RISSO'S DOLPHIN (*Grampus griseus*):
Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphins are distributed worldwide in tropical and temperate seas and in the northeast Atlantic occur from Florida to eastern Newfoundland (Leatherwood *et al.* 1976; Baird and Stacey 1990). Off the northeast U.S. coast, Risso's dolphins are distributed along the continental shelf edge from Cape Hatteras northward to Georges Bank during spring, summer, and autumn (CETAP 1982; Payne *et al.* 1984). In winter, the range is in the mid-Atlantic Bight and extends outward into oceanic waters (Payne *et al.* 1984). In general, the population occupies the mid-Atlantic continental shelf edge year round, and is rarely seen in the Gulf of Maine (Payne *et al.* 1984). During 1990, 1991 and 1993, spring/summer surveys conducted along the continental shelf edge and in deeper oceanic waters sighted Risso's dolphins associated with strong bathymetric features, Gulf Stream warm-core rings, and the Gulf Stream north wall (Waring *et al.* 1992; Waring 1993). There is no information on stock structure of Risso's dolphin in the western North Atlantic.

POPULATION SIZE

The total number of Risso's dolphins off the U.S. or Canadian Atlantic coasts is unknown, although ten estimates from selected regions of the habitat are available for select time periods. Sightings have been almost exclusively in continental shelf edge and continental slope areas (Figure 1). An abundance estimate of 4,980 Risso's dolphins (CV=0.34) was derived from an aerial survey program conducted from 1978 to 1982 in continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 11,017 (CV=0.58) Risso's dolphins was obtained from a June and July 1991 shipboard line transect sighting survey conducted primarily between the 200 and 2,000 m isobaths between Cape Hatteras and Georges Bank (Waring *et al.* 1992; Waring 1998). Abundance estimates of 6,496 (CV=0.74)

Figure 1. *Distribution of Risso's dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in 1998, 1999, and 2004. Isobaths are 100 m, 1,000 m, and 4,000m.*

and 16,818 (CV=0.52) Risso's dolphins were calculated from line transect aerial surveys conducted during August-September 1991 using Twin Otter and AT-11 aircraft, respectively (NMFS 1991). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations. Further, due to changes in survey methodology, these earlier estimates should not be compared to more current estimates.

An abundance estimate of 212 (CV=0.62) Risso's dolphins was obtained from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000m isobaths from the southern edge of Georges Bank, across the Northeast Channel, to the southeastern edge of the Scotian Shelf (NMFS 1993). Sightings data were collected by two alternating teams that searched with 25x150 binoculars and the data were analyzed using DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993). Estimates include school-size bias, if applicable, but do not include corrections for *g(0)* or dive-time. Variability was estimated using bootstrap resampling techniques.

An abundance estimate of 5,587 (CV=1.16) Risso's dolphins was derived from a July to September 1995 sighting survey conducted by two ships and an airplane that surveyed waters from Virginia to the mouth of the Gulf of St. Lawrence (NMFS unpublished data). Total track line length was 32,600 km. The ships covered waters between the 50 and 1000 fathom depth contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the mid-Atlantic from the coastline to the 50 fathom depth contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom depth contour line. Data collection and analysis methods used are described in Palka (1996).
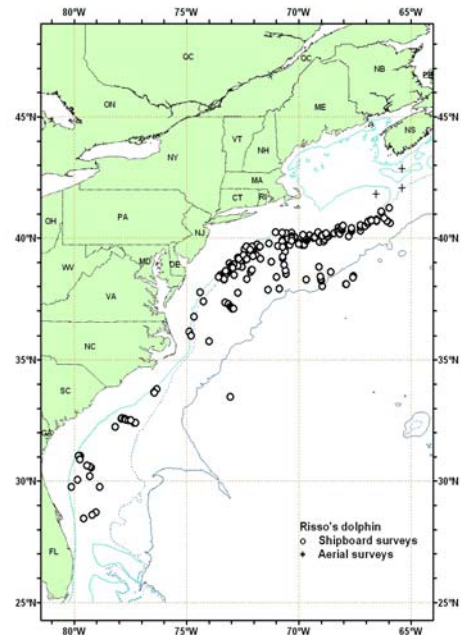
An abundance estmate of 18,631 (CV=0.35) Risso's dolphins was obtained from a line transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Table 1; NMFS unpublished data; Palka 2006). Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) which accounts for school size bias and $g(0)$, the probability of detecting a group on the track line. Aerial data were not corrected for $g(0)$.

