Common Bottlenose Dolphins At Risk Of Bycatch

Posted on October 10, 2018

Bottlenose dolphins are among the most familiar marine mammals living along the coast of North Carolina. They are frequently seen in estuaries, sounds, bays, beaches, and nearshore waters. Their presence makes them an important part of the state's coastal environment and economy, but it also places them in direct contact with commercial and recreational fishing activity.

One of the most serious human-related threats to these dolphins is incidental capture in fishing gear, commonly known as bycatch. Dolphins may become entangled in gillnets while trying to capture fish, following prey, approaching fishing vessels, or swimming through areas where nets are deployed. Because dolphins must surface to breathe, entanglement can cause serious injury or death.

For broader context, see Characteristics Of The Bottlenose Dolphin.

Research using North Carolina stranding records has shown that fisheries interaction is not distributed equally across all dolphins. Age and season strongly influence risk. Older calves and subadults appear to be especially vulnerable, while risk also changes across different fishing periods and management regimes.

The Common Bottlenose Dolphin

The common bottlenose dolphin (*Tursiops truncatus*) is a highly social and adaptable marine mammal. Bottlenose dolphins live in coastal and offshore waters throughout temperate and tropical regions. They use sound for communication and echolocation and feed on fish, squid, and other marine organisms.

Dolphins living near the coast often form small groups that change in membership according to feeding, reproduction, age, and social relationships. Adult females may remain in relatively stable social networks, while males may form long-term alliances. Calves stay with their mothers for several years and learn important behaviors such as navigation, prey selection, and feeding.

Bottlenose dolphins are protected in the United States under the Marine Mammal Protection Act. The law generally prohibits taking marine mammals, but incidental mortality may still occur in commercial fisheries operating under federal management systems.

Dolphin Stocks in North Carolina

The term “stock” refers to a management unit of animals that share a common range, population identity, or pattern of movement. Several bottlenose dolphin stocks use North Carolina waters. These include migratory coastal dolphins and more localized estuarine animals.

The most relevant groups include the northern migratory coastal stock, southern migratory coastal stock, and several estuarine stocks. Some dolphins move through North Carolina seasonally, while others remain in specific sounds or coastal areas throughout much of the year.

This overlap complicates conservation because dolphins from several stocks may encounter the same fishing gear. A carcass recovered on a beach may also have drifted before stranding, making it difficult to identify the precise location and fishery involved.

What Is Fisheries Bycatch?

Bycatch occurs when an animal that is not the intended target of a fishing operation is accidentally captured or harmed. Marine mammals, sea turtles, seabirds, and non-target fish may all become bycatch.

For bottlenose dolphins, gillnets are one of the most important sources of concern. Gillnets are walls of mesh placed in the water to catch fish by their gills. Dolphins may fail to detect the net, approach it while chasing fish, attempt to remove captured prey, or become trapped while swimming nearby.

Entanglement can cause drowning, deep cuts, broken bones, infection, or loss of fins. Some dolphins escape but carry scars that indicate previous interaction with fishing gear.

Evidence From Stranded Dolphins

Directly observing dolphin bycatch is difficult because fishing operations occur across large areas, observer coverage is limited, and many deaths happen underwater. Stranded carcasses therefore provide an important source of evidence.

North Carolina has maintained systematic marine mammal stranding records since the early 1990s. Trained responders examine carcasses, record location and condition, photograph injuries, perform necropsies when possible, collect samples, and assess whether human interaction contributed to death.

Byrd and Hohn (2017) used these records to investigate which bottlenose dolphins faced the greatest risk of fisheries interaction. Their study analyzed strandings from January 1997 through December 2012.

Human Interaction Categories

Stranded dolphins were classified into three general categories:

- Fisheries interaction: Evidence suggested entanglement or another interaction with fishing gear.
- No evidence of human interaction: The carcass was sufficiently complete and examined in enough detail to determine that human involvement was not observed.
- Could not be determined: The body was too decomposed, incomplete, or poorly documented to make a reliable assessment.

Evidence of fisheries interaction included net impressions, cuts or constrictions around the body, severed appendages, wounds consistent with entanglement, gear still attached, or other documented signs.

The “could not be determined” category was large because marine carcasses decompose quickly, are scavenged, or may wash ashore incomplete. This is one of the major limitations of stranding-based research.

