

COMMON DOLPHIN (*Delphinus delphis*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The common dolphin may be one of the most widely distributed species of cetaceans, as it is found world-wide in temperate, tropical, and subtropical seas. In the North Atlantic, common dolphins appears to be present along the coast over the continental shelf along the 200-300 m isobaths or over prominent underwater topography from 50° N to 40° S latitude (Evans 1994). The species is less common south of Cape Hatteras, although schools have been reported as far south as eastern Florida (Gaskin 1992). At least some of the reported sightings of common dolphins in the Gulf of Mexico may have been *Stenella clymene*, which has a color pattern similar to that of common dolphins (Evans 1994). Information regarding common dolphin stock structure in the western North Atlantic does not exist. However, a high variance in skull morphometric measurements suggests the existence of more than a single stock (J. G. Mead, pers. comm.).

Common dolphins are distributed in broad bands along the continental slope (100 to 2,000 meters), and are associated with other Gulf Stream features in waters off the northeastern U.S. coast (CETAP 1982; Selzer and Payne 1988; Waring *et al.* 1992). They are widespread from Cape Hatteras northeast to Georges Bank (35° to 42° North latitude) in outer continental shelf waters from mid-January to May (Hain *et al.* 1981; CETAP 1982; Payne *et al.* 1984). Common dolphins move northward onto Georges Bank and the Scotian Shelf from mid-summer to autumn. Selzer and Payne (1988) reported very large aggregations (greater than 3,000 animals) on Georges Bank in autumn. Common dolphins are rarely found in the Gulf of Maine, where temperature and salinity regimes are lower than on the continental slope of the Georges Bank/mid-Atlantic region (Selzer and Payne 1988). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs during summer and autumn when water temperatures exceed 11 °C (Sergeant *et al.* 1970; Gowans and Whitehead 1995).

POPULATION SIZE

The total number of common dolphins off the eastern U.S. and Canadian Atlantic coast is unknown, although four estimates are available from selected regions during June-July 1991, June-July 1993, and July-September 1995 (Table 1; Figure 1).

A population size of 29,610 (CV = 0.39) common dolphins was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (Table 1; CETAP 1982). R. Kenney (pers. comm.) provided abundance estimates that accounted for survey effort in two continental slope survey blocks and uncertainties resulting from sightings of unidentified small dolphins. The estimate is based on an inverse variance weighted pooling of spring and summer data. An average of these seasons were chosen because the greatest proportion of the population off the northeast U.S. coast appeared in the study area during these seasons. This estimate does not include a correction for dive-time or $g(0)$, the probability of detecting an

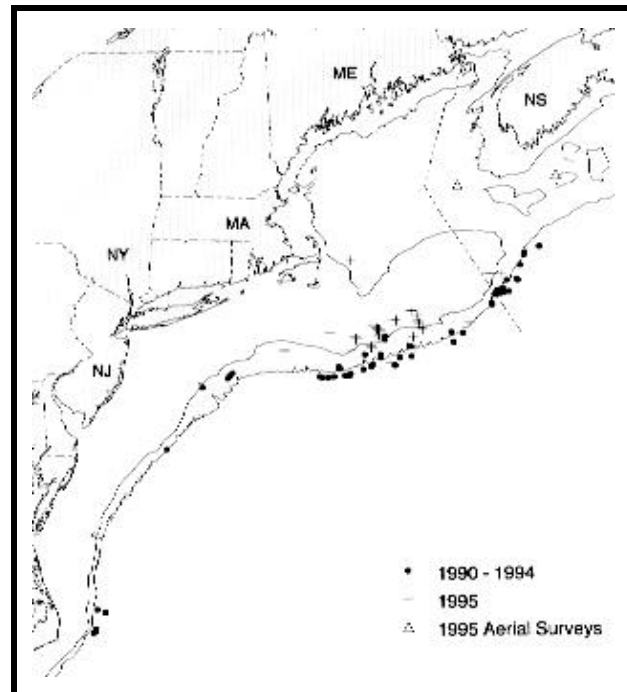


Figure 1. Distribution of common dolphin sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.

animal group on the track line. This estimate may not reflect the current true population size because of its high degree of uncertainty, its old age, and it was estimated just after cessation of extensive foreign fishing operations in the region.

