AMMPA Standardized Information:
Bottlenose Dolphin

Note: Bottlenose dolphins (Tursiops truncatus truncatus) in human care primarily originate from coastal (inshore) animals from western North Atlantic and Gulf of Mexico stocks. Due to potential variations in the life history and environment of stocks from different areas of the world, information and studies in this document pertain only to bottlenose dolphins in those regions. Bottlenose dolphins are also referred to as the "common bottlenose dolphin."

Scientific Classification

Order: Cetacea

- Cetacea is one of only two scientific orders of large aquatic mammals that live their entire lives in water (Sirenia is the other). Cetaceans include all whales, dolphins and porpoises.
- The word "cetacean" is derived from the Greek word for whale, *kētos.*
- Living cetaceans are divided into two suborders: Odontoceti (toothed whales) and Mysticeti (baleen whales).

Suborder: Odontoceti

- The scientific suborder, Odontoceti, is comprised of toothed whales. These whales also have only one blowhole opening. The word "Odontoceti" comes from the Greek word for tooth, *odontos.*

Family: Delphinidae

- Dolphins are part of the scientific family Delphinidae. There are at least 36 species of delphinids, including bottlenose dolphins, Pacific white-sided dolphins, pilot whales and killer whales.

Genus: Tursiops

- The genus was named by Gervais in 1855 (Wilson and Reeder, 2005).
- Tursiops, meaning "dolphin-like," comes from the Latin word Tursio for "dolphin" and the Greek suffix ops for "appearance."

Species: truncatus

- The species was described by Montagu in 1821 under the genus Delphinus, (which, subsequently, was determined to be incorrect)(Wilson and Reeder, 2005).
- The species name *truncatus* was derived from natural wear exhibited on the teeth of the type specimen Montagu observed. It was apparently an old animal with worn (truncated) teeth. He thought (incorrectly) that worn teeth were an identifying characteristic of the species (Wilson and Reeder, 2005).They are found in temperate and tropical waters around the world.
- In 1966, a published study reported that there were 20 or more species of *Tursiops* (Hershkovitz, 1966). At a 1974 meeting (Mitchell, 1975), biologists recognized the confusion and recommended that, until proper taxonomic studies had been done comparing all of the purported species of the world's *Tursiops*, there should be one species—*Tursiops truncatus*, the Atlantic bottlenose dolphin.

- Recently, taxonomists determined that the term, Atlantic bottlenose dolphin, was too narrow. Because of the species' vast numbers and distribution, taxonomists now recognize the animals as the "common bottlenose dolphin" (Moeller et al. 2008; Charlton et al., 2006; Natoli et al., 2003; Wang et al., 1999). Further, *Tursiops truncatus* has been divided into two subspecies, the common bottlenose dolphin (*T. t. truncatus*) and the Black Sea bottlenose dolphin (*T. t. ponticus*) (Committee on Taxonomy. 2009. List of marine mammal species and subspecies. Society for Marine Mammalogy, http://www.marinemammalscience.org , consulted on 17 January 2011). In addition, the terminology separates these species from the Indo-Pacific bottlenose dolphin (*Tursiops aduncus*).
- In 2010, the U.S. National Marine Fisheries Service changed its terminology for the bottlenose dolphin stocks for which the agency conducts annual assessments; the animals are now referred to as the common bottlenose dolphin. Details can be found on the agency's Web site (http://www.nmfs.noaa.gov/pr/sars/region.htm accessed 17 January 2011.
- As additional studies are conducted around the world, there may be further changes to *Tursiops* taxonomy. The advent of molecular taxonomic techniques will further help eliminate confusion.

Fossil Record

Early whales evolved over 50 million years ago from primitive mammals that returned to the sea (Barnes, 1990).
Remains of *Tursiops truncatus* appear in the fossil record approximately two million years ago (Reynolds *et al*., 2000).

Recent mitochondrial and nuclear DNA analyses sustain the theory that cetaceans are distant cousins of even-toed ungulates (artiodactyls) and that hippopatamids are the closest living relative to cetaceans (Berta and Sumich, 1999; Reynolds *et al*., 2000; Milinkovitch *et al*., 1993).

