

Tursiops truncatus (Montagu, 1821)

English: Common bottlenose dolphin

German: GroÙerTümmeler

Spanish: Delfín mular

French: Grand dauphin

Family: Delphinidae

1. Description

The common bottlenose dolphin is presumably the most familiar of the small cetaceans because of its coastal occurrence around the world, its prevalence in dolphinariums and zoos and its frequent appearance in the media (Jefferson et al. 2008). This species is recognized by its medium-sized, robust body, with a sharp demarcation between the melon and the short rostrum, and the moderately curved dorsal fin. Pigmentation is light grey to black dorsally, with a light belly. Adult length ranges from 2–3.8 m and body mass from 220–500 kg, varying geographically. Body size seems to vary inversely with water temperature in many parts of the world (Bloch and Mikkelsen, 2000; Wells and Scott, 2009).

Geographical variation in bottlenose dolphins is only vaguely comprehended, and in most parts of the world subspecific designations are best avoided. The name *T. t. truncatus* (type locality: Great Britain) may be applied to the offshore populations on both sides of the North Atlantic, and some authors have used it for similar animals that live in the temperate waters of the western North Pacific, South Africa, Walters Shoal, southern Australia, and New Zealand (Rice, 1998 and refs. therein).

Often, there are size differences between neighbouring populations: The dolphins that live in the Black Sea (named *T. t. ponticus* Barabash-Nikiforov, 1940) are smaller than those in the North Atlantic and possess a uniquely shaped skull, while those in the Mediterranean are intermediate in size. The Black Sea population was found to be genetically distinct from these two populations, with relatively low levels of mtDNA diversity (Viaud-Martinez et al. 2008).

In some parts of the world, sharply differentiated inshore and offshore populations live in close proximity. Results of mtDNA analyses do not indicate genetic isolation among offshore populations from different ocean basins, but do show that there are differing coastal or inshore populations which are genetically isolated from offshore populations (Rice, 1998 and refs. therein). Thus bottlenose dolphins occurring in the pelagic waters of the North Atlantic, including the Azores and Madeira archipelagos, were shown to belong to a large oceanic population, which must be regarded as a single conservation unit (Querouil et al. 2007). In the eastern South Pacific, there is also genetic evidence for a single, wide-ranging Peru-Chile offshore stock, whereas a separate cluster is formed by the Peruvian inshore ecotype and a single resident inshore community (pod-R) in central-north Chile differing from both (Sanino et al. 2005).

Oceanic bottlenose dolphins seem to maintain high levels of gene flow, unlike coastal populations. E.g. in the Gulf of Mexico, a significant genetic population structure was found among four resident, inshore bottlenose dolphin stocks (Sarasota Bay, FL, Tampa Bay, FL, Charlotte Harbor, FL and Matagorda Bay, TX) and one coastal stock (1-12 km offshore). This is surprising given the short geographical distance between many of these areas and the lack of obvious geographic barriers to prevent gene flow (Sellas et al. 2005).

Finally, genetic work (Le Duc et al. 1999; Wells and Scott, 2009), osteological comparisons (Wang et al. 2000; Wang and Yang 2009) and morphological analyses by Hale et al. (2000) support the view that some bottlenose dolphins of the tropical Indian Ocean and western Pacific, *T. aduncus*, are reproductively isolated from the widespread *T. truncatus*.

2. Distribution

<http://www.iucnredlist.org/apps/redlist/details/22563/0/rangemap>

Distribution of Tursiops truncatus: widely distributed in cold temperate to tropical seas worldwide (map mod. from Hammond et al. 2008; © IUCN).

Bottlenose dolphins are found primarily in coastal and inshore regions of tropical and temperate waters of the world, and population density seems to be higher near-shore. There are also pelagic populations, such as those in the eastern tropical Pacific and around the Faroe Islands. The bottlenose dolphins occurring around the Faroe Islands (62°N 7°W) seem to be the most northerly of the North Atlantic offshore populations (Bloch and Mikkelsen, 2000).

In the Atlantic *T. truncatus* occurs north to Massachusetts, the southern coast of Iceland, northern Norway (Lofoten Islands), the Mediterranean and Black seas. In the Pacific it ranges north to the Okhotsk Sea, the Skuril Islands and Central California. In the Southern Hemisphere *T. truncatus* occurs south to Tierra del Fuego, South Africa, Australia and New Zealand (Wells and Scott, 2009). The species is rare in the Baltic Sea, and there is some question as to its occurrence in the Barents Sea (Wells and Scott, 1999 and refs. therein)

3. Population size

Summing available estimates, a minimum world-wide estimate is 600,000 (Wells and Scott, 2009; Hammond et al. 2008). There are recent abundance estimates for several parts of the species' range, but there is generally insufficient data to estimate population trends:

Atlantic:

From central Florida to Canada, the abundance estimate of the western North Atlantic offshore stock from aerial and vessel surveys conducted between 2002 and 2004 provides complete coverage of the offshore habitat during summer months. The combined abundance estimate from these surveys is 81,588 (CV=0.17) (Waring et al. 2009).

From Florida to New Jersey, the primary habitat of the western North Atlantic coastal morphotype during summer months is in waters less than 20 m deep, including estuarine and inshore waters. Re-analysis of stranding data (McLellan *et al.* 2003) and extensive analysis of genetic, photo-identification, satellite telemetry, and stable isotope studies demonstrate a complex mosaic, with seven prospective stocks of coastal morphotype bottlenose dolphins inhabiting nearshore coastal waters along the Atlantic coast. Best estimates are from summer aerial surveys conducted in 2002 and/or 2004: Northern Migratory Stock: 7,489 (CV = 0,36), Southern Migratory Stock: 10,341 (CV = 0,33), Southern North Carolina stock: 4,818 (CV = 0,50), South Carolina stock: 1,952 (CV = 0,28), Georgia stock: 5,996 (CV = 0,37), Northern Florida stock: 3,064 (CV =0,24) and Southern Florida stock: 6,317 (CV = 0,26) (Waring et al. 2009).

Estimates of the northern Gulf of Mexico coastal stocks date from 1991-1994 surveys with 9,912 (CV = 0,12) in the eastern, 4,191 (CV = 0,21) in the northern and 3,499 (CV = 0,21) in the western parts of the northern Gulf of Mexico (Waring et al. 2009). For the northern Gulf of Mexico continental shelf and slope stock, the best abundance estimate is based on data pooled from 2000 through 2001 for continental shelf vessel surveys and is 17,777 (CV=0.32) (Waring et al. 2009). The northern Gulf of Mexico Oceanic (outer continental shelf) stock estimate is pooled from 2003 to 2004 data and is 3,708 (CV=0.42) (Mullin 2007).

From the North Atlantic Sightings Surveys in 1987 and 1987 (NASS-87 and NASS-89) a very cautious estimate of the bottlenose dolphins around the Faroe Islands comes to about 1,000 animals (Sigurjónsson et al. 1989; Sigurjónsson and Gunnlaugsson, 1990; Bloch and Mikkelsen, 2000).

A wide-scale survey in 2005 of western European continental shelf waters including the western Baltic, North Sea and Atlantic margin as far as southern Spain estimated that there were 12,600 bottlenose dolphins in this area (CV=27%, Hammond et al. 2006).

Pacific:

Estimates for the eastern tropical Pacific stem from data gathered in the early 1990's, yielding 243,500 (CV=29%) (Wade and Gerrodette 1993), and the same can be said for Japanese surveys in the Northwestern Pacific west of 180°E where 168,000 (CV=26%) were found, including 36,791 (CV=25%) in Japanese coastal waters (Miyashita 1993). More recently, the California/Oregon/Washington offshore stocks were estimated on the basis of ship surveys conducted between 2001-2005 at 3,257 (CV= 0.43) offshore bottlenose dolphins (Barlow 2003, Forney 2007). The California coastal stock abundance, estimated from photographic mark-recapture surveys in 2004 and 2005 and including an additional 35% of animals (lacking identifiable dorsal fin marks) was ca. 450-500 animals (Carretta et al. 2009).