Study Population and Sample Size

During the 16-year study period, 1,368 bottlenose dolphin strandings were recorded in North Carolina.

Of these:

- 229 were classified as fisheries interaction
- 316 had no evidence of human interaction
- 823 could not be determined

The researchers excluded cases without complete information about age class, sex, location, or season. They also excluded strandings connected to unusual mortality events and offshore bottlenose dolphins that were not part of the coastal population being studied.

The final statistical analysis included 361 dolphins:

- 191 fisheries-interaction cases
- 170 non-human-interaction cases

These records provided a sufficiently large sample to test how age, sex, season, geographic area, habitat, and management period were associated with relative bycatch risk.

Age Classification

Researchers divided the dolphins into three age groups based on total body length:

- Young-of-year: Calves in approximately their first year of life
- Older calves and subadults: Immature dolphins older than young-of-year but not yet fully adult
- Adults: Sexually mature dolphins

Male and female dolphins grow at different rates and reach different adult sizes, so the study used sex-specific length thresholds where appropriate.

This classification was central to the research because younger dolphins differ from adults in behavior, experience, feeding strategies, and physical development.

Three Management Time Periods

The 16-year study was divided into three periods based on major changes in fishing effort and federal regulation.

Time Period 1: 1997 to October 2000

This period occurred before the major reduction in the North Carolina spiny dogfish gillnet fishery. Fishing effort was comparatively high, and dolphins had greater exposure to gillnets targeting spiny dogfish and other species.

Time Period 2: November 2000 to April 2006

Spiny dogfish fishing effort declined sharply after November 2000. Earlier research documented a corresponding decline in observer-recorded bottlenose dolphin bycatch and entanglement-related strandings.

Time Period 3: May 2006 to December 2012

This period began when regulations under the Bottlenose Dolphin Take Reduction Plan were implemented. The plan imposed measures on gillnet fisheries and other fishing practices intended to reduce dolphin injury and mortality.

Comparing these periods allowed researchers to examine whether changes in fishing effort and regulation were accompanied by changes in relative bycatch risk.

Statistical Analysis

The study used generalized linear models to determine which characteristics predicted whether a stranded dolphin would show evidence of fisheries interaction.

The main variables were:

- Age class
- Sex
- Season
- Geographic area
- Habitat type
- Management period

Before including variables together in one complex model, the researchers first tested variables separately. Factors that showed statistically meaningful relationships were then considered in the generalized linear model.

This approach allowed the researchers to evaluate whether the observed pattern was associated with age, sex, season, location, habitat, or management period rather than relying only on raw counts.

Age Was the Strongest Predictor

Age class was the clearest predictor of fisheries-interaction risk. Older calves and subadults were significantly more likely to strand with evidence of fisheries interaction than adults or young-of-year dolphins.

Depending on the season, a stranded older calf or subadult was approximately 1.5 to 3.5 times as likely to show evidence of fisheries interaction as a stranded adult or young-of-year animal. The difference remained significant even after sex was considered in the statistical model.

This finding is particularly important because older calves and subadults have already survived the earliest stage of life, when natural mortality tends to be highest. Under normal conditions, dolphins that survive the first years of life should enter a period of comparatively lower natural mortality. The authors concluded that fishery-related mortality among these age groups “appears to exceed natural mortality,” at least according to the stranding evidence available (Byrd & Hohn, 2017, p. 564).

Several explanations may account for their increased vulnerability. Young dolphins may:

- Have less experience identifying or avoiding nets
- Explore unfamiliar objects or fishing operations
- Be developing independent feeding strategies

- Remain near their mothers while also moving more independently
- Attempt to capture fish concentrated around nets
- Learn depredation behavior from other dolphins
- Lack the body strength or experience required to escape entanglement

These explanations remain hypotheses. The study did not follow identified free-swimming dolphins to determine exactly how individual behavior changed with age. It established a pattern in recovered strandings rather than directly observing the events that caused each entanglement.

Season Also Influenced Risk

Season was another significant predictor. The statistical analysis found that bycatch risk was higher in spring than in summer. Differences between other seasonal comparisons were not statistically significant.

