Marine Mammals of the Atlantic Region and the Gulf of Mexico

Unit 24

STEVE SWARTZ

NMFS Southeast Fisheries Science Center

Miami
Florida

DEBRA L. PALKA

GORDON T. WARING

PHIL J. CLAPHAM

NMFS Northeast Fisheries Science Center

Woods Hole
Massachusetts

INTRODUCTION

The Atlantic region has at least 91 stocks of 39 species of marine mammals. The U.S. Fish and Wildlife Service has management authority for two stocks of the endangered West Indian manatee (Florida and Antillean), and the National Marine Fisheries Service (NMFS) has responsibility for management of the remaining cetacean and pinniped stocks.

According to criteria provided by the 1994 Amendments to the Marine Mammal Protection Act (MMPA) there are 23 strategic stocks (Table 24-1). In the western North Atlantic, the strategic stocks include 6 stocks of endangered whales (right, humpback, fin, sei, blue, and sperm whales); the coastal bottlenose dolphin which is depleted under the MMPA; and stocks where estimated mortality exceeds their Potential for Biological Removal (PBR) (dwarf sperm whale, pygmy sperm whale, killer whale, Cuvier's beaked whale, mesoplodont beaked whale, short-finned pilot whale, common dolphin, Atlantic spotted dolphin, pantropical spotted dolphin, and the Gulf of Maine/Bay of Fundy harbor porpoise).

In the northern Gulf of Mexico, strategic stocks include the endangered sperm whale, bottlenose dolphin in coastal bays, sounds and estuaries, dwarf and pygmy sperm whales, and the Florida and Antillean stocks of endangered West Indian manatees.

Recent assessments indicate that there is an increasing trend in the four seal stocks; the coastal bottlenose dolphin stock is believed to be stable; West Indian manatees are believed to be declining; and the trends for the remaining 84 stocks are unknown.

BOTTLENOSE DOLPHIN: GULF BAY, SOUND, AND ESTUARINE STOCKS

Stock Definition and Geographic Range

There are now 33 recognized provisional stocks that occupy the bays, sounds, and estuaries along the U.S. Gulf of Mexico. Seaward of these are recognized an additional three coastal-to-shelf edge and three offshore provisional stocks. Studies relying on identification of individual dolphins suggest that bottlenose dolphins inhabiting many of the bays, sounds, and other estuaries form discrete communities. Although breeding may occur between adjacent communities, the geographic nature of these areas suggests that each community exists as a functioning unit of its ecosystem and, under the MMPA, must be maintained as such. Therefore, each of the areas forming a contiguous enclosed or semi-enclosed body of water is provisionally considered to contain a distinct bottlenose dolphin stock or management unit, but the number of these will likely change as new information on the biological uniqueness and degree of mixing among these communities is obtained. Although this is believed to be a risk averse ap-

Table 24-1

Status of marine mammal stocks in the Atlantic region and Gulf of Mexico.

Species	Stock area	Minimum population estimate (N_{min})[1]	Potential biological removal level (PBR)[2]	Annual human-caused mortality[3]	Strategic status[4]	ESA/ MMPA status[5]	Trend[6]
Harbor seal	Western North Atlantic	30,990	1,859	898	N		I
Gray seal	Northwest North Atlantic	2,010	121	41	N		I
Harp seal	Northwest North Atlantic	N/A	N/A	329	N		I
Hooded seal	Northwest North Atlantic	N/A	N/A	5.6	N		I
Harbor porpoise	Gulf of Maine/ Bay of Fundy	48,289	483	1,667	Y		U
Risso's dolphin	Western North Atlantic	11,140	111	18	N		U
Atlantic white-sided dolphin	Western North Atlantic	19,196	192	218	Y		U
White-beaked dolphin	Western North Atlantic	N/A	N/A	0	N		U
Common dolphin	Western North Atlantic	15,470	155	247	Y		U
Atlantic spotted dolphin	Western North Atlantic	1,617	16	16	Y		U
Pantropical spotted dolphin	Western North Atlantic	1,617	16	16	Y		U
Striped dolphin	Western North Atlantic	18,220	182	11	N		U
Spinner dolphin	Western North Atlantic	N/A	N/A	0.31	N		U
Bottlenose dolphin	Western North Atlantic, offshore	8,794	88	58	N		U
Bottlenose dolphin	Western North Atlantic, coastal	2,482	25	29	Y	D	S
Dwarf sperm whale	Western North Atlantic	N/A	N/A	0.2	Y		U
Pygmy sperm whale	Western North Atlantic	N/A	N/A	N/A	N		U
Killer whale	Western North Atlantic	N/A	N/A	0	N		U
Pygmy killer whale	Western North Atlantic	6	0.1	0	N		U
Northern bottlenose whale	Western North Atlantic	N/A	N/A	0	N		U
Cuvier's beaked whale	Western North Atlantic	895	8.9	9.7	Y		U
Mesoplodont beaked whale	Western North Atlantic	895	8.9	9.7	Y		U
Pilot whale, long-finned	Western North Atlantic	4,968	50	32	N		U
Pilot whale, short-finned	Western North Atlantic	457	4.6	32	Y		U
Sperm whale	Western North Atlantic	1,617	3.2	0	Y	E	U
North Atlantic right whale	Western North Atlantic	295	0.4	2.3	Y	E	U
Humpback whale	Western North Atlantic	10,019	32.6	5.7	Y	E	U
Fin whale	Western North Atlantic	1,704	3.4	0.5	Y	E	U
Sei whale	Western North Atlantic	N/A	N/A	N/A	Y	E	U
Minke whale	Canadian east coast	2,145	21	0.8	N		U
Blue whale	Western North Atlantic	N/A	N/A	N/A	Y	E	U
Bottlenose dolphin	Gulf of Mexico, outer continental shelf	43,233	432	2.8	Y		U
Bottlenose dolphin	Gulf of Mexico, continental shelf edge and slope	4,530	45	2.8	Y		U
Bottlenose dolphin	Western Gulf of Mexico coastal	2,938	29	13	Y		U
Bottlenose dolphin	Northern Gulf of Mexico coastal	3,518	35	10	Y		U
Bottlenose dolphin	Eastern Gulf of Mexico coastal	8,963	90	8	Y		U
Bottlenose dolphin	Gulf of Mexico bay, sound, and estuarine[7]	3,933	39.7	30	Y		U
Atlantic spotted dolphin	Northern Gulf of Mexico	2,255	23	1.5	N		U
Pantropical spotted dolphin	Northern Gulf of Mexico	26,510	265	1.5	N		U
Striped dolphin	Northern Gulf of Mexico	3,409	34	0	N		U
Spinner dolphin	Northern Gulf of Mexico	4,465	45	0	N		U
Rough-toothed dolphin	Northern Gulf of Mexico	660	6.6	0	N		U