Mediterranean:

In north-eastern Mediterranean waters, including a putative subpopulation in the Balearic Islands, total abundance was estimated as 7,654 (CV = 0.47). Abundance in inshore waters of the Balearic Islands varied from 727 (CV = 0.47) dolphins in spring 2002 to 1,333 (CV = 0.44) dolphins in autumn 2002, with an average estimate of 1,030 (CV = 0.35) (Forcada et al. 2004). In the central Spanish Mediterranean, aerial surveys conducted between 2001 and yielded a mean abundance of 1,333 dolphins (95% CI = 739-2,407) (Gomez de Segura et al. 2006). Off southern Spain, surveys conducted in the Alboran Sea between 2000 to 2003 yielded an estimate of 584 dolphins (95% CI=278-744) (Cañadas and Hammond, 2006). In eastern Ionian Sea coastal waters boat surveys conducted between 1993 and 2003 yielded 235 bottlenose dolphin sightings. Individual photo-identification showed a relatively stable presence, some individuals showing high levels of site fidelity and others using the area only occasionally (Bearzi et al. 2005). In the 400-km² Amvrakikos Gulf, western Greece, boat surveys conducted between 2002 and 2005 yielded a total population estimate of 148 individuals (95% CI=132-180). Mean dolphin density in the Gulf was 0.37 animals km² (Bearzi et al. 2008).

The total population size in the Black Sea is unknown. However, there are recent abundance estimates for parts of the range suggesting that population size is at least several thousand (Birkun 2006).

Finally, there are only a few estimates from other parts of the world. Approximately 900 bottlenose dolphins inhabit the 400km stretch of coastal waters off Natal, south-east of

southern Africa (Wells and Scott, 1999 and refs. therein; Reyes, 1991 and refs. therein). In the eastern Sulu Sea, Dolar et al. (2006) estimated the population size at 2,630.

4. Biology and Behaviour

Habitat: As a result of increased pelagic survey efforts, researchers have come to recognise *T. truncatus* as a truly cosmopolitan species. Although it tends to be primarily coastal, it can also be found in pelagic waters (Wells and Scott, 1999). Bottlenose dolphins exploit a wide variety of habitats. The inshore form frequents river mouths, bays, lagoons and other shallow coastal regions (between 0.5–20m). Occasionally they may travel far up into rivers. In Santa Monica Bay, California, e.g. they occur year-round and are found 80% of the time in waters within 0.5 km of shore (Bearzi, 2005).

The offshore form is apparently less restricted in range and movement, and can be found in many productive areas, particularly in the tropics. Some offshore populations are residents around oceanic islands. A coastal habitat seems to be preferred in the Black Sea, with limited movements into offshore waters (Reyes, 1991 and refs. therein). Limits to the species' range appear to be temperature related, either directly, or indirectly through distribution of prey.

Off the coasts of North America, they tend to inhabit waters with surface temperatures ranging from about 10°C to 32°C (Wells and Scott, 1999 and refs. therein). In the Gulf of Mexico off the coast of Louisiana, their distribution is correlated with depth, distance to shore, bottom oxygen, distance to the edge of a hypoxic zone and density of sciaenid fishes, particularly Atlantic croaker, *Micropogonias undulatus* (Good et al. 2006), and in Sarasota Bay, Florida, seagrass areas are particularly important to foraging dolphins (Weiss, 2006).

In Moray Firth, NE Scotland, there are clear relationships between feeding events and submarine habitat characteristics; during June and July certain forms of feeding occur primarily over steep sea bed gradients and in deeper waters (Hastie et al. 2004). Along the Dorset coast of England chlorophyll a and fish distribution (brill, cuttlefish, plaice, Pollack, red and grey mullet, sole, sprat and spurdog) were the main factors influencing distribution and could explain 13.5% and 88% of the frequency of dolphin sightings, respectively (Sykes et al. 2003).

Food: The differences between inshore and offshore *Tursiops* are also reflected in their feeding habits. The inshore form feeds primarily on a variety of fish and invertebrates from both the littoral and sub-littoral zones, whereas mesopelagic fish and oceanic squids are commonly reported as the diet of animals of the offshore form (Reyes, 1991 and refs. therein). Diet varies with local prey availability including benthic-reef and sandy-bottom prey and their associated predators, pelagic schooling fish and cephalopods, and deeper-water fish (Wells and Scott, 1999 and refs. therein).

In North Carolina, USA, sciaenid fishes were the most common prey, with Atlantic croaker (*Micropogonias undulatus*) dominating the diet of dolphins that stranded inside estuaries, whereas weakfish (*Cynoscion regalis*) was most important for dolphins in the ocean. Inshore squid (*Loligo* sp.) was eaten commonly by dolphins in the ocean, but not in the estuaries (Gannon and Waples 2004). The overwhelming majority of prey were soniferous species, which are detected through passive listening. Gannon et al. (2005) showed that by listening passively, dolphins obtain useful information on identity, number, size and location of soniferous prey. Once prey is detected, dolphins then use echolocation for tracking during pursuit and capture.

In South Carolina, stomach contents included fish (89% of stomachs) and cephalopods (sole dietary component in 11% of stomachs). Dolphins preferred smaller-sized benthic and demersal fish species of the family Sciaenidae, with star drum (*Stellifer lanceolatus*) the most abundant species. Brief squid (*Lolliguncula brevis*) was the most frequently observed cephalopod (Pate, 2008).

Off the coast of Normandy, France, the diet was dominated by gadoid fish (*Trisopterus* sp.), gobies and mackerel (*Scomber scombrus*) (de Pierrepont et al. 2005).

Off Galicia, north-western Spain, the most important prey species between 1990 and 2005 were blue whiting (*Micromesistius poutassou*) and hake (*Merluccius merluccius*), both of high commercial importance. Although bottlenose dolphins are often seen close inshore, their diet suggests that they feed at the shelf edge. The amount of hake in the diet remained stable against a background of falling local abundance, while the amount of blue whiting declined despite an increase in spawning stock size (Santos et al. 2007).

Off Peru, both coastal and offshore dolphins consumed Pacific sardines, anchovetas, and hake, but demersal species such as sciaenids and toadfish were found only in coastal dolphins. By contrast, the offshore animals were the only ones with mesopelagic fish and squid in their stomachs (Wells and Scott, 1999 and refs. therein).

Although individual feeding is perhaps most prevalent, co-operative herding of schools of prey fish has been reported from a number of regions. During the hunt, dolphins are very agile and were observed to rapidly manoeuvre during chases of fish in open water or around patches of rooted vegetation. Video analysis of chase sequences indicates that mean rate of turn was 561.6 degrees /sec with a maximum rate measured at 1,372.0 degrees /sec (or 3.8 turns per sec). High turning rates with small turning radii were primarily the result of maneuvers in which the dolphin rolled 90 degrees and rapidly flexed its body ventrally (Maresh et al. 2004). In the deep waters surrounding the Bermuda Pedestal, satellite-tracked dolphins travel a mean distance of 28.3 km/day. Dive behaviour correlates with the reported nightly vertical migrations of mesopelagic prey. At night, dive depths are greater than 450 m and last longer than 5 min. whereas during daytime dives are restricted to 50 m of the surface, lasting less than 1 min (Klatsky et al. 2007).