Distribution

Bottlenose dolphins in the western North Atlantic are found from Nova Scotia to Patagonia and from Norway to the tip of South Africa. They are the most abundant dolphin species along the United States coast from Cape Cod through the Gulf of Mexico (Reeves *et al.*, 2002). Other types of bottlenose dolphins are found in the Pacific and Indian Oceans, as far north as the southern Okhotsk Sea, the Kuril Islands and central California. They are found as far south as Australia and New Zealand.

Bottlenose dolphins have separate inshore and offshore distributions that can be differentiated hemotologically and genetically (Hersh and Duffield, 1990, pg. 129). In the Northwest Atlantic, researchers determined that bottlenose dolphins within 7.5 km (4.65 mi) of shore were coastal ecotypes. Dolphins beyond 34 km (21 mi) from shore were offshore ecotypes (Torres, *et al*., 2003).

Habitat

Inshore bottlenose dolphins are typically seen in bays, tidal creeks, inlets, marshes, rivers and waters along the open ocean beach, often at depths of 3m (9.8ft) or less (Wells and Scott, 1999; Hersh *et al*., 1990; Connor *et al*., 2000).

The distribution/migration of prey correlated with seasonal changes in water temperature may account for the seasonal movements of some dolphins (Shane, *et al*., 1990).

Inshore bottlenose dolphins found in warmer waters show less extensive, localized seasonal movements and many have been observed staying within a limited, long-term home range, such as in Sarasota Bay, Florida. Adult males range more widely than females, often encompassing the ranges of several female bands. Dolphin communities may overlap providing for genetic exchange. These neighboring communities may be distinct in both behavior and genetics (Scott *et al*., 1990; Wells *et al*., 1980, 1987; Wells 1991, 2003, 2009; Wells and Scott, 1999; Duffield and Wells, 1990; Urian 2009).

Diet

The diet of coastal bottlenose dolphins is diverse and depends upon location. Many dolphins eat only fish, although some also eat small numbers of cephalopods, crustaceans, small rays and sharks. They generally consume about 5% of their body weight daily (Barros and Odell, 1990). There is strong evidence that bottlenose dolphins are selective feeders, taking fish disproportionately based on their availability in the environment and especially selecting soniferous (sound-producing) fish (Berens-McCabe *et al*., 2010).

Scientists identified 43 diverse prey species in the stomachs of 76 stranded dolphins in southeastern U.S. waters; proportion varies by location. Most fish in their stomachs were bottom dwellers (*Sciaenids* - drums/croakers/seatrout and *Batrachoidids* - toadfish) but some were types found throughout the water column (*Mugilids* - mullet and *Clupeids* - herring/mackerel/sardines) and pelagic (*Carangidae* - jacks and *Pomatomidae* - blue fish) (Barros and Odell, 1990; Barros and Wells, 1998; Connor, *et al.*, 2000; Mead and Potter 1990).

Anatomy and Physiology

Bottlenose dolphins are generally slate grey to charcoal in color including simple counter shading (dark dorsally and lighter ventrally). The sides of the body often have light brush markings. Some ventral speckling may be found on the belly depending on location.

Counter shading is considered by scientists to be camouflage that helps conceal dolphins from predators and prey. When viewed from above, a dolphin’s dark back surface blends with the dark depths. When seen from below, a dolphin’s lighter belly blends with the bright sea surface.

Bottlenose dolphins have sleek, streamlined, fusiform (spindle shaped) bodies designed to minimize drag as they travel through the water.

In general, the inshore ecotype seems to be adapted for warm, shallow waters. Its smaller body and larger flippers suggest increased maneuverability and heat dissipation (Hersh and Duffield, 1990,).

Average Age to reach Adult Mass
Females attain most of their adult mass by 10–12 years. Males reach adult size around 13 years or older (several years after reaching sexual maturity) and continue growing until at least 20 (Wells, *et al*., 1987; Read *et al*., 1993).

Average Adult Length in AMMPA Facilities
8.5 feet (259 cm) (*Based on a 2001 survey of animals in Alliance member facilities. Submitted to the Animal and Plant Health Inspection Service*.)