Seasonal patterns likely reflect changes in both dolphin distribution and fishing activity. Different fisheries operate at different times of the year, and target species move according to temperature, reproduction, and prey availability. Dolphins also change their movements and feeding behavior seasonally.

Spring risk may therefore rise when particular dolphin stocks overlap with gillnet fisheries targeting species such as spiny dogfish or other coastal fish. The study's finding does not mean that bycatch occurs only in spring. Fisheries-interaction strandings were recorded throughout the year, but the relative probability differed among seasons.

Sex Did Not Determine Bycatch Risk

More male than female dolphins were recovered during the combined second and third study periods. However, sex did not significantly predict whether a stranding would show evidence of fisheries interaction.

This distinction is important. A larger number of male strandings does not necessarily mean that male dolphins are more likely to become entangled. The higher number may reflect sex differences in the population, behavior, distribution, natural mortality, or the likelihood of a carcass reaching shore.

When age and sex were considered together, age remained statistically significant while sex did not. Both male and female older calves and subadults showed the elevated fisheries-interaction pattern.

Geographic Area Was Not a Reliable Predictor

Initial comparisons suggested differences among geographic areas. However, one area contained only a small number of strandings. When that area was removed to test whether the result was caused by its limited sample size, the geographic effect was no longer statistically significant.

The researchers therefore concluded that area was not a reliable predictor of bycatch risk in the final analysis. This was somewhat unexpected because dolphin abundance and gillnet effort differ along the North Carolina coast.

One possible explanation is that several dolphin stocks and fisheries overlap across multiple regions. Carcasses can also move with tides and currents before being recovered, meaning that the stranding location may not be the location where the animal became entangled.

Changes Across the Three Time Periods

Bycatch risk differed significantly among the three management periods. It was higher during TP1 than TP2. This decrease coincided with regulations that sharply reduced the North Carolina spiny dogfish gillnet fishery beginning in November 2000.

The result is important because it suggests that reducing fishing effort in a high-risk fishery can reduce dolphin mortality. Previous studies had similarly found that declining spiny dogfish fishing activity was accompanied by reductions in observer-documented bycatch and strandings with entanglement evidence.

Risk increased slightly during TP3, although it was not statistically different from both earlier periods. The study proposed that renewed spiny dogfish activity may have contributed to this increase even after the Bottlenose Dolphin Take Reduction Plan was introduced. Two of four observer-documented North Carolina gillnet entanglements after 2009 involved gear targeting spiny dogfish. However, the study could not establish that increased dogfish effort directly caused the TP3 pattern.

The Bottlenose Dolphin Take Reduction Plan

NOAA Fisheries implemented the Bottlenose Dolphin Take Reduction Plan to reduce incidental mortality and serious injury in commercial fisheries along the western North Atlantic coast.

The plan includes measures such as:

- Seasonal gillnet restrictions
- Limits on the length of fishing gear
- Requirements concerning how close fishers must remain to their gear

- Restrictions on overnight gillnet sets in designated areas
- Gear modifications for particular pound-net fisheries
- Outreach and cooperation with the fishing industry

The plan was developed through collaboration among NOAA, commercial fishers, scientists, conservation organizations, fishery-management bodies, and state and federal agencies.

The North Carolina study does not prove that the plan failed. Fishing effort, target species, net size, soak duration, dolphin distribution, and observer coverage all changed during the study period. The authors concluded only that a slight increase in relative bycatch risk occurred during TP3 and that additional investigation was required.

Limitations of the Study

The findings should be interpreted as evidence of relative risk among recovered strandings, not as a precise estimate of the probability that any living dolphin will become entangled.

Several limitations are important.

First, only a proportion of dolphins that die at sea eventually strand and are recovered. Second, carcass condition affects whether injuries can be identified. Sixty percent of the original 1,368 strandings were classified as could not be determined.

Third, identifying a fisheries interaction may require only one recognizable lesion, while determining that no human interaction occurred requires a relatively complete and well-preserved body. This could influence comparisons between the two categories.

Fourth, the precise fishing gear responsible usually could not be identified. Dolphins in North Carolina interact with several fisheries, so a stranding with an entanglement wound cannot always be attributed to a particular target species or gear configuration.

