats are not typically considered to overlap. Here we detail twelve novel examples of bottlenose dolphins photo-identified in estuarine waters with cookiecutter shark bites in various healing stages. Bites on two pantropical spotted dolphins that stranded in Mississippi support the presence of cookiecutter sharks in local deep waters, suggesting that the dolphins move across established stock boundaries. These movements are likely seasonal as open cookiecutter wounds varied significantly by season and were more likely to be seen in winter and spring months ( $p = 0.03$ ), correlating with seasonal abundance trends. Even resident dolphins with high site fidelity may have home ranges that span multiple stock areas as one such bottlenose dolphin was also documented with a cookiecutter shark bite. These natural interactions provide evidence of dolphin movement, as well as insights into how these stock boundaries can be evaluated in the future.

**KEYWORDS:** COMMON BOTTLENOSE DOLPHIN; HABITAT; MOVEMENT; PHOTO-ID

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## INTRODUCTION

Marine animals range from highly mobile species to almost fully sessile, with marine mammals falling somewhere in between. Bottlenose dolphins are considered to have variable ranges, with the full extent of their movements unknown. This uncertainty has meant that managing dolphin populations has relied on geographical stock designations. Populations of common bottlenose dolphins (*Tursiops truncatus*; hereafter referred to as bottlenose dolphins) in the northern Gulf of Mexico are divided into several stocks and managed by the National Oceanic and Atmospheric Administration (NOAA). The Marine Mammal Protection Act defines a stock as ‘a group of individuals of the same species or smaller taxa in a common spatial arrangement that interbreed when mature’ (NOAA, n.d.). Currently, 32 dolphin stocks within the northern Gulf of Mexico designated by NOAA are spatially divided based on depth and location along the United States’ shoreline (Fig. 1). Our study area falls within the ‘Northern Gulf of Mexico Bay, Sound, and Estuary stocks,’ as outlined by NOAA, and is designated stock number 13: the ‘Mississippi Sound, Lake Borgne, Bay Boudreau’ stock (hereafter referred to as the Mississippi Sound

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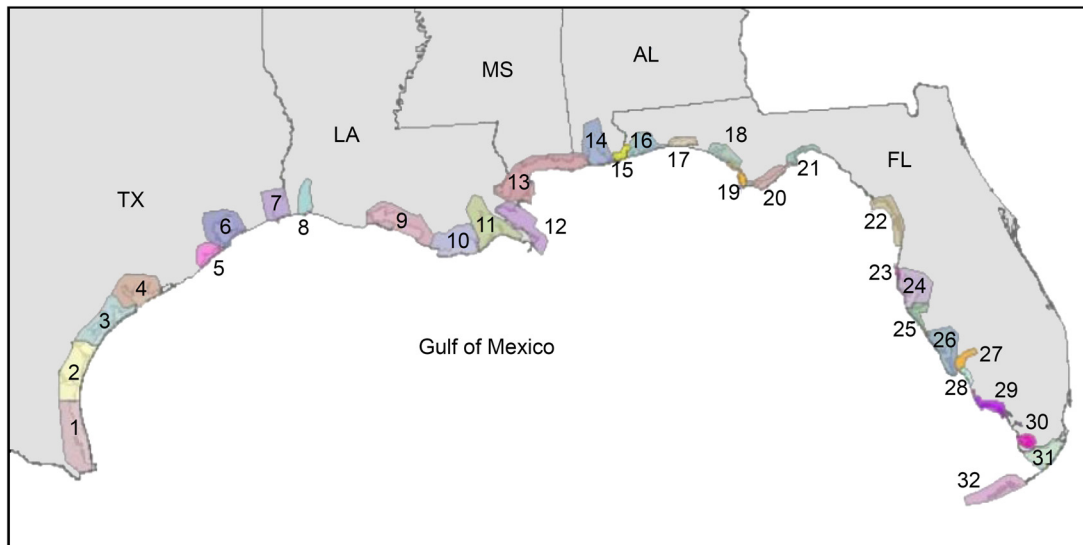


Figure 1. 32 unique bays, sounds and estuaries stocks in the northern Gulf of Mexico, outlined by NOAA (2021a).

