Status of the Bottlenose Dolphin, *Tursiops truncatus*, with Special Reference to Canada*

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The Bottlenose Dolphin, *Tursiops truncatus*, is distributed worldwide in warm temperate and tropical waters. This report reviews the general biology, worldwide status and management of this species, with special reference to its status in Canadian waters. More is known about the biology of the Bottlenose Dolphin than perhaps any other cetacean. No estimates of worldwide population size exist, although there are numerous estimates for specific regions. Two forms are recognized, coastal and offshore; they are distinguishable through a wide variety of characteristics. The species is not threatened, although the population in the Black Sea is currently considered at risk. In some areas, Bottlenose Dolphins are taken deliberately in drive fisheries, and they are caught incidentally in fishing operations worldwide. Levels of pollutants recorded in this species are among the highest recorded from any cetacean. The Bottlenose Dolphin is rare in Canadian waters, where it is at the northern limits of its range. Twenty-two records from eastern Canada, representing only 11 occurrences, are presented. Future records from the Canadian east coast may be less frequent, as an apparently natural die-off in the population off the north east coast of the U.S. in 1987-1988 may have resulted in a population reduction of over 50%. We know of no confirmed records from western Canada, although a stray animal from the inshore waters of Washington State has recently been recorded, and there are historical records from an Indian midden from the outer Washington coast. A single unconfirmed record from offshore British Columbia waters exists.

Le dauphin à gros nez, *Tursiops truncatus*, se rencontre dans les eaux tempérées et tropicales du monde entier. Le présent rapport traite de la biologie générale, de la situation et de la gestion de l'espèce, en insistant plus particulièrement sur sa situation dans les eaux canadiennes. La biologie du dauphin à gros nez est probablement mieux connue que celle de tout autre cétacé. Il n'existe pas d'estimations de la taille de la population mondiale, mais les estimations de la taille de populations vivant dans certaines régions bien définies sont nombreuses. On distingue deux formes de dauphin à gros nez, la forme côtière et la forme hauturière, lesquelles se différencient par de nombreuses caractéristiques. L'espèce n'est pas menacée, bien que la population de la mer Noire soit présentement considérée comme en danger. Dans certaines régions, les dauphins à gros nez sont capturés délibérément dans le cadre d'activités de pêche par rabattage; un petit nombre de dauphins sont également pris accidentellement par des pêcheurs un peu partout dans le monde. Les concentrations de pollutants relevées dans les tissus de certains membres de cette espèce sont parmi les plus élevées enregistrées pour tous les cétacés. Le dauphin à gros nez est rare dans les eaux canadiennes, qui se situent à la limite nord de son aire de répartition. Vingt-deux mentions provenant de l'est du Canada, mais ne représentant que 11 spécimens, sont présentées. Le nombre de ces mentions pourrait encore diminuer dans l'avenir: une vague de morts apparement naturelles aurait en effet causé la disparition de plus de la moitié de la population qui vit au large de la côte nord-est des États-Unis en 1987 - 1988. Aucune mention n'a été confirmée dans l'ouest du Canada, bien qu'on ait récemment signalé la présence d'un spécimen dans les eaux côtières de l'État de Washington et que des restes de spécimens appartenant à l'espèce aient été découverts sur le site d'un tertre indien, sur la côte de l'État de Washington. Il existe une autre mention non confirmée concernant un spécimen aperçu dans les eaux situées au large de la Colombie-Britannique.

Key Words: Bottlenose Dolphin, douphin à gros nez, *Tursiops truncatus*, Canada, status.

For many species of cetaceans, the task of reviewing their biology or status is difficult, due to the small number of scattered references. Such is not the case for the Bottlenose Dolphin, *Tursiops truncatus* (Montagu, 1821), a species on which perhaps more has been published than any other cetacean (see, for example, the recent compilation edited by Leatherwood and Reeves 1990). We summarize here the current state of knowledge of the Bottlenose Dolphin (Figure 1), with special reference to its status and management in Canadian waters.

Considerable controversy has existed over the content of the genus *Tursiops*, with *Tursiops aduncus*, considered valid by some until recently (Ross 1977; Ross and Cockcroft 1990). Early designations of two or more species of *Tursiops* reflect the considerable variation in morphological and other characters of this species along geographic and ecologi-

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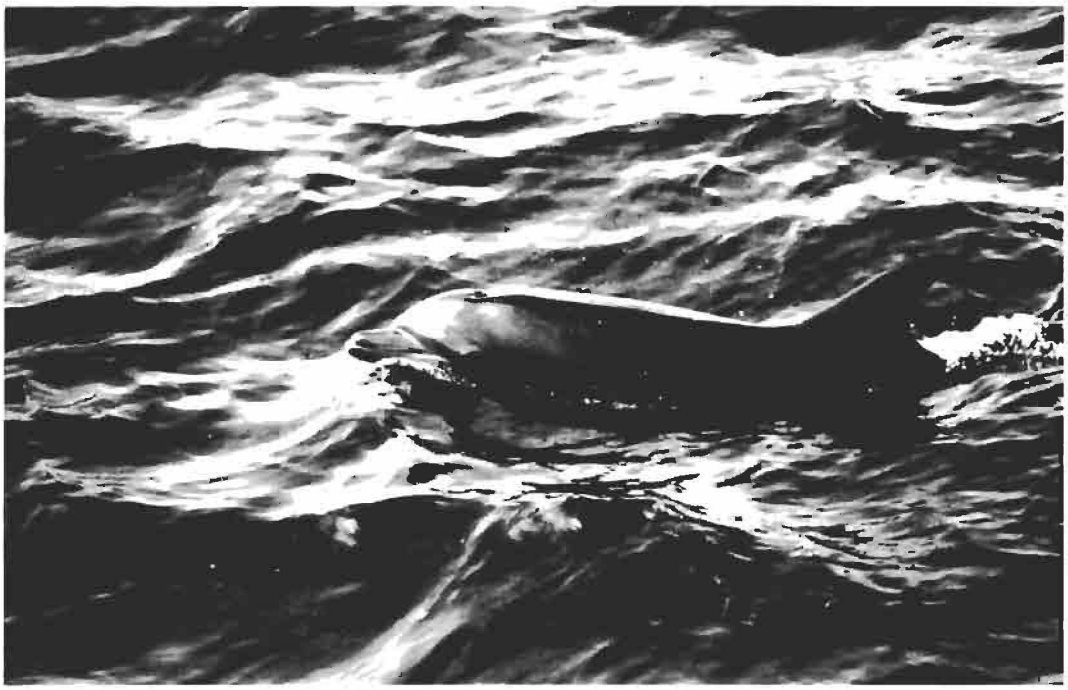

