Aquatic Mammals 2000, **26.3,** 196–201

Injury of an Indian Ocean bottlenose dolphin (*Tursiops aduncus*) in the Red Sea by a stingray spine

Ehud Spanier[1,2], Oz Goffman[1], Dan Kerem[1,2] and Kari Lavalli[3]

[1]*Israel Marine Mammal Research & Assistance Center (IMMRAC), the Leon Recanati Institute for Maritime Studies, University of Haifa, Mt. Carmel, Haifa 31905 Israel*
[2]*Department for Maritime Civilizations, University of Haifa, Mt. Carmel, Haifa 31905 Israel*
[3]*Department of Biology, Southwest Texas State University, 601 University Drive, San Marcos, TX 78666, USA*

Abstract

There are only rare reports on injuries inflicted by stingrays to dolphins, all of which are based on necropsies of dolphin carcasses. The present report is the first documented case that deals with stingray injury to a live bottlenose dolphin that recuperated from the sting. The injured animal is an adult female Indian Ocean bottlenose dolphin (*Tursiops aduncus*) that resides in the Gulf of Aqaba, Red Sea off a Bedouin fishing village in the Sinai Peninsula, Egypt. The spine extracted from the dolphin identified the injuring species. It was as a mature male darkspotted stingray (*Himantura uarnak*, family Dasyatidae), with an estimated disk diameter of 106 cm. The symptoms of the injury are described and the probable circumstances of the incident are discussed.

Key words: bottlenose dolphin, stingray, Red Sea.

Introduction

Every marine animal, even a sizable vertebrate such as a marine mammal, is subject to injury by other marine organisms. Stingrays (class Chondrichthyes, order Rajiformes) have developed a formidable defensive weapon against potential, large predators—the venomous barbed spine(s) near the base of their long tail. At present, nonetheless, most of the available information on stingray injuries are from human victims (e.g., Russell, 1959, 1961, 1965; Edmonds, 1975; Halstead, 1988, Edstorm, 1992); while there are only a few reports on injuries inflicted by stingrays to marine mammals in general, and to dolphins in particular, all of which were based on necropsies.

McLellan *et al*. (1996) reported on a stranding of a bottlenose dolphin, *Tursiops truncatus*, in North Carolina waters where the cause of death was ascribed to a perforation of the caudal vena cava by the spine of a southern stingray, *Dasyatis americana*. Walsh *et al*. (1988) summarized seven known encounters between bottlenose dolphins and stingrays in Florida. A stingray spine discovered within the carcass was considered by these authors to be a major factor in the death of the six animals. Three dolphins had spines located in the lung parenchyma, while in two others the spines punctured the lateral chest wall without entering the lung tissue. One dolphin contained a ray spine located in the liver tissue. Jenkins and Cardeilhac (1982) recovered a spine covered with calcified deposits that perforated the small intestine of a bottlenose dolphin. They suggested that the spine was imbedded within the dolphin for a considerable period. The present report is, to our knowledge, the first documented case that deals with stingray injury to a live bottlenose dolphin that recuperated from the sting.

Materials and Methods

The subject of the present report is an adult female Indian Ocean bottlenose dolphin (*Tursiops aduncus*) that in the spring of 1994, took up a daytime residence in the Gulf of Aqaba, Red Sea, off the Bedouin fishing village of Nuweiba M'zeina in the Sinai Peninsula, Egypt. (Fig. 1) She was dubbed 'Holly' by the first European tourists and 'Oleen' by the local residents. During daytime hours, except for very rare observations of short associations with 1–5 unidentified individual dolphins, Holly leads a solitary existence.

She established a very narrow 'daytime home range' of $\sim$30,000 m^2, in fairly shallow water ($\leq$5 m depth), just beyond the fringing reef in front of the fishing village. The site is comprised predominantly of a sandy bottom with scattered old tires and a few patches of coral outcroppings and eelgrass (*Halophila stipulacea*). Approximately 500 m south of this site, at a depth of 15 m, there is a larger reef that supports a good fish population.