Average Adult Length in the Wild
7.2–8.9 feet (220–270 cm)
Mass and length of the animals varies by geographic location. Body size of bottlenose dolphins appears to vary inversely with water temperature of location (the colder, the bigger). In some populations, there are size differences between the genders with females growing faster in the first decade of life and males usually growing larger later in life. In other populations there is no size difference. The only way to concretely identify male from female is to examine their differing genital slits on the ventral side of the body (Reynolds, *et al*., 2000; Cockroft and Ross, 1989; Read *et al.,* 1993; Mead and Potter, 1990; Wells and Scott, 1999; Perrin and Reilly, 1984).

Maximum Length Reported in the Wild
<u>Eastern North Atlantic</u>: 13.5 ft (410 cm) (Fraser 1974, Lockyer, 1985) Larger body size appears to be associated with cold water regions (Ross and Cockroft, 1990,).

Maximum Adult Weight Reported in the Wild
<u>Eastern North Atlantic</u>: 1400 lbs (650kg) (Pabst *et al*., 1999)
<u>Western North Atlantic</u>: 626 lbs (284 kg) (Reynolds *et al*. 2000)
Again, body size is thought to vary inversely with water temperature of location.

Skin
Dolphin skin is highly specialized and plays an important role in hydrodynamics. Upon close observation, cutaneous ridges may be seen on the surface of a dolphin's skin that run circumferentially around the body trunk and varied in direction past the dorsal fin and other isolated areas. Cutaneous ridges may play an important role in sensory function and in drag reduction as a dolphin swims (Ridgway & Carder, 1993)

Dolphin skin has no scent or sweat glands and is without hair except for small whiskers found on the snouts of fetuses and newborn calves (Geraci, *et al*., 1986).

The animals' outer skin layer, the epidermis, is an average of 15–20 times thicker than the epidermis of humans (Hicks et. al, 1985). The skin layer under the epidermis is the dermis. The dermis contains blood vessels, nerves, and connective tissue (Sokolov, 1982).

Bottlenose dolphins slough (shed) the outer layer of their skin 12 times per day (every 2 hours). Increased skin cell turnover increases swimming efficiency by creating a smooth body surface which reduces drag (Hicks et. al, 1985).

A dolphin's blubber (hypodermis) lies beneath the dermis. Blubber is a layer of fat reinforced by collagen and elastic fibers (Pabst *et al*., 1999; Parry, 1949). Blubber plays a number of important functions:

- contributing to a dolphin's streamlined shape, which helps increase swimming efficiency;
- storing fat, which provide energy when food is in short supply;
- reducing heat loss, which is important for thermoregulation; and
- providing a measure of protection from predation, as predators must bite through this layer to reach vital organs. Shark bite scars are not uncommon on wild bottlenose dolphins.

A number of persistent organic pollutants can be stored in the lipids of blubber, including PCBs and some pesticides. Blubber thickness fluctuates by season (water temperature) as well as with body size and health status.

Number of Teeth
Number of teeth: 72–104
18-26 per row of teeth (4 rows = 72–104 teeth) (Rommel, 1990; Wells and Scott, 1999).

Dolphins have only one set of teeth; they are not replaced once lost (Rommel, 1990).

Sensory Systems

Hearing

A dolphin's brain and nervous system appear physiologically able to process sounds at much higher speeds than humans, most likely because of their echolocation abilities (Ridgway, 1990; Wartzok and Ketten, 1999). Ears, located just behind the eyes, are pinhole sized openings, with no external ear flaps.

Range of Hearing
The hearing range for the bottlenose dolphin is 75 to 150,000 Hz (0.075 to150 kHz) (Johnson, 1967 and 1986; Au, W.W.L., 1993; Nachtigall, *et al.*, 2000; Ridgway and Carder, 1997; McCormick *et al*., 1970).

The range of hearing of a young, healthy human is 15–20,000 Hz (0.015 – 20 kHz) (Grolier, 1967, pg. 285; Cutnell and Johnson, 1998). Human speech falls within the frequency band of

100 to 10,000 Hz (0.1 to 10 kHz), with the main, useful voice frequencies within 300 to 3,400 Hz (0.3 to 3.4 kHz) (Titze, 1994). This is well within a dolphin's range of hearing.