FIGURE 1. Bottlenose Dolphin photographed off Clipperton Island. Note the tall falcate dorsal fin and the well defined beak. Photo by R.L. Pitman, National Marine Fisheries Service.

cal lines. At least two forms of Bottlenose Dolphins do exist; a coastal form and an offshore form. These differ in morphology, blood chemistry, feeding habits and parasite loads (Walker 1981; Duffield et al. 1983; Hersh and Duffield 1990; Mead and Potter 1990). The following review derives information from both currently accepted forms and previous species designations, and the reader must recognize that the wide range in many characters reflects both intra- and inter-population variability.

Bottlenose Dolphins have been recorded at a maximum length of at least 3.9 m and weights up to 490 kg (Leatherwood and Reeves 1983; Mead and Potter 1990). Although some authors have reported that males are larger than females, Hersh et al. (1990) found no evidence for a difference in total body length in animals off the east coast of Florida. Body shape varies considerably between geographic locations, and even within a single group. Most individuals have a short (less than 16 cm), blunt-shaped rostrum and a robust head and trunk region (Leatherwood et al. 1982). The snout is clearly divided from the forehead by a sharp, well-defined line or crease (Leatherwood and Reeves 1983). The pectoral fins are of moderate length and taper to a point (Leatherwood et al. 1982). The tail flukes are deeply notched and have a smooth, concave rear margin (Leatherwood et al. 1982). The dorsal fin is tall and falcate, and is located at the midpoint of the body. The body is so robust in the anterior region however, that the dorsal fin often appears to be posterior to the midpoint (Leatherwood and Reeves 1983). As with other cetaceans, the presence of congenital and acquired markings on the dorsal fin, as well as general dorsal fin shape, allow for the long-term identification of some individuals (Würsig and Würsig 1977). This technique for identifying individuals in the wild has been used in a variety of studies on this species (e.g., Wells and Scott 1990).

General body colour varies, from charcoal to light grey and brown. Leatherwood and Reeves (1983) described the average appearance as follows: The body is marked with a nondescript cape, which begins at the apex of the melon and broadens from the blowhole to the dorsal fin, where it then narrows to a thin line. The flanks appear lighter than the cape, with the ventral surface even lighter still, ranging from light grey to pink. There is no clear division between the flanks and ventral surface based on skin pigmentation. Spots are found on some individuals, and subtle face and throat markings as well as an eye-to-flipper stripe are present but are barely discernible on most individuals. Colour variations include all black, all white, and cinnamon-coloured

animals (Hain and Leatherwood 1982; Leatherwood and Reeves 1983). Individuals frequently have numerous scars and scratches on the body, caused by rubbing on inanimate objects, by other Bottlenose Dolphins, or through interspecific interactions (Lockyer and Morris 1985).

Distribution

Dolphins of the genus *Tursiops* are cosmopolitan, found throughout the world with the exception of higher latitudes (Leatherwood and Reeves 1983). They occur in the Indian Ocean from South Africa to Australia; in the eastern Atlantic from southern Norway to the tip of South Africa; in the Mediterranean and Black Seas; in the western Pacific from northern Japan to Australia; in the eastern South Pacific from the equator to Chile; and in the western South Atlantic from the equator to Patagonia, Argentina (Leatherwood and Reeves 1983).

Leatherwood and Reeves (1982) reported that the coastal form of the Bottlenose Dolphin in the eastern North Pacific regularly occurred as far north as southern California. At that time, the northern most records reported were two confirmed records at San Francisco (Orr 1963; Walker 1981). Surprisingly, the type specimen for *Tursiops gilli* was collected in Monterey Bay, which until recently was considered somewhat out of the regular range of the Bottlenose Dolphin. Subsequent to Leatherwood and Reeves' (1982) publication, coastal Bottlenose Dolphins expanded their range northward from southern to central California (Wells et al. 1990). More recently,

TABLE 1. Records of the Bottlenose Dolphin within the Canadian 320 km (200 mi) extended economic zone. Twenty-two records (listed as "positive" identifications by the observers) from the east coast are presented, but multiple records from single dates exist, likely indicating only 11 occurrences from the east coast. One unconfirmed record from the west coast is presented.

Date	Location	Number	Type[A]	Depth[B]	Temp[C]	Source[D]
East Coast						
15 September 1950	Petitcodiac River, NB	1	1	—	—	1
3 September 1968	Milford, NS 45°05'N, 63°25'W	1	2	—	—	2[E]
27 June 1969	NE edge Artimon Bank ≈ 45°10'N, 57°49'W	4	3	—	≈9	3
24 August 1969	43°50'N, 59°14'W	—	3	—	—	4
24 August 1969	43°53'N, 59°2'W	6	3	—	—	4
18 August 1978	42°5'N, 61°4'W	15	3	—	—	4
25 April 1979	41°19'N, 65°47'W	10	3	1100	9.4	4
25 April 1979	41°24'N, 65°53'W	40	3	390	9.9	4
9 August 1979	42°7'N, 66°18'W	10	3	60	18.9	4
18 August 1979	42°5'N, 61°4'W	17	3	—	—	4
30 May 1980	41°36'N, 66°2'W	2	3	50	11.2	4
30 May 1980	41°11'N, 66°14'W	9	3	600	15.5	4
30 May 1980	41°49'N, 66°33'W	1	3	40	9.1	4
26 June 1980	41°42'N, 66°18'W	20	3	45	—	4
25 August 1980	41°51'N, 65°47'W	12	3	75	17.5	4
25 August 1980	41°54'N, 66°0'W	25	3	50	18.0	4
25 August 1980	41°54'N, 66°0'W	26	3	50	18.0	4
25 August 1980	41°16'N, 65°56'W	4	3	800	24.5	4
25 August 1980	41°18'N, 66°1'W	3	3	700	25.0	4
25 August 1980	41°21'N, 66°4'W	39	3	100	24.0	4
25 August 1980	41°21'N, 66°5'W	60	3	100	24.0	4
25 August 1980	41°19'N, 66°22'W	15	3	50	24.0	4
21 January 1981	41°24'N, 65°56'W	20	3	300	10.0	4
West Coast						
13 September 1986	50°01.6'N, 133°11.5'W	1	4	—	—	5[F]

