SUMMARY OF CURRENT KNOWLEDGE OF SHORT-BEAKED COMMON DOLPHINS (*Delphinus delphis*) IN THE WESTERN NORTH ATLANTIC

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ABSTRACT

A single population of short-beaked common dolphins (*Delphinus delphis*) with an estimated abundance of 120,743 (CV=0.23) inhabits the waters of the western North Atlantic (wNA) between North Carolina, USA and Nova Scotia, Canada. Large schools are often seen in waters between 100-2,000 m depth. There is a seasonal shift in their distribution being more northern in the summertime and more southern in the winter. Strandings have been reported year round on Cape Cod. The population has been historically impacted by several fisheries but recent by-catch estimates are below the Potential Biological Removal (PBR) level. Additional threats to the population have not been quantified. *D. delphis* in the wNA have seasonal reproduction with conception and birth occurring in July. Males undergo profound seasonal increases in the size and mass of their testes which also peaks in July. Over an estimated 30 year life span, females reach sexual maturity before males (8 vs. 9.5 y) and reach a shorter asymptotic length (200 vs 220 cm). We still know little about the ecology of wNA *D. delphis*.

STOCK STRUCTURE

The single stock model for western North Atlantic (wNA) short-beaked common dolphins (*Delphinus delphis*) has recently been supported using both genetic and morphometric techniques (Westgate 2005, 2007; Mirimin *et al.* 2009). In these studies the *a priori* assumption was that only short-beaked common dolphins were present in the wNA. This assumption was supported *post hoc* in both analyses and also by Jefferson *et al.* (2009) who recently conducted a detailed geographic analysis of the genus *Delphinus* in the western Atlantic Ocean.

Briefly, systematic differences in short-beaked common dolphin cranial morphology, in relation to geographic location within the wNA, were examined. Cranial specimens (n=141) were obtained from between Nova Scotia, Canada, and Florida, USA. A Wilks' λ canonical discriminant analysis (CDA) was performed on the within-groups covariance matrix to test whether significant differences in group centroids (multivariate means) existed between putative population units, separately for males and females. In addition, the CDA was used to reclassify each dolphin into a geographic group based on the discriminant function. The CDA of 35 cranial variables found no evidence (Males- Wilks' $\lambda = 0.603$, P = 0.286; Females- Wilks' $\lambda = 0.145$, P=0.08) of population structure below the species level within the wNA using two separation schemes. The first divided the sample based on a North-South separation at 39º N, the second used a distance from shore criteria of 130km (Westgate 2007).

A similar analysis was conducted using both microsatellite and control region mitochondrial markers. A group of 183 mtDNA and 49 microsatellite samples were collected from stranded, by-caught and biopsied common dolphins between North Carolina and Massachusetts, USA. Using an analysis of molecular variation (AMOVA, F_{ST} and Φ_{ST} for mtDNA and R_{ST} for microsats) no significant geographically based genetic variation was observed in either sex when examined using similar spatial cut-offs as in the cranial analysis (Westgate 2005; Mirimin *et al.* 2009).

It is worth pointing out that significant population structure was documented with the North Atlantic using both the genetic and morphometric techniques when samples from the wNA were compared to those collected in the eastern North Atlantic (Ireland, Scotland, England) (Westgate 2007; Mirimin *et al.* 2009).

DISTRIBUTION

In waters off the northeastern USA and Canadian coast, short-beaked common dolphins are generally distributed from the Georgia/South Carolina border (32˚N) to about 47-50˚N off Newfoundland (Jefferson *et al.* 2009). They are most prevalent along the continental slope (100 to 2,000 m) and are also associated with canyon and Gulf Stream features (CETAP 1982; Selzer and Payne 1988; Waring *et al.* 1992; DON 2007a,b,c).

The species is less common south of Cape Hatteras, North Carolina (35˚N). Historically (early 1950s), short-beaked common dolphins were seen off the northeastern coast of Florida (Gaskin 1992), but have not been seen there since the early 1960s (Caldwell *et al.* 1971; Leatherwood *et al.* 1976; Jefferson *et al.* 2009). Jefferson and Schiro (1997) and Jefferson *et al.* (2009) speculated that this may be because of population or distribution fluctuations; perhaps due to the increases in sea surface temperature (SST) that have occurred since the 1960s which in turn changed the prey field. Consequently in these waters common dolphins have been replaced by *Stenella* spp. There is no evidence that short-beaked common dolphins inhabit the Gulf of Mexico (Jefferson *et al.* 2009).

During mid-January to May, short-beaked common dolphins generally occur from Cape Hatteras northeast to Georges Bank, 35˚ to 42˚N (CETAP 1982; Payne *et al.* 1984). During summer to autumn, they move northward onto Georges Bank and the Scotian Shelf and over prominent bottom escarpments, such as the Flemish Cap; this generally occurs when water temperatures exceed 11ºC (Sergeant *et al.* 1970; Gowans and Whitehead 1995). In fact, Selzer and Payne (1988) reported very large aggregations (greater than 3,000 animals) on Georges Bank in autumn. They are frequently seen near the "Gully", a prominent submarine canyon off Nova Scotia and there have been several strandings and sightings reported at Sable Island, Canada which is west of the Gully (Mercer 1973; Lucas and Hooker 2000). Short-beaked common dolphins do not normally enter the Gulf of St. Lawrence (Kingsley and Reeves 1998), and are not generally found in waters off Quebec or Labrador (Alling and Whitehead 1987). In general, they are considered an occasional visitor to eastern Canada (Gaskin 1992). In the 1980's and 1990's, short-beaked common dolphins were occasionally seen in the Gulf of Maine in the summer (Selzer and Payne 1988); however, since 2000 they are frequently seen in these waters, even near the coast of Maine.

ABUNDANCE

Abundance estimates of short-beaked common dolphins (Table 1) have been available from the US western North Atlantic since the CETAP surveys were conducted during 1 November 1978 through 28 January 1982 (CETAP 1982). The best estimate (29,610 CV=0.39) from this series of surveys was based on an inverse variance weighted pooling of the average spring (20 March through 20 June) and average summer (21 June through September 21) estimates.