Sound Production Frequency Range

Vocal range is 200 Hz to 150 kHz (Popper, 1980; Au, W.W.L., 1993)

Whistles generally occur within 1–25 kHz (Caldwell *et al.*, 1990) (Au, W.W.L. *et al.*, 2000). It has been determined that bottlenose dolphins develop an individually specific "signature whistle" within the first few months of life and that this signature whistle remains the same throughout most if not all of their lives. They use these unique whistles to communicate identity, location and, potentially, emotional state. Dolphins have been observed using signature whistles to maintain cohesion, address other individuals and, possibly, to broadcast affiliation with other individuals (Caldwell et al., 1990; Sayigh et al. 1998; Tyack, 2000; Janik et al., 2006).

Echolocation

Ecolocation clicks: 30kHz to 150kHz (Popper, 1980; Au, 1993).

Dolphins often need to navigate in the absence of light/good visibility. Therefore, hearing is essential to them. The bottlenose dolphin's primary sensory system is the auditory system. It is a highly-developed system that includes biological sonar ability or echolocation.

The animals emit high-frequency sounds, and detect and analyze returning echoes from those sounds, to determine the size, shape, structure, composition, speed and direction of an object. Dolphins can detect objects from over 70 meters away. There is evidence to suggest that dolphins vary the frequency of their clicks depending on their environment, target type and range of the object and to avoid competing with background noise (Popper, 1980; Au, 1993). Field studies have shown that bottlenose dolphin echolocation is used only as necessary in the wild; individuals do not continuously produce clicks.

Vision

Dolphins are primarily monocular, but also possess limited capability for binocular vision (Dawson, 1980).

Glands at the inner corners of the eye sockets secrete an oily mucus that lubricates the eyes, washes away debris and may help streamline the eye as a dolphin swims (Tarpley and Ridgway, 1991).

Maximum Range of Vision Reported

Bottlenose dolphins have a double slit pupil allowing for similar visual acuity in air and water. Their eyes are adapted to mitigate varying light intensities. Studies show that the visual acuity of dolphins is similar or below the range of many terrestrial animals (Herman *et al*., 1975; Griebel and Peichl, 2003). There is currently no reference that measures distance of visual capability.

Color vision

Scientists are unsure if dolphins possess color vision. Chemical, physiological and genetic studies suggest they have monochromatic vision (cannot see colors) in the green spectrum based on the absence of certain cones in their eyes. Behavioral studies have suggested they might have some color vision. However, behavioral color vision studies are difficult due to the inability to accurately determine whether the animal is responding to color vs. brightness (Griebel and Peichl, 2003).

<u>Smell</u> (Olfaction)
Dolphin brains lack an olfactory system (sense of smell) (Morgane and Jacobs, 1972; Jacobs *et al.*, 1971; Sinclair 1966).

<u>Taste</u> (Gustation)
Behavioral evidence suggests that bottlenose dolphins can detect three if not all four primary tastes. The way they use their ability to "taste" is unclear (Friedl *et al*., 1990). Scientists are undecided whether dolphins have taste buds like other mammals. Three studies indicated that taste buds may be found within 5 to 8 pits at the back of the tongue. One of those studies found them in young dolphins and not adults. Another study could not trace a nerve supply to the taste buds. Regardless, behavioral studies indicate bottlenose dolphins have some type of chemosensory capacity within the mouth (Ridgway, 1999).

<u>Touch</u>
The skin of bottlenose dolphins is sensitive to vibrations. Nerve endings are particularly concentrated around the dolphin's eyes, blowhole, genital area and snout, suggesting that these areas are more sensitive than the rest of the body (Ridgway & Carder, 1990).

<u>Swimming, Diving and Thermoregulation</u>

Dolphins are among the world's most efficient swimmers. Their "fusiform" body shape (rounded torpedo like shape and gradually tapering tail) allows water to flow inseparably from the body to the tail region. This delayed separation results in a small wake and reduced drag. Additionally, the curvature of the pectoral fins, dorsal fin and tail ("flukes") of the dolphin reduce drag and can also create lift (Carpenter, et al. 2000; Fish, 2006).