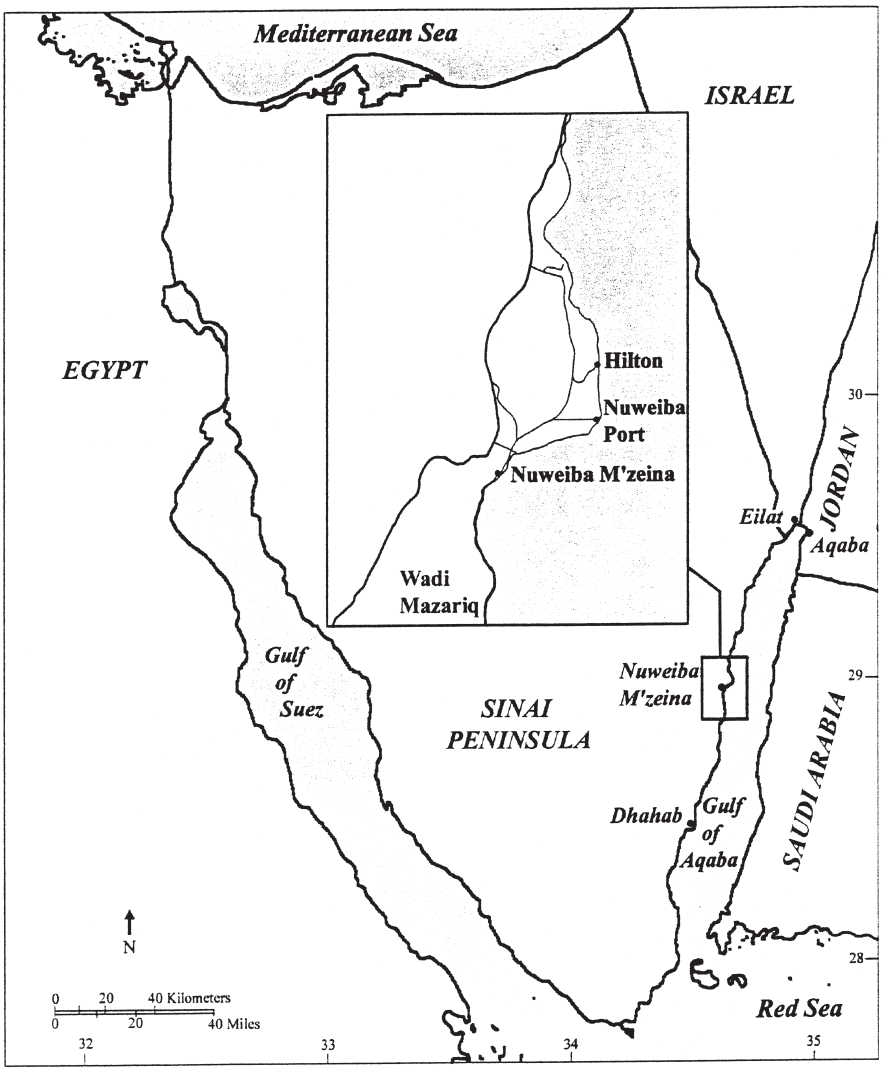

Figure 1. Map of the study site.

Water temperature ranges from 20°C in the winter to 22°C in the summer. During some particularly hot days in the summer, the temperature in the very shallow water can rise to 28°C. She occasionally was sighted moving east into deeper water, but never for long periods (more than ~3 days). Her whereabouts during nights are unknown.

The interactive behavior of Holly with humans has been followed for the last 6 years, including two cycles of pregnancy and calf rearing, and documented by underwater video on a monthly basis (Goffman, 1997).

Since July 1994, Holly permitted (and later also initiated) body contact with humans, first with one particular Bedouin fisherman (Obaidallah Mehissan) and later with additional members of the Bedouin tribe, and visitors to the area. Measurements taken at that time showed her to be 2.41 meters long, with a body girth (in front of the dorsal fin) of 165 cm.

Her ready accessibility and the excellent underwater visibility enabled lengthy daily observations at close range of her physique and behavior (and subsequent detection of the stingray spine injury) by the two Bedouin fishermen who swim with her for hours every day and by the authors (mainly O.G.), via snorkeling and SCUBA diving, during their regular visits.