A population size of 22,215 (CV=0.40) common dolphins was estimated from a June and July 1991 shipboard line transect sighting survey conducted primarily between the 200 and 2,000 m isobaths from Cape Hatteras to Georges Bank (Table 1; Waring *et al.* 1992; Waring 1998). Data were collected by one team that searched by naked eye and analyzed using DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993). Estimates include school size-bias, if applicable, but no corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 1,645 (CV=0.47) common dolphins was estimated from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (Table 1; Anon. 1993). Data were collected by two alternating teams that searched with 25x150 binoculars and 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.

A population size of 6,741 (CV=0.69) common dolphins was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; NMFS, unpublished data). Total track line length was 32,600 km (17,600 nmi). The ships covered waters between the 50 and 1000 fathom contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. However, the August 1995 ship survey on Georges Bank was greatly hindered by hurricane events. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom contour line. Shipboard data were collected using a two independent sighting team procedure and were analyzed using the product integral method (Palka 1995) and DISTANCE (Buckland *et al.* 1993). Shipboard estimates were corrected for g(0) and, if applicable, also for school size-bias. Standard aerial sighting procedures with two bubble windows and one belly window observer were used during the aerial survey. An estimate of g(0) was not made for the aerial portion of the survey. Estimates do not include corrections for dive-time. Variability was estimated using bootstrap resampling techniques.

Although the 1991, 1993, and 1995 surveys did not sample the same areas or encompass the entire common dolphin habitat (e. g., little effort in Scotian shelf edge waters), they did focus on segments of known or suspected high-use habitats off the northeastern U.S. coast. The 1991, 1993, and 1995 data suggest that, seasonally, at least several thousand common dolphins are occupying continental shelf edge waters, with perhaps highest abundance in the Georges Bank region. This is consistent with the earlier CETAP data from a decade previous. Survey coverage to date is not adequate to provide a definitive estimate of common dolphin abundance for the western North Atlantic.

The best available current abundance estimate for common dolphins is 22,215 (CV=0.40) as estimated from the June to July 1991 line transect survey because this survey provided the most complete coverage of the known habitat, particularly Georges Bank which was inadequately surveyed in 1995 (see above).

Table 1. Summary of abundance estimates for western North Atlantic common dolphin. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
spring & summer 1978-82	Cape Hatteras, NC to Nova Scotia	29,610	0.39
Jun-Jul 1991	Cape Hatteras, NC to Georges Bank, shelf edge only	22,215	0.40
Jun-Jul 1993	Georges Bank to Scotian shelf, shelf edge only	1,645	0.47
Jul-Sep 1995	Virginia to Gulf of St. Lawrence	6,741	0.69

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 common dolphins is 22,215 (CV=0.40). The minimum population estimate for the western North Atlantic common dolphin is 16,060 (CV=0.40).

Current Population Trend

There are insufficient data to determine the 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 16,060 (CV=0.40). The maximum productivity rate is 0.04, the default value for cetaceans. 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 0.5 because this stock is of unknown status. PBR for the western North Atlantic common dolphin is 161.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality to this stock during 1992-1996 was 247 common dolphins (CV = 0.14; Table 2).

Fishery Information

USA

Prior to 1977, there was no documentation of marine mammal by-catch in distant-water fleet (DWF) activities off the northeast coast of the U.S. With implementation of the Magnuson Fisheries Conservation and Management Act (MFCMA), an observer program was established which has recorded fishery data and information of incidental by-catch of marine mammals. DWF effort in the Atlantic coast Exclusive Economic Zone (EEZ) under MFCMA 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 Atlantic coast EEZ. In 1982, there were 112 different foreign vessels; 16%, or 18, were Japanese tuna longline vessels operating along the U.S. 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 the Atlantic coast 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.

During the period 1977-1986, observers recorded 123 mortalities in foreign *Loligo* squid-fishing activities (Waring *et al.* 1990). In 1985 and 1986, Italian vessels took 56 and 54 animals, respectively, which accounts for 89% (n = 110) of the total takes in foreign *Loligo* squid-fishing operations. No mortalities were reported in foreign *Illex* squid fishing operations. Because of spatial/temporal fishing restrictions, most of the by-catch occurred along the continental shelf edge (100 m) isobath during winter (December to February).

From 1977-1991, observers recorded 110 mortalities in foreign mackerel-fishing operations (Waring *et al.* 1990; NMFS unpublished data). This total includes one documented take by a U.S. vessel involved in joint-venture fishing operations in which U.S. captains transfer their catches to foreign processing vessels. The by-catch occurred during winter/spring (December to May).