Maximum Swimming Speed
Maximum observed speed of a trained bottlenose dolphin swimming alongside a boat was 26.7 feet/second (8.2 meter/second). Maximum observed swimming speed of a dolphin swimming upward prior to a vertical leap was 36.8 f/s (11.2 m/s). Both were completed in very short durations. Maximum swim speed observed for wild dolphins fleeing a pod of killer whales was 27.2 f/s (8.3 m/s) (Noren, *et al.*, 2006; Rohr, *et al*., 2002; Würsig and Würsig, 1979; Lang and Norris, 1966).

Average Swimming Speed
Bottlenose dolphins routinely swim at speeds of 4.6-10.2 feet per second (1.4–3.1 m/s) with a mean speed of 4.9-5.6 f/s (1.5 to 1.7 m/s) (Williams *et al.*, 1993; Würsig and Würsig, 1979; Shane 1990).

Average Dive Duration
The average dive duration of coastal bottlenose dolphins ranges from 20–40 seconds (Mate *et al*., 1995; Bassos, 1993; Shane, 1990; Irvine *et al*., 1981; Wursig, 1978).

Maximum Breath Hold/Dive Time Reported
The maximum voluntary breath hold recorded for a coastal bottlenose dolphin was 7 minutes 15 seconds (Ridgway *et al*., 1969; Irving *et al.*, 1941).

Average Dive Depth
Depths of dives depend on the region inhabited by the species. Coastal bottlenose dolphins usually inhabit waters of less than 9.8 feet (3 meters) (Hersh *et al*., 1990).

Maximum Dive Depth Recorded
Trained coastal bottlenose dolphin: 1,280 feet (390 meters)(Ridgway and Sconce (1980, unpublished observations) cited in Bryden and Harrison (1986); Tagged wild offshore bottlenose dolphin: 1614+ feet (492+ meters) (Klatsky, *et al*., 2007)

Behavior

Social Grouping
Coastal bottlenose dolphins are primarily found in groups of 2–15 individuals. The associations of the animals are fluid, often repeated but not constant. Solitary coastal animals are observed in various regions of the world. Group composition has been observed to be dependent upon sex, age, reproductive condition, familial relationships and affiliation history. Typical social units include nursery groups (females and their most recent calves), mixed sex groups of juveniles and strongly-bonded pairs of adult males (Wells and Scott, 1990; Wells *et al*., 1987; Wells, *et al.,* 1980; Wells, 1991).

Foraging
Foraging methods are diverse and tend to vary based on region, season, age, sex and reproductive classes. Hunting methods are learned by calves primarily through observing their mothers and have been seen to proliferate throughout a population, suggesting that knowledge may be culturally transmitted (Wells 2003). Most often, coastal bottlenose dolphins feed individually, but sometimes cooperate in small groups. Coastal bottlenose dolphins often feed in water that is 10ft (3m) or less. They are active both during the day and at night. Dolphins often passively listen for sounds produced by fish they hunt (Shane, 1990; Barros and Wells, 1998; Wells and Scott, 1999; Wells *et al*., 1999; Smolker *et al*., 1997).

Sleep State
Several species of cetaceans, including the bottlenose dolphin, have been shown to engage in unihemispheric slow wave sleep (USWS) during which one half of the brain goes into a sleep state, while the other maintains visual and auditory awareness of the environment and allows the animal to resurface for respiration. This ability may help to avoid predators as well as

maintain visual contact with cohorts/offspring). Dolphins have one eye closed during USWS (Lyamin, *et al*., 2008; Lyamin, *et al*., 2004; Ridgway, 2002; Ridgway, S.H. 1990).

Reproduction and Maternal Care

Gestation
12 months (Robeck, *et al*., 1994; Perrin and Reilly, 1984; Schroeder, J.P, 1990; Tavolga and Essapian, 1957)

Ovulation cycle
Female dolphins are spontaneous ovulators and seasonally polyestrous. They generally ovulate 2–7 times per year with a cycle length of about 30 days. The estrous cycle varies in length from 21–42 days (Robeck, *et al*., 1994; Schroeder, 1990; Kirby and Ridgway 1984).