proach to management, the small size of many of these populations often results in estimates of sustainable removal levels (i.e. potential biological removal (PBR)) of less than one individual, and this becomes problematic. To this end, a major research objective is to develop biologically based criteria to better define and manage this species in the Gulf of Mexico.

The continuous distribution of bottlenose dolphins around the Gulf coast theoretically allows genetic exchange between adjacent communities. However, long-term mark-recapture studies using photo-identification of individual dolphins in the vicinity of Sarasota and Tampa Bays in Florida demonstrate that individual dolphins remain in a given area year-round. Three distinct dolphin communities have been described in and around Sarasota Bay. One community was formed by dolphins residing in the Gulf of Mexico coastal waters, another consisted of the dolphins in the deepwater areas of Passage Key Inlet and Tampa Bay (adjacent to Sarasota Bay), and a third community resided in the shallow waters of Sarasota Bay.

Females of the highly structured Sarasota dolphin community form a stable, discrete, long-term breeding unit with strong geographical fidelity. Electrophoretic isozyme analysis showed significant differences between dolphins of the shallow-water Sarasota community and the Tampa Bay community, and from dolphins from Charlotte Harbor, to the south; however, there was a high degree of genetic heterozygosity indicating that the Sarasota community, while socially and geographically distinct, is not genetically isolated. It has been suggested that the Sarasota community is likely one of a number of communities which comprise an extended population, the limits of which are unknown.

Table 24-1
Continued from previous page.

Species	Stock area	Minimum population estimate (N_{min})[1]	Potential biological removal level (PBR)[2]	Annual human-caused mortality[3]	Strategic status[4]	ESA/ MMPA status[5]	Trend[6]
Clymene dolphin	Northern Gulf of Mexico	4,120	41	0	N		U
Fraser's dolphin	Northern Gulf of Mexico	66	0.7	0	N		U
Killer whale	Northern Gulf of Mexico	197	2	0	N		U
False killer whale	Northern Gulf of Mexico	236	2.4	0	N		U
Pygmy killer whale	Northern Gulf of Mexico	285	2.8	0	N		U
Dwarf sperm whale	Northern Gulf of Mexico	N/A	N/A	N/A	Y		U
Pygmy sperm whale	Northern Gulf of Mexico	N/A	N/A	N/A	Y		U
Melon-headed whale	Northern Gulf of Mexico	2,888	29	0	N		U
Risso's dolphin	Northern Gulf of Mexico	2,199	22	19	N		U
Cuvier's beaked whale	Northern Gulf of Mexico	20	0.2	0	N		U
Blainville's beaked whale	Northern Gulf of Mexico	N/A	N/A	0	N		U
Gervais' beaked whale	Northern Gulf of Mexico	N/A	N/A	0	N		U
Pilot whale, short-finned	Northern Gulf of Mexico	186	1.9	0.3	Y[8]		U
Sperm whale	Northern Gulf of Mexico	411	0.8	0	Y	E	U
Bryde's whale	Northern Gulf of Mexico	17	0.2	0	N		U
Manatee[9]	Florida				Y	E	D
Manatee[9]	Antillean				Y	E	D

[1]N_{min} is a conservative estimate of abundance used to estimate PBR and provides reasonable assurance that the stock size is equal to or greater than the estimate.
[2]PBR (potential biological removal) is the maximum number of animals, not including natural mortalities, that may be removed from a stock while allowing that stock to reach or stay at its optimum sustainable population level (50–100% of its carrying capacity).
[3]Annual human-caused mortality is an estimate of the total number of annual mortalities and serious injuries (likely to result in death) caused by humans.
[4]Strategic status: Y = yes, N = no.
[5]E = listed as endangered, and T = listed as threatened under the Endangered Species Act. D = listed as depleted under the Marine Mammal Protection Act.
[6]Trend is increasing (I), stable (S), decreasing (D), or unknown (U).
[7]Represents at least 33 individually recognized stocks of bottlenose dolphin in U.S. Gulf of Mexico bays, sounds, and other estuaries.
[8]The total level of estimated fishery-related mortality and serious injury is unknown, but because there is a record of a fishery-related mortality or serious injury and because of the extremely low estimated stock size, this is a strategic stock.
[9]This species is under the jurisdiction of the U.S. Fish and Wildlife Service, and is not included in the stock-status tables of the National Overview.