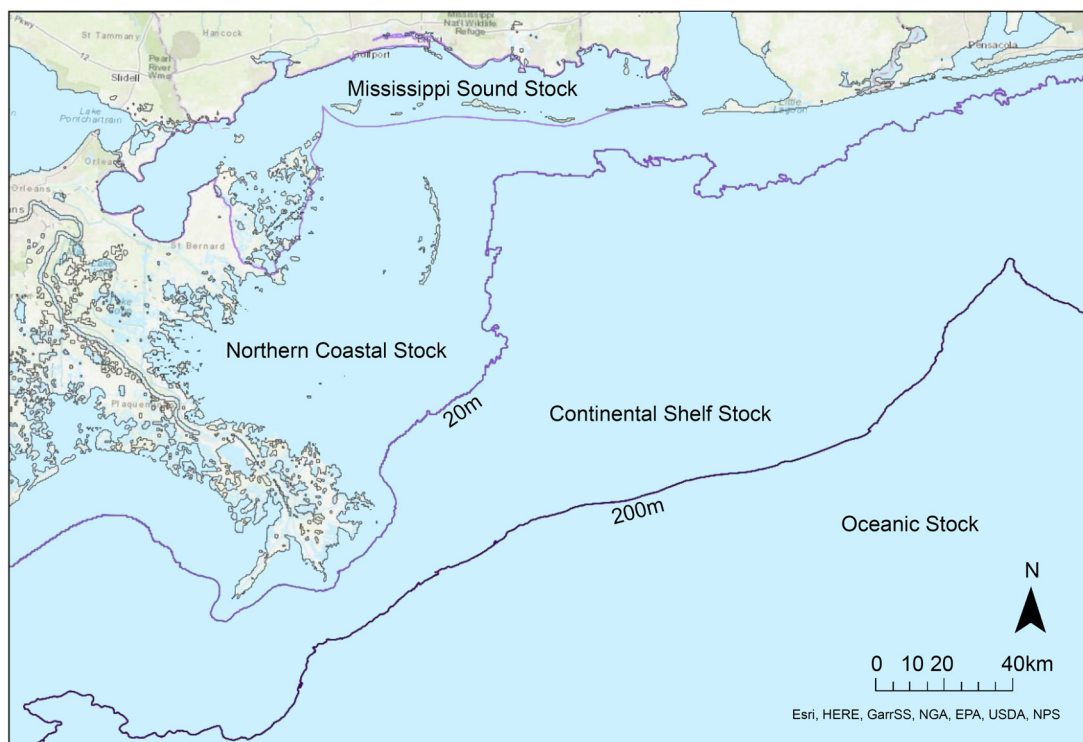


Figure 2. Northern Gulf of Mexico bottlenose dolphins stocks: Stock 13: Mississippi Sound, Lake Borgne and Bay Boudreau ('Mississippi Sound stock'; within light purple line); Northern Coastal stock 0–20 m (light purple to medium purple line); Continental Shelf stock 20–200 m (medium purple line to dark purple line); and Oceanic Stock > 200 m (beyond dark purple line). All stock boundaries are determined by NOAA (2021b).

stock) (NOAA, 2022b; Figs. 1 and 2). Beyond this stock, designated to fall between the barrier islands and continental shelf (up to the 20 m isobath), is the Gulf of Mexico Northern Coastal stock, the Continental Shelf stock (20–200 m isobaths) (NOAA, 2022a; NOAA, 2022b), and the Oceanic stock (> 200 m water depth) (NOAA, 2021b; Fig. 2). While these stocks are managed independently, the Mississippi Sound stock has been shown to have a high number of transient dolphins moving in and out of the area compared with neighboring areas (Hubard *et al.*, 2004; Mackey, 2010; Sinclair, 2016; Arick *et al.*, 2024). Stock boundaries are generally considered a 'working hypothesis' subject to change as new information becomes available (NOAA, 2021a, 2022a).

One potential way to evaluate broad scale movements is through interactions between common bottlenose dolphins and other species with restricted habitat ranges. Wounds from cookiecutter shark (*Isistius brasiliensis*) bites have been used to evaluate movement patterns and the spatial range of other cetaceans, such as minke whales (*Balaenoptera acutorostrata*; Bando *et al.*, 2010), orcas (*Orcinus orca*; Dwyer & Visser, 2011), beaked (*Ziphiidae*; Claridge, 2006), Bryde's (*Balaenoptera brydei*; Best & Photopoulou, 2016) and fin whales (*Balaenoptera physalus*; Moore *et al.*, 2003).

Dolphin populations, including in the Mississippi Sound, are often composed of both residents, i.e., core individuals that inhabit a certain area for a long period of time (Morteo *et al.*, 2017; Bolaños-Jiménez *et al.*, 2021; Pamperin *et al.*, 2025), and transient dolphins, i.e., individuals that enter an area but do not stay for an extended period (Conn *et al.*, 2011). Resident dolphins display varying degrees of site fidelity, ranging from seasonal to year-round (Bassos-Hull *et al.*, 2023). However, dolphins that show residency patterns, even year-round, may have ranges that extend past study areas (Morteo *et al.*, 2017). In the Mississippi Sound specifically, 27.91% of identified individuals were seen more than five times within the study area, and 30.11% were seen only once from 2010–23 (Pamperin *et al.*, 2025), suggesting both resident and transient individuals use this area. Previous studies in the Mississippi Sound found similar results, suggesting that site fidelity varies on both temporal and spatial scales (Hubard *et al.*, 2004).

Dolphin abundance in the Mississippi Sound varies by season, with the lowest seasonal abundance in the winter and the highest in the summer following the spring calving season (Hubard *et al.*, 2004; NOAA, 2021a). This may be due to the Mississippi Sound being used by offshore dolphins for calving in the spring and summer months, increasing the relative abundance during that time (Hubard *et al.*, 2004). Vollmer *et al.* (2021) suggest a genetically homogenous population from the Mississippi Sound to the 200 m isobath, demonstrating that, while different animals may use this space differently, there is genetic intermixing. However, these stocks are spatially divided and managed separately. New genetic analyses also demonstrate genetic subpopulations of bottlenose dolphins within the Mississippi Sound, indicating that multiple subgroups of dolphins may use the range delineated for the Mississippi Sound stock (Arick *et al.*, 2024).