[A]Type of Record: 1. Killed; 2. Stranded, dead; 3. Sighting; 4. Caught in fishing gear, released alive.

[B]Depth in fathoms.

[C]Sea surface temperature in degrees celsius.

[D]Source of Record: 1. Sergeant and Fisher 1957; 2. Sergeant et al. 1970; 3. Beamish and Mitchell 1973; 4. Unpublished data collected through the CETAP program, University of Rhode Island, provided by R. Kenney; 5. Unpublished field notes of R. Burke, courtesy D. Heritage, Department of Fisheries and Oceans, Nanaimo.

[E]Identification not positive. This record is of a dead individual found washed up at the upstream limit of tidal penetration into the Shubenacadie River, Nova Scotia.

[F]Identification not positive.

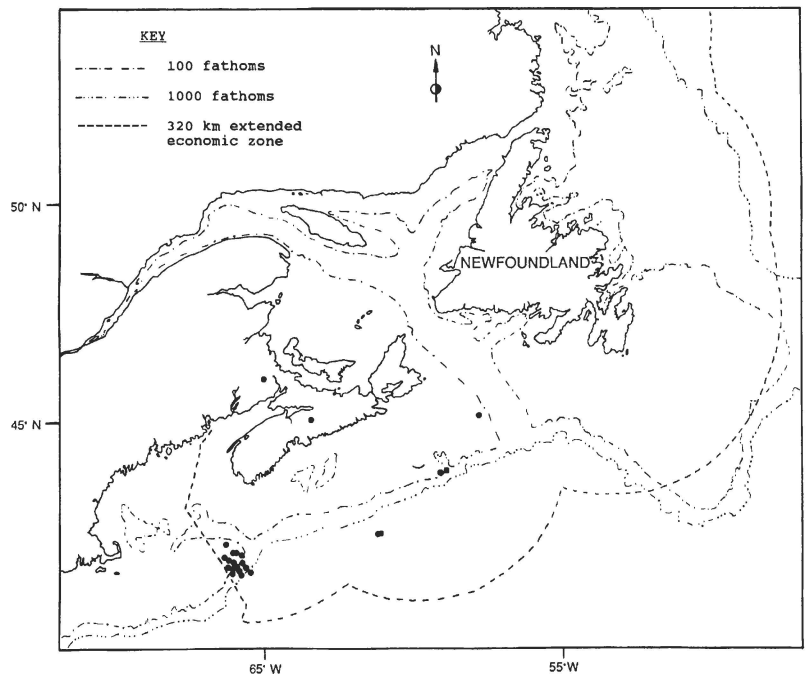

FIGURE 2. Locations of records of Bottlenose Dolphins off Canada's east coast (see Table 1 for details).

in March 1988, a single animal, apparently of the coastal form, was found dead in the inshore waters of Washington State (Osborne and Ransom 1988; Ferrero and Tsunoda 1989). This specimen was not the first record for Washington State however, as W. A. Walker (personal communication) has identified the remains of at least five Bottlenose Dolphins from an Indian midden near Willapa Bay, on the outer coast of southern Washington. Unfortunately the midden site was disturbed, and the age of the remains are unknown at this time. Based on skeletal characteristics, these specimens appear to be of the coastal form (W. A. Walker, personal communication). Nearby habitats are typical of areas that Bottlenose Dolphins frequent further to the south, and it is unlikely that these specimens came from a single stranding event, as mass strandings in this species are very infrequent (*see* Limiting Factors, below). Two possibilities account for such records north of the present day range; long-term expansions and contractions of the range, or short-term movements associated with warm-water events. Unfortunately, current information is insufficient to determine which of these explanations is most likely. The March 1988 stranding is to the northeast of the southernmost portion of Vancouver Island, British Columbia, and thus the animal likely moved through B.C. waters. However, we know of no other confirmed records of Bottlenose Dolphins from western Canada. Because of the limited research effort, information on the distribution of offshore Bottlenose Dolphins in the temperate eastern North Pacific is less detailed than for inshore populations. Walker (1981) indicated that offshore forms have been sighted only as far north as Point Conception, California (approximate latitude 34°31'N), although skeletal remains dredged from San Francisco Bay in 1980 were from an offshore individual. The Department of Commerce (1978) alleged that the Bottlenose Dolphin "infrequently occurs in offshore currents, perhaps as far north as southern Oregon", but at present there are no data to support this contention. One possible record exists from offshore British Columbia of an animal caught and released alive during experimental fishing for Flying Squid (*Ommastrephes bartrami*), over 150 nautical miles off the northern tip of Vancouver Island (details in Table 1). The Canadian Department of Fisheries and Oceans observer, R. Burke, recorded the animal as a probable Bottlenose Dolphin (D. Heritage, personal communication), but unfortunately, confirmation of the identity is not possible.

In the western North Atlantic, Leatherwood and Reeves (1982) noted that there is at least one reliable record from southern Greenland. In Canadian waters, Bottlenose Dolphins have been recorded almost as far

north as Newfoundland, with records published by Beamish and Mitchell (1973) and Sergeant and Fisher (1957). Sergeant et al. (1970) also noted a possible record from Milford, Nova Scotia. Kenney (1990) discussed records from the western North Atlantic collected through the Cetacean and Turtle Assessment Program (CETAP) operated out of the University of Rhode Island. Published records noted above and previously unpublished details on records from Canadian waters obtained through the CETAP program (R. Kenney, University of Rhode Island), are presented in Table 1 (Figure 2). Only those CETAP records are included where the identifications were listed as positive. Not including Sergeant et al.'s (1970) possible record, there have been 11 occurrences, represented by 22 records, recorded from the Canadian east coast.