The most recent abundance surveys that covered the largest portion of the short-beaked common dolphin's habitat were conducted in 2004 (Table 1; Figure 1). This set of surveys covered waters between Florida and the Bay of Fundy, Canada using two ships (*R/V Gunther* and *R/V Endeavor*) and one plane (NOAA Twin Otter) in 16, 420 km of track line and resulted in an abundance estimate of 120,743 (CV=0.23).

Eight line-transect abundance surveys were conducted between 1982 and 2006 (Table 1; Figure 1). However, several different analytical methods were used to analyze the results from these surveys, which have resulted in a series of estimates that are not directly comparable. Thus, until the estimates are made more comparable, it is not possible to conduct a reliable trend analysis.

DIRECTED TAKES

Directed takes of short-beaked common dolphins is not known to have occurred in the US western North Atlantic, except perhaps in the whaling days when a variety of small cetaceans were infrequently taken as the ships sailed south to the Antarctic (Church 1938).

INCIDENTAL TAKES

US -Short-beaked common dolphin mortalities have been documented in the following US fisheries: Atlantic pelagic drift gillnet, Northeast and Mid-Atlantic gillnet, Northeast and Mid-Atlantic bottom trawl, and Mid-Atlantic mid-water trawl (including pair trawl) fisheries. Short-beaked common dolphins have been documented to be hooked and released alive in the pelagic longline fishery.

Since 1991, these fisheries were observed and bycatch was estimated, though not all fisheries were observed every year (Table 2; Figure 2). The mortality estimates for fisheries were calculated using stratified ratio estimation methods. The bycatch rate was estimated from a sample of the fishery that was observed by the Northeast Fisheries Observer Program. The observed bycatch rate was then expanded to a bycatch estimate for the entire fishery using fisheries effort data from the Northeast Regional Vessel Trip Reports and the Northeast Dealer Reported Landings database. Examples of the estimation process for gillnets is in Belden (2007) and Belden and Orphanides (2007) and for bottom trawls is in Rossman (in review).

On average 415 (CV=0.15) animals were taken annually as incidental bycatch in these fisheries during years/fisheries which had at least some observer coverage. The Atlantic pelagic drift gillnet and Mid-Atlantic bottom trawl fisheries had the highest annual averages: 185 animals (CV=0.03) and 181 animals (CV=0.34), respectively (Table 2). A brief description of each fishery and the annual observer coverage is below.

Atlantic pelagic drift gillnet

The Atlantic pelagic fishery concentrated along the southern edge of Georges Bank and off Cape Hatteras, North Carolina when it was active; it was shut down in January 1999. Examination of the species composition of the catch and locations of the fishery throughout the year suggested that this fishery was stratified into two strata: a southern winter stratum and a northern summer stratum. Observer coverage, expressed as percent of sets observed, was 8%, 6%, 20%, 40%, 42%, 87%, 99%, 64%, during 1989 through 1996, no fishery in 1997, and 99% coverage during 1998. The estimated bycatch of short-beaked common dolphins for 1991 to 1998 are (CV in parentheses): 223 (0.12), 227 (0.09), 238 (0.08), 163 (0.02), 83 (0), 106 (0.07), NA, 225 (0), respectively, where the fishery was closed during 1997 (Table 2; Figure 2). The annual average during 1991 to 1998 was 164 animals per year.

Northeast gillnet

The Northeast gillnet fishery is distributed throughout the Gulf of Maine, Georges Bank, and Southern New England Regions. Effort occurs year-round with a peak during May, June, and July primarily on the continental shelf region in depths ranging from 30 to 750 feet. Target species include Atlantic cod, haddock, pollock, yellowtail flounder, winter flounder, witch flounder, American plaice, windowpane flounder, spiny dogfish, monkfish, silver hake, red hake, white hake, ocean pout, and skate spp. Monofilament is the dominant material used with stretched mesh sizes ranging from 6 to 12 inches. String lengths range from 600 to 10,500 feet long. The mesh size and string length vary by the primary fish species targeted for catch. In 2006, approximately 220 federal Northeast gillnet permit holders reported the use of gillnets in the Northeast Region Dealer Reported Landings Database. Total metric tons of fish landed from 1998 to 2007 were 22,933, 18,681, 14,487, 14, 634, 15,201, 17,680, 19,080, 15.390, 14,950, and 15,808 respectively. Observer coverage started in 1990. During the period 1990-2007, estimated observer coverage (number of trips observed/total commercial trips reported) was 1%, 6%, 7%, 5%, 7%, 5%, 4%, 6%, 5%, 6%, 6%, 4%, 2%, 3%, 6%, 7%, 4%, and 7% respectively. The estimated bycatch of short-beaked common dolphins are (CV in parentheses): 63 (1.39) in 1996, 146 (0.97) in 1999, 26 (0.80) in 2005, 20 (1.05) in 2006, 11 (1.08) in 2007, and 0 in all other years (Table 2; Figure 2). The annual average during 1990 to 2007 was 15 animals per year.