In Mauritania and Brazil, dolphins regularly drive schools of mullet towards fishermen wading with nets in shallow water, and in other regions they have been observed feeding behind shrimp trawlers and in the vicinity of small purse seiners, collecting discarded fish from these operations after the nets are retrieved, and stealing fish from a variety of fishing gear (Wells and Scott, 1999 and refs. therein). E.g. in Florida, bottlenose dolphins prey on king mackerel (*Scomberomorus cavalla*) taken by the troll fishery. Dolphins took 6% of king mackerel caught by charter fishermen and 20% of fish caught by commercial fishermen, causing substantial losses. A modification to the outrigger planer was suggested to deter bottlenose dolphins from engaging in depredation without causing a reduction in catch (Zollett and Read, 2005).

Schooling: Group size is commonly around 2-15 animals, but large herds of several hundred to a thousand are regularly seen offshore (Bloch, 1998; Wells and Scott, 2009). In order to maintain group cohesion, bottlenose dolphins developed individually distinctive signature whistles to transmit identity information, which was found to be independent of the caller's voice or location (Janik et al. 2006).

The plasticity of bottlenose dolphin behaviour is shown, e.g. in the San Luis Pass area near Galveston, Texas, where there are two populations of bottlenose dolphins using adjacent habitats in different ways. Resident dolphins forage predominantly in the bays and pass and display group foraging behaviour. In contrast, Gulf dolphins are only observed foraging in coastal waters, and do so individually. These behavioural differences may reflect strategies based on habitat variation but may also be indicative of distinct social structures. There is also a seasonal component to behaviour and group size, with larger mixed groups and more social behaviour occurring in summer (Henderson and Würsig, 2007).

Bottlenose dolphins are commonly associated with other cetaceans, such as pilot whales, white-sided, spotted, rough-toothed and Risso's dolphins, and humpback whales. Hybrids with other species are known from both captivity and in the wild (Jefferson et al. 1993; Bloch, 1998; Wells and Scott, 1999). However, interspecific interactions may be aggressive, and in Baía Norte, southern Brazil, e.g. attacks of bottlenose dolphins on estuarine dolphins (*Sotalia guianensis*) were observed (Wedekin et al. 2004). Aggressive and lethal interactions with harbour porpoises (*Phocoena phocoena*) were frequently reported (e.g. Read, 1999).

Reproduction: Longevity in females is more than 57 years and in males up to 48 years (Wells and Scott, 1999). Females reach sexual maturity at 5 – 13 years and males at 9-14 years. Spring and summer or spring and autumn calving peaks are known for most populations, and gestation lasts about 12 months (Jefferson et al. 1993; Wells and Scott, 2009).

5. Migration

According to Wells and Scott (1999; 2009), coastal dolphins exhibit a full spectrum of movements, including 1) seasonal migrations, 2) year-round home ranges, 3) periodic residency, and 4) a combination of occasional long range movements and repeated local residency. Long-term residency may take the form of a relatively permanent home range or repeated occurrence in a given area over many years. For example, the residents of several dolphin communities along Florida's west coast have maintained relatively stable home ranges during more than 28 years of observations. In other areas, residency is long-term but more variable. Dolphins seen frequently during 1974–1976 in Golfo San Jose, Argentina, showed a subsequent decline in frequency of occurrence, but were still occasionally identified in the area 8–12 years later.

Along the central west coast of Florida, communities of resident dolphins appear to inhabit a mosaic of overlapping home ranges. Most of the activities of the residents are concentrated within the home ranges, but occasional movement between ranges occurs also. The same applies to bottlenose dolphins off San Luis Pass, Texas (Maze and Würsig, 1999). Within the home range, habitat use varies with season, with shallow estuarine waters frequented during the summer and coastal waters and passes between barrier islands used during the winter (Wells and Scott, 1999 and refs. therein). However, behaviour may also vary among animals within the same area: Simões-Lopez and Fabian (1999) found that in Laguna, southern Brazil 88.5% of the individuals were resident and the rest were non-resident.

In Southern California, a high proportion of dolphins photographed off Santa Barbara, Orange County, and Ensenada, Mexico, were also photographed off San Diego. The majority of these dolphins exhibited back-and-forth movements between study areas, with no evidence of site fidelity to any particular region. Minimum range estimates were between 50 and 470 km. Minimum travel-speed estimates were 11–47 km/d, and all dolphin schools sighted during the study were within 1 km of the shore (Defran et al. 1999). Long-distance movements have also

been reported in conjunction with an El Niño warm water event, expanding the species' range more than 500 km northward (Wells and Scott, 1999 and refs. therein). Following the El Niño, some dolphins remained in northern waters, while others returned to their previous range to the south. Würsig (1978, in Wells and Scott, 1999) reported a 600-km round-trip for several identifiable dolphins in Argentina. Tanaka (1987) reported that a satellite-tracked dolphin off Japan apparently travelled 604 km in 18 days along the Kuroshio Current.

Dolphins living at the high latitude or cold water extremes of the species' range may migrate seasonally. It has been suggested that some dolphins may use seasonal home ranges joined by a travelling range: a 4-month cycle of occurrence of dolphins was observed in Golfo San Jose, Argentina (Wells and Scott, 1999 and refs. therein). In Moray Firth, northeastern Scotland, bottlenose dolphins were seen in all months of the year, but numbers were low in winter and spring and peaked in summer and autumn. Individuals exhibited rapid movements across the population's range, and one individual was sighted at locations 190 km apart within a 5-day period (Wilson et al. 1997). Similarly in the Faroes, bottlenose dolphins are observed all year round but with peaks in March and July-October (Bloch, 1998). In the coastal waters of Cornwall, UK, dolphins demonstrated a seasonal residency pattern, spending the winter in southern Cornwall and moving farther north-eastward during spring and summer. The dolphins occupied a linear coastal range of 650 km. Within this range they repeatedly made long-distance journeys covering up to 1,076 km and lasting up to 20 days (Wood, 1998).

Wells et al. (1999) tracked two rehabilitated adult male bottlenose dolphins with satellite-linked transmitters in 1997. "Rudy" was equipped in the Gulf of Mexico off central west Florida. He moved around Florida and northward to Cape Hatteras, NC, covering 2,050 km in 43 d. "Gulliver" was released off Cape Canaveral, FL. He moved 4,200 km in 47d to a location north-east of the Virgin Islands. Gulliver swam through 5,000-m-deep waters 300 km offshore of the northern Caribbean islands, against the North Equatorial Current.

Long-distance migrations are presumably regularly undertaken by offshore bottlenose dolphins, whose diet is comprised of highly migratory species of fish and squids. E.g. in the Azores, North Atlantic bottlenose dolphins carry out extensive movements and have large home ranges in response to the lower density and patchy distribution of prey compared to other areas. The extensive ranging behaviour and the lack of territoriality provide an opportunity for interbreeding between different island groups, thus preventing genetic differentiation within the population (Silva et al. 2008).

6. Threats

Direct catch: Directed fisheries taking bottlenose dolphins have previously occurred around the Black Sea as well as in Mexico, Guatemala, Costa Rica, the West Indies, Venezuela, Sri Lanka, and off southern Africa, India and Peru. Drive fisheries for bottlenose and other dolphins were also reported from the Republic of China (Taiwan), but the numbers are not known. The species was taken in a drive fishery in the Faroe Islands which dates back to 1803, annual takes numbering from 1–308, often in mixed schools with long finned pilot whales (*Globicephala melas*) (Reyes, 1991 and refs. therein; Bloch, 1998). However, there are no reports on catches in recent years (NAMMCO, 2008).

In Peru, coastal fisheries still take *Tursiops* and other cetaceans for human consumption, using gill nets, purse seines, and harpoons. A similar fishery occurs in Sri Lanka (Wells and Scott, 1999 and refs. therein; Wells and Scott, 2009). Although direct killing has noticeably decreased since dolphin hunting was banned by law in 1996, around a thousand dolphins and other small whales are still falling victim annually to fishermen to supply bait meat for the

shark fishery there. The most significant take probably occurs off Japan, where bottle-nose dolphins are killed for human consumption, bait and because of perceived competition with fisheries (Wells and Scott, 2009). Reported catches in 2007 are 300 in the drive fisheries and 101 in the hand-harpoon fishery (Iwasaki, 2008).