Fifth, the analysis assumed that dolphins killed in fishing gear and dolphins dying from non-human causes were equally likely to strand. That assumption cannot be tested easily because currents, depth, weather, and cause of death may affect carcass recovery differently. Byrd and Hohn explicitly acknowledged these potential biases.

Conservation Significance

The loss of older calves and subadults may have long-term population consequences. Bottlenose dolphins reproduce slowly. Females carry a calf for approximately 12 months, nurse it for an extended period, and generally give birth only once every three to six years. Removing young dolphins before they reach reproductive maturity reduces the number that can later contribute to population growth.

This issue is especially important in North Carolina because several estuarine and coastal stocks use overlapping waters. Some local stocks contain relatively small numbers of dolphins, and even a limited amount of preventable mortality may be biologically significant.

NOAA's later Mid-Atlantic analysis demonstrated the difficulty of estimating total bycatch when observer coverage is low. From 2007 to 2015, observers documented only five bottlenose dolphin takes in commercial gillnet fisheries, yet model-based estimates suggested that actual mortality could be considerably higher. Observer coverage in some internal and state waters was extremely limited, reinforcing the value of stranding records as a complementary monitoring tool.

Ways to Reduce Dolphin Bycatch

Effective conservation should protect dolphin populations while recognizing the economic importance of coastal fishing communities. Potential strategies include:

Improving Observer Coverage

Greater coverage would provide more accurate information about when, where, and how entanglements occur. Electronic cameras and other monitoring systems may supplement human observers where appropriate.

Adjusting Fishing Seasons and Areas

Temporary restrictions can reduce overlap when dolphins and high-risk fisheries occur in the same location and season. The decline following reduced spiny dogfish effort suggests that such measures can be effective.

Limiting Net Length and Soak Time

Shorter nets and reduced soak times may allow fishers to detect and respond to entanglements more quickly. Gear left unattended overnight may pose a greater risk because trapped animals cannot be released promptly.

Developing Safer Gear

Researchers and fishers can test net modifications, acoustic warning devices, weak links, reflective materials, and alternative fishing methods. A successful modification must reduce dolphin injury without creating unacceptable economic losses or additional risks to other wildlife.

Preventing Dolphin Feeding

Members of the public should never feed wild dolphins or discard bait in ways that encourage animals to approach fishing vessels. Feeding changes natural behavior and may increase the likelihood that dolphins will steal bait or catch from fishing gear.

Supporting Stranding Networks

Rapid examination of stranded dolphins improves the quality of data. Networks require trained personnel, veterinary expertise, transportation, laboratory capacity, and long-term funding.

Working With Fishers

Fishers possess detailed knowledge of gear, currents, target species, and animal behavior. Conservation measures are more likely to be practical and effective when the fishing community participates in their development, testing, and evaluation.

Conclusion

Common bottlenose dolphins in North Carolina face a measurable risk of injury and death through fisheries bycatch, particularly in gillnets. Although direct observations of entanglement are uncommon, stranding records provide valuable evidence about the animals most affected and the conditions under which risk changes.

Between 1997 and 2012, 1,368 bottlenose dolphin strandings were recovered in North Carolina. Sixty percent could not be evaluated conclusively for human interaction. Among the remaining animals, 229 displayed evidence of fisheries interaction. After applying strict inclusion criteria, researchers analyzed 191 fisheries-interaction strandings and 170 strandings with no evidence of human involvement.

Age class was the strongest predictor. Older calves and subadults were approximately 1.5 to 3.5 times more likely than adults or young-of-year dolphins to strand with evidence of fisheries interaction. Spring presented a higher relative risk than summer, while sex and geographic area did not reliably predict bycatch after other factors and sample-size limitations were considered.

The decline in bycatch risk following the sharp reduction of the spiny dogfish gillnet fishery demonstrates that fishery-management measures can contribute to marine-mammal protection. At the same time, the slight increase observed after 2006 shows that conservation must be continuously evaluated as fishing practices, regulations, and dolphin distributions change.

Stranding data cannot reveal every entanglement or calculate total mortality precisely. However, they clearly indicate that fisheries interactions are an important source of human-caused mortality. Protecting bottlenose dolphins will require improved monitoring, carefully designed fishing regulations, safer equipment, strong stranding-response networks, public education, and sustained cooperation with commercial and recreational fishers.

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