Photo-identification and radio-tracking studies confirmed that some individual dolphins remain in the same general areas within Matagorda Bay, Texas, throughout the year (Lynn, 1995); thus, the situation there may be similar to that of the Florida west coast. Movement of resident bottlenose dolphins in Texas through passes linking bays with the Gulf of Mexico appears to be relatively limited, but does occur and suggests that these communities, like those along the Florida west coast, may not be reproductively isolated from the coastal populations. For example, two bottlenose dolphins previously seen in the South Padre Island, Texas, coastal area were seen in Matagorda Bay, 285 kilometer north, in May 1992 and May 1993. Preliminary analyses of mitochondrial DNA using polymerase chain reaction procedures suggested that Matagorda Bay dolphins appear to be a localized population, despite the suggestion of mixing of some individuals over large distances (NMFS, unpublished data[1]). Over 1,000 individual bottlenose dolphins have been identified in bay and coastal waters near the northeast end of Galveston Island, Texas, but most of these were sighted only once with only 200 individuals reported to use the area over the long term, suggesting that a significant number of dolphins are not resident in this area.

Much less is known about the movements of resident bottlenose dolphins in estuaries of the northern Gulf of Mexico. Seasonal differences in bottlenose dolphin abundance in Mississippi Sound suggest seasonal migration; however, these migration patterns are yet to be fully described. It is probable that some exchange occurs between the Mississippi Sound communities and the coastal dolphins in this area as well.

Population Size

Population size for all of the provisional stocks except Sarasota Bay, Florida, was estimated from preliminary analyses of line-transect data collected during aerial surveys conducted in September-October 1992 in Texas and Louisiana, in September-October 1993 in Louisiana, Mississippi, Alabama, and the Florida panhandle, and aerial surveys of the west coast of Florida in September-November. Population estimates for the Sarasota Bay, Florida, community were obtained through direct count of known individuals. Minimum population estimates were calculated from the estimates of population size and their associated coefficients of variation (Table 24-1). Where the population size resulted from a direct count of known individuals, the minimum population size was identical to the estimated population size.

Current Population Trend

Population data are insufficient to determine trends for the provisional stocks of bottlenose dolphin that inhabit the bays, sounds, and estuaries in the Gulf of Mexico. However, three anomalous mortality events occurred among portions of these communities between 1990 and 1994. While these events may have resulted in declines in some locations, it is not possible to accurately partition the mortalities between the bay, sound, and estuary communities and adjacent coastal dolphin communities. Thus, the effect of these mortality events on the growth of these populations cannot be determined at this time. Ongoing monitoring will be required to establish more accurate populations estimates and, over time, trends in abundance for these dolphin communities.

Status of Stock

In the absence of information on population trends and unknown status for Gulf bay, sound, and estuary bottlenose dolphin communities, PBR's are calculated using a recovery factor of 0.50. The estimates for each provisional stock are given in Table 24-1.

Although these provisional stocks are not listed as threatened or endangered, the occurrence of the three anomalous mortality events within their communities is cause for concern. While the specific factors that presumably caused and or contributed to these mortality events has yet to been determined, evidence suggests that bottlenose dolphins in the northern and western coastal portion of the U.S. Gulf of Mexico may have experienced

[1]National Marine Fisheries Service, Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543

a morbillivirus epidemic in 1993 (Lipscomb, 1994). Seven of 35 live-captured bottlenose dolphins (20%) from Matagorda Bay, Texas, in 1992, tested positive for previous exposure and it is possible that other estuarine resident dolphin communities have been exposed as well. The relatively high number of bottlenose dolphin deaths which occurred during these mortality events suggests that these populations may be physiologically stressed, possibly from nearshore pollution and chemical contamination or other causes. For these reasons, and because the PBR for most of these relatively small provisional stocks would be exceeded with the incidental capture of a single dolphin, each is recognized as a strategic stock.

HARBOR PORPOISE: GULF OF MAINE-BAY OF FUNDY STOCK

Stock Definition and Geographic Range

This harbor porpoise stock is found in U.S. and Canadian Atlantic waters. During the summer (July to September), harbor porpoises are concentrated in the northern Gulf of Maine-southern Bay of Fundy region, generally in waters less than 150 meters (m) deep (Palka et al., 1996). During fall (October to December) and spring (April to June), harbor porpoises are widely dispersed from North Carolina to Maine, though in much lower densities than that seen during the summer. No specific migratory routes to the northern Gulf of Maine-lower Bay of Fundy region have been documented. Animals are seen from the coastline to the middle of the Gulf of Maine (>200 m deep) in both spring and fall. During winter (December to March), some harbor porpoises have been reported in waters off the Mid-Atlantic (from New Jersey to North Carolina). Two stranding records from Florida occurred during the 1980's.

Gaskin (1984, 1992) proposed that there were four separate populations in the western North Atlantic: the Gulf of Maine-Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland populations. Recent analyses involving mitochondrial DNA (Wang et al., 1996), organochlorine contaminants (Westgate et al., 1997), heavy metals (Johnston, 1995), and life history parameters (Read and Horn, 1995) support Gaskin's proposal. In particular, there is a suggestion that the Gulf of Maine-Bay of Fundy females are different than Gulf of St. Lawrence females, but males were statistically indistinguishable (Palka et al., 1996). Research on microsatellites, a potentially powerful genetic tool, is currently being conducted to reanalyze existing genetic data and analyze new samples in order to resolve the larger scale stock structure question.