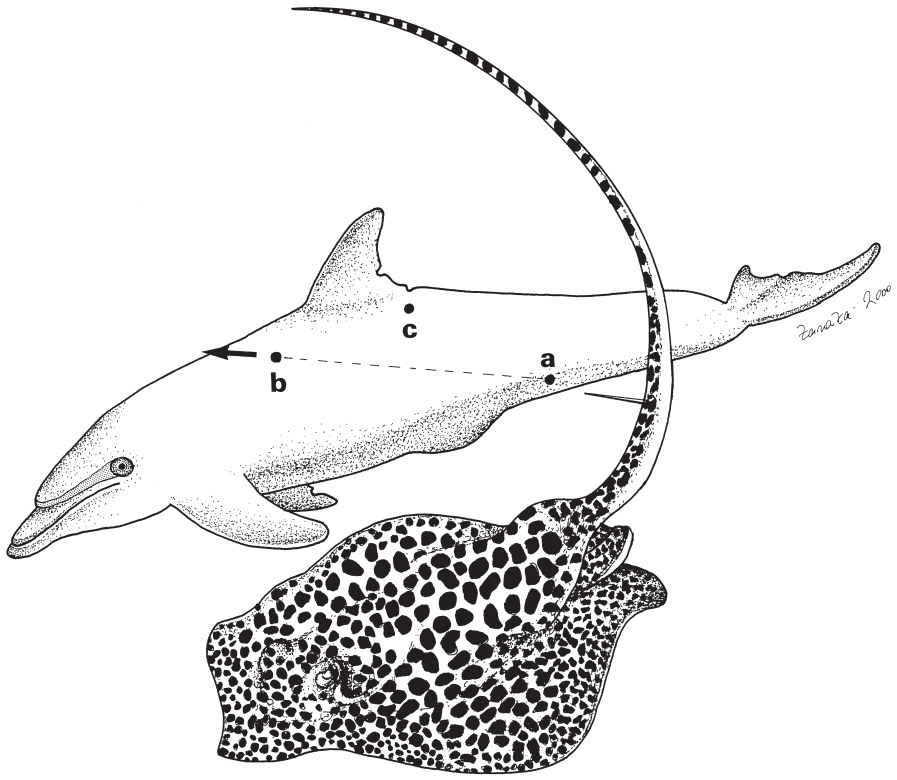

Figure 2. Schematic drawing of the hypothetical interaction between the female Indian Ocean bottlenose dolphin (*Tursiops aduncus*) and the darkspotted stingray *Himantura uarnak*, with the three wounds noticed (a–c). (Drawing by Z. Friedman.) Scale—1:10.

Between June 1994 and November 1999, Holly became pregnant and gave birth twice (two years apart) and reared male calves while maintaining contact with humans. Both calves died at exactly the same age—six months and 3 weeks.

Results

The following reconstruction is mainly based on information recounted by Susan Cossi-Burgess, a diving instructor operating from the nearby Hilton Hotel. The information from her and the fishermen seems very reliable since, in the last 6 years, our research team verified various reports on this dolphin from these individuals.

On 12 July 1997, Obaidallah Mehissan, who was most closely associated with Holly and spent the maximum time swimming with her on a daily basis, noticed some bleeding on the snout of Holly's 6-month-old calf, after he rubbed Holly's flank. Stroking the spot himself, Obaidallah felt a sharp scratch which, on close inspection, was caused by a white, 'bone like' object protruding from the dolphin's skin, on the upper left side of the body, just below the front edge of the base of the dorsal fin (Fig. 2b). After failing to extract the object with his fingers, he gripped the protruding end with his teeth and eased it out. The dolphin did not object to these activities.

The object was a 16.9-cm long spine of a stingray, which extruded tip-first, namely with the direction of insertion. The spine (Fig. 3) was handed over to O. G. and a picture of it was subsequently sent to Professor Frank J. Schwartz from the Institute of Marine Science, the University of North Carolina, Morehead City, NC, USA for identification. It was identified as the spine of a mature male darkspotted stingray (*Himantura uarnak*, family Dasyatidae), with an estimated disk diameter of 106 cm.

Interrogated by the diving instructor, who was present on the scene, the fisherman recalled noticing a deep penetration wound in her left ventral side, in front of and above the genital area (Fig. 2a) about 3 weeks before. Ever since the birth of the first calf, Holly started to accept dead fish given to her by the Bedouins (up to 8 kg per day). Previously, she only

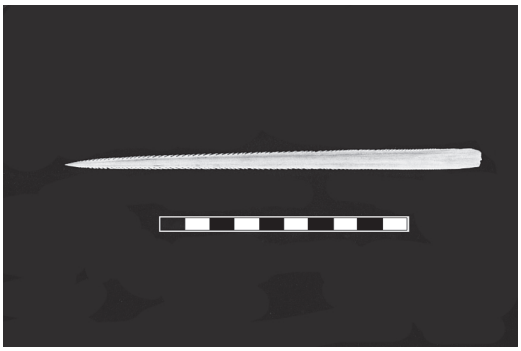

Figure 3. Spine of dark-spotted stingray, *Himantura uarnak*, removed from a dorsal wound in a female Indian Ocean bottlenose dolphin (Photo by Z. Friedman). Scale bar divisions are 1 cm.

accepted occasional live octopus offered her by the fishermen. The fisherman could fix the approximate date, since it was the first of six days in a row that the dolphin refused to eat at all. The same behavior was observed two days prior to the extraction of the spine.