Mid-Atlantic gillnet

The Mid-Atlantic gillnet fishery operates year-round, extending from New York to North Carolina. It is comprised of a combination of small vessels that target a variety of fish species: monkfish, spiny and smooth dogfish, bluefish, weakfish, menhaden, spot, croaker, striped bass, coastal sharks, spanish mackerel, king mackerel, American shad, black drum, skate spp., yellow perch, white perch, herring, scup, kingfish, spotted seatrout, and butterfish. This fishery is prosecuted right off the beach (6 feet water depth), in nearshore coastal waters to offshore waters (250 feet depth). This fishery utilizes both drift and sink gillnets, including nets set in a sink, stab, set, strike or drift fashion. These nets are most frequently attached to the bottom, although unanchored drift or sink nets are also utilized to target specific species. Monofilament twine is the dominant material used with stretched mesh sizes ranging from 2.5 to 12 inches. String lengths range from 150 to 8400 feet. The mesh size and string length vary by the primary fish species targeted for catch. In 2006, approximately 230 federal mid-Atlantic permit holders reported the use of gillnets in the Northeast Region Dealer Reported Landings Database. Total metric tons of fish landed from 1998 to 2007 were 15,494, 19,130, 16,333, 14,855, 13,389, 13,107, 15,124, 12,994, 8,755, and 17,941 respectively. Observer coverage started in 1995. During the period 1995-2007, the estimated observer coverage was 5%, 4%, 3%, 5%, 2%, 2%, 2%, 1%, 1%, 2%, 3%, 4% and 6%, respectively. The estimated bycatch of short-beaked common dolphins are (CV in parentheses): 7.4 (0.69) in 1995, 43 (0.79) in 1996, 16 (0.53) in 1997, 11 (1.03) in 2006, and 0 in all other years (Table 2; Figure 2). The annual average during 1995 to 2007 was 6 animals per year.

Northeast bottom trawl

The Northeast bottom trawl fishery occurs year-round with a peak during May, June, and July primarily on the continental shelf and is distributed throughout the Gulf of Maine, Georges Bank and Southern New England Regions. Target species include Atlantic cod, haddock, pollock, yellowtail flounder, winter flounder, witch flounder, American plaice, Atlantic halibut, redfish, windowpane flounder, summer flounder, spiny dogfish, monkfish, silver hake, red hake, white hake, ocean pout, *Loligo* squid and Skate spp. The average footrope length for the bottom

trawl fleet was about 84 feet from 1996 – 1999; in 2000 there was a sharp increase to almost 88 feet followed by a steady decline to 85 feet in 2004. Seasonality was evident, with larger footrope lengths in the first quarter, which drop sharply from March to the low in May, and followed by a steady increase in size until December. There are some differences in mean gear size between species. In 2006, approximately 600 federal northeast permit holders reported the use of bottom trawls in the Northeast Region Dealer Reported Landings Database. Total effort, measured in trips, for the Northeast bottom trawl fishery from 1998 to 2007 was 13,263, 10,795, 12,625, 12,384, 12,711, 11,577, 10,354, 10,803, and 8,603, respectively. Observer coverage started in 1994. During the period 1994-2007, estimated observer coverage (measured in trips) was 0.4%, 1.1%, 0.2%, 0.2%, 0.1%, 0.3%, 1%, 1%, 3%, 4%, 5%, 12%, 6% and 6% respectively. The estimated bycatch of short-beaked common dolphins are (CV in parentheses): 142 (0.77) in 1995, 93 (1.06) in 1997, 26 (0.29) in 2003, 26 (0.29) in 2004, 32 (0.28) in 2005, 25 (0.28) in 2006, 24 (0.28) in 2007, and 0 in all other years (Table 2; Figure 2). The annual average during 1991 to 2007 was 21 animals per year.

Mid-Atlantic bottom trawl

The mid-Atlantic bottom trawl fishery is managed as two fisheries, a mixed groundfish fishery and a squid, mackerel, butterfish (SMB) fishery. Because they are very different from each other, each fishery will be described separately.

Mixed groundfish mid-Atlantic bottom trawl

The mixed groundfish mid-Atlantic bottom trawl fishery occurs year-round from Cape Cod, Massachusetts to Cape Hatteras, North Carolina and targets Atlantic cod, haddock, pollock, yellowtail flounder, winter flounder, witch flounder, American plaice, Atlantic halibut, redfish, windowpane flounder, summer flounder, spiny and smooth dogfish, monkfish, silver hake, red hake, white hake, ocean pout, scup, black sea bass and skate spp. Total effort, measured in trips, for the mixed groundfish bottom trawl from 1998 to 2007 was 27,521, 26,525, 24,362, 27,890, 28,103, 25,725, 22,303, 15,070, 12,457, and 11,279 respectively. During the period 1996-2007, estimated observer coverage (measured in trips) for this fishery was 0.24%, 0.22%, 0.15%, 0.14%, 1%, 1%, 1%, 1%, 3%, 3%, 2% and 3%, respectively.

Squid, mackerel, butterfish mid-Atlantic bottom trawl

In the SMB fishery, Atlantic butterfish is a non-directed fishery, therefore effort on this species will not be reported. The *Illex* (*Illex illecebrosus*) and *Loligo* (*Loligo pealeii*) squids are usually fished using small-mesh otter trawls.

The U.S. domestic fishery for *Illex* squid, ranges from southern New England to Cape Hatteras, North Carolina, which reflect patterns in the seasonal distribution of the squid. *Illex* is harvested offshore (along or outside of the 100-m isobath), mainly by small-mesh otter trawlers, when this species of squid is distributed in continental shelf and slope waters during the summer months (June-September) (Clark 1998). Total effort, measured in trips, for the *Illex* squid fishery from 1998 to 2007 were 412, 141, 108, 51, 39, 103, 445, 181, 159, and 103, respectively (NMFS). During the period 1996-2007, estimated observer coverage (trips) in the *Illex* fishery was 3.7%, 6.21%, 0.97%, 2.84%, 11.11%, 0.00%, 0.00%, 8.74%, 5.07%, 6%, 15%, 14%, respectively.

The U.S. domestic fishery for *Loligo* squid occurs mainly in southern New England and mid-Atlantic waters. Fishery patterns reflect *Loligo* seasonal distribution, therefore most effort is directed offshore near the edge of the continental shelf during the fall and winter months (October-March) and inshore during the spring and summer months (April-September) (Clark 1998). Total effort, measured in trips, for the *Loligo* squid fishery from 1998 to 2007 were 1,048, 495, 529, 413, 3,585, 1,848, 1,124, 1,845, 3,058, and 2,127 respectively. During the period 1996-2007, estimated observer coverage (trips) of the *Loligo* fishery was 0.37%, 1.07%, 0.72%, 0.69%, 0.61%, 0.95%, 0.42%, 0.65%, 5.07%, 4%, 3%, and 2% respectively.