An abundance estimate of 9,533 (CV=0.50) Risso's dolphins was obtained from a shipboard line transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Table 1; Mullin and Fulling 2003). Abundance was estimated using the program DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993) in which school size bias and ship attraction were accounted for.

The best 1998 abundance estimate for Risso's dolphins, 28,164 (CV=0.29), is the sum of the estimates from the two 1998 U.S. Atlantic surveys. This joint estimate (18,631+9,533=28,164 dolphins) is considered best because the two surveys together have the most complete coverage of the species' habitat.

An abundance estimate of 15,053 (CV=0.78) Risso's dolphins was obtained from a line transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761km of track line in waters north of Maryland (38ºN) to the Bay of Fundy (45ºN) (Table 1; Palka 2006). Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and $g(0)$, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for $g(0)$ and biases due to school size and other potential covariates (Palka 2005).

A survey of the U.S. Atlantic outer continental shelf and continental slope (water depths > 50m) between Florida and Maryland (27.5 and 38ºN latitude) was conducted during June-August 2004. The survey employed two independent visual teams searching with 50x bigeye binoculuars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf stream front in the Mid-Atlantic. The survey included 5,659 km of track line and accomplished a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina along the shelf break. Data were corrected for visibility bias ($g(0)$) and group-size bias and analyzed using line transect distance analysis (Palka, 1995; Buckland *et al.* 2001). The resulting abundance estimate for Risso's dolphins between Florida and Maryland was 5,426 animals (CV =0.54).

The best abundance estimate for Risso's dolphins is the sum of the estimates from the two 2004 U.S. Atlantic surveys. This joint estimate (15,053+5,426=20,479 dolphins) is considered best because these two surveys together have the most complete coverage of the species' habitat.

Table 1. Summary of abundance estimates for the western North Atlantic stock of Risso's dolphin. Month, year, and area covered during each abundance survey, resulting abundance estimate (N_{best}) and coefficient of variation (CV).			
Month/Year	**Area**	**N_{best}**	**CV**
Jul-Sep 1998	Maryland to Gulf of St. Lawrence	18,631	0.35
Jul-Aug 1998	Florida to Maryland	9,533	0.50
Jul-Sep 1998	Florida to Gulf of St. Lawrence (COMBINED)	28,164	0.29
Jun-Aug 2004	Maryland to Bay of Fundy	15,053	0.78
Jun-Aug 2004	Florida to Maryland	5,426	0.54
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	20,479	0.59

Minimum Population Estimate

The minimum population estimate is 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 Risso's dolphins is 20,479 (CV=0.59) obtained from the 2004 surveys. The minimum population estimate for the western North Atlantic Risso's dolphin is 12,920.

Current Population Trend

There are insufficient data to determine population trends for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of 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 12,920. The maximum productivity rate is 0.04, the default value for cetaceans (Barlow *et al.* 1995). The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.48 because the CV of the average mortality estimate is between 0.3 and 0.6 (Wade and Angliss 1997). PBR for the western North Atlantic stock of Risso's dolphin is 124.

ANNUAL HUMAN-CAUSED MORTALITY

Total annual estimated average fishery-related mortality or serious injury to this stock during 2000-2004 was 52 Risso's dolphins (CV= 0.34; Table 2).

Fishery Information

Detailed fishery information is reported in Appendix III.