No further unusual behavior was detected from 13 July onward, until the morning of 22 July when Holly's first calf died with no prior detection of any reduction or alteration in his activities. He was observed to regurgitate milk under water and then to sink to the bottom. The second and fourth authors (O. G. & K. L.) were summoned hastily and on the following day supervised a rather superficial on-site necropsy. The only obvious finding was vomited milk in the calf's breathing passages.

Upon checking Holly's body some 36 h after the death of her calf, O. G. & K. L. noticed three wounds, atypical to the superficial cuts and scars found regularly on dolphins' surface: a deep fresh one, at the site of spine removal (Fig. 2b) and two additional round scars of recuperating wounds—one in the ventral region, in front of the genital area (roughly agreeing with Obaidallah's description, Fig. 2a) and one ~30 cm behind the exit spot (Fig. 2c). The wounds' locations were later rechecked and pinpointed from the video footage taken that day. None of these wounds were apparent on the video sequences taken on the previous visit, 30 days before.

Discussion

The dark-spotted stingray, *Himantura uarnak*, which is the stinging animal in the present report, is a large dasyatid ray found in the Red Sea close inshore (Randall, 1992). The tail is very long and slender, at least twice the disc diameter in adults, and bears one or two venomous spines at a point 1/5 the length of the tail, from its base. The largest recorded specimen from Arabian waters had a 153 cm disk diameter, was 323 cm in total length (it was not specified if the tail was intact), and weighed 87 kg (Randall, 1995).

It is estimated that the specimen that injured Holly had a total length of ~320 cm and weighed ~60 kg. This species has invaded the eastern Mediterranean through the Suez Canal (Golani, 1996). It is usually found on sandy bottoms at depths of 0.5–10 m (Randall, 1992)—a habitat and depth distribution that coincides with Holly's home range. It is not uncommon to observe specimens of T. *aduncus* in the northern Red Sea close to shore (O. Goffman, personal observations). Holly and her calves, however, are exceptional by the permanent nature of inhabiting such shallow waters. Despite the fact that the dark-spotted stingray is known from the Mediterranean coast of Israel, there are no reports of injuries or mortalities by it or by autochthonous stingrays, that are also typical to sallow waters (Lythgoe and Lythgoe, 1992), to specimens of the two most common local dolphin species (*Tursiops truncatus* and *Stenella coeruleoalba*). While stingray wounds and even embedded spines could easily be missed on necropsy (Walsh *et al*., 1988), no evidence of stingray injuries were found in 88 cetaceans, including 56 specimens of *T. truncatus*, stranded or in by-catch along the Mediterranean coast of Israel during 1993–1999 (Roditi-Elasar, 1999). Twenty-two of those cetaceans, including 16 *T. truncatus*, were thoroughly dissected with no signs of stingray spines. How and why would an adult wild dolphin come in close contact with a stingray that could result in an injury? In their case of mortality of a bottlenose dolphin due to stingray injury, McLellan *et al.* (1996) suggested that the victim came in contact with the stingray while swimming and feeding in shallow near-shore waters, where stingrays abound (Schwartz, 1984). Scott *et al*. (1990) stated that dolphins in Sarasota Bay, Florida favored shallow water, less than 2 m deep during birthing and rearing young. They suggested that shallow areas apparently afford dolphin' calves protection from sharks and provide readily available prey for mothers during this energetically demanding period. This potentially makes female dolphins and especially lactating mothers in the first months of calf rearing more vulnerable to stingray injury. It is interesting to note that 3 out of 5 cases of wild dolphins wounded by stingray spines were mature females (Walsh *et al*., 1988).

Walsh *et al*. (1988) considered ingestion as a possible origin of ray spines. Dolphins could ingest members of the smaller ray species or swallow a spine they had found. Stomach contents of Indian Ocean bottlenose dolphins from the Natal region in

South Africa had remains of only one identified ray and rare instances of another unidentified elasmobranch (Cockcroft and Ross, 1990). Apparently, stingrays can be caught with impunity if properly approached and gripped from the front end, an area that they can not reach to retaliate with their spine bearing tail. Ingestion does not seem possible in the injury case of Holly, due to the large size of the stingray.