Protection

International

Regulation of international trade between members of the Convention on International Trade in Endangered Species of Wild Fauna and Flora 1973 (CITES), and between non-members and Convention members, has been established by listing the Bottlenose Dolphin under Appendix II of the Convention (*see* Birnie 1982). International trade can take place, but this requires export permits from the country of origin. The International Convention for the Regulation of Whaling (1946) regulates the taking of whales in accordance with the current Schedule provisions. The International Whaling Commission (IWC) is responsible for whale management under this Convention, but whether the Commission's mandate covers small cetaceans is rather unclear, as members of the Commission are divided as to whether "whale" refers to all cetaceans, or only to some species (Klinowska 1987). In 1990, however, delegates to the IWC adopted a resolution requesting their Scientific Committee to assess the status of small cetaceans and the impacts of direct and incidental takes. For years the Small Cetaceans Subcommittee of the IWC Scientific Committee has reviewed the status of small cetaceans, although until now they have had little support in this task from the Scientific Committee or Commission as a whole. Regardless, Canada is not currently a member of the IWC, having withdrawn in 1982 (International Whaling Commission 1982).

National

Canada: Until they were repealed in 1993, the Cetacean Protection Regulations of the Fisheries Act of Canada of 1867 protected all cetacean species from "hunting". "Hunting was defined as "to chase, shoot at, harpoon, take, kill, attempt to take or kill, or to harass cetaceans in any manner", and could be only be undertaken under licence. Aboriginal "hunting", however, could be undertaken without licences. The Cetacean Protection Regulations were replaced with the Marine Mammal Regulations of the Fisheries Act in early 1993. These regulations appear to provide no more or no less protection, by stating only that "no person should disturb a marine mammal except when ... under the authority of these regulations." No provisions for regulation of incidental catches in fishing operations exist.

United States: All cetaceans are protected through the Marine Mammal Protection Act of 1972, as well as through the Packwood-Magnuson Amendment of the Fisheries and Conservation Act and the Pelly Amendment of the Fisherman's Protective Act.

Population Size(s) and Trends

No estimates of worldwide population sizes exist. The U.S. Department of Commerce (1988) estimated a level between 14 000 and 23 000 for the western North Atlantic, although this is prior to the die-off which occurred in 1987-1988 (see Limiting Factors below), and the methodology from which the estimate was determined was not indicated. The U.S. Marine Mammal Commission (1990) noted that the Bottlenose Dolphin is the most common cetacean in the coastal waters of the southeast United States. Subsequent to the 1987-1988 die-off however, there has been a move for the National Marine Fisheries Service to designate this population as depleted (Marine Mammal Commission 1990). Kenney (1990) reported seasonal estimates for the continental shelf waters off the northeastern U.S. coast which varied from a minimum of 1500 to 2300 in the winter and 9700 to 12 800 during the summer. Numerous estimates exist for small areas along the southeast U.S. coast and the Gulf of Mexico (e.g., Leatherwood 1979; Barham et al. 1980; Irvine et al. 1981). Barham et al. (1980) presented a population estimate of 1319 for a region of the Texas coast, which, based on their density and population estimates, is an area of approximately 1750 km^2. Estimates provided by Odell and Reynolds (1980) for the west coast of Florida and the Florida panhandle totalled 787 ± 269 and 744 ± 527 (± 95% C.I.) individuals respectively. Holt and Powers (1980) estimated, for a portion of the eastern Tropical Pacific, 40 200 individuals.

No accurate estimates of population trends are available. There have been some reports of localized decreases in numbers, but documentation and comprehensive studies are for the most part lacking. Although the species is not considered threatened, the population of Bottlenose Dolphins in the Black Sea is currently considered at risk (Brownell et al. 1989). Kayes (1985) reviewed evidence indicating a decline in numbers of Bottlenose Dolphins in the North Sea. In 1942, Gunter suggested that the number of Bottlenose Dolphins along the Texas coast had declined in the preceding 40 years. Bottlenose

Dolphins were apparently absent from San Diego Bay for a period of about 10 years, reportedly due to high levels of pollution there, but subsequently reappeared as pollution levels decreased (Leatherwood and Reeves 1982).

Habitat

The Bottlenose Dolphin is found in a wide variety of habitats, both coastal and offshore. In the U.S., where most studies have been undertaken, the coastal form of the dolphin has been found to occur in rivers (Gunter 1942), coastal channels and waterways (Irvine and Wells 1972; Shane 1980; Scott et al. 1990), and enclosed protected bays and seagrass meadows (Scott et al. 1990). In Argentina, Bottlenose Dolphins observed from shore spend 92% of their time in water less than 10 m deep (Würsig and Würsig 1979). Studies by CETAP have documented the presence of the Bottlenose Dolphin off the northeast coast of the U.S., along the continental shelf, Georges Bank, and the shelf-break region (Kenney 1990). The offshore form of Bottlenose Dolphin inhabits the waters around offshore islands as well as the open ocean (Leatherwood and Reeves 1982; Figure 1). Sightings of Bottlenose Dolphins in mainly offshore areas in the eastern tropical Pacific are presented in Scott and Chivers (1990) and indicate a wide distribution in this area. Au and Perryman (1985) identified two different areas in the eastern tropical Pacific, defined by their water masses, that have specific dolphin communities. One area is characterized by Common Dolphins (*Delphinus delphis*), Striped Dolphins (*Stenella coeruleoalba*), and Short-finned Pilot Whales (*Globicephala macrorhynchus*), and the other by Spotted (*Stenella attenuata*) and Spinner (*Stenella longirostris*) dolphins, while Bottlenose Dolphins are found in both regions.