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fishery information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling 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.

By-catch has been observed by NMFS Sea Samplers in the pelagic drift gillnet, pelagic pair trawl, mid-Atlantic coastal sink gillnet, North Atlantic bottom trawl, New England multispecies sink gillnet, and Atlantic squid, mackerel, butterfish trawl fisheries, but no mortalities or serious injuries have documented in pelagic longline fishery.

Pelagic Drift Gillnet

The estimated total number of hauls in the pelagic drift gillnet fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls in 1991, 1992, 1993, 1994, 1995, and 1996 were 233, 243, 232, 197, 164, and 149 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Since 1994, between 10-12 vessels have participated in the fishery (Table 2). Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, and 64% in 1996. Effort was concentrated along the southern edge of Georges Bank and off Cape Hatteras. Examination of the species composition of the catch and locations of the fishery throughout the year, suggested that the pelagic drift gillnet fishery be stratified into two strata, a southern or winter stratum, and a northern or summer stratum. Estimates of the total by-catch, from 1989 to 1993, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge 1996). Estimates of total annual by-catch for 1994 and 1995 were estimated from the sum of the observed caught and the product of the average bycatch per haul and the number of unobserved hauls as recorded in self-reported fishery information. Variances were estimated using bootstrap re-sampling techniques. Six hundred and six common dolphin mortalities were observed between 1989 and 1996 in this fishery. Mortalities were observed in all seasons and areas. Seven animals were released alive, but six were injured. Estimated annual mortality and serious injury attributable to this fishery (CV in parentheses) was 540 in 1989 (0.19), 893 in 1990 (0.18), 223 in 1991 (0.12), 227 in 1992 (0.09), 238 in 1993 (0.08), 163 in 1994 (0.02), 83 in 1995 (0), and 106 in 1996 (0.07); average annual estimated fishery-related mortality during 1992-1996 attributable to this fishery was 164 common dolphins (CV = 0.04) (Table 2). Injured and released alive animals are not included in the Table 2 mortality estimates. The 1992-1996 period provides a better characterization of this fishery (i.e., fewer vessels and increased observer coverage). Table 3 summarizes the number of animals released alive and classified as injured or non-injured. It also includes the ratio of observed to estimated mortalities for this fishery.

Pelagic Pair Trawl

During the period 1989 to 1993, effort in the pelagic pair trawl fishery increased from zero hauls in 1989 and 1990, to an estimated 171 hauls in 1991 and then to an estimated 536 hauls in 1992 and 586 in 1993, 407 in 1994 and 440 in 1995. This fishery ceased operations in 1996, when NMFS rejected a petition to consider pair trawl gear as an authorized gear type in Atlantic tunas fishery. The fishery operated from August to November in 1991, from June to November in 1992, from June to October in 1993 (Northridge 1996), and from mid-summer to December in 1994 & 1995. Sea sampling began in October of 1992 (Gerritor *et al.* 1994) where 48 sets (9% of the total) were sampled. In 1993, 102 hauls (17% of the total) were sampled. In 1994 and 1995, 52% (212) and 55% (238), respectively, of the sets were observed. Nineteen vessels have operated in this fishery. The fishery operates in the area between 35°N to 41°N and 69°W to 72°W. Approximately 50% of the total effort was within a one degree square at 39°N, 72°W, around Hudson Canyon from 1991 to 1993. Examination of the (1991-1993) locations and species composition of the by-catch, showed little seasonal change for the six months of operation and did not warrant any seasonal or areal stratification of this fishery. Twelve mortalities were observed between 1991 and 1995. The estimated annual fishery-related mortality and serious injury attributable to this fishery (CV in parentheses) was 5.6 in 1991 (0.53), 32 in 1992 (0.48), 35 in 1993 (0.43), 0 in 1994 (0), and 5.6 in 1995 (0.35). Average annual estimate fishery-related mortality attributable to this fishery during 1992-1993 was 18.2 common dolphins (CV = 0.30) (Table 2).

During the 1994 and 1995 experimental pelagic pair trawl fishing seasons, fishing gear experiments were conducted to collect data on environmental parameters, gear behavior, and gear handling practices to evaluate factors affecting catch and bycatch (Goudey 1995, 1996). Results of these studies have been presented at Offshore Cetacean Take Reduction Team Meetings.