The U.S. domestic fishery for Atlantic mackerel (*Scomber scombrus*) occurs primarily in the southern New England and mid-Atlantic waters between the months of January and May and in the Gulf of Maine during the summer and fall months (May-December) (Clark 1998). Total effort, measured in trips, for the domestic Atlantic mackerel bottom trawl fishery in the mid-Atlantic region from 1997 to 2007 were 373, 278, 262, 102, 175, 310, 238, 231, 0, 117, and 88 respectively. During the period 1997-2007, estimated observer coverage (trips) of this fishery was 0.81%, 0%, 1.14%, 4.90%, 3.43%, 0.97%, 5.04%, 18.61%, 0%, 3% and 2%, respectively.

During the period 1977-1986, observers recorded 123 mortalities of short-beaked common dolphins in foreign *Loligo* squid-fishing activities (Waring *et al.* 1990). In 1985 and 1986, Italian vessels took 56 and 54 short-beaked

common dolphins, respectively, which accounts for 89% (n=110) of the total takes in foreign *Loligo* squid-fishing operations. These takes were during December to February.

From 1977-1991 observers recorded 110 mortalities of short-beaked common dolphins in foreign mackerel-fishing operations (Waring *et al.* 1990). This bycatch occurred during December to May.

The estimated bycatch of short-beaked common dolphins for 1996 to 2007 are (CV in parentheses): 940 (0.75), 161 (0.49), 0 (0), 49 (0.78), 273 (0.57), 126 (1.09), 0 (0), 99 (0.28), 159 (0.3), 141 (0.2), 131 (0.28), and 66 (0.27), respectively (Table 2; Figure 2). The annual average during 1996 to 2007 was 179 animals per year.

Mid-Atlantic mid-water single and pair trawl

The mid-Atlantic mid-water single and pair trawl fisheries occurs year-round in waters from New York to North Carolina and target primarily Atlantic mackerel, chub mackerel and a few other pelagic species. In 2006, approximately 5 federal mid-Atlantic permit holders reported the use of mid-water trawls in the Northeast Region Dealer Reported Landings Database. Total effort, measured in trips, for the mid-Atlantic mid-water trawl fishery from 1997 to 2007 was 331, 223, 374, 166, 408, 261, 428, 360, 359, 405, and 14 respectively (NMFS). During the period 1996-2007, estimated observer coverage (trips) was 0.00%, 0.00%, 0.00%, 1.01%, 8.43%, 0.00%, 0.77% , 3.5%, 12.16%, 8.4%, 8.9% and 31.4%, respectively. The estimated bycatch of short-beaked common dolphins are (CV in parentheses): 32 (0.48) in 1992, 35 (0.43) in 1993, 5.6 (0.35) in 1995, 3.2 (0.70) in 2007, and 0 in all other years (Table 2; Figure 2). The annual average during 1992 to 2007 was 7 animals per year.

Pelagic Longline

The pelagic longline fishing effort occurs year round and operates in waters both inside and outside the U.S. EEZ throughout Atlantic, Caribbean and Gulf of Mexico waters. During 2007, the majority of fishing effort in the Atlantic was reported in the Mid-Atlantic Bight (Virginia to New Jersey, 1,887 sets) and the South Atlantic Bight (Georgia to North Carolina, 1,070 sets) fishing areas (Fairfield Walsh and Garrison 2007). Large pelagic fish species including: swordfish, yellowfin tuna, bigeye tuna, bluefin tuna, albacore tuna, dolphin fish, shortfin mako shark, and a variety of other shark species. Between 2001 and 2006, a mean of 4,475 sets (3.15 million hooks) was reported each year. During 2007, the total reported fishing effort in the Atlantic Ocean component of the fishery was 4,839 sets and 3.37 million hooks (Fairfield Walsh and Garrison 2007). Seventy-four vessels reported pelagic longline effort in the Atlantic during 2007. During the period 2000-2007, observer coverage as a percentage of reported sets in the Atlantic component of the fishery was 4%, 4%, 4%, 7%, 9%, 6%, 7% and 7%. These values do not include the experimental portion of the fishery in the northeast distant water (NED) area, which was 100% of sets during 2001-2003. Between 1990 and2007, sixteen common dolphins were hooked and released alive (Yeung *et al.* 2000; Yeung 2001).

Canada -Very little is known about short-beaked common dolphin bycatch in Atlantic Canadian waters. Examples of documented bycatch are below.

Between January 1993 and December 1994, 36 Spanish deep water trawlers, covering 74 fishing trips (4,726 fishing days and 14,211 sets) were observed in NAFO Fishing Area 3 (off the Grand Bank) (Lens 1997). A total of 47 incidental catches were recorded, which included 1 common dolphin. The incidental mortality rate for common dolphins was 0.007/set.

An unknown number of common dolphins have been taken in an experimental salmon drift-gillnet fishery off Greenland (Read 1994).

STRANDINGS

US -From 2003 to 2007, 407 short-beaked common dolphins were reported stranded between Maine and Florida. The total includes mass stranded common dolphins in Massachusetts during 2004 (one event of 6 animals and one of 3 animals), 2005 (a total of 43 in 4 separate events), 2006 (a total of 65 in 10 events), and 2007 (a total of 23 in 5 separate events). Five of the 2005 Massachusetts stranded animals, 18 animals in 2006, and 2 animals in 2007 were released alive. Common dolphins were included in a UME (unusual mortality event) declared for Virginia in 2004 (MMC 2005). The strandings were primarily bottlenose dolphins, but common dolphins were also involved. Human interactions were indicated on one of the 2004 Virginia common dolphin mortality records, one of the 2005 and one of the 2007 New York mortality records and one of the 2006 Virginia mortality records. Stranding have been documented year round on Cape Cod but summertime strandings are rare in Virginia and North Carolina (Westgate 2005).