Cookiecutter sharks are small sharks that are found in deep water areas around the world (Compagno *et al.*, 2005). They feed by scooping out chunks of flesh from large fish (Muñoz-Chápuli *et al.*, 1988; Papastamatiou *et al.*, 2010; Menezes *et al.*, 2022), whales (Dwyer & Visser, 2011; Best & Photopoulou, 2016) and dolphins (Feunteun *et al.*, 2018; Grace *et al.*, 2018). This results in semicircular, oblong or circular lacerations and scars on the bodies of the victims (Best & Photopoulou, 2016) which, in turn, allow researchers to identify cookiecutter shark predation on various marine species without having witnessed the predation events. Cookiecutter sharks have been documented in the deep waters of the Gulf of Mexico (Grace *et al.*, 2018), but the Mississippi Sound is an estuary system that is much shallower than the Gulf as a whole (average depth ~3 m) and is therefore considered out-of-habitat for cookiecutter sharks (out-of-habitat in waters < 200 m; Best & Photopoulou, 2016). Therefore, cookiecutter shark bites on any species within the Mississippi Sound would indicate habitat overlap in the deeper waters of the Gulf of Mexico.

This study aims to evaluate the presence of wounds and scars consistent with cookiecutter shark bites on both live and stranded common bottlenose dolphins in the Mississippi Sound to further understand broad-scale dolphin movements within the northern Gulf of Mexico.

## METHODS

### Study area

The study area is approximately 2966 km<sup>2</sup> and encompasses Mississippi state waters, Lake Borgne and the Biloxi Marshes. Seven photo-ID survey routes were established in 2013 to sample the study area (Fig. 3) and were followed once per month, weather permitting. Data for this analysis were collected through October 2024.

### Photo-ID data collection

Photo-ID methods were adapted from Würsig & Jefferson (1990) and Rosel *et al.* (2011). During photo-ID surveys, the vessel was driven along the pre-determined survey route until a group of bottlenose dolphins was spotted

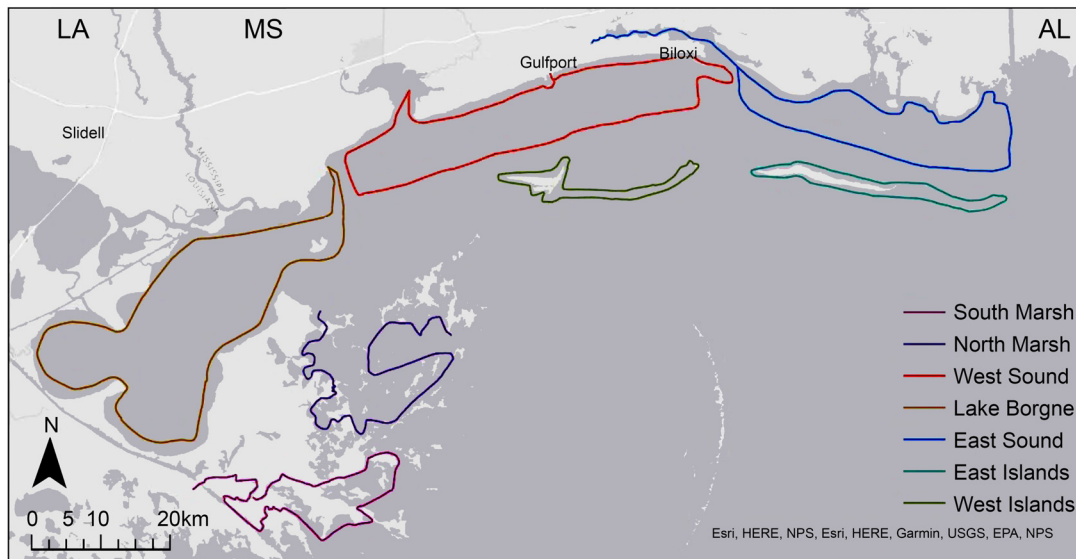


Figure 3. Seven photo-ID survey routes followed monthly and conducted by the Institute for Marine Mammal Studies (figure adapted from Pamperin *et al.*, 2025).

by a crew member. Initial sighting coordinates were marked on a Garmin GPSMAP 86sci Marine Handheld GPS. Using Canon EOS cameras (R5) and telephoto lenses (100–500 mm), a minimum of two trained photographers took high-quality photographs of each individual dolphin's dorsal fin and exposed body. When possible, photographers attempted to take photos of both sides of each individual. Depth and final GPS coordinates were recorded at the point of termination for each sighting. All survey data were entered and managed in FinBase v.2 (Adams *et al.*, 2006).