Kenney (1990) presented information on sea-surface temperatures from 607 sightings in the eastern North Atlantic, in the region from North Carolina to Nova Scotia. Sea-surface temperatures from sightings ranged from 1°C to 31.1°C, with a mean of 19.7°C, and a mode of 20°–22.5°C. Sightings in offshore waters were in cooler waters than those in nearshore areas. This is relevant to potential sightings in Canadian waters, indicating both that sightings should not be completely precluded by low water temperatures, and that sightings might be expected more frequently in offshore waters. Water temperatures from 15 of the records presented in Table 1 range from 9.1° to 25°C, with a mean temperature of 17.3°C.

General Biology

Reproduction

Estimates of sex ratios vary between areas, and between captive and wild populations. Collet (1984) found that females comprised 80% of captive-born calves. Kasuya (1985) showed that of about 500 Bottlenose Dolphins for which sex was determined in a Japanese drive fishery, 57.3% were females. Sergeant et al. (1973) noted a sex ratio of about 1:1 in a sample of 61 animals captured off Florida. Perrin and Reilly (1984) summarized other sex ratios reported from the Black Sea and the western North Atlantic, which range from about 47%–66% females.

Estimates of gestation range from 11.5–14 months (Perrin and Reilly 1984; Kasuya 1985). Schroeder (1990) found that births usually occur during the night, nearer dawn than dusk, and labour can last from 20 minutes to 2 hours. Length at birth has been recorded as being from 0.84 to 1.26 m (Harrison et al. 1969; Ross 1984). Suckling occurs both day and night, and in a captive animal was more frequently observed at night (Eastcott and Dickinson 1987). Suckling typically occurs two to four times an hour for less than a minute (Harrison 1969; Schroeder 1990). Calves are weaned at an average age of 18–20 months, although first solid food is taken between 4–11 months (Perrin and Reilly 1984); weaning is likely complete when a body length of 170–180 cm is reached (Barros and Odell 1990). The oldest nursing calf recorded by Perrin and Reilly (1984) was 38 months old. Echolocation and other feeding-related behaviour is believed to be learned during this prolonged period of nursing (Leatherwood and Reeves 1983). Bottlenose Dolphin calves are closely watched by adults during the first half-year, and "babysitting" has been observed, in which nearby adults remain with a calf as its mother forages. Offspring typically remain with their mothers for three to six years, although some associations last longer (Scott et al. 1990).

Estimates of sexual maturity are based both on examination of reproductive tracts from animals killed in fisheries, and from long-term observational studies of wild populations. The former estimates are dependent on the ability to determine age, using growth layer groups (GLGs) in the teeth. Hohn et al. (1989), using teeth pulled from known-aged individuals from a population off Florida, demonstrated that growth layer groups are deposited annually. Males reach sexual maturity between 9 and 20 years of age, with an average of 11 years (Perrin and Reilly 1984). Females apparently can attain sexual maturity at a younger age, with a range from 3.5 to 14 years of age, although the average age is 12 years (Perrin and Reilly 1984; Kasuya 1985). As noted above however, such estimates may be applicable only for some populations; Kasuya (1985) noted that in the animals off Japan, 50% of the females were sexually mature by 6.9 years of age, at a mean body length of about 2.86 m.

Once reproductively active, females bear a single calf, at an interval estimated to be from 1.3 to 2

years (Perrin and Reilly 1984; Ozharovskaya 1990). Based both on the observed presence of young calves and on hormone levels, calving is suggested to occur primarily from early spring to early fall, although calving year-round is known to occur (Harrison et al. 1969; Ozharovskaya 1990; Scott et al. 1990). In a captive male, Schroeder and Keller (1989) found that peak sperm production and density coincided with a fall peak in breeding activity. A promiscuous mating system has been suggested by Scott et al. (1990). Schroeder (1990) indicated that Bottlenose Dolphins are spontaneous ovulators, and captive animals have ovulated up to 7 times in a 13 month period. In their study around Sarasota, Florida, the oldest male examined was estimated at 34 years old, while the oldest female was estimated at 46 years old (Scott et al. 1990).

Species Movements

Bottlenose Dolphins may inhabit limited home ranges along overlapping segments of coast, although long-distance movements, up to 600 km, have been recorded by Wells et al. (1990), who also found that northward movements in the eastern North Pacific are linked either directly or indirectly (i.e., in response to movements of prey) to variations in water temperature. The offshore form appears less restricted in range and movements, being present in many productive areas, particularly in the tropics (Leatherwood and Reeves 1983). Burn et al. (1987) found that the distribution of dolphins off Florida appears to shift from the southwest coast north toward the Panhandle area during the fall. In the Gulf of Mexico they also found seasonal inshore/offshore changes in abundance. Seasonal movements by a proportion of the population off Texas have also been reported by Shane (1980), possibly due to changes in water temperature and food availability. Some Bottlenose Dolphins appear to be "resident" of particular areas such as the offshore islands of Clipperton and Galapagos (Leatherwood et al. 1982).

Behaviour

Scott and Chivers (1990), analyzing records from the eastern Tropical Pacific, recorded mean and median group sizes of offshore Bottlenose Dolphins of 57 and 10 individuals respectively. They also noted that herds of over 1000 individuals made up about 1% of the sightings (n = 5461) compiled from that area and suggested that some herds could contain as many as 10 000 individuals. Coastal Bottlenose Dolphins are normally found in groups of fewer than ten (Leatherwood and Reeves 1983). Barham et al. (1980) found a mean herd size of 6.95 for dolphins off the Gulf Coast of Texas, and noted that 9.3% of a typical herd consisted of calves.