Live captures: More than 530 *Tursiops* have been taken from US waters since the passage of the Marine Mammal Protection Act of 1972 (MMPA), particularly from the southeastern USA. Present federal regulations limit the annual allowable take to less than 2% of the minimum estimated population in designated management areas, but no bottlenose dolphins have been collected in US waters since 1989. Some live-capture removals continue in other countries, including Cuba where at least 238 were captured in 1986-2004 (Van Waerebeek *et al.* 2006), the Solomon Islands, Japan, and Russia (Wells and Scott 1999; 2009).

Incidental catch: Fisheries around the world account for incidental takes of bottlenose dolphins, in gillnets, driftnets, purse seines, trawls, long-lines, and on hook-and-line gear used in commercial and recreational fisheries, but the present level of take remains unknown (Hammond *et al.* 2008).

Along the east coast of the United States, by-catches of bottlenose dolphins in gillnet fisheries exceed removal levels set under the US Marine Mammal Protection Act (Cox *et al.* 2004). The use of acoustic deterrents, so-called “pingers” to deter dolphins from nets, however, did not show clear results and was not recommended. In North Carolina interactions between dolphins and gill nets are common, and many of these interactions are food-based. Surprisingly, however, dolphins engaging in depredation do not appear to become entangled; instead it seems more likely entanglement occurs as a result of dolphins failing to change course around the net (Read *et al.* 2003). A new type of net material made with barium sulphate was found to be acoustically more reflective than the standard nylon net and should increase dolphin detection range sufficiently to reduce entanglement (Mooney *et al.* 2004).

The best protective measure, however, seems to be a decrease in fishing effort. A marked decrease in fishing effort for spiny dogfish in North Carolina corresponded with a marked decrease in winter stranding rates of bottlenose dolphins with entanglement lesions (Byrd *et al.* 2008). In South Carolina, analysis of historical strandings showed that approximately 24% of the 42 entanglement cases from 1992-2003 resulted from the blue crab fishery. The average number of entanglements per year exceeded 1% of PBR across a five-year period (1999-2003) (Burdett and McFee, 2004). Longlines seem to be far less dangerous: in the Hawaii-based longline fishery targeting primarily tunas and swordfish. In 159,572 sets during 1994-2005, only 1 bottlenose dolphin was caught (Forney and Kobayashi, 2007).

A high proportion of the common dolphins that strand on the south coast of England in winter months bear evidence of fishery interactions. Many animals were recorded from trawl tows targeted at bass. Preliminary mitigation trials using pingers, however, were not effective, and current work is focussed on using exclusion grids to allow dolphins to escape from the sleeve of the trawl, as the number of stranded by-caught dolphins has raised concerns for their conservation status (Northridge, 2003).

Around the Balearic Islands, the artisanal gillnet fishery is experiencing a growing problem with bottlenose dolphins depredating bottom-set nets. The resulting catch loss engenders hostility from fishers, and interactions between dolphins and nets can result in bycatch mortality. A large-scale experimental trial using pingers to deter dolphins from the nets suggests that some pinger types are effective in reducing net interactions (Brotons *et al.* 2008). Whereas cetacean interactions with fishing gear are reported regularly and most

frequently involve incidental capture, another cause of mortality is the ingestion of gill-net parts and subsequent larynx strangulation documented e.g. in 10% of dolphins stranded along the Croatian coast of the Adriatic Sea (Gomeric et al. 2009).

The use of shark nets to protect bathing beaches in South Africa and Australia has caused mortality as well. Dolphins were found with full stomachs, indicating recent feeding in the vicinity of the nets, and there was a correlation of mortality rates with the direction of the prevailing current. Attempts to prevent the animals from entangling by incorporating active and passive devices in the net were not successful. The relatively high incidental catches of coastal dolphins off South Africa has prompted concerns that the take is not sustainable (Wells and Scott, 1999 and refs. therein).

Incidental catches in Chinese fisheries reach several hundred per year (Yang et al. 1999), and a large incidental take of *Tursiops* has apparently occurred in the Taiwanese gill net fishery off Australia, with an annual mortality perhaps exceeding 2000 animals, although these may be of the other species, *Tursiops aduncus*. Molecular monitoring of 'whalemeat' markets in the Republic of (South) Korea revealed that at least some *T. truncatus* by-catch is sold and used in human consumption (Baker et al. 2006).

Overfishing:

Peddemors (1999) summarises for the coast of Africa south of 17°S that more research emphasis should in future be placed on possible detrimental interactions due to overfishing of delphinid prey stocks. Increased commercial fishing pressure will inevitably increase interactions between the fishery and the affected delphinids. One of the inshore species considered to be vulnerable is the bottlenose dolphin in KwaZulu-Natal and Namibia.

Culling: *Tursiops* have been intentionally killed by fishermen in Japan and Hawaii, and presumably such practices are found elsewhere in their range (Reyes, 1991). The Japanese drive fishery off Iki Island and the Kii Peninsula took several hundred *Tursiops truncatus* annually to reduce the perceived competition with the commercial fishery for yellowtail, *Seriola* sp. (Wells and Scott, 1999 and refs. therein).

Pollution: Its worldwide distribution and great adaptability to diverse habitats make this species a good indicator of the quality of inshore marine ecosystems. Concentrations of many contaminants in common dolphin tissues are magnified through bio-accumulation and often are the highest recorded in any mammal.

In the blubber of South African specimens, concentrations of polychlorinated biphenyls and dieldrin in tissues of males reached levels that theoretically could impair testosterone production and thus reduce reproductive ability. First-born calves received 80% of their mother's body burden of contaminant residues, possibly leading to increased neonatal mortality (Wells and Scott, 1999, and refs. therein), as even relatively low levels of PCBs and DDT can result in a decline in immune system function (Lahvis et al. 1995). This was confirmed by subsequent results. In primiparous females from Sarasota Bay, Florida, PCB concentrations in blubber and plasma and the rates of first-born calf mortality were both high. Subsequent calves of similar age had lower concentrations than first-born calves (Wells et al. 2005).

Persistent organic pollutants in coastal ecosystems have half-lives of decades or more, and their signatures can be used to confirm site-specificity of local populations. In Biscayne Bay (Miami, FL), male dolphins in the northern, metropolitan area had PCB concentrations that were 5 times higher than in their congeners from the southern, more rural area (43 mg/g vs.

8.6 mg/g wet mass), demonstrating local and persistent differences in habitat use. PCB concentrations in northern bay dolphins are high compared to other estuarine dolphin populations and may place these animals at risk of reproductive failure and decreased immune function (Litz et al. 2007). Similarly, along the coast of Georgia, southeastern USA, blubber PCB concentrations from free-ranging animals from the Turtle/Brunswick River estuary were ten times higher (77 μ g/g lipid) and showed different Aroclor 1268 signatures compared with strandings samples from Savannah area estuaries 90 km to the north, confirming that inshore *T. truncatus* populations exhibit long-term fidelity to specific estuaries (Pulster and Maruya, 2008) and highlighting the necessity to control local pollution sources.

Contamination of bottlenose dolphin is a world-wide problem, and blubber samples from the Bay of Bengal (southeast coast of India) contained considerable concentrations of the organochlorine pesticides hexachlorocyclohexane (HCHs), dichlorodiphenyl trichloroethane (DDTs), and polychlorinated biphenyls (PCBs) (Karuppiah et al. 2005). Dolphins stranded on the coasts of the Mediterranean sea between 2000 and 2003 showed very high concentrations of PCBs and DDT in all tissues and organs analysed. Their values were still comparable to those obtained during the 1990's in the Mediterranean environment (Wafu et al. 2005).