Canada -Four short-beaked common dolphin strandings (6 individuals) were reported on Sable Island, Nova Scotia from 1996 to 1998 (Lucas and Hooker 1997; 2000). One common dolphin was reported stranded in Halifax County, Nova Scotia in 2005 (Tonya Wimmer, pers. comm.).

HABITAT DEGRADATION

Because of their offshore habitat wNA short-beaked common dolphins have been impacted less directly than more coastal dwelling species. Potential threats to habitat include pollution, halogenated contaminants and anthropogenic noise; however, none of these threats have been directly quantified with respect to wNA *Delphinus.* It is worth noting that this population spends considerable time in the waters adjacent to the Gulf Stream. Changes in ocean circulation patterns brought on by global climate change may have impacts on the ecology of wNA pelagic dolphins including wNA short-beaked common dolphins.

LIFE HISTORY

Reproduction -The life history of wNA short-beaked common dolphins has been recently clarified. Most of the samples were collected between 1989 and 1998 by observers monitoring the swordfish driftnet fishery on both the northern (39-41°N) and southern (35- 38°N) fishing grounds. Additional samples were collected from individuals stranded along the eastern coast of the United States, from Massachusetts to North Carolina. Standard lengths were taken from each carcass and testes, ovaries, and jaws were also collected. In some cases the uterus and foetus of pregnant females were collected whole. Samples were examined from 74 female and 161 male individuals. A highly significant ($p<0.001$) male bias in the sex ratio of both the bycatch and stranding samples suggests that sex-based habitat partitioning or school segregation occurs in this population. Age was estimated from decalcified thin sections of teeth (Figure 3) and testis and ovarian samples were examined both macro- and microscopically. Females reach sexual maturation at approximately age eight; males mature at 9.5 y. Conception occurs during July and August (mean day 24 July). Gestation is estimated to last just under a year, so most females give birth during July and August (mean day 15 July). Calf size at birth is approximately 93 cm. Annual pregnancy rate is estimated to be between 25 and 33%. Male short-beaked common dolphins are characterized by pronounced seasonal changes in both morphology and histology of their testes. The mean mass of regressed testes was 802.9 ± 455.5 g, compared to 4049.6 ± 1317.4 g for testes in full production. Peak sperm production potential was observed in July. At the end of the breeding season testis size and activity decrease after August. Male dolphins in this population are hypothesized to engage in some form of sperm competition.

There is compelling evidence that reproduction in wNA *D. delphis* is both seasonal and synchronized. With the exception of lactation, all significant reproductive events (peak potential sperm production, ovulation, conception, and parturition) peak during July. Males undergo a five-fold seasonal increase in testicular mass and reach peak sperm production in the beginning of July. At the microscopic level, their seminiferous tubule diameters also double in size. Observations of females are more limited, but their reproductive cycles appear to mirror those of the males. The greatest follicular diameters, indicating ovulation was about to occur, were recorded from mature females in July. Two additional lines of evidence support seasonal reproduction in females: a decrease in the diameter of the largest CA following August; and synchronous linear growth in foetal length prior to birth in July. Mean dates of birth and conception were estimated to be 15 July and 24 July, respectively.

Feeding habits -There are no published accounts of the feeding habitats of wNA *Delphinus.*

Growth –Age and length were recorded from 192 animals captured in the driftnet fishery (104 males; 88 females) between 1989 and 1998. This sample was supplemented with data from 28 stranded animals (20 males, 8 females) collected between 1989 and 2005. The Laird-Gompertz curves provided a good description of the growth trajectories. For the female sample the equation of the curve was,

$$L(t) = L_0 e^{(0.76/0.988(1-e^{(-0.988t)}))}$$

where L(t) is the standard length at time t and t is the age. For males the equation was,

$$L(t) = L_0 e^{(0.416/0.484(1-e^{(-0.484t)}))}$$

Both curves rose steeply until they reached about 190 cm at 3.5 years (Figure 3). Here they diverged as the female curve quickly became asymptotic, while the male curve continued to climb steeply until it reached 210 cm at 6.5 years. The growth rate of females changed much more dramatically during the first year and by age six females

were changing in size by about one cm a year whereas it took males until 12 years to approach this rate (Figure 3). Differences in the size at birth can influence growth trajectories, but there was no difference in the length of male and female calves (pooled sample from July and August, T-test, p=0.34, n= 24 females and 21 males, Westgate 2005). The estimated asymptotic length for males was 219.2 cm and for females 200.2 cm, giving a size sexual dimorphism ratio (SSD) of 1.1. Many previous studies have examined post-natal growth using a two step function. In this type of analysis two curves are simultaneously fitted to the data with the goal that early maturation is documented by the first curve and later development by the second. We choose not to conduct this kind of analysis for two reasons. First, our limited sample size, especially in the younger age classes, cautioned against using the necessary statistical approaches to find the inflection point, and second, we did not see any obvious decreases and subsequent increases in growth associated with early maturation, puberty, or the onset of sexual maturity that have been documented in other populations of pelagic dolphins (Perrin *et al.* 1975, 1977).

ECOLOGY

Other than the few details mentioned in the sections of this report there is very little is known about the ecology of wNA short-beaked common dolphins. The highly significant male bias observed in the sex ratios of the biopsy, stranding and bycatch sample sets (Westgate 2005) suggests that wNA *Delphinus* display sexual segregation over the spatial scale of their habitat. This could be in the form of larger scale habitat partitioning or actual school based sexual segregation. Seasonal changes in the distribution of wNA short-beaked common dolphins may be related to changes in the abundance or distribution of their prey but to date very little is known about their feeding ecology.

STATUS

US -The short-beaked common dolphin is not listed as threatened or endangered under the US Endangered Species Act (ESA). Under the US Marine Mammal Protection Act (MMPA), the value of the Potential Biological Removal (PBR) is 1000 animals (Waring *et al.* 2009). PBR is defined as the product of the minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 99,975 animals. The minimum population estimate is defined as the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for short-beaked common dolphins in the US Northwest Atlantic is 120,743 animals (CV =0.23), as derived from the 2004 surveys. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened, or stocks of unknown status, relative to optimum sustainable population (OSP) is assumed to be 0.5 because the CV of the average mortality estimates during 2003-2007 is less than 0.3 (Wade and Angliss 1997).