New England Multispecies Sink Gillnet

In 1993, there were approximately 349 full and part-time vessels in the New England multispecies sink gillnet fishery, which covered the Gulf of Maine and southern New England (Table 2). An additional 187 vessels were reported to occasionally fish in the Gulf of Maine with gillnets for bait or personal use; however, these vessels were not covered by the observer program (Walden 1996) and their fishing effort was not used in estimating mortality. Observer coverage in terms of trips has been 1%, 6%, 7%, 5%, 7%, 5%, and 4% for 1990 to 1996, respectively. The fishery has been observed in the Gulf of Maine and in Southern New England. In 1996, the first observed mortality of common dolphins in this fishery was recorded. The estimated mortality was 63 common dolphins (CV = 1.39); estimated annual mortality (1992-1996) was 12.6 common dolphins (CV = 1.39) (Table 2). Annual estimates of common dolphin by-catch in the New England multispecies sink gillnet fishery reflect seasonal distribution of the species and of fishing effort.

Atlantic Coastal Gillnet

Observer coverage of the U.S. Atlantic coastal gillnet fishery was initiated by the NEFSC Sea Sampling program in July, 1993; and from July to December 1993, 20 trips were observed. During 1994 and 1995 221 and 382 trips were observed, respectively. This fishery, which extends from North Carolina to New York, is actually a combination of small vessel fisheries that target a variety of fish species, some of which operate right off the beach. The number of vessels in this fishery is unknown, because records which are held by both state and federal agencies have not been centralized and standardized. Observer coverage, expressed as percent of tons of fish landed, was 5% and 4% for 1995 and 1996 (Table 2).

No common dolphins were taken in observed trips during 1993 and 1994. Two common dolphins were observed taken in 1995 and 1996 (Table 2). Observed effort was concentrated off NJ and scattered between DE and NC from 1 to 50 miles off the beach. All by-catches were documented during January to April. Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 7.4 in 1995 (CV = 0.69) and 43 in 1996 (0.79). Average annual estimated fishery-related mortality attributable to this fishery during 1995-1996 was 25 common dolphins (CV = 0.68)

North Atlantic Bottom Trawl

Vessels in the North Atlantic bottom trawl fishery, a Category III fishery under MMPA, were observed in order to meet fishery management needs, rather than marine mammal management needs. An average of 970 vessels (full and part time) participated annually in the fishery during 1991-1995. The fishery is active in all seasons in New England waters. Three mortalities were observed between 1991-1995. The estimated annual fishery-related mortality and serious injury attributable to this fishery (CV in parentheses) was 0 in 1991, 0 in 1992, 0 in 1993, 0 in 1994 (0), and 142 in 1995 (0.77). Average annual estimated fishery-related mortality attributable to this fishery during 1992-1996 was 28.4 common dolphins (CV = 0.77) (Table 2).

Atlantic Squid, Mackerel, Butterfish Trawl

The mid-Atlantic mackerel and squid trawl fisheries were combined into the Atlantic mid-water trawl fishery in the revised proposed list of fisheries in 1995. The fishery occurs along the U.S. mid-Atlantic continental shelf region between New Brunswick, Canada, and Cape Hatteras year around. The mackerel trawl fishery was classified as a Category II fishery since 1990 and the squid fishery was originally classified as a Category II fishery in 1990, but was reclassified as a Category III fishery in 1992. The combined fishery was reclassified as a Category II fishery in 1995. In 1996, mackerel, squid, and butterfish trawl fisheries were combined into the Atlantic squid, mackerel, and butterfish trawl fishery, and maintained a Category II classification. Three common dolphin mortalities were observed in 1996 (Table 2). The estimate of the annual mortality is underway.

Estimated average annual mortality and serious injury during 1992-1996 for all of the NMFS-observed fisheries is 247 common dolphins per year (CV = 0.14) (Table 2).

CANADA

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 one common dolphin. The incidental mortality rate for common dolphins was (0.007/set).