Birthing Season
Birthing season is dependent on geographical location. Births may occur in all seasons, but typically peaks occur during spring, early summer and fall (Mead and Potter, 1990; Wells *et al*., 1987; Caldwell and Caldwell, 1972; Cockcroft and Ross, 1990).

Nursing Period
For the first year, and, in some cases more than a year, lactation is the primary source of nutrition for dolphin calves in zoological parks and aquariums. Calves in human care generally start eating fish sometime within their first year, depending upon mothering style and facility. Nursing/lactation periods are difficult to determine in the wild but appear to be a primary source of nutrition for wild calves for an average of 18-24 months (Wells *et al*., 1999; Cockroft and Ross, 1990; Perrin and Reilly, 1984; Oftedal, 1997).

Average Dependent Period
In the wild, bottlenose dolphin calves stay an average of 3 to 6 years with their mothers, during which time calves learn effective foraging methods and other essential life skills. The longest period that a calf in the wild was observed with its mother was 11 years, documented in the Sarasota, Florida, region. Generally calves become independent about the time the next calf is born. The dependency period of calves in zoological facilities is much shorter because the animals are not vulnerable to predation, do not have to learn foraging techniques and are well fed (Wells *et al*., 1999; Cockroft and Ross, 1990; Wells and Scott, 1999; Read *et al*., 1993; Perrin and Reilly, 1984).

Maximum Nursing Period Observed
The maximum nursing period observed was 7 years in Sarasota and may serve as a bonding activity (Wells *et al*., 1999; Wells and Scott, 1999; Cockcroft and Ross, 1990).

Average Years between Offspring
Bottlenose dolphins have a 3 to 6 year calf interval in Sarasota Bay, Florida (Wells *et al*., 1999; Cockroft and Ross, 1990; Wells and Scott, 1999; Read *et al*., 1993; Perrin and Reilly, 1984). Zoological facilities have very successful reproduction programs. Calving intervals in human care vary based on individual facility animal management planning.

Average Age at Sexual Maturity
Bottlenose dolphins display variation in the average age at which they reach sexual maturity, based on sex, geography and individuals. Females have been known to reach sexual maturity as early as 5 years of age. The average age at which bottlenose females in Sarasota Bay have their first offspring is 8–10 years.

In that population in the wild, males reach sexual maturity as young as 8, but generally between 10 and 13 years of age (Wells *et al*., 1987; Wells *et al*., 1999; Mead and Potter, 1990; Perrin and Reilly, 1984; Odell, 1975; Harrison ed., 1972).

There is little or no indication of senescence (menopause) in the female bottlenose dolphin. Successful births and rearing have been witnessed up through 48 years of age in the Sarasota dolphin population (Wells, pers. comm. Dec. 2010; Reynolds, *et al*., 2000; Wells and Scott, 1999).

Longevity and Mortality

Current scientific data show that the average lifespan of bottlenose dolphins in Alliance of Marine Mammal Parks and Aquariums member facilities is longer than their counterparts in the wild. Calves born in AMMPA member zoological parks and aquariums have higher rates of survivability than those born in the wild. (See references below.)

Average Life Span in AMMPA Facilities
On average, a one-year old bottlenose dolphin in Alliance of Marine Mammal Parks and Aquariums member facilities is expected to live for more than 25 years (Willis 2007, unpublished data).

Average Life Span in the Wild
Research based on tooth extraction from 290 stranded dolphins, in cooperation with the Texas Marine Mammal Stranding Network, produced data that show the average life expectancy from birth of animals off the coast of Texas is 11.73 years, and the average life expectancy from one year of age is 12.72. These numbers are also consistent with the results of other tooth-aging studies of stranded animals (Neuenhoff, 2009; Mattson *et al.,* 2006; Stolen and Barlow, 2003; Hohn, 1980).

Maximum Known Longevity in AMMPA Facilities (2010)
As of 2010, the oldest dolphin in human care was 57 years old. She was born February 27, 1953, at Marineland of Florida, now Georgia Aquarium's Marineland, St. Augustine, Florida.