In the Charleston Harbor estuary, South Carolina, USA, the levels of another bioaccumulative chemical, polybrominated diphenyl ethers (PBDE) in dolphins represent some of the highest measured in marine mammals (5,860 ng/g lipid) and warrant further investigation of potential deleterious effects (Fair et al. 2007).

Almost all bottlenose dolphins found stranded along the western Italian and Greek coasts in the mid-1990's contained the anti-fouling component tributyltin (TBT) and its degradation products, monobutyltin (MBT) and dibutyltin (DBT), in the liver and kidney. BTs were found to be transferred from mother to fetus. (Focardi et al. 2000). In waters around Japan butyltin concentrations in coastal *T. truncatus* were higher than in offshore populations, indicating land-based sources (Le et al. 1999), e.g. shipyards where contaminated paint is stripped during repair.

Specimens stranded along the Corsican coast, Mediterranean, France, in the mid-1990's showed high levels of mercury accumulation in the liver, with concentrations as high as 4,250 μ g Hg/g dw suggesting a life-long uptake of this heavy metal (Frodello et al. 2000).

Finally, there are also biological sources of toxic substances. In Sarasota Bay, Florida, USA, brevetoxins produced by blooms of the harmful alga *Karenia brevis* were measured at high levels in bottlenose dolphin carcasses after large-scale mortality, and levels in animals stranded during non-bloom conditions were also detectable (Fire et al. 2007). Since mass-occurrence of these algae is linked to high concentrations of fertilizers in terrestrial runoff, this toxic substance can also be indirectly attributed to anthropogenic activities (NOAA, 2009).

Noise pollution:

Anthropogenic sounds in the ocean are increasing from such influences as shipping, drilling, sonars, and scientific exploration, and several marine mammal strandings have been linked to anthropogenic noise-induced events. Odontocetes rely on utilizing sound in the ocean and are particularly affected by man-made noise. In April 2006, an exceptional mass stranding event occurred in the northern part of Zanzibar involving more than 600 dolphins. The dolphins were alive at the stranding spot and the locals ate the meat without any problems, which excludes red tides as a mortality cause. Amir and Jiddawi (2007) speculated that a seismic

event which at the time was taking place in the southern part of Tanzania for gas exploration, a sea quake or sonar activities could have caused the stranding.

Mooney et al. (2006) showed that temporary threshold shifts in the bottlenose dolphin can be induced by long exposure times or high sound pressure levels. Whereas bottlenose dolphins may have a protective mechanism that reduces harmful physiological noise damage at shorter duration exposures, the inverse might be true for long duration exposures at lower levels. In Teignmouth Bay, UK, stationary boats elicited no response, but speedboats and jet skis were associated with aversive behaviours, even when boats were not directly approaching the dolphins (Goodwin and Cotton, 2004). In Aberdeen harbour, Scotland, dolphins were usually concentrated around the harbour entrance. Their responses to boats varied considerably according to boat size, activity and speed, but there was evidence of habituation to boat traffic (Sini et al. 2005). A more subtle effect of noise is the acoustic detection range of female dolphins and their dependent calves. Quintana-Rizo et al. (2006) found it to be noise limited as opposed to being limited by hearing sensitivity. In shallow-water seagrass areas, low-frequency (7-13 kHz) whistles with a 165 dB source level can be normally heard by dolphins at a distance of 487 m, which is larger than usual mother-calf separation distances.

Tourism: Excessive and unregulated visiting of wild dolphins habituated to humans has raised concern in several areas, in particular in Europe (Reyes, 1991 and refs. therein). Off Sarasota, Florida animal behavioral observations conducted during boat approaches detected longer interbreath intervals compared to control periods (no boats within 100m). Dolphins decreased interanimal distance, changed heading, and increased swimming speed significantly more often in response to an approaching vessel than during control periods (Nowacek et al. 2001). These findings provide additional support for the need to consider disturbance in management plans for cetacean conservation (P. Yazdi, pers. comm. 2003).

In South Carolina, USA, and New Zealand multiple boats were found to have a greater influence on dolphin behaviour and movement than the presence of a single boat (Constantine et al. 2004; Mattson et al. 2005). Dolphin-watching boats, motorboats, shrimp boats, and jet skis affected group size and behaviour of dolphin groups, with jet-skis having the most pronounced effects. Boat-related effects on bottlenose dolphin behaviour are considered "harassment" under the USA Marine Mammal Protection Act (1972) and should be scrutinized (Mattson et al. 2005).

However, in Zanzibar waters, Western Indian Ocean, local fishermen realised that the touristic value of dolphins far exceeds that of using them as bait for shark. As many as 2,000 tourists visit the dolphin site at Kizimkazi per month and dolphin-tourism has become a popular economic activity. It is hoped that successful management of the dolphin-tourist trade will ensure continued visitors to coastal villages and thus add to local income while contributing to management and conservation (Ali and Jiddawi, 1999) This is also a problem in Australia, where excessive interaction with tourists has led to reduced survivorship of juveniles at Shark Bay (W. Perrin, 2010, pers. comm..).

7. Remarks

Range states (Hammond et al. 2008) :

Albania; American Samoa; Anguilla; Antigua and Barbuda; Argentina; Aruba; Australia; Bahamas; Bangladesh; Barbados; Belgium; Belize; Benin; Bermuda; Brazil; Brunei Darussalam; Bulgaria; Cambodia; Cameroon; Canada; Cape Verde; Cayman Islands; Chile;

China; Cocos (Keeling) Islands; Colombia; Comoros; Cook Islands; Costa Rica; Côte d'Ivoire; Croatia; Cuba; Cyprus; Denmark; Djibouti; Dominica; Dominican Republic; Ecuador; El Salvador; Falkland Islands (Malvinas); Fiji; France; French Guiana; French Polynesia; Gabon; Gambia; Georgia; Germany; Ghana; Gibraltar; Greece; Grenada; Guadeloupe; Guam; Guatemala; Guinea; Guinea-Bissau; Guyana; Haiti; Honduras; Hong Kong; India; Indonesia; Iran, Islamic Republic of; Ireland; Italy; Jamaica; Japan; Kenya; Kiribati; Liberia; Madagascar; Malaysia; Maldives; Malta; Marshall Islands; Mauritania; Mexico; Micronesia, Federated States of; Montenegro; Morocco; Mozambique; Myanmar; Namibia; Nauru; Netherlands; Netherlands Antilles; New Caledonia; New Zealand; Nicaragua; Niue; Northern Mariana Islands; Oman; Pakistan; Palau; Panama; Papua New Guinea; Peru; Philippines; Pitcairn; Portugal; Puerto Rico; Romania; Russian Federation; Saint Helena; Saint Kitts and Nevis; Saint Lucia; Saint Pierre and Miquelon; Saint Vincent and the Grenadines; Samoa; Senegal; Singapore; Slovenia; Solomon Islands; Somalia; South Africa; Spain; Sri Lanka; Suriname; Taiwan, Province of China; Tanzania, United Republic of; Thailand; Timor-Leste; Togo; Tonga; Trinidad and Tobago; Turkey; Ukraine; United Arab Emirates; United Kingdom; USA; Uruguay; Vanuatu; Venezuela; Viet Nam; Virgin Islands, British; Virgin Islands, U.S.; Wallis and Futuna; Western Sahara; Yemen

The common bottlenose dolphin is listed in Appendix II of CITES. The North Sea, Baltic Sea, Mediterranean and Black sea populations are listed in Appendix II of CMS. The IUCN lists the species as “Least Concern” with the exception of the Black sea bottlenose dolphin *T. t. ponticus*, which is listed as “Endangered”. Its current population size is around several thousand animals, but the population was significantly reduced by large directed takes, incidental mortality in fisheries, live-catches and a mass mortality of unknown cause in 1990, and it is currently suffering from a degradation of the Black Sea environment (Birkun, 2008).