Table 2. Summary of the incidental mortality of common dolphins (*Delphinus delphis*) 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 mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type ¹	Observer Coverage ²	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Drift Gillnet	92-96	1994=11 1995=12 1996=10 ³	Obs. Data Logbook	.40, .42, .87, .99, .64	97, 113, 142, 82, 74	223, 227, 238, 163, 83 ⁴ ,106	.12, .09, .08, .02, 0, .07	163.6 (.04)
Pelagic Pair Trawl	92-95	12	Obs. Data Logbook	.10, .18, .52, .54	3, 6, 0, 3	32, 35, 0, 5.6	.48, .43, 0, .35	18.2 (.30)
New England Multispecies Sink Gillnet	92-96	349	Obs. Data Weighout, Logbooks	.07, .05, .07, .05, .04	0, 0, 0, 0, 1	0, 0, 0, 0, 63	0, 0, 0, 0, 1.39	12.6 (1.39)
Mid-Atlantic Coastal Sink Gillnet	95-96	NA ⁷	Obs. Data Weighout	.05, .04	2, 2	7.4, 43	.69, .79	25.0 (.68)
Atlantic squid, mackerel, butterfish trawl	96	NA ⁷	Obs. Data Logbook	0.007	3	NA ⁷	NA ⁷	NA ⁷
North Atlantic Bottom Trawl	92-96	970	Obs. Data Weighout	.006, .004, .004, .011 ⁵ , NA ⁷	0, 0, 0, 3, 0	0, 0, 0, 142, 0	0, 0, 0, .77, 0	28.4 (.77)
TOTAL								247 (.14)

¹ Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. NEFSC collects weighout (Weighout) landings data, and total landings are used as a measure of total effort for the coastal gillnet fishery and days fished are used as total effort for the North Atlantic bottom trawl fishery. Mandatory logbook (Logbook) data are used to measure total effort for the pelagic drift gillnet fishery, and these data are collected at the Southeast Fisheries Science Center (SEFSC).

² The observer coverage for the pelagic drift gillnet and pair trawl fishery is measured in terms of sets, and the North Atlantic bottom trawl fishery is in days fished. Assessments for the coastal gillnet fishery have not been completed. The number of trips sampled by the NEFSC Sea Sampling Program are reported here.

³ 1994 - 1996 shown, other years not available on an annual basis.

⁴ One vessel was not observed and recorded 1 set in a 10 day trip in the SEFSC mandatory logbook. If you assume the vessel fished 1.4 sets per day as estimated from the 1995 SS data, the point estimate may increase by 7.0 animals. However, the SEFSC mandatory logbook data was taken at face value, and therefore it was assumed that 1 set was fished within this trip, and the point estimate would then increase by 0.50 animals.

⁵ Observer coverage for the North Atlantic bottom trawl fishery in 1995 is based on January to May data.

⁶ Injured and released alive animals are not included in the Table 2 mortality estimates.

⁷ Data not available.

Table 3. Summary of common dolphins (*Delphinus delphis*) released alive, by commercial fishery, years sampled (Years), ratio of observed mortalities recorded by on-board observers to the estimated mortality (Ratio), the number of observed animals released alive and injured (Injured), and the number of observed animals released alive and uninjured (Uninjured)

Fishery	Years	Ratio	Injured ⁵	Uninjured
Pelagic Drift Gillnet	92-96	97/227, 113/238, 142/163, 82/83, 74/106	1 ¹ , 3 ² , 1 ³ , 0, 3 ⁴	1, 0, 0, 0, 0

¹ Released alive and severely injured.

² Released alive, 2 were moderately injured and 1 common dolphin was severely injured.

³ Released alive and gear was “in/around several body parts”.

⁴ Released alive, one animal “seemed tired,” but had few wounds, little bleeding from fluke. Both animals were smaller as compared to other common dolphins taken in the same set.

⁵ Injured and released alive animals are not included in the Table 2 mortality estimates.

Other Mortality

From 1992-1996, 42 common dolphins were stranded between North Carolina and Massachusetts, predominantly along beaches in the latter state (NMFS unpublished data).

STATUS OF STOCK

The status of common 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 fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This is a strategic stock because average annual fishery-related mortality and serious injury exceeds PBR.