Canada -Under the Species at Risk Act (SARA), the short-beaked common dolphin is considered "not at risk". The reason for this designation is that this species is considered a seasonal visitor to the shelf off Nova Scotia and Newfoundland and no significant threats were identified.

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Figure 1. Distribution of common dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007. Isobaths are the 100-m, 1000-m and 4000-m depth contours.

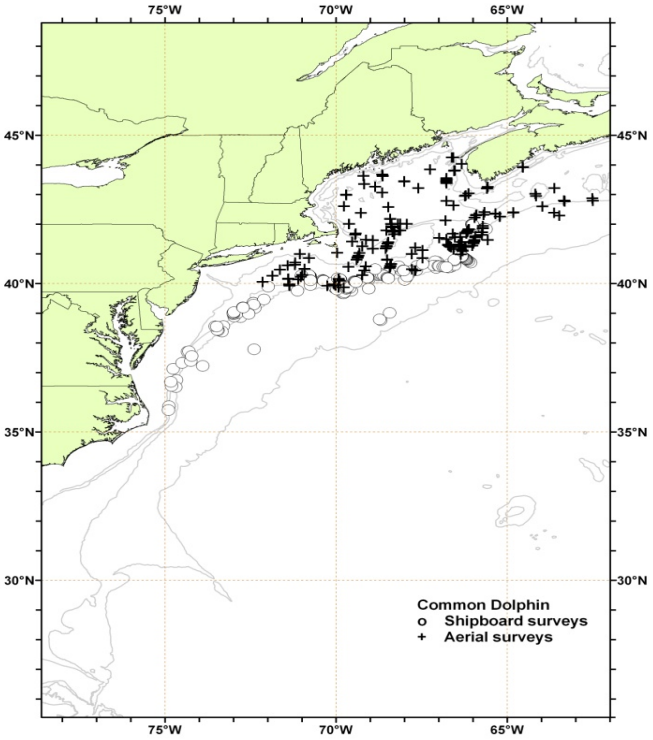

Figure 2. Number of estimated bycaught short-beaked common dolphins during 1990 to 2007 for all US fisheries and by each fisheries: Mid-Atlantic (MA) bottom trawl, gillnet and midwater single and pair trawl, Northeast (NE) bottom trawl and gillnet, and pelagic drift gillnet fisheries.

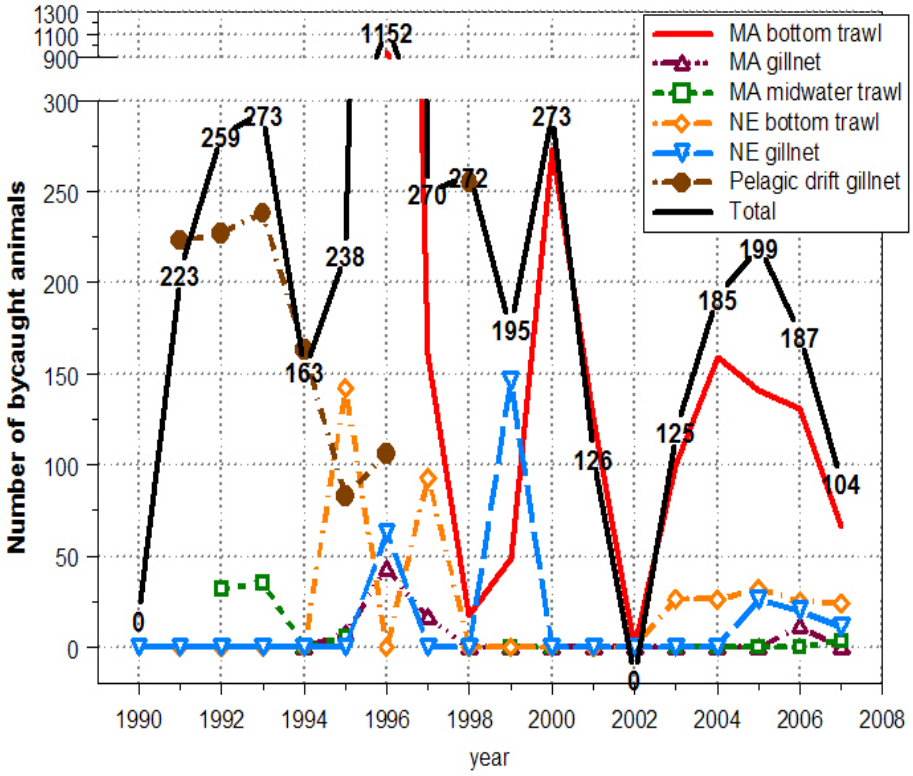

Figure 3. Observed age distribution of 220 wNA *D. delphis* collected from bycaught and stranded individuals.