### Photo processing: identifying individuals

Photographs of individual dorsal fins were scored by photo quality (PQ) and distinctiveness (D), as outlined by Urian *et al.* (2014). Photographs with a PQ of 1 or 2 ('excellent' or 'good,' respectively) and a D score of 1 or 2 ('very distinct' or 'moderately distinctive,' respectively) were used for analysis. The contrast of each image was then increased using *Adobe Bridge versions* 11.1, 13 and 14 before being analysed with fin matching software for identification.

Darwin version 2.22 (Wilkin *et al.*, 1998) was used to match fins from the survey photographs to the catalogue of identified dolphins from 2010–21. After 2021, matches were made using artificial intelligence software, *FinFindR* version 0.1.10 (Thompson *et al.*, 2019). Each individual fin was then linked to the specific spatial, environmental and behavioural information associated with that trip and sighting.

### Photo processing: visual information and characterisation of wounds

Survey photos were examined for any visual anomalies present on the exposed skin of each dolphin, particularly wounds or scars consistent with those inflicted by cookiecutter sharks. Cookiecutter shark bites are characterised by the removal of an oblong or circular bite plug (Jones, 1971; Compagno *et al.*, 2005; Grace *et al.*, 2023). The remaining laceration or scar is a round or oblong crater with relatively smooth edges and grooves resulting from tooth imprints (Compagno *et al.*, 2005; Su *et al.*, 2022; Grace *et al.*, 2023). The healing process of these wounds works from the periphery towards the centre, resulting in a remaining scar that is a similar shape to the original wound (Su *et al.*, 2022). Any photograph of a laceration or scar matching these descriptions was isolated for further review.

Photos of stranded animals recovered by the Institute for Marine Mammal Studies' Stranding Team were also examined for wounds consistent with cookiecutter shark bites. At each stranded animal response, coordinates of each stranded animal location, as well as detailed body photos, were recorded. Photos of all scars, injuries and wounds were taken with a scale bar to appropriately examine and measure in post analysis. Lacerations

were further examined, measured and photographed during necropsy. All field and necropsy photos from January 2010 to November 2024 were assessed for any wounds consistent with cookiecutter shark bites by experienced stranding technicians. In the case of four stranded pantropical spotted dolphins (*Stenella attenuata*), these wounds were characterised on-site by a veterinarian and pathologist at the time of their necropsy.

Each potential case was then classified as consistent with a cookiecutter shark bite or dismissed by a team of highly trained individuals comprising trained research technicians, a veterinarian specialising in marine mammal medicine, a marine mammal researcher with 30 years of experience, and a shark expert who has worked extensively with cookiecutter sharks. Any cases that were of questionable origin, whether due to wound characteristics or photo quality, were not included in the analysis. Any stranded animal case with excessive epidermal and dermal sloughing or advanced necrosis was also excluded, due to possible alteration of the presentation of wounds. Each identified case was then classified by the healing stage of the bite, as outlined by Su *et al.* (2022), based on the bite's macroscopic properties: Stage 1: fresh/recent/immature wound; Stage 2: initiation of healing process, no presence of granulation tissue; Stage 3: mature open wound with granulation tissue; Stage 4: immature healed wound with cellular and vascular blubber; Stage 5: mature healed wound without any cellular or vascular blubber (Su *et al.*, 2022) (Fig. 4). Each case was then described pathologically by a veterinary team in necropsy reports. These reports included the size of the wounds, the depth of penetration, and gross description of healing pattern and shape when applicable. The complete healing time for blubber-penetrating wounds has been described as ranging from two weeks to two months (Sprogis *et al.*, 2018; Su *et al.*, 2022).

## Data analysis

Bathymetry data was downloaded from NOAA's National Centers for Environmental Information for the study area and surrounding waters (National Centers for Environmental Information, n.d.). These data were uploaded to and analyzed in *ArcGIS Pro 3.1.2*. Depth contour lines were defined for every 100 m of depth. Spatial data for each live dolphin with wounds or scars consistent with cookiecutter shark bites was then overlaid on top of depth contour data. Any dolphin with five or more sightings in non-consecutive seasons was considered to have site fidelity according to Pamperin *et al.* (2025).



Figure 4. Cookiecutter shark bites of various healing stages (top left: Stage 3; top right: Stage 4; bottom left: Stage 4; bottom right: Stage 5).

## RESULTS

### Photo-identified dolphins

#### *Healing stage and sighting histories*

Twelve live bottlenose dolphins were identified as having wounds consistent with cookiecutter shark bites (Table 1, Fig. 5). Of these, four were classified as healing Stage 5, four as Stage 4, and four as Stage 3. No dolphins were identified as having wounds in healing Stages 1 or 2. A majority of the dolphins analysed in this study were individuals who had not previously been identified within the study area and were not seen again within the study period ( $n = 10$ ). Two dolphins with cookiecutter shark bites were previously identified in the Mississippi Sound: dolphin labels ID\_2024 and ID\_3015.

Dolphin ID\_2024 was the only animal identified as having site fidelity, with 11 sightings around the Mississippi barrier islands since June 2013 (Fig. 6). The longest duration between these sightings was three years, three months and 16 days (16 October 2018–31 January 2022), and the shortest duration was 31 days (average 360.73 days, median 237 days). ID\_2024 was seen in each of the four seasons at least once across this 10-year period (e.g., 26 January 2014, 4 April 2014, 6 July 2017, 16 October 2018), indicating some degree of residency within

Table 1  
Total identified cookie-cutter bites classified by healing stage and season first identified.