Population Size

Line-transect surveys were conducted during 1991, 1992, and 1995 to estimate the population size of harbor porpoises aggregated in the Gulf of Maine-Bay of Fundy region during the summer. The next scheduled survey is in the summer of 1999. The abundance estimated from the 1991 survey was 37,500 (CV[2] = 0.29, 95% CI = 26,700–86,400) (Palka, 1995a), 67,500 from the 1992 survey (CV = 0.23, 95% CI = 32,900–104,600) (Smith et al., 1993) and 74,000 harbor porpoises from the 1995 survey (CV = 0.20, 95% CI = 40,900–109,100) (Palka, 1996). The inverse variance weighted-average abundance estimate from all three surveys (Smith et al., 1993) was 54,300 harbor porpoises (CV = 0.14, 95% CI = 41,300–71,400). Possible reasons for inter-annual differences in abundance and distribution include experimental error and inter-annual changes in water temperature and availability of primary prey species (Palka, 1995b). The minimum population estimate calculated for this population is 48,289 (CV = 0.14).

Current Population Trend

Data are not sufficient to determine the population trends for this species. Previous abundance

[2]Coefficient of variation (CV) is a statistical measure used to calculate confidence intervals (CI), which gauge the accuracy of population estimates. An accurate population estimate is characterized by a low CV and a narrow CI. CI is often given a percentage likelihood of being correct (e.g. 95% means that if the data were resampled and the CI were recalculated 100 times, then 95 times it would contain the true value.

estimates for harbor porpoises in the Gulf of Maine-Bay of Fundy are available from earlier studies (e.g. 4,000 animals (Gaskin, 1977) and 15,800 animals (Kraus et al., 1983)). These estimates cannot be used in a trends analysis because they were from selected small regions within the entire known summer range and, in some cases, do not incorporate an estimate for the probability that an animal on the transect track line will be missed (NEFSC, 1992).

Status of the Stock

The National Marine Fisheries Service has proposed listing the Gulf of Maine-Bay of Fundy harbor porpoise as threatened under the Endangered Species Act (NMFS, 1993). The Gulf of Maine-Bay of Fundy harbor porpoise stock has also been classified as strategic because total U.S. annual fishery-related mortality and serious injury (1,667) exceeds PBR (483) (Waring et al., 1997). The estimated annual mortalities from the New England multispecies sink gillnet fishery from 1990 to 1996 are 2,900 (CV = 0.32), 2000 (CV = 0.35), 1,200 (CV = 0.21), 1,400 (CV = 0.18), 2,100 (CV = 0.18), 1,400 (CV = 0.27), and 1,200 (CV = 0.25) respectively (Bravington and Bisack, 1995; Bisack, 1997a). The annual estimated mortalities from the pelagic drift gillnet fishery from 1991 to 1996 are 0.7 (CV = 1.0), 0.4 (CV = 1.0), 1.5 (CV = 0.34), 0, 0, and 0, respectively (Bisack, 1997b). The annual estimated mortalities from the Mid-Atlantic coastal sink gillnet fisheries for 1995 and 1996 are 103 (CV = 0.57) and 311 (CV = 0.31) (Waring et al, 1999). In addition, harbor porpoise bycatch in Canadian gillnets in the Bay of Fundy from 1994 to 1997 were 101 (95% CI = 80–122), 87, 20, and 43 respectively (Trippel et al., 1996).

To address bycatch of harbor porpoises two take reduction teams have been formed to design a plan to reduce bycatch. The first team met in 1996 to address bycatch in the New England multispecies sink gillnet fishery. The second team met in 1997 to address bycatch in the Mid-Atlantic coastal gillnet fisheries.

HARBOR SEAL: WESTERN NORTH ATLANTIC STOCK

Stock Definition and Geographic Range

In the western North Atlantic, harbor seals are common from Labrador to southern New England and New York, and occasionally to the Carolinas (Boulva and McLaren, 1979; Katona et al., 1993; Gilbert and Guldager, 1998). Although the stock structure is unknown, the northwest Atlantic subspecies, *Phoca vitulina concolor*, is believed to represent one breeding population. Breeding and pupping normally occurs in waters north of the New Hampshire-Maine border, although breeding occurred as far south as Cape Cod in the early part of the twentieth century (Temte et al., 1991; Katona et al., 1993).

Harbor seals are year-round inhabitants of the coastal waters of eastern Canada and Maine (Katona et al., 1993), and seasonally along the southern New England and New York coasts from September through late May (Schneider and Payne, 1983). A general southward movement from the Bay of Fundy to southern New England waters occurs in autumn and early winter (Rosenfeld et al., 1988; Whitman and Payne, 1990). A northward movement from southern New England to Maine and eastern Canada occurs prior to the pupping season, which takes place from mid-May through June along the Maine Coast (Richardson, 1976; Kenney, 1994). The overall geographic range throughout U.S. Atlantic coast waters has not changed greatly during the last century.

Population Size

Since passage of the Marine Mammal Protection Act in 1972, the number of seals along the New England coast has increased nearly fivefold. Coast-wide aerial surveys along the Maine coast were conducted in May-June during pupping in 1981, 1982, 1986, 1993, and 1997 (Gilbert and Stein, 1981; Gilbert and Wynne, 1983; Gilbert and Wynne, 1984; Kenney, 1994; and Gilbert and Guldager, 1998). Aerial survey haul-out counts (adults and pups) were 10,540 (1981), 9,331

(1982), 12,940 (1986), 28,810 (1993), and 30,990 (1997). These numbers are considered to be minimum abundance estimates because they are uncorrected for animals in the water or outside the survey area. The annual increase since 1993 has been 1.8 percent (Gilbert and Guldager, 1998). Since 1981, the average annual increase has been 4.2 percent (Gilbert and Guldager, 1998), about 50% of the 8.9 percent annual increase estimated by Kenney (1994) from counts through 1993. Pup counts along the Maine coast during the May-June period were: 676 (1981), 1,198 (1982), 1,713 (1986), 4,250 (1993), and 5,359 (1997). The 1997 estimate is 26 percent above the 1993 value. Since 1981, the number of pups along the Maine coast has increased at an annual rate of 12.9 percent (Gilbert and Guldager, 1998).