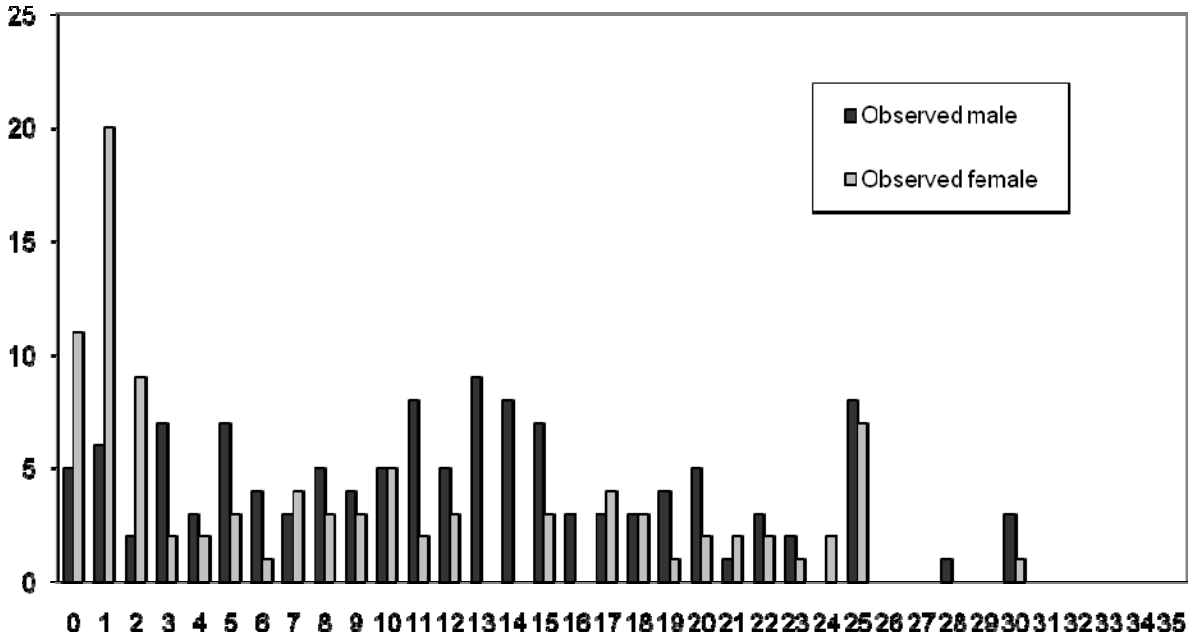

Figure 4. Growth curves from wNA *D. delphis* collected from bycaught and stranded individuals.

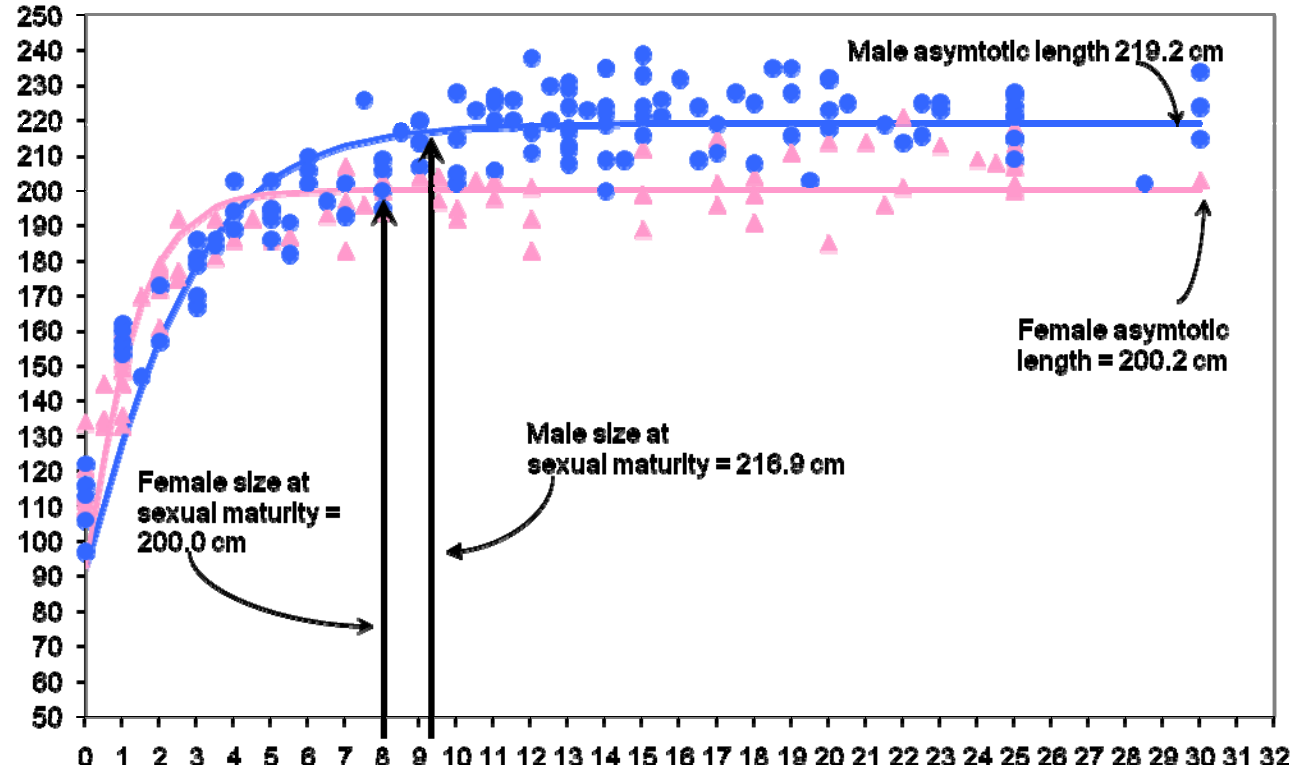

Table 1 Available abundance estimates of short-beaked common dolphins in the US Northwest Atlantic