An alternative explanation offered by Walsh *et al*. (1988) was that bottlenose dolphins may 'pay for' their well known 'strong sense of curiosity'. Jones (1985) documented a group of 4 to 6 dolphins chasing and apparently 'teasing' small stingrays along the ocean floor in the Bahamas. Individual dolphins appeared to take turns diving at the fleeing rays, often turning on their sides when closing in on the ray being chased. Walsh *et al*. (1988) suggested that this behavior filmed by Jones' crew would explain the lateral chest wounds involved in the majority of the dolphins' mortality cases reported by them.

Curiosity or play hardly could explain the present case. While Holly frequently plays with animals and inanimate objects buried in the sand, both with her snout and flukes, it seems that this >20 years-old dolphin would have already learned to avoid a stingray twice her diameter. Also, the relative dimensions and locations of both alleged spine entry points would place her snout beyond the rostrum of the buried ray (Fig. 2). It could be that she disturbed the ray while trying to drive away her curious calf or to intercept his approach, and received the sting from below while swimming close to the ray. We assume that effective stings are only dealt when the ray can use the bottom as leverage.

Changes in the behavior of the dolphin in the days following the detection of the possible wound indicated that at least some toxic effect could have occurred. It should be pointed out that most stings, at least in humans, involve the double action of stabbing and wrenching out of the spine, which results in a wide, profusely bleeding gash, lined with shreds of the venomous sheath. This gash greatly facilitates venom entry to the blood stream, accentuating the short-term effects (thus, permitting a better cause-effect association by the victim), and allowing reuse of the weapon. Dislodgment of the spine and its embedment in the tissue could abate the immediate reaction and accentuate the long-term effects (Edmonds, 1975; Edstorm, 1992). Such long-term toxic effects could include a depressed appetite and lethargy (Halstead, 1988). Holly did show a depressed appetite suggestive of a toxic effect of the spine. Another possible reason for her loss of appetite would be a reaction to infection, which could explain her refusal to be fed after extraction of the spine.

If the penetration wound is the site in the posterior ventral region of the dolphin (Fig. 2a) and not the one behind the exit spot (Fig. 2c), which could be an older scar, than the spine migrated within several weeks from the ventral to the dorsal surface of the dolphin. Walsh *et al*. (1988) reported signs of migration of the stingray spines found in the necropsies of their dolphins. McLellan *et al*. (1996) also assumed migration of the spine in their report. A stingray spine can stay within a dolphin for a considerable period, as was suggested from the report of Jenkins and Cardeilhac (1982). However, the possible ventro-dorsal migration of the spine in the present case probably did not include passage through internal cavities. It is more likely that muscle action gradually advanced the retro-serrated spine in the direction of insertion (which coincides with the line connecting the entry and exit wounds) through the body wall (Fig. 2).

Finally, the death of the calf only 9 days after apparently being scratched by the tip of the spine, with implication of vomiting on the day he died (previous vomiting episodes could have passed unnoticed), leads one to speculate that the calf also was the victim of the stingray venom. Such toxins are known to cause vomiting at least in humans (e.g., Edstorm, 1992). However, the chance that the spine retained venom after the lengthy passage in Holly's body seems remote. One also could hypothesize that the calf received the venom through its mother's milk, although its affect via this route is not known. However, the subsequent death of her second calf at the same age suggests searching elsewhere for the cause of death of both calves.

Admittedly, the circumstances of this injury are speculative, as is the end result had the spine not been removed. Yet one can summarize this incident by acknowledging the fact that while some dolphin injuries by stingrays could prove lethal to the former, others could be relatively harmless. The size of the ray may not correlate with the severity of the reaction, as large and old individuals have a higher chance of losing the venom glands and the spine's protective sheath (Herald, 1971). Dislodged spines devoid of toxin, which do not invade body cavities, could transit the dolphin's body over long times and distances, apparently causing minimal symptoms.

Acknowledgments

We acknowledge the cooperation of the Bedouin fishermen Obaidallah Mehissan and Muhammed Salem Atwa and Susan Cossi-Burgess for their collaboration in obtaining information about the incident. Many thanks are due to Prof. Frank J. Schwartz, Institute of Marine Science, University of North Carolina, Morehead City for identification

of the species and the sex of the stingray from the spine and for the approximation of the dimensions of the stingray. We acknowledge Ms. Z. Friedman for the photography and the drawing.