In the Mediterranean Sea, important ongoing threats include incidental mortality in fishing gear and the reduced availability of key prey caused by overfishing and environmental degradation throughout the region. Additional potential or likely threats include the toxic effects of xenobiotic chemicals, epizootic outbreaks, direct disturbance from boating and shipping, noise, and the consequences of climate change. Dolphin abundance is thought to have declined considerably in the region and management measures are needed to prevent further decline. Compliance with existing legislation and treaties, which outline appropriate measures, is urgently required (Bearzi et al. 2009).

8. Sources

- Ali O, Jiddawi NS (1999) Dolphin tourism and community participation in Zanzibar: The case of Kizimkazi Village. Conference on Advances on Marine Sciences in Tanzania Zanzibar Tanzania Ims 1999, p. 48.
- Amir O, Jiddawi NS (2007) Stranding event of the common bottlenose dolphin (*Tursiops truncatus*) in the northern part of Zanzibar, April 2006 5th Western Indian Ocean Marine Science Association Scientific Symposium; Science, Policy and Management Pressures and Responses in the Western Indian Ocean region; Book of Abstracts.
- Baker CS, Lukoschek V, Lavery S, Dalebout ML, Yong-un M, Endo T, Funahashi N (2006) Incomplete reporting of whale, dolphin and porpoise 'bycatch' revealed by molecular monitoring of Korean markets. *Anim Conserv* 9: 474-482.
- Barco SG, Swingle WM, Mclellan WA, Harris RN, Pabst DA (1999) Local abundance and distribution of bottlenose dolphins (*Tursiops truncatus*) in the near-shore waters of Virginia Beach, Virginia. *Mar Mamm Sci* 15: 394-408.

- Barlow J (2003) Preliminary estimates of the abundance of cetaceans along the U.S. west coast: 1991_2001. Southwest Fisheries Science Center Administrative Report LJ_03_03.
- Bearzi G, Agazzi S, Bonizzoni S, Costa M, Azzellino A (2008) Dolphins in a bottle: abundance, residency patterns and conservation of bottlenose dolphins *Tursiops truncatus* in the semi-closed eutrophic Amvrakikos Gulf, Greece. *Aquat Conserv: Mar Freshw Ecosyst* 18: 130-146.
- Bearzi G, Fortuna CM, Reeves RR (2009) Ecology and conservation of common bottlenose dolphins *Tursiops truncatus* in the Mediterranean Sea. *Mamm Rev* 39: 92-123.
- Bearzi G, Politi E, Agazzi S, Bruno S, Costa M, Bonizzoni S (2005) Occurrence and present status of coastal dolphins (*Delphinus delphis* and *Tursiops truncatus*) in the eastern Ionian Sea. *Aquat Conserv: Mar Freshwat Ecosyst* 15: 243-257.
- Bearzi M (2005) Aspects of the ecology and behaviour of bottlenose dolphins (*Tursiops truncatus*) in Santa Monica Bay, California. *J Cetacean Res Manag* 7: 75-83
- Birkun JrAA (2008) *Tursiops truncatus ssp. ponticus*. In: IUCN 2009. IUCN Red List of Threatened Species. Version 2009.2. <www.iucnredlist.org>.
- Bloch D (1998) A review of marine mammals observed, caught or stranded over the last two centuries in Faroese Waters. *Shetland Sea Mammal Report, 1997*: 15-30.
- Bloch D, Mikkelsen B (2000) Preliminary estimates on seasonal abundance and food consumption of Marine Mammals in Faroese Waters. NAMMCO WG on Marine Mammal and Fisheries Interactions. Copenhagen 17-18 February 2000. SC/8/EC/7: 1-16.
- Brotons JM, Munilla Z, Grau AM, Rendell L (2008) Do pingers reduce interactions between bottlenose dolphins and nets around the Balearic Islands? *Endang Species Res* 5: 301-308
- Burdett LG, McFee WE (2004) Bycatch of bottlenose dolphins in South Carolina, USA, and an evaluation of the atlantic blue crab fishery categorisation. *J Cetacean Res Manag* 6: 231-240.
- Byrd BL, Hohn AA, Munden FH, Lovewell GN, Lo Piccolo RE (2008) Effects of commercial fishing regulations on stranding rates of bottlenose dolphin (*Tursiops truncatus*). *Fish Bull* 106: 72-81
- Canadas A, Hammond PS (2006) Model-based abundance estimates for bottlenose dolphins off southern Spain: implications for conservation and management. *J Cetacean Res Manag* 8: 13-27.
- Carretta JV, Forney KA, Lowry MS, Barlow J, Baker J, Johnston D, Hanson, Muto MM, Lynch D, Carswell L (2009) U.S. Pacific Marine Mammal Stock Assessments: 2008. NOAA-TM-NMFS-SWFSC-434
- Carwardine M (1995) Whales, dolphins and porpoises. Dorling Kindersley, London, UK, 257 pp.
- Constantine R, Brunton DH, Dennis T (2004) Dolphin-watching tour boats change bottlenose dolphin (*Tursiops truncatus*) behaviour. *Biol Conserv* 117: 299-307.
- Cox TM, Read AJ, Swanner D, Urian K, Waples D (2004) Behavioural responses of bottlenose dolphins, *Tursiops truncatus*, to gillnets and acoustic alarms. *Biol Conserv* 115: 203-212.
- Defran RH, Weller DW, Kelly DL, Espinosa MA (1999) Range characteristics of Pacific coast bottlenose dolphins (*Tursiops truncatus*) in the Southern California Bight. *Mar Mamm Sci* 15: 381-393.
- Dolar MLL, Perrin WF, Taylor BL, Kooyman GL, Alava MNR (2006) Abundance and distributional ecology of cetaceans in the central Philippines. *J Cetacean Res Manage* 8: 93-112.
- Fair PA, Mitchum G, Hulse TC, Adams J, Zolman E, McFee W, Wirth E, Bossart GD (2007) Polybrominated diphenyl ethers (PBDEs) in blubber of free-ranging bottlenose dolphins (*Tursiops Truncatus*) from two southeast Atlantic estuarine areas. *Arch Environ Contam Toxicol* 53: 483-494
- Fire SE, Fauquier D, Flewelling LJ, Henry M, Naar J, Pierce R, Wells RS (2007) Brevetoxin exposure in bottlenose dolphins (*Tursiops truncatus*) associated with *Karenia brevis* blooms in Sarasota Bay, Florida. *Mar Biol* 152: 827-834.
- Foccardi S, Corsolini S, Aurigi S, Pecetti G, Sanchez Hernandez JC (2000) Accumulation of butyltin compounds in dolphins stranded along the Mediterranean Coasts. *Appl Organomet Chem* 14: 48-56.