Maximum Known Longevity in the Wild (2010)
As of 2010, the oldest dolphin in the wild was 60, documented in the Sarasota Bay population. Researchers extracted a tooth from the animal in 1984 to determine her age. The Sarasota Dolphin Research Program, a partnership led by the Chicago Zoological Society since 1989, has studied dolphins in Sarasota Bay, Florida, since 1970 and is the longest running study of a wild dolphin population in the world (Randall Wells, pers. comm. 6/16/2010).

Infant First-Year Survivorship in AMMPA Facilities (*within the first year of life*)
86.3 % Total live births living 1 year or longer (Sweeney *et al*., 2010, unpublished data)

Infant First-Year Survivorship in Sarasota Bay, Florida (*within the first year of life*)
76% (Wells, 2009)

Predators

Sharks are the most common predators of coastal bottlenose dolphins, especially tiger, great white, bull and dusky sharks, but dolphins are an uncommon item in the diet of most sharks. In Sarasota Bay, Florida, about 31% of dolphins bear shark bite scars (Wells *et al*., 1987). Killer whales also attack dolphins (Mead and Potter, 1990; Urian *et al.,* 1998; Würsig and Würsig, 1979).

Conservation

Bottlenose dolphins are found in great numbers in the open ocean and along shorelines. The species is not endangered, threatened or vulnerable. The International Union for the Conservation of Nature (IUCN) lists it as a species of least concern. However, threats to the animals are increasing.

Marine mammals are excellent sentinels of the health of their environments because they have long life spans, feed high on the food chain and their blubber can be analyzed for toxin build up. The 2002 Marine Mammal Commission report states *"A variety of factors, both natural and human-related, may threaten the well-being of individual dolphins or the status of dolphin stocks. Natural factors include predation by large sharks, disease, parasites, exposure to naturally occurring biotoxins, changes in prey availability, and loss of habitat due to environmental variation. Growing human-related factors include loss of habitat due to coastal development, exposure to pollutants, disturbance, vessel strikes, entanglement in debris, noise and pollution related to oil and gas development, direct and indirect interactions with recreational and commercial fisheries, and injury, mortality, or behavior modification that may result from direct human interactions such as the feeding of wild dolphins. These factors may act independently or synergistically. Compared with offshore bottlenose dolphins, coastal dolphins may be at greater risk to human-related threats due to their greater proximity to human activities."*

Increased vulnerability to diseases, as well as reproductive failure, are concerns for wild dolphin populations due to extremely high accumulation of chemical and heavy metal residues released into the environment by human activities through runoff or incineration and airborne transport of toxic chemicals such as pesticides, herbicides, and fire retardants (Starvos *et al*., 2011; Hall *et al*., 2006; Wells *et al*., 2005; Schwacke *et al*., 2002; Lahvis *et al*., 1995; Kuehl *et al*., 1991; Cockcroft *et al.,* 1989). These findings have both direct and indirect impact on human health as well (Fair *et al*., 2007; Bossart, 2006; Houde *et al*., 2005).

The increase of emerging and resurging diseases affecting dolphins and other marine mammals in the wild could signify a broad environmental distress syndrome as human activities trigger ecologic and climate changes that foster new and reemerging, opportunistic pathogens affecting both terrestrial and marine animals (Bossart, 2010).

Mortalities and serious injuries from recreational and commercial fishing gear are among the most serious threats dolphins face (Wells and Scott 1994; Wells et al., 1998). Entanglement in fishing gear is a significant cause of injury and mortality to many marine mammal populations throughout the world. Along the east coast of the United States, gill net fisheries by-catches of bottlenose dolphins exceed sustainable population mortality levels established under the U.S. Marine Mammal Protection Act. Research focused on mitigation efforts center around disentanglement, gear modification and deterrent devices/enhancements; however, until recently most of the emphasis has been on commercial fisheries.