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Totals
Winter	0	0	2	1	1	4
Spring	0	0	2	3	1	6
Summer	0	0	0	0	2	2
Fall	0	0	0	0	0	0
<b>Totals</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>12</b>



Figure 5. All identified Cookiecutter shark bites confirmed by the review team.

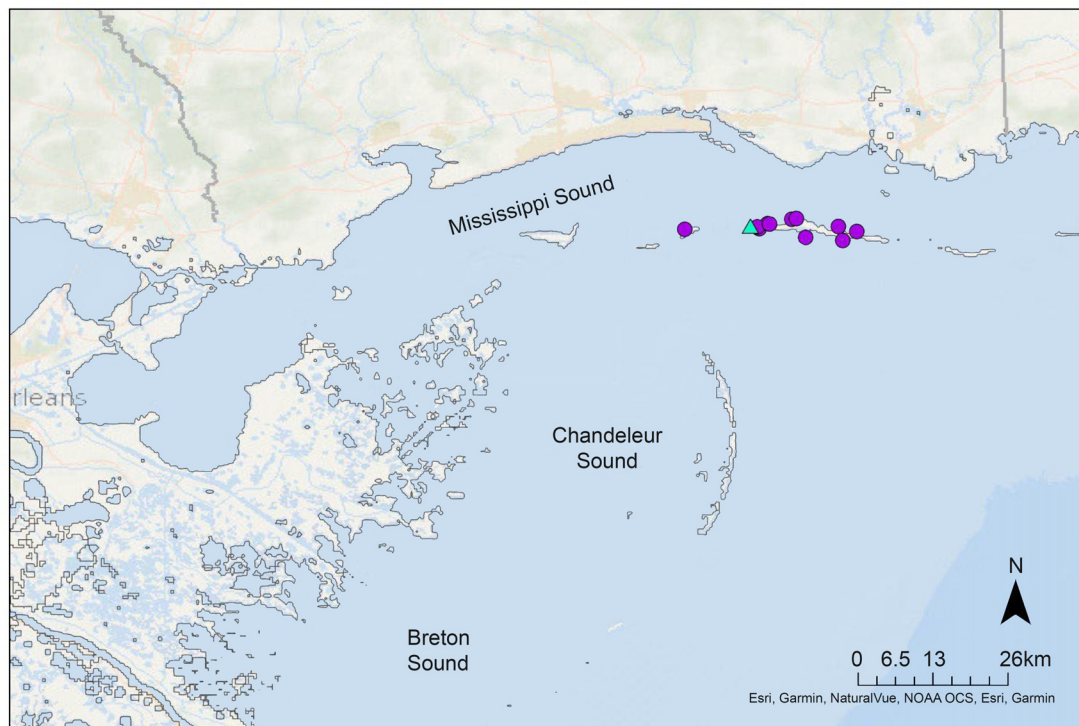


Figure 6. ID\_2024 sightings around the barrier islands before Cookiecutter bites (circles) and at the point at which the Cookiecutter bite was identified (triangle).

this area. A cookiecutter shark bite wound was recorded on ID\_2024 on 14 April 2024, with its last unwounded sighting 131 days prior (5 December 2023), indicating that the wound was, at maximum, 130 days old. The wound was classified as healing Stage 3, indicating that this wound was likely inflicted less than 90 days prior to sighting (Sprogis *et al.*, 2018).

ID\_3015 was not identified as having site fidelity in our conservative definition. However, this individual was seen three times within the study period. ID\_3015 was last seen on 16 December 2018 as an adult, then seen again on 20 April 2024 with a Stage 5 cookiecutter shark bite. Because the bite had healed, it was not possible to determine when it may have been inflicted during this period of over five years.

All dolphins with cookiecutter shark bites were sighted at the barrier islands (East and West Islands survey routes) or in the South Marsh route (Fig. 7). These regions within the study area are the closest to the 200 m minimum depth for cookiecutter shark habitat (Best & Photopoulou, 2016). The dolphin sighted closest to cookiecutter shark habitat was located 106 km from a depth of 200 m on the eastern edge of the South Marsh route (Fig. 7).

### Seasonal trends

Unhealed lesions consistent with cookiecutter shark bites varied significantly across seasons, with more being seen in winter and spring months (chi-square = 9.00, p-value = 0.03). All eight dolphins with healing wounds were seen in the winter or spring months between December and April, suggesting that this is the period in which they return from deeper waters. Cookiecutter shark bites on live dolphins, regardless of healing stage, were also significantly more likely to be seen in winter and spring months than in summer or autumn (December to February and March to May; Chi Square = 5.33, p-value = 0.02, Fig. 8), including those on identified dolphins ID\_2024 and ID\_3015. This peak in the winter and spring is the opposite of trends in dolphin abundance, which are highest in the summer and autumn (Fig. 8).