Increased abundance of seals in wintering areas in southern New England and New York has also been documented in monitoring programs conducted by a variety nongovernment organizations. Canadian scientists counted 3,600 harbor seals during an August 1992 aerial survey in the Bay of Fundy (Stobo and Fowler, 1994), but noted that the survey was not designed to obtain a population estimate.

Harbor seals, like gray seals, were bounty hunted in New England waters until the late 1960's. This hunt may have caused the demise of this stock in U.S. waters (Katona et al., 1993). Researchers and fishery observers have documented incidental mortality in several fisheries in recent years, particularly within the Gulf of Maine (Waring et al., 1997). An unknown level of mortality also occurs in the mariculture industry (i.e. salmon farming), in power plant intake pipes, and by deliberate shooting (NMFS unpublished data[3]). An unknown number of harbor seals have been taken in Newfoundland and Labrador, Gulf of St. Lawrence, and Bay of Fundy groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, Atlantic Canada cod traps, Bay of Fundy herring weirs, and from deliberate shooting (Read, 1994). Estimated average annual mortality and serious injury to this stock during 1990–93 are 602 (CV = 0.68), 231 (CV = 0.22), 373 (CV = 0.23), 698 (CV = 0.19), 1,330 (CV = 0.25), 1,179 (CV = 0.21), and 911 (CV = 0.27), respectively.

Small numbers of harbor seals regularly strand during the winter period in southern New England and Mid-Atlantic regions (NMFS unpublished data[1]). Sources of mortality include human interactions (boat strikes, fishing gear, power plant intake, aquaculture operations), storms, abandonment by the mother, and disease (Katona et al., 1993; NMFS unpublished data[1]). In 1980, more than 350 seals were found dead in the Cape Cod area from an influenza outbreak (Geraci et al., 1981). The minimum population estimate is 30,990 harbor seals (Waring et al., 1997).

Current Population Trend

Based on recent aerial survey counts during the May-June pupping season along the Maine coast, harbor seal abundance in U.S. waters is increasing, but the actual trend is unknown.

Status of Stock

PBR (Barlow et al., 1995) was specified as the product of minimum population size (30,990), one-half the maximum productivity rate (0.06), and a recovery factor of 1.0, to give a PBR for this stock of 1,859 harbor seals (Waring et al., 1997).

The status of the harbor seal population, relative to the optimum sustainable population, in the U.S. Atlantic Exclusive Economic Zone is unknown, but the population is increasing. The species is not listed as threatened or endangered under the Endangered Species Act. The estimated annual level of human-caused mortality and serious injury in U.S. waters does not exceed PBR; therefore, this is not a strategic stock.

NORTHERN RIGHT WHALE: NORTH ATLANTIC STOCK

Historical Background

The northern right whale was the first large whale to be hunted on a systematic, commercial basis. The species was taken by Basque whalers in the Bay of Biscay at least as early as the 11th cen-

[3]Northeast Fisheries Science Center, NMFS, 166 Water Street, Woods Hole, MA 02543.

tury (Aguilar, 1986). By the late 1500's the Basques had established a substantial fishery off the Labrador coast (Cumbaa, 1986). This was succeeded by intensive shore whaling off New England in the 17th and 18th centuries, an activity which continued sporadically into the early part of this century. Similarly intensive exploitation occurred in the North Pacific population beginning in 1835. Although the right whale was officially protected throughout its range in 1935, it is now known that the former Soviet Union took substantial numbers of these animals in the North Pacific and Sea of Okhotsk into the 1960's (Yablokov, 1994). There is presently no evidence that these illegal catches extended to the North Atlantic.

Stock Definition and Geographic Range

The right whale is a slow animal which frequents coastal and shelf habitats. It feeds in temperate or high latitudes in summer and calves in warmer water in winter. The North Atlantic population is generally thought to consist of two relatively discrete stocks in the eastern and western portions of this ocean basin.

Historically, right whales were found in coastal waters throughout the North Atlantic in a range which extended from Florida (and perhaps further south) to Greenland in the west, and from western Africa to Norway in the east. However, intensive exploitation has greatly reduced the range of this animal. In the western North Atlantic, the remaining population is today largely confined to U.S. and Canadian waters, feeding in the Gulf of Maine and on the Scotian Shelf, and calving in the coastal waters of Georgia and Florida (Kraus et al., 1986b; Winn et al., 1986). Right whales appear in the Cape Cod and Massachusetts Bays region in late winter, move to the Great South Channel (southeast of Cape Cod) in spring, and then migrate to Canadian waters for the summer. The Bay of Fundy constitutes a major summer nursery area for the population, although recent genetic studies suggest the existence of a second, unidentified nursery (Schaeff et al., 1993). In winter, pregnant females migrate to give birth off the southeastern United States; although other whales are also found there at this time, the whereabouts of a substantial portion of the population in winter remains unknown.

In the eastern North Atlantic, right whales are rarely observed today and the stock appears to be close to extinction. Historically, the species fed in northern European and Icelandic waters and was believed to have calved off the west coast of Africa (Reeves and Mitchell, 1986).

Female right whales are sexually mature between about 4 and perhaps 12 years of age, and produce a single calf on average every 3–4 years (Knowlton et al., 1994); this is a significantly slower rate of reproduction than that of the rorquals (Lockyer, 1984). The right whale is stenophagous on zooplankton, notably copepods (Mayo and Marx, 1989). Individual animals can be identified from photographs of the pattern of callosities on the head, and from prominent scarring (Kraus et al., 1986a).