Inshore Bottlenose Dolphins appear to be quite liberal in their feeding habits, taking a wide variety of fishes, crustaceans, and cephalopods (Barros and Odell 1990; Leatherwood et al. 1982). Walker (1981) noted that coastal animals from southern California feed primarily on fish and invertebrates inhabiting littoral and sub-littoral zones. Barros and Odell (1990) found that prey size ranged from about 5–30 cm. In many areas, Bottlenose Dolphins have adapted their feeding to take advantage of human activities, including ramming trawl nets to spill net contents, taking fish out of nets, eating fish discarded by fishermen or stirred up by nets and propeller washes, or catching fish attracted to idle vessels and fixed platforms (Leatherwood and Reeves 1983; Abel and Leatherwood 1985; see also Special Significance of the Species, below). Near the surface, Bottlenose Dolphins occasionally invert and feed upside-down, presumably to aid in echolocation by reducing noise from surface echoes (Leatherwood and Reeves 1983). Barros and Myrberg (1987) suggested that passive listening for "noisy" fish is an important cue in prey choice. Various types of cooperative hunting have been reported. Similar to the deliberate beach stranding behaviour reported for Killer Whales (*Orcinus orca*; Lopez and Lopez 1985; Guinet 1990), in some areas Bottlenose Dolphins chase and wash fish onto mudbanks, following them onto shore, and snapping up the stranded prey (Hoese 1971; Rigley 1983). Offshore Bottlenose Dolphins appear to feed primarily on epipelagic fish and cephalopods (Walker 1981).

Associations with at least 24 species of cetaceans have been recorded, including: Sperm Whale (*Physeter macrocephalus*), Risso's Dolphin (*Grampus griseus*), Short-finned Pilot Whale, Long-finned Pilot Whale (*Globicephala melas*), False Killer Whale (*Pseudorca crassidens*), Pacific White-sided Dolphin (*Lagenorhynchus obliquidens*), Atlantic White-sided Dolphin (*Lagenorhynchus acutus*), White-beaked Dolphin (*Lagenorhynchus albirostris*), Fraser's Dolphin (*Lagenodelphis hosei*), Melon-headed Whale (*Peponocephala electra*), Northern Right Whale Dolphin (*Lissodelphis borealis*), Rough-toothed Dolphin (*Steno bredanensis*), Common Dolphin, Indo-Pacific Humpbacked Dolphin (*Sousa chinensis*), Spotted Dolphins (*Stenella frontalis* and *Stenella attenuata*), Spinner Dolphin, Striped Dolphin, Southern Right Whale (*Eubalaena glacialis*), Fin Whale (*Balaenoptera physalus*), Minke Whale (*Balaenoptera acutorostrata*), and Sei Whale (*Balaenoptera borealis*) (Kraus and Gihr 1971; Leatherwood and Walker 1979; Würsig and Würsig 1979; Evans 1982; Martin 1986; Au and Pitman 1988; Corkeron 1990; Kenney 1990; Scott and Chivers 1990). Bottlenose Dolphins are often observed bow-riding or wake-riding on moving vessels (Figure 3), and will also ride ground swells and pressure waves of big whales such as Grey (*Eschrichtius robustus*) and Humpback (*Megaptera novaeangliae*) whales (Leatherwood

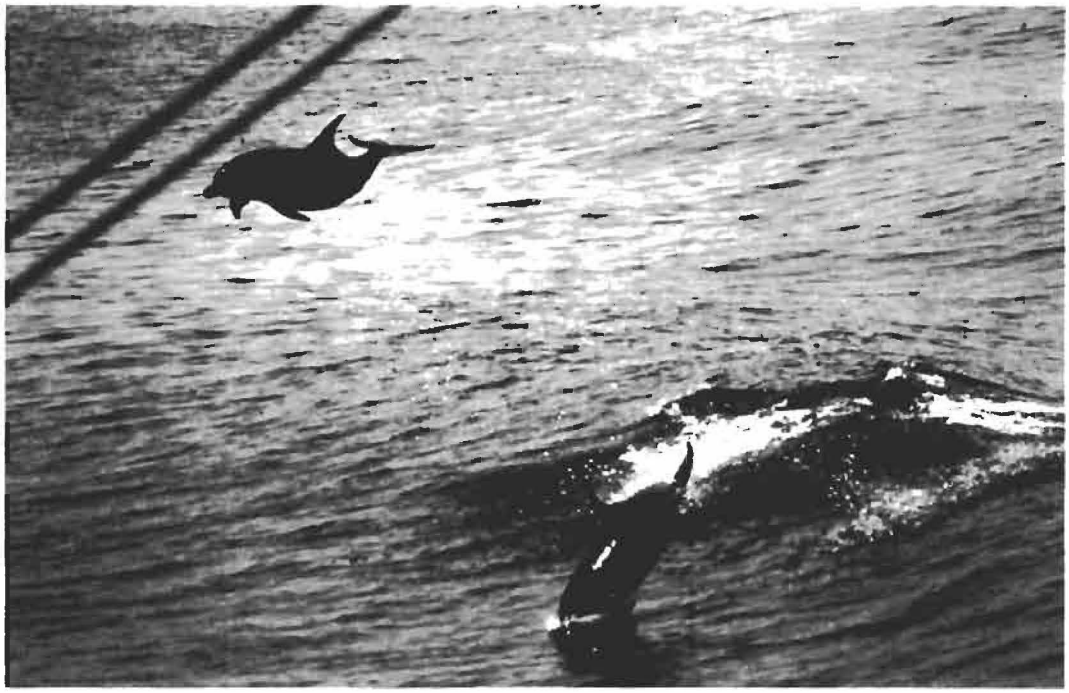

FIGURE 3. Bottlenose Dolphins playing in a vessel's stern wake, in the eastern Tropical Pacific. Photo by K. Sexton, National Marine Fisheries Service.

1974; Leatherwood et al. 1982; they can also frequently be found body surfing in nearshore areas – e.g., Caldwell and Fields 1959). Würsig and Würsig (1980) reported that although they recorded Bottlenose Dolphins within 0.5 km of Dusky Dolphins (*Lagenorhynchus obscurus*) on eight occasions, no interactions were observed, and each species was more abundant when the other was absent. Associations with seabirds and pinnipeds also occur (Würsig and Würsig 1979; Evans 1980; Martin 1986; Au and Pitman 1988). In captivity, Brown and Norris (1956) observed interspecific mating every day between male Bottlenose Dolphins and female Pacific White-sided Dolphins. Interspecific associations in captivity are not always so benign, however: they also noted a case where a male Bottlenose Dolphin killed a male Pacific White-sided Dolphin in captivity.