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch in distant-water fleet (DWF) activities off the northeast coast of the U.S. With implementation of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) in that year, an observer program was established which recorded fishery data and information on incidental bycatch of marine mammals. DWF effort in the U.S. Atlantic Exclusive Economic Zone (EEZ) under MSFCMA has been directed primarily towards Atlantic mackerel and squid. From 1977 through 1982, an average of 120 different foreign vessels per year (range 102-161) operated within the US Atlantic EEZ. In 1982, there were 112 different foreign vessels; 16%, or 18, were Japanese tuna longline vessels operating along the USA east coast. This was the first year that the Northeast Regional Observer Program assumed responsibility for observer coverage of the longline vessels. Between 1983 and 1991, the numbers of foreign vessels operating within US Atlantic EEZ each year were 67, 52, 62, 33, 27, 26, 14, 13, and 9, respectively. Between 1983 and 1988, the numbers of DWF vessels included 3, 5, 7, 6, 8, and 8, respectively, Japanese longline vessels. Observer coverage on DWF vessels was 25-35% during 1977-82, and increased to 58%, 86%, 95%, and 98%, respectively, in 1983-86. From 1987-91, 100% observer coverage was maintained. Foreign fishing operations for squid and mackerel ceased at the end of the 1986 and 1991 fishing seasons, respectively. NMFS foreign-fishery observers have reported four deaths of Risso's dolphins incidental to squid and mackerel fishing activities in the continental shelf and continental slope waters between March 1977 and December 1991 (Waring *et al*. 1990; NMFS unpublished data). Three animals were taken by squid trawlers and a single animal was killed in longline fishing operations.

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and provides observer coverage of vessels fishing south of Cape Hatteras.

In the pelagic drift gillnet fishery fifty-one Risso's dolphin mortalities were observed between 1989 and 1998. One animal was entangled and released alive. Bycatch occurred during July, September and October along continental shelf edge canyons off the southern New England coast. Estimated annual mortality and serious injury (CV in parentheses) attributable to the drift gillnet fishery was 87 in 1989 (0.52), 144 in 1990 (0.46), 21 in 1991 (0.55), 31 in 1992 (0.27), 14 in 1993 (0.42), 1.5 in 1994 (0.16), 6 in 1995 (0), 0 in 1996, no fishery in 1997, 9 in 1998 (0).

In the pelagic pair trawl fishery one mortality was observed in 1992. Estimated annual fishery-related mortality (CV in parentheses) attributable to the pelagic pair trawl fishery was 0.6 dolphins in 1991 (1.0), 4.3 in 1992 (0.76), 3.2 in 1993 (1.0), 0 in 1994 and 3.7 in 1995 (0.45).

Pelagic Longline

Pelagic longline bycatch estimates of Risso's dolphins in 1998, 1999, and 2000 were obtained from Yeung (1999a), Yeung *et al.* (2000), and Yeung (2001), respectively. Bycatch estimates for 2001and 2002, 2003, and 2004 were obtained from Garrison (2003), Garrison and Richards (2003), and Garrison (2005). Most of the estimated marine mammal bycatch was from U.S. Atlantic EEZ waters between South Carolina and Cape Cod. Excluding the Gulf of Mexico, from 1992 to 2000 one mortality was observed in both 1994 and 2000, and 0 in other years. The observed numbers of seriously injured but released alive individuals from 1992 to 2000 were, respectively, 2, 0, 6, 4, 1, 0, 1, 1, and 1 (Cramer 1994; Scott and Brown 1997; Johnson *et al.* 1999; Yeung 1999a; Yeung *et al.* 2000; Yeung 2001) (Table 2). Estimated annual fishery-related mortality (CV in parentheses) was 17 animals in 1994 (1.0), 41 in 2000 (1.0), 24 in 2001(1.0), 20 in 2002 (0.86), and 0 in 2003 and 2004 (Table 2). Seriously injured and released alive animals were estimated to be 54 dolphins (0.7) in 1992, 0 in 1993, 120 (0.57) in 1994, 103 (0.68) in 1995, 99 (1.0) in 1996, 0 in 1997, 57 (1.0) in 1998, 22 (1.0) in 1999, 23 (1.0) in 2000, 45 (0.7) in 2001, 8 (1.0) in 2002, 40 (0.63) in 2003 and 28 in 2004 (Table 2).   The annual average combined mortality and serious injury for 2000-2004 is 46 Risso's dolphins (CV =0.37; Table2).