The western North Atlantic population has been the subject of a long-term study since the 1970's, and much of its biology and behavior is reasonably well understood (see Kraus et al., 1986b; Kenney et al., 1994; Knowlton et al., 1994). Most of the population has been biopsy sampled, and genetic analyses are ongoing (Schaeff et al., 1993, 1997; Brown et al., 1994). There is no ongoing field research on this species in the eastern North Atlantic.

Population Size

Based upon photographs of identified individuals, studies indicate that the present western North Atlantic population numbers fewer than 300 animals (Knowlton et al., 1994). The size of the eastern North Atlantic stock is unknown, but is clearly extremely small. It is assumed that the census of identified whales in the western North Atlantic in 1992 represents a minimum population size estimate (295 individuals). The minimum size of the eastern stock, based on rare sightings, is assumed to be a handful of individuals (perhaps fewer than 20).

Current Population Size

No sustained growth is apparent despite six decades of protection, although the initial post-whaling size of this stock in 1935 is unknown.

Status of Stock

The northern right whale is critically endangered throughout its range (Brownell et al., 1986; Clapham et al., In press). Given the various problems described below, this species is arguably the most threatened of all baleen whales, and further conservation action is urgently required to avoid its extinction.

In the North Atlantic, the eastern stock appears to be essentially extinct; it is likely that much of the then-extant population was wiped out by Norwegian whaling at the turn of the century (Collett, 1909). Rare sightings are made of single individuals in European waters (Brown, 1986), but it is not clear whether these represent a tiny remnant population or individuals who have wandered in from the west. Nineteenth-century whaling occurred at Cintra Bay on the coast of West Africa (Reeves and Mitchell, 1986), raising the hope that this area may still be a breeding ground for any remaining eastern North Atlantic animals. A survey in this region in early 1996 failed to find a single whale, although survey conditions were extremely poor.

Analyses based upon photographs of identified individuals indicate that the present western North Atlantic population numbers fewer than 300 animals (Knowlton et al., 1994); given that the majority of the population appears to have been identified, this is likely to represent one of the more accurate estimates of abundance for any large whale.

Unfortunately, the right whale appears to suffer from anthropogenic mortalities more than any other. In the western North Atlantic, entanglement in fishing gear and ship strikes are known to have caused several right whale deaths in recent years, undoubtedly contributing to the apparent failure to recover. Kraus (1990) estimated mortality in the first 4 years of life at between 2% and 17%, with at least a third attributable to ship collisions and entanglement. Photographs of 118 identified individuals showed that 57% possessed scarring indicative of entanglement (Kraus, 1990). Sources of ship strikes are generally unknown, but are primarily large commercial vessels; regrettably, many of the right whale's major habitats in the western North Atlantic are adjacent to, or even straddle, major shipping lanes. Given this population's dependence upon nearshore habitat for much of its life cycle, intensive coastal development in this and other portions of the range poses additional threats to recovery.

Studies showing relatively low genetic diversity in the western North Atlantic population (Schaeff et al., 1993, 1997) suggest that inbreeding may be inhibiting recovery, but this is difficult to interpret without a knowledge of historic genetic structure. The latter topic is currently being investigated using DNA extracted from historic baleen samples (Rosenbaum et al., 1997, 1998).

This is a strategic stock. PBR was specified as the product of minimum population size (295), one-half the maximum productivity rate (0.02), and a recovery factor of 0.1 because this species is listed as endangered under the ESA. PBR for the northern right whale is therefore 0.4 whales. Over the past several years, known human-caused mortality has consistently exceeded PBR. This is a cause for concern, given the critically endangered status of the stock and its apparent failure to recover.

LITERATURE CITED

Aguilar, A. 1986. A review of old Basque whaling and its effect on the right whales (Eubalaena glacialis) of the North Atlantic. Report of the International Whaling Commission, Special Issue 10:191–199.

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. National Oceanic and Atmospheric Administration Technical Memorandum NMFS-OPR-6, 73 p.

Bisack, K. D. 1997a. Harbor porpoise bycatch estimates in the U.S. New England multispecies sink gillnet fishery: 1994 and 1995. Report of the International Whaling Commission 47:705–714.

Bisack, K. D. 1997b. Marine mammal bycatch estimates and their sampling characteristics in the U.S. New England sink gillnet, pelagic pair trawl, pelagic drift gillnet and North Atlantic bottom trawl fisheries: 1994 to 1995. Working Paper SC/49/SM35 submitted to the International Whaling Commission Scientific Committee meeting in Bournemouth, U.K., September 1997.

Boulva, J., and I. A. McLaren. 1979. Biology of the harbor seal (*Phoca vitulina*) in Eastern Canada. Fisheries Research Board of Canada Bulletin 200, 24 p.

Bravington, M. V., and K. D. Bisack. 1995. Estimates of harbor porpoise bycatch in the Gulf of Maine sink gillnet fishery, 1990–1993. Report of the International Whaling Commission 46:567–74.

Brown, M. W., S. D. Kraus, D. E. Gaskin, and B. N. White. 1994. Sexual composition and analysis of reproductive females in the North Atlantic right whale (*Eubalaena glacialis*) population. Marine Mammal Science 10:253–265.

Brown, S. G. 1986. Twentieth century records of right whales (*Eubalaena glacialis*) in the northeast Atlantic Ocean. Report of the International Whaling Commission, Special Issue 10:121–127.

Brownell, R . L., Jr., P. B. Best, and J. H. Prescott, (Editors). 1986. Right whales: past and present status. Report of the International Whaling Commission, Special Issue 10, 289 p.

Clapham, P. J., S. E. Young, and R. L. Brownell, Jr. In press. Baleen whales: conservation issues and the status of the most endangered populations. Mammal Review.