Limiting Factors

Throughout their range, Bottlenose Dolphins are strongly attracted by human activities (see e.g., Abel and Leatherwood 1985). They exhibit great behavioural flexibility (Shane 1990); their ability to adapt to human disturbance, in areas with high levels of fishing activity and boat traffic, may be responsible for frequent conflicts with humans. In some areas Bottlenose Dolphins have been shot as a nuisance to fishermen (Leatherwood and Reeves 1983; Reynolds 1985). Mortality by collisions with vessel propellers, particularly in confined areas, has been recorded (Reynolds 1985). A net fishery for Bottlenose Dolphins was operated periodically for over 100 years off the N.E. coast of the U.S., with catches in peak years of 2000 or more annually (Mead 1975). This fishery was discontinued in about 1929. In the Black Sea, a commercial fishery for oil and fishmeal depleted the Bottlenose Dolphin population severely by the mid-1960s, after which the Soviet Union terminated its harvest (Mitchell 1975; Leatherwood and Reeves 1983). Hunting by Turkey continues, however, and unknown numbers are taken annually (Leatherwood and Reeves 1983). A few are taken for food in Sri Lanka, West Africa, Venezuela, the West Indies, and other parts of the world (Leatherwood and Reeves 1983). Over a seven year period, from 1976 to 1982, over four thousand Bottlenose Dolphins were killed in drive fisheries off Japan, the largest number of the four species regularly taken (Kasuya 1985). Small numbers continue to be killed there, and in drive fisheries off the Faroe Islands (Bloch and Hoydal 1989; International Whaling Commission 1990, 1991). In Peru, up to several hundred Bottlenose Dolphins are killed

annually for human consumption, in gillnets, purse seines and occasionally with beach seines and hand-thrown harpoons (Waerebeek et al. 1990). Small numbers are killed incidently in seine and gillnet fisheries worldwide (e.g., Harwood et al. 1984; Reynolds 1985; Chivers et al. 1990; Heyning et al. 1990; International Whaling Commission 1990, 1991; Notarbartolo-di-Sciara 1990). Animals are also killed in anti-shark nets off Australia and South Africa (Ross 1984; Cockcroft 1987; Australia 1990). Studies have been made to try to identify possible environmental and behavioural factors that may be contributing to this incidental catch, but no relationships have been found (Cockcroft 1987).

The United States has had a controlled live-capture fishery for the species in operation since 1938 (Leatherwood and Reeves 1983). Most animals have been taken off eastern Florida, in the Gulf of Mexico, and off southern California. Scattered live specimens have also been captured in recent years off Hawaii, South Africa, Japan, Mexico, the Philippines, Bahamas, and in the Mediterranean (Leatherwood and Reeves 1983). Leatherwood and Reeves (1982) noted that over 1500 were brought into captivity between 1938 and 1980.

There is a potential problem with humans feeding Bottlenose Dolphins in the wild. Commercial cruises operate out of several states in the U.S., including Florida, Georgia and South Carolina, taking people out to feed fish to wild dolphins. Young (1990) reported that fish handling techniques currently used could easily result in the transfer of pathogens to dolphins. As well, there are fears that allowing dolphins to rely on fish from feeding cruises could result in serious disruption of normal behaviour.

Large numbers of Bottlenose Dolphins off the east and Gulf of Mexico coasts of the U.S. have died in recent years. Geraci (1989) suggested that the primary cause of death for animals from the east coast stranding event was poisoning by brevetoxin, a neurotoxin produced by the dinoflagellate *Ptychodiscus brevis*. An estimated 50% or more of the coastal migratory stock between Florida and New Jersey died between June 1987 and May 1988 (Scott et al. 1988; Marine Mammal Commission 1990), and this stock may be considered depleted. Certainly the likelihood of animals from the U.S. north east coast straying into east coast Canadian waters must be much lower as a consequence of this die-off.

A wide variety of pollutants have been recorded in the tissues of this species (O'Shea et al. 1980; Geraci 1989; Morris et al. 1989). Geraci (1989) indicated that levels of contaminants, such as PCBs and DDE, in animals off the U.S. east coast are among the highest recorded from any cetacean worldwide, although the role of pollutants in mortality remains unknown. The potential effects of oil are largely unknown, but Würsig (1990) suggested that among the odontocetes, Bottlenose Dolphins are one of the few species that may be exposed to the highest risk. Another potential threat to this species is through competition with humans for food, by human over-utilization of fish stocks.

Because of the large numbers of animals held in captivity, and as a result of investigations into the recent U.S. east coast die-off, considerable research into causes of mortality have been undertaken. A variety of diseases and pathologies have been recorded from this species, including; acute pancreatitis, blastomycosis, chronic pancreatic fibrosis, gastric ulcers, hypertensive intracerebral hemorrhage, lobomycosis, malignant pustules, mitral valve endocardiosis, myocardial rhabdomyolysis, puerperal sepsis, renal tubular adenoma, and vertebral osteomyelitis (Tomilin 1957; Geraci and Gerstmann 1966; Medway et al. 1966; Sweeney and Ridgway 1975; Dudok van Heel 1977; Hall et al. 1977; Greenwood and Taylor 1979; Greenwood and Tinsley 1979; Cates et al. 1986; Alexander et al. 1989; Geraci 1989). A variety of bacteria, including; *Acinetobacter*, *Aspergillus fumigatus*, *Bacillus*, *Clostridium perfrengens*, *Edwardsiella*, *Erysipelothrix insidiosa*, *Klebsiella*, *Pasteurella multocida*, *Pseudomonas*, *Staphylococcus*, *Streptococcus*, *Vibrio damsela*, and *Vibrio alginolyticus*, have been recovered from this species (Fujioka et al. 1988; Geraci et al. 1966; Sweeney and Ridgway 1975; Greenwood and Taylor 1979; Schroeder et al. 1985; Geraci 1989). Viruses have also been recorded, including papovavirus and several reovirus-like forms (Geraci 1989). Heavy infestations of some parasites may contribute to mortality. A wide variety of parasites have been recorded, including *Anisakis tursionis*, *Anisakis typica*, *Anisakis marina*, *Braunina cordiformis*, *Campula oblonga*, *Campula delphini*, *Campula palliata*, *Corynosoma cetaceum*, *Crassicauda crassicauda*, *Diphyllobothrium* sp., *Gnathostoma* sp., *Halocercus lagenorhynchi*, *Isocyamus delphini*, *Monorygma grymaldii*, *Nasitrema delphini*, *Pholetes gastrophilus*, *Phyllobothrium delphini*, *Stenurus ovatus*, *Stenurus minor*, *Syncyamus* sp., *Synthesium tursionis*, and *Xenobalanus globicipitis* (Tomilin 1957; Johnston and Ridgway 1969; Zam et al. 1971; Margolis and Dailey 1972; Duguy 1978; Greenwood and Taylor 1979; Greenwood et al. 1979; Ross 1984).