## Stranded dolphins

### Bottlenose dolphins

Five stranded bottlenose dolphins were identified as having wounds consistent with cookiecutter shark bites. However, three of those dolphins were classified as 'advanced decomposition' and were excluded from analysis.

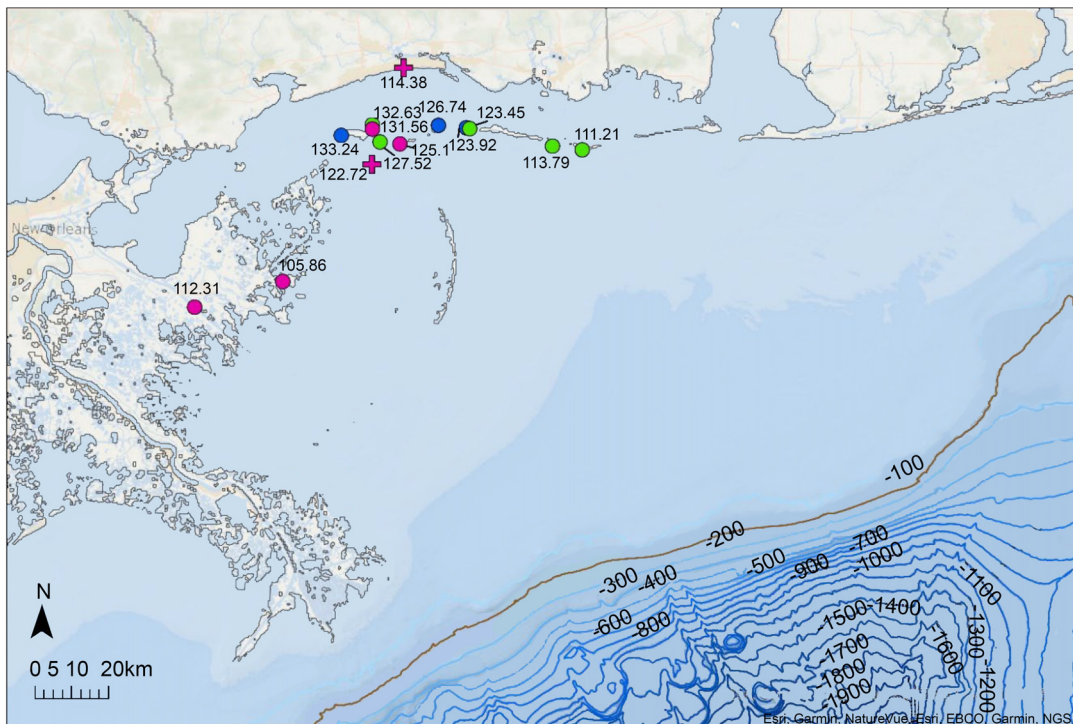


Figure 7. Sighting locations of live (circles) and stranded (cross) bottlenose dolphins with Cookiecutter bites and their respective distances from the 200m drop-off (pink = Stage 5; green = Stage 4; blue = Stage 3).

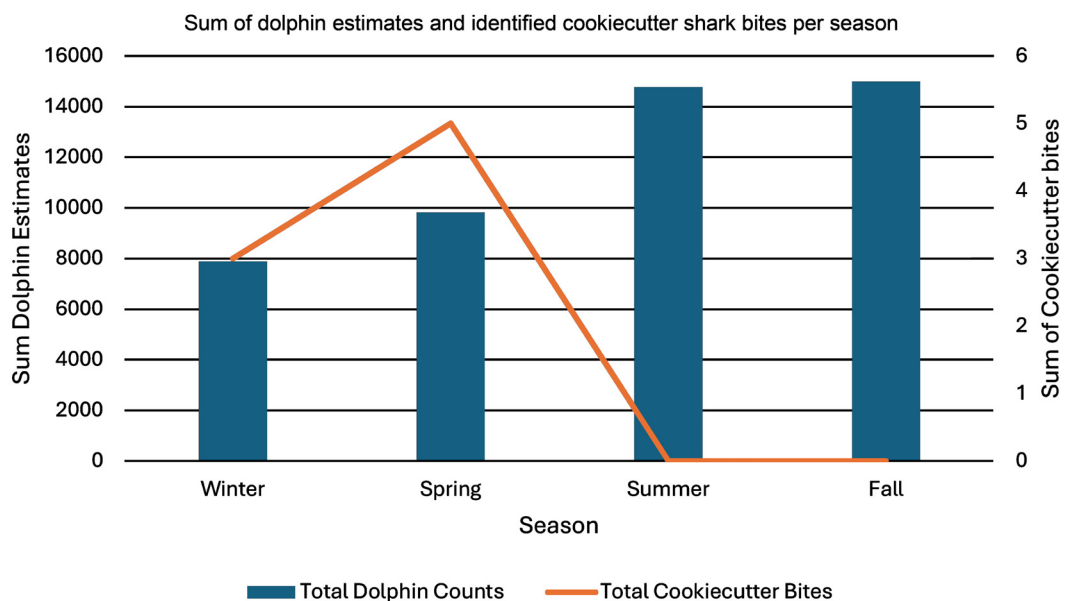


Figure 8. Sum of dolphin counts per season from January 2010 to October 2024 with the total number of unhealed Cookiecutter shark bites observed within this period per season.