Literature Cited

Cockcroft, V. G. & Ross, G. J. B. (1990) Food and feeding of the Indian Ocean Bottlenose dolphin off Southern Natal, South Africa. In: S. Leatherwood & R. R. Reeves (eds) *The Bottlenose Dolphin*, pp. 295–308. Academic Press, New York.

Edmonds, C. (1975) *Dangerous Marine Animals of the Indo-Pacific Region*. Wedneil Publications, Newport, Victoria, Australia.

Edstorm, A. (1992) *Venomous and Poisonous Animals*. Krieger Publishing Comp., Malabar, Florida.

Goffman, O., E. Spanier, D. Kerem & Zur, I. (1995) Distribution and death of dolphins along the Mediterranean coast of Israel. *Israel J. Zool.* **41,** 88.

Goffman, O. (1997) Solitary dolphin-human interactions: anecdotal evidence from ancient sources versus modern-day observations focusing on the solitary female dolphin from Nuweiba, Sinai (in Hebrew with an English abstract). M.A. thesis, University of Haifa, 93 pp.

Golani, D. (1996) The marine ichthyofauna of the Eastern Levant—history, inventory and characterisation. *Israel J. Zool.* **42**, 15–55.

Halstead, B. W. (1988) *Poisonous and Venomous Marine Animals of the World* (Second revised edition). The Darwin Press, Inc., Princeton, New Jersey, USA.

Herald, E. S. (1971) *Living Fishes of the World*. Doubleday and Company, Inc., New York.

Jenkins, R. L. & Cardeilhac, P. T. (1982) Intestinal perforation by a stingray spine in an Atlantic bottlenose dolphin, *Tursiops truncatus,* resulting in fatal peritonitis. Abstracts of the Thirteenth Annual Conference and Workshop, International Association of Aquatic Animal Medicine. May 9–13, 1982, Baltimore, MD. p. 12.

Jones, H. (1985). *Kingdom of the Dolphin*. KQED Television Production, San Francisco, California.

Lythgoe, J. & Lythgoe, G. (1992) *Fishes of the Sea—the North Atlantic and Mediterranean.* The MIT Press, Cambridge, Massachusetts.

McLellan, W. A., Thayer, V. G. & Pabst, D. A. (1996) Stingray spine mortality in a bottlenose dolphin, *Tursiops truncatus*, from North Carolina waters. *J. Elisha Mitchell Scientific Society* **112** (2), 98–101.

Randall, J. E. (1992) *Red Sea Reef Fishes*. Immel Publishing, London.

Randall, J. E. (1995) *Coastal Fishes of Oman*. University of Hawaii Press, Honolulu.

Roditi-Elasar, M. (1999) Marine pollution as a morbidity factor in dolphins: evidence from heavy metal concentrations in tissues and bones of modern dolphins found along the Mediterranean coast of Israel and in bones of dolphins from ancient times (in Hebrew with an English abstract). M.A. thesis, University of Haifa, 79 pp.

Russell, F. H. (1959) Stingray injuries. *Public Health Repts.* **74** (10), 855–859.

Russell, F. H. (1961) Injuries by venomous animals in the United States. *J. Am. Med. Assoc.* **177** (13), 903–907.

Russell, F. H. (1965) Marine toxins and venomous and poisonous marine animals. In: F. S. Russell (ed) *Advances in Marine Biology*. Vol. 3. pp. 255–384. Academic Press, New York.

Schwartz, F. J. (1984) Sharks, Sawfish, Skates and Rays of the Carolinas. Spec. Publ. Inst. Mar. Sci. Morehead City, NC. 101 pp.

Scott, M. D., Wells, R. S., & Irvine, A. B. (1990) A long-term study of bottlenose dolphins on the west coast of Florida. In: S. Leatherwood & R. R. Reeves (eds) *The Bottlenose Dolphin*, pp. 235–244. Academic Press, San Diego.

Walsh, M. T. D., Beusse, G. D., Young, W. G., Odell, D. K. & Patton, G. W. (1988) Ray encounters as a mortality factor in Atlantic bottlenose dolphin, *Tursiops truncatus*. *Mar. Mammals Sci.* **4**(2), 154–162.