- Forcada J, Gazo M, Aguilar A, Gonzalvo J, Fernandez-Contreras M (2004) Bottlenose dolphin abundance in the NW Mediterranean: Addressing heterogeneity in distribution. *Mar Ecol Prog Ser* 275: 275-287.
- Forney KA (2007) Preliminary estimates of cetacean abundance along the U.S. west coast and within four National Marine Sanctuaries during 2005. NOAA Tech Memo NMFS-SWFSC-406. 27 p.
- Forney KA, Kobayashi DR (2007) Updated estimates of mortality and injury of cetaceans in the Hawaii-based longline fishery, 1994-2005. NOAA Tech Memo NMFS SWFSC. no. 412, 35 pp
- Frodello JP, Romeo M, Viale D (2000) Distribution of mercury in the organs and tissues of five toothed-whale species of the Mediterranean. *Env Poll* 108: 447-452.
- Gannon DP, Barros NB, Nowacek DP, Read AJ, Waples DM, Wells RS (2005) Prey detection by bottlenose dolphins, *Tursiops truncatus*: an experimental test of the passive listening hypothesis. *Anim Behav* 69: 709-720.
- Gannon DP, Waples DM (2004) Diets of coastal bottlenose dolphins from the U.S. Mid-Atlantic coast differ by habitat. *Mar Mamm Sci* 20: 527-545.
- Gomericic MD, Galov A, Gomericic T, Skrtic D, Curkovic S, Lucic H, Vukovic S, Arbanasic H, Gomericic H (2009) Bottlenose dolphin (*Tursiops truncatus*) depredation resulting in larynx strangulation with gill-net parts *Mar Mamm Sci* 25: 392-401.
- Gomez de Segura A, Crespo EA, Pedraza SN, Hammond PS, Raga JA (2006) Abundance of small cetaceans in waters of the central Spanish Mediterranean. *Mar Biol* 150: 149-160
- Good C, Craig K, Hazen E, Crowder L, Read A (2006) Distribution of bottlenose Dolphins (*Tursiops truncatus*) in the northern Gulf of Mexico in relation to summertime hypoxic events. *EOS Trans Am Geophys Union* 87: 36
- Goodwin L, Cotton PA (2004) Effects of boat traffic on the behaviour of bottlenose dolphins (*Tursiops truncatus*). *Aquat Mamm* 30: 279-283.
- Hale PT, Barreto AS, Ross GJB (2000) Comparative morphology and distribution of the aduncus and truncatus forms of bottlenose dolphin *Tursiops* in the Indian and western Pacific Oceans. *Aquat Mamm* 26: 101-110.
- Hammond PS, Bearzi G, Bjørge A, Forney K, Karczmarski L, Kasuya T, Perrin WF, Scott MD, Wang JY, Wells RS, Wilson B (2008) *Tursiops truncatus*. In: IUCN 2009. IUCN Red List of Threatened Species. Version 2009.2. <www.iucnredlist.org>.
- Hammond PS, McLeod K, Scheidat M (2006) SCANS II estimates of abundances. <http://biology.st-andrews.ac.uk/scans2/inner-furtherInfo.html>.
- Hastie GD, Wilson B, Wilson LJ, Parsons KM, Thompson PM (2004) Functional mechanisms underlying cetacean distribution patterns: Hotspots for bottlenose dolphins are linked to foraging. *Mar Biol* 144: 397-403.
- Henderson EE, Würsig B (2007) Behavior patterns of bottlenose dolphins in San Luis Pass, Texas. *Gulf Mex Sci* 25: 153-161.
- Iwasaki T (2008) Japan. Progress report on small cetacean research April 2007 to March 2008, with statistical data for the calendar year 2007. International Whaling commission SM / 2008. http://www.jfa.maff.go.jp/j/whale/w_document/pdf/h19_progress_report.pdf
- Janik VM, Sayigh LS, Wells RS (2006) Signature whistle shape conveys identity information to bottlenose dolphins. *Proc Natl Acad Sci USA* 103: 8293-8297.
- Jefferson TA, Leatherwood S, Webber MA (1993) FAO Species identification guide. Marine mammals of the world. UNEP/FAO, Rome, 320 pp.
- Jefferson TA, Webber MA Pitman RL (2008) Marine mammals of the world. Elsevier, Amsterdam, 573 pp.
- Karuppiah S, Subramanian A, Obbard JP (2005) Organochlorine residues in odontocete species from the southeast coast of India. *Chemosphere* 60: 891-897.
- Klatsky LJ, Wells RS, Sweeney JC (2007) Offshore bottlenose dolphins (*Tursiops Truncatus*): movement and dive behavior near the Bermuda pedestal. *J Mammal* 88: 59-66

- Lahvis GP, Wells RS, Kuehl DW, Stewart JL, Rhinehart HL, Via CS (1995) decreased lymphocyte responses in free-ranging bottlenose dolphins (*Tursiops truncatus*) are associated with increased concentrations of PCBs and DDT in peripheral blood. *Env Health Persp* 103(Suppl 4): 67-72.
- Le LTH, Takahashi S, Saeki K, Nakatani N, Tanabe S, Miyazaki N, Fujise Y (1999) High percentage of butyltin residues in total tin in the livers of cetaceans from Japanese coastal waters. *Env Sci Tech* 33: 1781-1786.
- LeDuc RG, Perrin WF, Dizon AE (1999) Phylogenetic relationships among the delphinid cetaceans based on full cytochrome B sequences. *Mar Mamm Sci* 15: 619-648.
- Litz JA, Garrison LP, Fieber LA, Martinez A, Contillo JP, Kucklick JR (2007) Fine-scale spatial variation of persistent organic pollutants in bottlenose dolphins (*Tursiops truncatus*) in Biscayne Bay, Florida. *Environ Sci Technol* 41: 7222-7228.
- Maresh JL, Fish FE, Nowacek DP, Nowacek SM, Wells RS (2004) High performance turning capabilities during foraging by bottlenose dolphins (*Tursiops truncatus*). *Mar Mamm Sci* 20: 498-509.
- Mattson MC, Thomas JA, Aubin DSt (2005) Effects of boat activity on the behavior of bottlenose dolphins (*Tursiops truncatus*) in waters Surrounding Hilton Head Island, South Carolina. *Aquat Mamm* 31: 133-140.
- Maze K S, Würsig B (1999) Bottlenose dolphins of San Luis Pass, Texas: Occurrence patterns, site-fidelity, and habitat use. *Aquat Mamm* 25: 91-103.
- McLellan WM, Friedlaender AS, Mead JG, Potter CW, Pabst DA (2003) Analysing 25 years of bottlenose dolphin (*Tursiops truncatus*) strandings along the Atlantic coast of the USA: do historic records support the coastal migratory stock hypothesis? *J Cetacean Res Manage* 4: 297-304.
- Miyashita, T. 1993. Abundance of dolphin stocks in the western North Pacific taken by the Japanese drive fishery. *Rep Int Whaling Commn* 43: 417-437.
- Mooney T, Nachtigall PE, Au WW, Breese M, Vlachos S (2006) The effects of noise intensity and exposure duration and potential protective mechanisms in the bottlenose Dolphin (*Tursiops truncatus*). *EOS Trans Am Geophys Union* 87: no. 36
- Mooney TA, Nachtigall PE, Au WWL (2004) Target strength of a nylon monofilament and an acoustically enhanced gillnet: predictions of biosonar detection ranges. *Aquat Mamm* 30: 220-226.
- Mullin KD (2007) Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. NMFS, Southeast Fisheries Science Center, 26 pp.
- NAMMCO (2008) Report of the meeting of the management committee for cetaceans. September 2008, Sisimiut, Greenland.
- NOAA (2009) Harmful algal blooms. <http://oceanservice.noaa.gov/topics/coasts/hab/>
- Northridge S (2003) A preliminary assessment of dolphin bycatch in trawl fisheries in the English Channel. Annual Meeting of the European Cetacean Society, Tenerife, Spain.
- Nowacek SM, Wells RS, Solow AR (2001) Short-term effects of boat traffic on bottlenose dolphins, *Tursiops truncatus*, in Sarasota Bay, Florida. *Mar Mamm Sci* 17: 673-688.
- Pate SM (2008) Stomach content analysis of stranded bottlenose dolphins (*Tursiops truncatus*) in South Carolina. *Masters Abstracts International* 46, no. 05, 255 p
- Peddemors VM (1999) Delphinids of southern Africa: A review of their distribution, status and life history. *J Cetacean Res Manag* 1: 157-165.
- Pierrepont Jfde, Dubois B, Desormonts S, Santos MB, Robin JP (2005) Stomach contents of the English Channel cetaceans stranded on the coast of Normandy. *J Mar Biol Assoc UK* 85: 1539-1546
- Pulster EL, Maruya KA (2008) Geographic specificity of Aroclor 1268 in bottlenose dolphins (*Tursiops truncatus*) frequenting the Turtle/Brunswick River Estuary, Georgia (USA). *Sci Total Environ* 393: 367-375.
- Querouil S, Silva MA, Freitas L, Prieto R, Magalhaes S, Dinis A, Alves F, Matos JA, Mendonca D, Hammond PS, Santos RS (2007) High gene flow in oceanic bottlenose dolphins (*Tursiops truncatus*) of the North Atlantic. *Conserv Genet.* 8: 1405-1419.