The remaining two stranded dolphins with cookiecutter shark bites were classified as Stage 5. Lacerations on stranded dolphins ranged from 3.6 – 4 cm in diameter across the longitudinal axis. Scarred, Stage 5 lacerations were described as oval, circumscribed scars, with a starburst healing pattern and pigmentation similar to the surrounding, unharmed tissue. These two stranded dolphins were labeled as Codes 2 and 3, freshly dead and moderately decomposed respectively.

### *Pantropical spotted dolphins*

Four pantropical spotted dolphins stranded within the study area in November of 2024. These pantropical spotted dolphins are outside our population of interest but were used to confirm the origin and identification of wounds

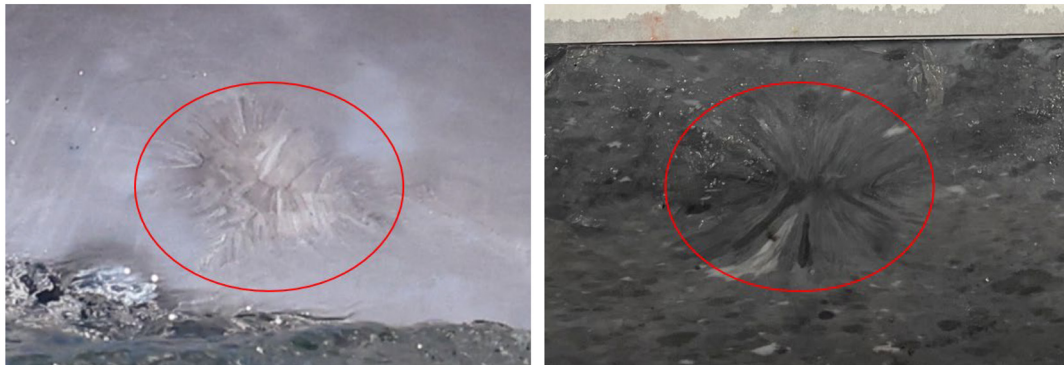


Figure 9. Cookiecutter bite wounds on live common bottlenose dolphin (left) and stranded pantropical spotted dolphin (right).

on the bottlenose dolphins (Fig. 9). Two of the pantropical spotted dolphins had multiple wounds consistent with cookiecutter shark bite wounds and with the wounds described on the bottlenose dolphins. All pantropical cookiecutter shark bite wounds ( $n = 7$ ) were described as healed circumscribed wounds with a radial healing pattern, ranging in size from 2.5–5.5 cm in diameter across their widest point. Individual ID\_027 had four bites in total, located along the left lateral flank ( $n = 1$ ), right lateral flank of midline cranial to the dorsal fin ( $n = 2$ ), and the right lateral flank in the caudal third of the body ( $n = 1$ ). Individual ID\_028 had three bites in total, located along the right ventral mid abdomen ( $n = 2$ ) and along the right lateral flank in the caudal third of the body ( $n = 1$ ). Palpation of lesions revealed penetration down to subcutaneous tissue.

## DISCUSSION

Twelve live and two stranded bottlenose dolphins in the Mississippi Sound were identified with cookiecutter shark bites. These data suggest that at least some of the bottlenose dolphins that use the area delineated for the Mississippi Sound stock likely spend part of their lives offshore. Furthermore, the expectation of cookiecutter sharks remaining in depths of  $> 200$  m suggests that these dolphins crossed multiple stock boundaries: from the Mississippi Sound stock area to the Northern Coastal stock, the Continental Shelf stock, and the Oceanic stock areas.

All previous sightings of the bottlenose dolphins with cookiecutter shark bites were in the barrier islands and South Marsh survey routes. The barrier islands routes and South Marsh are the southernmost survey routes within the study area and lack any physical barrier to dolphin movements offshore. A relatively short-term study (three years) suggested that the barrier islands have the highest proportion of transient dolphins in the Mississippi Sound area (73.5%; Mackey, 2010). However, a recent, long-term site fidelity study (10 years) reported that this area had the highest percentage of dolphins exhibiting site fidelity of any region within the study area (Pamperin *et al.*, 2025). Together, these data suggest a pattern of high site fidelity but with large scale movements.

One example of these movements can be seen through ID\_2024, who had an extensive sighting history in the Mississippi Sound, beginning almost 11 years prior to acquiring a cookiecutter shark bite. Because this cookiecutter shark bite was categorised as Stage 3, it most likely occurred within two months prior to wound identification (Sprogis *et al.*, 2018). The most likely explanation is that this adult dolphin maintains a core area that includes the barrier islands in addition to using offshore areas of the Gulf of Mexico.