Predation by sharks, evidenced largely by healed wounds and occasional shark stomach contents, has been recorded (Wood et al. 1970). Tomilin (1957) and Wells et al. (1980) reported that Killer Whales prey on Bottlenose Dolphins, although surprisingly, no records of actual predation by Killer Whales appear to be available (Jefferson et al. 1991). Würsig and Würsig (1979) reported two instances where Bottlenose Dolphins moved away from Killer Whales, and recorded one individual with possible

Killer Whale tooth rakes on its side. Death related to food acquisition has been recorded in several cases, by blockage of air passages because of attempted ingestion of large prey (Hult et al. 1980), or from injuries from encounters with ray spines (Walsh et al. 1988). Mass strandings of Bottlenose Dolphins usually only comprise a small number of individuals at a time, and occur infrequently (Sergeant 1982).

Special Significance of the Species

The Bottlenose Dolphin is the most common cetacean held in captivity for both public display and scientific research (Figure 4); they have been regularly kept in aquaria since 1914, and were first publicly displayed in Boston in 1861 (Leatherwood and Reeves 1982, 1983). Bottlenose Dolphins have been live-captured for display purposes around the world (Abel and Leatherwood 1985), and have been (or currently are) held in aquaria in several countries, including: Canada, England, France, Hong Kong, Indonesia, Israel, Japan, Netherlands, New Zealand, South Africa, Spain, and the United States (Defran and Pryor 1980). Some of these animals are taken from drive fisheries, and would otherwise be killed and used for human consumption (Abel and Leatherwood 1985). In recent years, swim-with-dolphin programs in captivity have become very popular; Linden (1989a) showed proceeds of $1 785 000 annually for four operations in Florida and Hawaii. The southeastern United States is the major area for live-capture operations (Burn et al. 1987).

Hybridization in captivity has been documented with the Rough-toothed Dolphin, False Killer Whale, and Risso's Dolphin (Shallenberger and Kang 1977; Nishiwaki and Tobayama 1982; Shimura et al. 1986). Interestingly, Fraser (1940) reported possible hybrids with Risso's Dolphins in the wild off Ireland, and Herzing (1990) reported hybrids in the wild with Atlantic Spotted Dolphins off the Bahamas.

Survival rates of Bottlenose Dolphins in captivity are fairly high; Demaster and Drevenak (1988) estimated mean annual survival rate in captivity of 0.93, for U.S. institutions. The ease of keeping this species, combined with the large number held in captivity, has resulted in numerous studies on a variety of factors related to cetacean biology in general. These have included determination of learning and intelligence characteristics, vision, hearing and echolocation, and pollution detection abilities (e.g., Lawrence and Schevill 1954; Johnson 1968; Hall et al. 1972; Geraci et al. 1983; Forestell and Herman 1988; Au and Moore 1988; Brill et al. 1988). They are also used in open-ocean free-ranging experi-

FIGURE 4. The Bottlenose Dolphin in the most widely kept species of cetacean in captivity. Photo by R.W. Baird/P.J. Stacey.

ments, such as diving physiology studies, diver assistance and rescue, and pingered object recovery (Irvine 1970), these being commonly associated with training done by the U.S. Navy. Individuals have been known to leave the study areas after a training session (Irvine 1970) and it is possible that animals occasionally observed outside the expected normal distribution range may include these escaped animals (*see* Ferrero and Tsunoda 1989). It has been reported in the popular literature that the U.S. Navy may be using Bottlenose Dolphins to patrol a submarine base at Bangor, Washington, in Puget Sound (Linden 1989b). If such is the case, sightings of animals from British Columbia waters in future years should be qualified with this in mind.

Associations with humans, beyond scavenging from fishing vessels or bowriding on boats, occur world-wide. In the Indian and Banana Rivers in Florida, Cato and Prochaska (1976) suggested that Bottlenose Dolphins may cause an estimated $441 000 damage to fishing gear annually, although some proportion of this damage may be due to sharks (Leatherwood 1979). In Shark Bay, Western Australia, groups of Bottlenose Dolphins swim close to shore to interact with people (Connor and Smolker 1985). Such behaviour also frequently occurs with Bottlenose Dolphins, usually solitary individuals, approaching divers and swimmers world-wide (Lockyer 1990). This "sociable" behaviour has been taken to an extreme in one area off Brazil, where Pryor et al (1990) reported that local fishermen and Bottlenose Dolphins cooperatively hunt Mullet, *Mugil cephalus*. The dolphins apparently cooperate in herding fish towards the fishermen, indicate the presence of the fish in turbid waters by characteristic surfacing patterns, and then feed on fish which scatter from the school when the hand-thrown net is used. Such cooperative associations in the wild between humans and other animals have also been noted elsewhere, both with birds or with other cetaceans (Wellings 1944; Isack and Reyer 1989).

Evaluation

The Bottlenose Dolphin is widespread and abundant in tropical and warm temperate seas worldwide. This species is, at most, only a rare visitor to Canadian waters, likely due to thermoregulatory constraints. As such, no COSEWIC status designation is required.

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