Northeast Sink Gillnet

Estimated annual mortalities (CV in parentheses) from this fishery are: 0 in 1999, 15 (1.06) in 2000, and 0 in 2001-2004 (Table 2). The 2000-2004 average mortality in this fishery is 3 Risso's dolphins (CV =1.06).

Table 2. Summary of the incidental mortality of Risso's dolphin (*Grampus griseus*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the observed mortalities and serious injuries recorded by on-board observers, the estimated annual mortality and serious injury, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the estimated CV of the combined estimates (Estimated CVs) and the mean of the combined estimates (CV in parentheses).

Fishery	Years	Vessels[c]	Data Type [a]	Observer Coverage	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Longline (excluding NED-E) [b,d]	00-04	116, 98, 87, 63, 58	Obs. Data Logbook	.04, .04, .05, .09, .09	1, 6, 4, 2, 2	1, 1, 0, 0, 0	23, 45, 8, 40, 28	41, 24, 20[e], 0, 0	64, 69, 28, 40, 28	1, .57, .67, .63, 72	46 (0.37)
Pelagic Longline - NED-E area only [d]	01-03	9, 14, 11	Obs. Data Logbook	1, 1, 1	4, 3, 0	0, 0, 1	4, 3, 0	0, 0, 1	4, 3, 1	0, 0, 0	3
Northeast Sink Gillnet	00-04	1993=349 1998=301	Obs. Data Weighout Trip Logbook	.06, .04, .02, .03, .06	0,0,0, 0,0	1, 0, 0, 0, 0	0, 0,0, 0,0	15, 0,0, 0,0	15, 0, 0, 0, 0,	1.06, 0, 0, 0, 0	3 (1.06)
TOTAL											52 (0.34)

[a] Observer data (Obs. Data) are used to measure bycatch rates and the data are collected within the Northeast Fisheries Observer Program. The Observer Program collects landings data (Weighout), and total landings are used as a measure of total effort for the coastal gillnet fishery.

[b] 2000 mortality estimates were taken from Yeung (2001), 2001and 2002 from Garrison (2003), 2003 from Garrison and Richards (2004) and 2004 from Garrison (2005).

[c] Number of vessels in the fishery are based on vessels reporting effort to the pelagic longline logbook.

[d] An experimental program to test effects of gear characteristics, environmental factors, and fishing practices on marine turtle bycatch rates in the Northeast Distant (NED-E) water component of the fishery was conducted from June 1, 2001-December 31, 2003. Observer coverage was 100% during this experimental fishery. Summaries are provided for the pelagic longline EXCLUDING the NED-E area in one row and for ONLY the NED in the second row (Garrison 2003; Garrison and Richards 2004).

[e] Note that the 2002 estimate of Risso's dolphin mortality is estimated from observed mortality rates in previous years (1998-2002) due to a gap in coverage during the 3rd quarter of 2002.

Other mortality

From 2000-2004, thirty-nine Risso's dolphin strandings were recorded along the U.S. Atlantic coast (NMFS unpublished data). In eastern Canada, one Risso's dolphin stranding was reported on Sable Island, Nova Scotia from 1970-1998 (Lucas and Hooker 2000).

Risso's dolphin	2000	2001	2002	2003	2004	TOTAL
Maine					2	**2**
New Hampshire						
Massachusetts		1[a]	5		4[b]	**10**
Rhode Island					1	**1**
Connecticut						
New York			1		3	**4**
New Jersey	1					**1**
Delaware					1	**1**
Maryland		1	1		1	**3**
Virginia		1			1	**2**
North Carolina		3	2	1	2	**8**
South Carolina						
Georgia						
Florida		1	1	1	3	**6**
EZ					1	**1**
TOTAL	1	7	10	2	19	**39**
a. Carcass showed signs of human interaction						
b. One animal was mutilated, fluke cut off						

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

STATUS OF STOCK

The status of Risso's dolphins relative to OSP in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total U.S. fishery mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, can not be considered to be insignificant and approaching a zero mortality and serious injury rate. The 2000-2004 average annual human-related mortality does not exceed PBR; therefore, this is not a strategic stock.

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