Collett, R. 1909. A few notes on the whale *Balaena glacialis* and its capture in recent years in the North Atlantic by Norwegian whalers. Proceedings of the Zoological Society of London, p. 91–98.

Cumbaa, S. L. 1986. Archaeological evidence of the 16th century Basque right whale fishery in Labrador. Report of the International Whaling Commission, Special Issue 10:187–190.

Gaskin, D. E. 1977. Harbour porpoise, *Phocoena phocoena* (L.), in the western approaches to the Bay of Fundy 1969–75. Report of the International Whaling Commission 27:487–492.

Gaskin, D. E. 1984. The harbor porpoise *Phocoena phocoena* (L.): Regional populations, status, and information on direct and indirect catches. Report of the International Whaling Commission 34:569–586.

Gaskin, D. E. 1992. The status of the harbour porpoise. Canadian Field-Naturalist 106:36–54.

Geraci, R., D. J. St. Aubin, and I. K. Barker. 1981. Mass mortality of harbor seals: pneumonia associated with influenza A virus. Science 215:1129–1131.

Gilbert, J. R., and N. Guldager. 1998. Status of harbor and gray seal populations in Northern New England. Final Cooperative Report 14-16-009-1157, NMFS Northeast Fisheries Science Center, Woods Hole, Massachusetts, 13 p.

Gilbert, J. R., and J. L. Stein. 1981. Harbor seal populations and marine mammal fisheries interactions, 1981. Annual Report, Northeast Fisheries Science Center, Contract NA-80-FA-C-00029, Woods Hole, Massachusetts.

Gilbert, J. R., and K. M. Wynne. 1983. Harbor seal populations and marine mammal fisheries interactions, 1982. Second Annual Report, Northeast Fisheries Science Center, Contract NA-80-FA-C-00029, Woods Hole, Massachusetts.

Gilbert, J. R. and K. M. Wynne. 1984. Harbor seal populations and marine mammal fisheries interactions, 1983. Third Annual Report, Northeast Fisheries Science Center, Contract NA-80-FA-C-00029, Woods Hole, Massachusetts.

Johnston. D. W. 1995. Spatial and temporal differences in heavy metal concentrations in the tissues of harbour porpoises (*Phocoena phocoena* L.) from the western North Atlantic. M.S. Thesis. University of Guelph, Guelph, Ontario, Canada, 152 p.

Katona, S. K., V. Rough, and D. T. Richardson. 1993. A field guide to whales, porpoises, and seals from Cape Cod to Newfoundland. Smithsonian Institution Press, Washington, D.C., 316 p.

Kenney, M. K. 1994. Harbor seal population trends and habitat use in Maine. M.S. thesis, University of Maine, Orono, 55 p.

Kenney, R. D., H. E. Winn, and M. C. Macauley. 1994. Cetaceans in the Great South Channel, 1979–1989: right whale (*Eubalaena glacialis*). Continental Shelf Research 15:385–414.

Knowlton, A. R., S. D. Kraus, and R. D. Kenney. 1994. Reproduction in North Atlantic right whales (*Eubalaena glacialis*). Canadian Journal of Zoology 72:1297–1305.

Kraus, S. D. 1990. Rates and potential causes of mortality in North Atlantic right whales (*Eubalaena glacialis*). Marine Mammal Science 6:278–291.

Kraus, S. D., K. E. Moore, C. E. Price, M. J. Crone, W. A. Watkins, H. E. Winn, and J. H. Prescott. 1986a. The use of photographs to identify individual North Atlantic right whales (*Eubalaena glacialis*). Report of the International Whaling Commission, Special Issue 10:145–151.

Kraus, S. D., J. H. Prescott, A. R. Knowlton, and G. S. Stone. 1986b. Migration and calving of right whales (*Eubalaena glacialis*) in the western North Atlantic. Report of the International Whaling Commission, Special Issue 10:139–144.

Kraus, S. D., J. H. Prescott, and G. S. Stone. 1983. Harbour porpoise, *Phocoena phocoena*, in the U.S. coastal waters of the Gulf of Maine: A survey to determine seasonal distribution and abundance. Report to the Director, NMFS Northeast Region, Woods Hole, Massachusetts, 15 p.

Lipscomb, T. P. 1994. Morbilliviral disease in an Atlantic bottlenose dolphin (*Tursiops truncatus*) from the Gulf of Mexico. Journal of Wildlife Diseases 30(4): 572–576.

Lockyer, C. L. 1984. Review of baleen whale (Mysticeti) reproduction and implications for management. Report of the International Whaling Commission, Special Issue 6:27–48.

Lynn, S. K. 1995. Movements, site fidelity, and surfacing patterns of bottlenose dolphins on the central Texas coast. M.S. thesis, Texas A&M University, College Station, 92 p.

Mayo, C. A., and M. K. Marx. 1989. Surface foraging behavior of the North Atlantic right whale, *Eubalaena glacialis*, and associated zooplankton characteristics. Canadian Journal of Zoology 68:2214–2220.

NEFSC. 1992. Harbor porpoise in eastern North America: Status and research needs. Results of a scientific workshop held May 5–8, 1992 at the Northeast Fisheries Science Center, Woods Hole, Massachusetts. NMFS Northeast Fisheries Science Center Reference Document 92-06, Woods Hole, Massachusetts.

NMFS. 1993. Proposed listing of Gulf of Maine population of harbor porpoises as threatened under the Endangered Species Act. Federal Register 58:3108–3120, 7 January 1993.

Palka, D. 1995a. Abundance estimate of the Gulf of Maine harbor porpoise. *In* A. Bjørge and G. P. Donovan (Editors), Biology of the Phocoenids, p. 27–50, Report of the International Whaling Commission, Special Issue 16.