Dolphins have been observed following recreational vessels and "depredating" fishing lines (removing the fish and eating it), sometimes resulting in entanglement/ingestion related mortality. Dr. Randall Wells, head of the Sarasota Dolphin Project, the longest running study on bottlenose dolphins in the world, noted that 2% of the study population was lost to ingestion/entanglement conflicts with recreational fishing gear in one year. This percent, in addition to natural mortality factors, is unsustainable and if not mitigated could put the population at risk (Powell and Wells, 2011; Cox et al., 2009; Noke and Odell, 2002; Waring et al 2009; Wells et al., 1998).

Heavy boat traffic can affect the distribution, behavior, communication and energetics of the animals (Nowacek *et al*., 2001; Buckstaff 2004). Dolphins have been known to be struck by boats in high traffic areas, causing injury and death (Wells and Scott 1997).

Feeding or swimming with dolphins in the wild teaches them to approach boats, making the animals vulnerable to potential propeller strikes, fishing gear entanglement, ingestion of foreign objects or intentional harm from humans. Additionally, increasing human interaction and/or boat traffic may cause coastal bottlenose dolphins to abandon important habitats (Bryant, 1994; Wells and Scott, 1997 pg. 479; Cunningham-Smith et al., 2006; Powell and Wells in press). The Alliance's *Guide to Responsible Wildlife Watching with a Focus on Marine Mammals* is posted on its Web site. This guide recommends viewing all wildlife from a safe and respectful distance and explains the harm caused by feeding dolphins in the wild (AMMPA, 1995).

AMMPA Facilities Contributions to Conservation

Much of what is known about dolphin and marine mammal health care, physiology, reproductive biology and intelligence has been learned through scientific studies in zoological parks and aquariums over the last 40 years, research not possible in the wild. Wild marine mammals directly benefit from knowledge gained from animals in human care.

- The National Marine Mammal Foundation hosts a database to provide searchable information on past and ongoing marine mammal research studies. These studies are conducted by members of the Alliance of Marine Mammal Parks and Aquariums, foundation researchers and other like-minded organizations pursuing bona fide research with marine mammals (http://nmmpfoundation.org/alliance.htm).

- Two special 2010 issues of the *International Journal of Comparative Psychology* (IJCP) titled "Research with Captive Marine Mammals Is Important" Part I and Part II highlight the significance of research with marine mammals in parks and aquariums. Contributing authors address the value of ex situ cetacean populations in understanding reproductive physiology, which plays a role in conservation efforts, and advancing our understanding of the animals and what they tell us about their counterparts in the wild (Kuczaj, 2010a, b).

Dolphins provide the opportunity for zoological parks and aquariums to play a unique and unrivaled role in marine mammal education and conservation. Alliance member education programs make a difference.

Two independent research studies conducted in 2009 conclude that guests viewing dolphin shows demonstrated an increase in conservation-related knowledge, attitudes, and behavioral intentions immediately following their experience and retain what they learn, and that participants in dolphin interactive programs learned about the animals and conservation, shifted their attitudes and acquired a sense of personal responsibility for environmental stewardship (Miller, 2009; Sweeney, 2009).

These studies confirm the results of a Harris Interactive® poll the Alliance commissioned in 2005 (Harris Interactive, Rochester, NY) and a 1998 Roper poll (Roper Starch Worldwide, Inc. New York, NY).

The Harris poll found that the public is nearly unanimous (95%) in its acclaim for the educational impact of marine life parks, zoos and aquariums. In addition, 96 percent of respondents agree that these facilities provide people with valuable information about the importance of our oceans and the animals that live there (AMMPA, 2005).

The Alliance's *Ocean Literacy Reference Guide* is a collection of ocean messages aimed at educating the public about the importance of our oceans to all living things. The fundamentals of these messages—the Essential Principles of Ocean Literacy—were developed by a consortium of some 100 members of the ocean sciences and education communities during an online workshop sponsored by the National Oceanic and Atmospheric Administration, the National Geographic Society's Ocean for Life Initiative, the National Marine Educators Association and the Centers for Ocean Sciences Education Excellence. Messages focus on marine debris, climate change and man-made sound in our oceans (AMMPA, 2007).

Above all, guests view parks and aquariums as cherished and traditional places for family recreation, a center for discovery, a resource for wildlife education and motivators for environmental stewardship.

For additional information please refer to one of the following books:

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