Year	Platform	Area	Track length (km)	Analyses methods	Abund	CV	Reference
1982 Spring-summer	plane (AT-11; 1978-1982)	Cape Hatteras, NC to Nova Scotia, continental shelf and shelf edge waters	211,585	Line transect analyses of distance data, no g(0)	29,610	0.39	CETAP 1982
1991 Jun-Jul	Ship (Chapman)	Cape Hatteras to Georges Bank, between 200 and 2,000m isobaths	4,032	One team data analyzed by DISTANCE, no g(0)	22,215	0.4	Waring et al. 1992; Waring 1998
1993 Jun-Jul	Ship (Delaware II)	S. edge of Georges Bank, across the Northeast Channel, to the SE. edge of the Scotian Shelf	1,874	One team data analyzed by DISTANCE, no g(0)	1,645	0.47	NMFS 1993
1995 Jul-Sep	2 ships (Abel-J and Pelican) and plane (Twin Otter)	Virginia to the mouth of the Gulf of St. Lawrence	32,600	SHIP: two independent team data analyzed with modified direct duplicate method, includes g(0). PLANE: one team data analyzed by DISTANCE, no g(0).	6,741	0.69	Palka 1996
1999 Jul-Aug	ship (Abel-J) and plane (Twin Otter)	south of Cape Cod to mouth of Gulf of St. Lawrence	6,123	SHIP: two independent team data analyzed with modified direct duplicate or Palka & Hammond analysis methods, depending on responsive movement, includes g(0). PLANE: circle-back data pooled with aerial data collected in 1999, 2002, 2004, 2006, 2007, and 2008 to calculate pooled g(0)'s and year-species specific abundance estimates for all years except 2008, includes g(0).	30,768	0.32	
2002 Jun-Jul	Ship (Gunther)	Florida to Maryland	6,734	Two independent team data analyzed with modified direct duplicate method, includes g(0).	6,460	0.74	Garrison et al. 2003b
2004 Jun-Aug	ship (Endeavor) and plane (Twin Otter)	Maryland to Bay of Fundy	10,761	Same as 1999 survey	90,547	0.24	Palka 2006
2004 Jun-Aug	Ship (Gunther)	Florida to Maryland	5,659	Same as 2002 survey	30,196	0.54	Garrison et al. in prep
2004 Jun-Aug	**See above 2 lines**	**Florida to Bay of Fundy**	**16,420**	**COMBINATION OF ABOVE TWO LINES**	**120,743**	**0.23**	**Garrison et al. in prep; Palka 2006**
2006 Aug	plane (Twin Otter)	Georges Bank to Bay of Fundy	10,676	Same as for plane in 1999	84,000	0.36	Palka in prep

Table 2. Estimated bycatch (byc) and CV of short-beaked dolphins in US fisheries during 1991 through 2007. Cells without values indicate there was no observer coverage during that year/fishery. Pelagic drift gillnet was stopped after 1998.

Year	Mid Atlantic bottom trawl		Mid Atlantic gillnet		Mid Atlantic midwater trawl		Northeast bottom trawl		Northeast gillnet		Pelagic drift gillnet		TOTAL	
	byc	cv	byc	cv	byc	cv	byc	cv	byc	cv	byc	cv	byc	cv
1991							0	0	0	0	223	0.12	223	0.12
1992					32	0.48	0	0	0	0	227	0.09	259	0.10
1993					35	0.43	0	0	0	0	238	0.08	273	0.09
1994			0	0	0	0	0	0	0	0	163	0.02	163	0.02
1995			7.4	0.69	5.6	0.35	142	0.77	0	0	83	0	238	0.46
1996	940	0.75	43	0.79			0	0	63	1.39	106	0.07	1152	0.62
1997	161	0.49	16	0.53			93	1.06	0	0			270	0.47
1998	17	0	0	0			0	0	0	0	255	0	272	0.00
1999	49	0.78	0	0	0	0	0	0	146	0.97			195	0.75
2000	273	0.57	0	0	0	0	0	0	0	0			273	0.57
2001	126	1.09	0	0			0	0	0	0			126	1.09
2002	0	0	0	0			0	0	0	0			0	0.00
2003	99	0.28	0	0	0	0	26	0.29	0	0			125	0.23
2004	159	0.3	0	0	0	0	26	0.29	0	0			185	0.26
2005	141	0.2	0	0	0	0	32	0.28	26	0.8			199	0.18
2006	131	0.28	11	1.03	0	0	25	0.28	20	1.05			187	0.24
2007	66	0.27	0	0	3.2	0.7	24	0.28	11	1.08			104.2	0.22
AVERAGE	180.17	0.34	5.53	0.48	6.89	0.29	21.65	0.40	15.65	0.64	185.00	0.03	414.88	0.15

~~Table 3. Short-beaked common dolphin (*Delphinus delphis*) reported strandings along the US Atlantic coast, 2003-2007.~~

~~STATE~~	~~2003~~	~~2004~~	~~2005~~	~~2006~~	~~2007~~	~~TOTALS~~
~~Maine~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~	~~1~~
~~Massachusetts[a]~~	~~22~~	~~26~~	~~64~~	~~100~~	~~65~~	~~277~~
~~Rhode Island~~	~~2~~	~~1~~	~~0~~	~~2~~	~~4~~	~~9~~

~~Connecticut~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~New York~~ [b, c]	~~11~~	~~3~~	~~4~~	~~3~~	~~23~~	~~44~~
~~New Jersey~~	~~6~~	~~17~~	~~4~~	~~2~~	~~4~~	~~33~~
~~Delaware~~	~~1~~	~~2~~	~~1~~	~~0~~	~~0~~	~~4~~
~~Maryland~~	~~0~~	~~5~~	~~0~~	~~0~~	~~0~~	~~5~~
~~Virginia~~ [b, c]	~~4~~	~~8~~	~~2~~	~~1~~	~~4~~	~~19~~
~~North Carolina~~	~~7~~	~~4~~	~~1~~	~~2~~	~~0~~	~~14~~
~~Georgia~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Florida~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~EZ~~	~~0~~	~~1~~	~~0~~	~~0~~	~~0~~	~~1~~
~~TOTALS~~	~~53~~	~~67~~	~~76~~	~~110~~	~~101~~	~~407~~

~~a. Massachusetts mass strandings (2004 – 6 and 3; 2005 – 7,5,25, and 4; 2006 – 2,2,3,4,4,3,9,10,14, and 14; 2007 – 9,2,4,6,2).~~

~~b. Virginia reports 1 common dolphin found in a pound net in 2004. One common dolphin was released alive from a pound net in 2006 in NY. Twenty (12 dead, 8 rescued; one of the mortalities classified as human interaction) animals involved in a mass stranding in Suffolk county in 2007.~~

~~c. One 2005 and one 2007 mortality in New York reported as having human interactions and one in VA in 2006.~~