Palka, D. 1995b. Influences on spatial patterns of Gulf of Maine harbor porpoises. *In* A. S. Blix, L. Walløe, and Ø. Ulltang (Editors), Whales, seals, fish and man, p. 69–75, Elsevier Science B.V., The Netherlands.

Palka, D. 1996. Update on abundance of Gulf of Maine/Bay of Fundy harbor porpoises. NMFS Northeast Fisheries Science Center Reference Document 96-04, Woods Hole, Massachusetts.

Palka, D. L., A. J. Read, A. J. Westgate, and D. W. Johnston, 1996. Summary of current knowledge of harbour porpoises in U.S. and Canadian Atlantic waters. Report of the International Whaling Commission 46:559–565.

Read, A. J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Report of the International Whaling Commission, Special Issue 15:133–147.

Read, A. J., and A. A. Hohn. 1995. Life in the fast lane: The life history of harbour porpoises from the Gulf of Maine. Marine Mammal Science 11(4):423–440.

Reeves, R. R., and E. Mitchell. 1986. American pelagic whaling for right whales in the North Atlantic. Report of the International Whaling Commission, Special Issue 10:221–254.

Richardson, D. T. 1976. Assessment of harbor and gray seal populations in Maine 1976–1975. Final report to Marine Mammal Commission, Contract MM-4-AC-009, Washington, D.C.

Rosenbaum, H. C., M. G. Egan, P. J. Clapham, R. L. Brownell, Jr., and R. DeSalle. 1997. An effective method for isolating DNA from historical specimens of baleen. Molecular Ecology 6:677–681.

Rosenbaum, H. C., M. G. Egan, P. J. Clapham, R. L. Brownell, Jr., S. Malik, M. Brown, B. White, and R. DeSalle. 1998. Levels of historic genetic diversity and population structure in North Atlantic right whales detected by an effective technique to isolate DNA from museum specimens. P. 117. *In* Proceedings of the Twelfth Biennial Conference on the Biology of Marine Mammals (abstract). Society for Marine Mammalogy, Lawrence, Kansas.

Rosenfeld M., M. George, and J. M. Terhune. 1988. Evidence of autumnal harbour seal, *Phoca vitulina*, movement from Canada to the United States. Canadian Field-Naturalist 102(3):527–529.

Schaeff, C. M., S. D. Kraus, M. W. Brown, J. S. Perkins, R. Payne, and B. N. White. 1997. Comparison of genetic variability of North and South Atlantic right whales (*Eubalaena*), using DNA fingerprinting. Canadian Journal of Zoology 75:1073–1080.

Schaeff, C. M., S. D. Kraus, M. W. Brown, and B. N. White. 1993. Assessment of the population structure of western North Atlantic right whales (*Eubalaena glacialis*) based on sighting and mtDNA data. Canadian Journal of Zoology 71:339–345.

Schneider, D. C., and P. M. Payne. 1983. Factors affecting haul-out of harbor seals at a site in southeastern Massachusetts. Journal of Mammology 64(3):518–520.

Smith, T., D. Palka, and K. Bisack. 1993. Biological significance of bycatch of harbor porpoise in the Gulf of Maine demersal gillnet fishery. NMFS Northeast Fisheries Science Center Reference Document 93-23, Woods Hole, Massachusetts.

Stobo, W. T., and G. M. Fowler. 1994. Aerial surveys of seals in the Bay of Fundy and off southwest Nova Scotia. Canadian Technical Report of Fisheries and Aquatic Sciences, 1943, 57 p.

Temte, J. L., M. A. Bigg, and O. Wiig. 1991. Clines revisited: the timing of pupping in the harbour seal (*Phoca vitulina*). Journal of Zoology, London 224:617–632.

Trippel, E. A., J. Y. Wang, M. B. Strong, L. S. Carter and J. D. Conway. 1996. Incidental mortality of harbour porpoise (*Phocoena phocoena*) by the gillnet fishery in the lower Bay of Fundy. Canadian Journal of Fisheries and Aquatic Sciences 53:1294–1300.

Wang, J. Y., D. E. Gaskin, and B. N. White. 1996. Mitochondrial DNA analysis of harbour porpoise, *Phocoena phocoena*, subpopulations in North American waters. Canadian Journal of Fisheries and Aquatic Sciences 53:1632–1645.

Waring, G. T., D. L. Palka, P. J. Clapham, S. Swartz, M. Rossman, T. Cole, K. D. Bisack, and L. J. Hansen. 1999. U.S. Atlantic marine mammal stock assessments—1998. NOAA Technical Memorandum NMFS-NE-116, 182 p.

Waring, G. T., D. L. Palka, K. D. Mullin, J. H. W. Hain, L. J. Hansen, and K. D. Bisack. 1997. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments—1996. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NE-114, 250 p.

Westgate, A. J., D. C. G. Muir, D. E. Gaskin, and M. C. S. Kingsley. 1997. Concentrations and accumulation patterns of organochlorine contaminants in the blubber of harbour porpoises, *Phocoena phocoena*, from the coast of Newfoundland, the Gulf of St. Lawrence and the Bay of Fundy/Gulf of Maine. Environmental Pollution 95:105–119.

Whitman, A. A., and P. M. Payne. 1990. Age of harbour seals, *Phoca vitulina concolor*, wintering in southern New England. Canadian Field-Naturalist 104(4):579–582.

Winn, H. E., C. A. Price, and P. W. Sorensen. 1986. The distributional biology of the right whale (*Eubalaena glacialis*) in the western North Atlantic. Report of the International Whaling Commission, Special Issue 10:129–138.

Yablokov, A. V. 1994. Validity of Soviet whaling data. Nature 367:108.