REFERENCES

- Anon. 1993. Cruise results, NOAA ship DELAWARE II, Cruise No. DEL 93-06, Marine mammal Survey. NOAA NMFS NEFSC, Woods Hole Laboratory, Woods Hole, MA. 5 pp.
- Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background, and a Summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.
- Buckland, S. T., D. R. Andersen, K. P. Burnham, and J. L. Laake. 1993. Distance Sampling: Estimating abundance of biological populations. *Chapman and Hall*, New York, 446 pp.
- CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report, Contract AA51-C78-48, Bureau of Land Management, Washington, DC, 538 pp.
- Evans, W. E. 1994. Common dolphin, white-bellied porpoise. Pages 191-224. *In*: S. H. Ridgway and R. Harrison (eds.). Handbook of marine mammals, Volume 5: The first book of dolphins. *Academic Press*, San Diego
- Gaskin, D. E. 1992. Status of common dolphin, *Delphinus delphis*, in Canada. *Can. Fld. Nat.* 106: 55-63.
- Gerrior, P., A.S. Williams, and D.J. Christensen. 1994. Observations of the 1992 U.S. pelagic pair trawl fishery in the Northwest Atlantic. *Mar. Fish. Rev.* 56(3): 24-27.
- Goudy, C.A. 1995. The 1994 experimental pair trawl fishery for tuna in the northwest Atlantic, MITSG 95-6, Cambridge, MA. 10 pp.
- Goudy, C.A. 1996. The 1995 experimental pair trawl fishery for tuna in the northwest Atlantic, MITSG 96-17, Cambridge, MA. 13 pp.
- Gowans S. and H. Whitehead. 1995. Distribution and habitat partitioning by small odontocetes in the Gully, a submarine canyon on the Scotian Shelf. *Can. J. Zool.* 73: 1599-1608.
- Hain, J. H.W., R. K. Edel, H. E. Hays, S. K. Katona, and J. D. Roanowicz. 1981. General distribution of cetaceans in the continental shelf waters of the northeastern U.S. Pages II1-II277 *in* CETAP (Cetacean and Turtle Assessment program), A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer

- continental shelf, Annual Report for 1979. Contract No. AA551-CT8-48, U.S. Dept. of Interior, Bureau of Land Management, Washington, DC.
- Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. 1993. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.
- Leatherwood, S., D. K. Caldwell, and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. U.S. Dept. of Commerce, NOAA Tech. Rep. NMFS Circ. 396, 176 pp.
- Lens, S. 1997. Interactions between marine mammals and deep water trawlers in the NAFO regulatory area. *ICES CM 1997/Q:8*. 10 pp.
- Northridge, S. 1996. Estimation of cetacean mortality in the U.S. Atlantic swordfish and tuna drift gillnet and pair trawl fisheries. Final report to the Northeast Fisheries Science Center, Contract No. 40ENNF500045, 18 pp.
- Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Pp. 27-50. *In*: A. Bjørge and G.P. Donovan (eds.). *Biology of the Phocoenids. Rep. int. Whal. Commn. Special Issue 16*.
- Payne, P. M., L. A. Selzer, and A. R. Knowlton. 1984. Distribution and density of cetaceans, marine turtles, and seabirds in the shelf waters of the northeastern United States, June 1980-December 1983, based on shipboard observations. NOAA/NMFS Contract No. NA-81-FA-C-00023.
- Read, A. J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. *Rep. int. Whal. Commn. Special Issue 15: 133-147*.
- Reilly, S. B. and J. Barlow. 1986. Rates of increase in dolphin population size. *Fish. Bull., U.S.* 84(3): 527-533.
- Selzer, L. A. and P. M. Payne. 1988. The distribution of white-sided (*Lagenorhynchus acutus*) and common dolphins (*Delphinus delphis*) vs. environmental features of the continental shelf of the northeastern United States. *Mar. Mamm. Sci.* 4(2): 141-153.
- Sergeant, D. E., A. W. Mansfield and B. Beck. 1970. Inshore records of cetacea for eastern Canada, 1949-68. *J. Fish. Res. Bd. Can.* 27: 1903-1915.
- Wade, P.R., and R.P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp.
- Waring, G.T. 1998. Results of the summer 1991 R/V Chapman marine mammal sighting survey. NOAA NMFS NEFSC, Lab. Ref. Doc. No. 98-09, 21pp. Northeast Fisheries Science Center, Woods Hole, Massachusetts.
- Waring, G. T., P. Gerrior, P. M. Payne, B. L. Parry and J. R. Nicolas. 1990. Incidental take of marine mammals in foreign fishery activities off the northeast United States, 1977-1988. *Fish. Bull., U.S.* 88(2): 347-360.
- Waring, G. T., C. P. Fairfield, C. M. Ruhsam and M. Sano. 1992. Cetaceans associated with Gulf Stream features off the northeastern USA shelf. *ICES Marine Mammals Comm. CM 1992/N: 12, 29 pp.*