- Quintana-Rizzo E, Mann DA, Wells RS (2006) Estimated communication range of social sounds used by bottlenose dolphins (*Tursiops truncatus*). J Acoust Soc Am 120: 1671-1683
- Read AJ (1999) Harbour porpoise – *Phocoena phocoena* (Linnaeus, 1758). In: Handbook of Marine Mammals (Ridgway SH, Harrison SR, eds.) Vol. 6: The second book of dolphins and porpoises, pp. 323-356.
- Read A, Waples D, Urian K, Swanner D, Gannon D (2003) Behavioural interactions between bottlenose dolphins and gill nets in North Carolina, USA. Annual Meeting of the European Cetacean Society, Tenerife, Spain.
- Reyes JC (1991) The conservation of small cetaceans: a review. Report prepared for the Secretariat of the Con-vention on the Conservation of Migratory Species of Wild Animals. UNEP / CMS Secretariat, Bonn.
- Rice DW (1998) Marine mammals of the world: systematics and distribution. Society for Marine Mammalogy, Spec Pub 4, Lawrence, KS. USA.
- Sanino GP, Waerbeek Kvan, Bressemer M-Fvan, Pastene LA (2005) A preliminary note on population structure in eastern South Pacific common bottlenose dolphins, *Tursiops truncatus*. J Cetacean Res Manag 7: 65-70.
- Santos MB, Fernandez R, Lopez A, Martinez JA, Pierce GJ (2007) Variability in the diet of bottlenose dolphin, *Tursiops truncatus*, in Galician Waters, North-Western Spain, 1990-2005. J Mar Biol Assoc UK 87: 231-241
- Sellas AB, Wells RS, Rosel PE (2005) Mitochondrial and nuclear DNA analyses reveal fine scale geographic structure in bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico. Conserv Genet 6: 715-728.
- Sigurjónsson J, Gunnlaugsson T (1990) Distribution and abundance of cetaceans in Iceland and adjacent waters during sightings surveys July-August 1989. ICES C.M.1990/N:5
- Sigurjónsson J, Gunnlaugsson T, Payne M (1989) Ship-board sightings surveys in Icelandic and adjacent waters June-July 1987. Rep Int Whal Commn 39: 395-409.
- Silva MA, Prieto R, Magalhaes S, Seabra MI, Santos RS, Hammond PS (2008) Ranging patterns of bottlenose dolphins living in oceanic waters: implications for population structure. Mar Biol 156: 179-192.
- Simoes Lopes PC, Fabian ME (1999) Residence patterns and site fidelity in bottlenose dolphins, *Tursiops truncatus* (Montagu) (Cetacea, Delphinidae) off southern Brazil. Rev Brasil Zool 16: 1017-1024.
- Sini MI, Canning SJ, Stockin KA, Pierce GJ (2005) Bottlenose dolphins around Aberdeen harbour, north-east Scotland: a short study of habitat utilization and the potential effects of boat traffic. J Mar Biol Assoc UK 85:1547-1554.
- Sykes R, Allen J, Owens C (2003) Factors influencing the seasonal distribution of sightings of bottlenose dolphins (*Tursiops truncatus*) along the Dorset coast. Annual Meeting of the European Cetacean Society, Tenerife, Spain.
- Tanaka S (1987) Satellite radio tracking of bottlenose dolphins *Tursiops truncatus*. Nippon Suisan Gakkaishi Bull Jap Soc Sci Fish 53: 1327-1338.
- Van Waerebeek K, Sequeira M, Williamson C, Sanino GP, Gallego P, Carmo P (2006) Live-captures of common bottlenose dolphins *Tursiops truncatus* and unassessed bycatch in Cuban waters: evidence of sustainability found wanting. Lat Amer J Aquat Mamm 5: 39-48.
- Viaud-Martinez KA, Brownell RL, Komnenou A, Bohonak AJ (2008) Genetic isolation and morphological divergence of Black Sea bottlenose dolphins. Biol Conserv 141: 1600-1611.
- Wade PR, Gerrodette T (1993) Estimates of cetacean abundance and distribution in the eastern tropical Pacific. Rep Int Whaling Commn 43: 477-493.
- Wafo E, Sarrazin L, Diana C, Dhermain F, Schembri T, Lagadec V, Pecchia M, Rebouillon P (2005) Accumulation and distribution of organochlorines (PCBs and DDTs) in various organs of *Stenella coeruleoalba* and a *Tursiops truncatus* from Mediterranean littoral environment (France). Sci Total Environ 348: 115-127.

- Wang JY, Chou LS, White BN (2000) Osteological differences between the two sympatric forms of bottlenose dolphins (genus *Tursiops*) in Chinese waters. *J Zool Lond* 252: 147-162.
- Wang JY, Yang AC (2009) Indo-Pacific bottlenose dolphin (*Tursiops aduncus*). In: Encyclopedia of marine mammals (Perrin WF, Würsig B, Thewissen JGM, eds.) Academic Press, Amsterdam, pp. 602-608
- Waring GT, Josephson E, Fairfield-Walsh CP, Maze-Foley K, eds. (2009) U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2008. NOAA Tech Memo NMFS NE 210; 440 p.
- Wedekin LL, Daura-Jorge FG, Simoes-Lopes PC (2004) An Aggressive Interaction Between Bottlenose Dolphins (*Tursiops truncatus*) and Estuarine Dolphins (*Sotalia guianensis*) in Southern Brazil. *Aquat Mamm* 30: 391-397.
- Weiss J (2006) Foraging habitats and associated preferential foraging specializations of bottlenose dolphin (*Tursiops truncatus*) mother-calf Pairs. *Aquat Mamm* 32: 10-19.
- Wells RS, Rhineheart HL, Cunningham P, Whaley J, Baran M, Koberna C, Costa DP (1999) Long distance offshore movements of bottlenose dolphins. *Mar Mamm Sci* 15: 1098-1114.
- Wells RS, Scott MD (1999) Bottlenose dolphin – *Tursiops truncatus* (Montagu, 1821) In: Handbook of marine mammals (Ridgway SH, Harrison SR, eds.) Vol. 6: The second book of dolphins and porpoises. pp. 137-182.
- Wells RS, Scott MD (2009) Common bottlenose dolphin – *Tursiops truncatus*. In: Encyclopedia of marine mammals 2nd Ed.(Perrin WF, Würsig B, Thewissen JGM, eds.) Academic Press, Amsterdam, pp. 249-255.
- Wells RS, Tornero V, Borrell A, Aguilar A, Rowles TK, Rhinehart HL, Hofmann S, Jarman WM, Hohn AA, Sweeney JC (2005) Integrating life-history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. *Sci Total Environ* 349: 106-119
- Wilson B, Thompson PM, Hammond PS (1997) Habitat use by bottlenose dolphins: Seasonal distribution and stratified movement patterns in the Moray Firth, Scotland. *J Appl Ecol* 34: 1365-1374.
- Wood CJ (1998) Movements of bottlenose dolphins around the south-west coast of Britain. *J Zool* 246: 155-164.
- Yang G, Zhou K, Xu X, Leatherwood S (1999) A survey on the incidental catches of small cetaceans in coastal waters of China. *Yingyong Shengtai Xuebao* 10: 713-716.
- Zollett EA, Read AJ (2005) Depredation of catch by bottlenose dolphins (*Tursiops truncatus*) in the Florida king mackerel (*Scomberomorus cavalla*) troll fishery. *Fish Bull* 104: 343-349.

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