The frequency of unhealed cookiecutter shark bites varied significantly by season (Chi-square = 9,  $p$ -value = 0.03). Dolphins were more likely to be spotted with unhealed cookiecutter shark bites in the winter and spring, especially during April. These data correspond with the shift in seasonal abundance estimates offered by Miller *et al.* (2013): the lowest dolphin abundance in the Mississippi Sound occurs in the winter months, and dolphins begin moving back into this area for the spring calving season (Fig. 8). Our data support the hypothesis proposed by Miller *et al.* (2013) that dolphins move offshore for these colder months. In addition, all cookiecutter shark bites, regardless of healing stage, were significantly more likely to be seen in winter and spring months than summer and autumn months (Chi-Square = 5.33,  $p$ -value = 0.02; Fig. 8). While it cannot be determined when healed wounds were inflicted, this further supports the hypothesis that transient animals start returning to the

Sound during these months, as healed bites are an indicator of offshore movement previously in the animals' life history.

Morphological characterisations of cookiecutter shark bite wounds on the pantropical spotted dolphins were the same as both the live and stranded bottlenose dolphins analysed in this study. Pantropical spotted dolphins are known to be an offshore species that occupy deep water, with ranges that consistently overlap with the known habitat of cookiecutter sharks (Grace *et al.*, 2018). They have been documented as having the highest instances of cookiecutter shark bites of any cetacean studied in the Gulf of Mexico (Grace *et al.*, 2018). The evidence of cookiecutter shark predation in the deep waters beyond the study area supports our findings.

The frequency of cookiecutter shark bites presented is likely a minimum estimate due to the opportunistic nature of photo-ID methodologies. A majority of the photographs taken were of the dorsal surface of the body from the melon to the dorsal peduncle. Therefore, these results likely underestimate bite occurrence and, likewise, underestimate the amount of movement across stock boundaries. Future research should aim to evaluate dolphin movements both between and within stocks, specifically the Mississippi Sound stock in the northern Gulf of Mexico.

It is possible that cookiecutter shark ranges extend into shallower waters than previously thought. While the literature clearly documents cookiecutter sharks restricting their range to deep waters > 200 m with vertical migrations, there are rare reports of cookiecutter sharks in shallow waters. One event documented three fresh cookiecutter shark bites on a cobia caught in 30 m of water, thought to be the result of opportunistic feeding by a cookiecutter shark on a prey item caught in a net (Wakida-Kusunoki, 2024). However, it is unlikely that the bites reported here are due to the movement of cookiecutter sharks given, firstly, the low proportion of wounded individuals, and, secondly, the distance between the 200 m isobath and the location at which these bites were identified within the study area (Fig. 7). In order for these bites to have occurred within the study area, the cookiecutter shark(s) responsible would have had to travel a minimum of ~105 km inshore, in addition to the distance travelled upwards into shallow water from their 200 m depth during the day. It is much more likely that these bites are evidence of dolphin movement, particularly considering the estimated age of the bite wounds, with no Stage 1 or Stage 2 open wounds observed. It is also possible that the two stranded bottlenose dolphins and pantropical spotted dolphins with cookiecutter shark bites washed in from offshore areas. However, the pantropical spotted dolphins were thought to be out-of-habitat and stranded alive in this area, and the stranded bottlenose dolphins were thought to have been alive within the sound prior to death. As a result, it is unlikely that these animals washed in due to the distance needed for the carcass to travel, the decomposition stage and the natural barriers (e.g., hydrology, land masses, etc.) exhibited by the Mississippi Sound.

The presence of cookiecutter shark bites on the bodies of bottlenose dolphins in the Mississippi Sound demonstrates that certain individuals seen in this area, including at least one with an extensive sighting history, have crossed multiple stock boundaries. While Vollmer *et al.* (2021) suggest a homogeneous population, their study only extends up to the 200 m isobath. Recent findings by Arick *et al.* (2024) suggest multiple subpopulations within the Mississippi Sound, which would explain differential habitat use by these animals. This study provides evidence for movement of these animals beyond the boundaries of previous studies (beyond the 200 m isobath) and provides additional information for consideration when delineating stock boundaries.

Using natural markings and interactions between a species of interest (in this case, dolphins) and a species with a restricted range (cookiecutter sharks) allows for inferences to be made about how these animals use offshore areas. Because the offshore waters of the Gulf of Mexico are not highly accessible for study, these natural interactions provide valuable insights into the movement ecology of dolphins in and out of the Mississippi Sound. In addition, this methodology is a non-invasive method of understanding broad, general movements of dolphins spotted within the area.

Understanding dolphin ranges and movements is difficult due to humans' inability to fully access the marine environment and extend studies beyond small regions. As a result, little is known about larger-scale dolphin movements and interactions within and between species. Using data from photo-ID, researchers have evidence of species interactions that can assist in evaluating spatial habitat use by bottlenose dolphins. These data can also be used to more accurately describe dolphin stocks and evaluate their delineations. While it cannot be

determined if these individuals are interbreeding with individuals of multiple stocks, our results provide evidence that current dolphin stock delineations in the northern Gulf of Mexico may not encompass the full spatial extent of their habitat use. As a result, local events, such as freshwater diversions, have a broader impact on the Gulf of Mexico bottlenose dolphin populations. The results of this study provide new information concerning how dolphins may use the northern Gulf of Mexico and new insight into how stock delineations can be evaluated.

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