NORTH ATLANTIC RIGHT WHALE (*Eubalaena glacialis*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Individuals of this population range from wintering and calving grounds in coastal waters of the southeastern United States to summer feeding, nursery, and mating grounds in New England waters and northward to the Bay of Fundy and the Scotian Shelf. Knowlton et al. (1992) recently reported several long-distance movements as far north as Newfoundland, the Labrador Basin, and southeast of Greenland, suggesting an extended range for at least some individuals and perhaps habitat areas not presently well described. Likewise, a calving and wintering ground has been described for coastal waters of the southeastern U.S., but the range may be somewhat more extensive because sightings have been reported from the Gulf of Mexico (Moore and Clark 1963; Schmidly et al. 1972) and 85% of the population is unaccounted for during this season.

Research results to date suggest five major habitats or congregation areas (southeastern United States coastal waters, Great South Channel, Cape Cod Bay, Bay of Fundy, and Scotian Shelf) for western North Atlantic right whales. However, movements within and between habitats and within regions may be more extensive than sometimes thought. Results from a few successfully attached satellite telemetry tags suggest that sightings separated by perhaps two weeks should not be assumed to indicate a stationary or resident animal. Instead, telemetry data have shown rather lengthy and somewhat distant excursions (Mate et al. 1992). These findings cast new light on movements and habitat use, and raise questions about the purpose or strategies for such excursions.

New England waters are a primary feeding habitat for the right whale, which appears to feed primarily on calanoid copepods in this area. Research suggests that right whales must locate and exploit extremely dense patches of zooplankton to feed efficiently. These dense zooplankton patches are likely a primary characteristic of the spring, summer, and fall right whale habitat (Kenney et al. 1986). The acceptable surface copepod resource is limited to perhaps 3% of the region during the peak feeding season in Cape Cod and Massachusetts Bays (Mayo and Goldman, in press). While feeding in the coastal waters off Massachusetts has been better studied, feeding by right whales has been observed elsewhere over Georges Bank, in the Gulf of Maine, in the Bay of Fundy, and over the Scotian Shelf. The characteristics of acceptable prey distribution in these areas is not well known. New England waters also serve as a nursery for calves and, in some cases, for mating.

Genetic analyses of tissue samples is providing insights to stock definition. Schaeff et al. (1993) have suggested that western North Atlantic right whales probably represent a single breeding population that may be based on three matrilines. They also suggest that, in addition to the Bay of Fundy, there exists an additional and undescribed summer nursery area utilized by approximately one-third of the population. As described above, a related question is where individuals other than calving females and a few juveniles overwinter. One or more major wintering and summering grounds have yet to be described.

POPULATION SIZE

Based on a census of individual whales identified using photo-identification techniques, the western North Atlantic population size was estimated to be 295 individuals in 1992 (Knowlton et al. 1994). Because this was a nearly complete census, it is assumed that this represents a minimum population size estimate.

Historical Population Estimate

An estimate of pre-exploitation population size is not available. Basque whalers may have taken as many as 200 right whales a year at times during the 1500s in the Strait of Belle Isle region, and the stock of right whales may have already been substantially reduced by the time whaling was begun by colonists in the Plymouth area in the 1600s (Reeves and Mitchell 1987). A modest but persistent whaling effort along the eastern U.S lasted three centuries, and the records include one report of 29 whales killed in Cape Cod Bay in a single day during January 1700. Based on incomplete historical whaling data, these authors could only conclude that there were at least some hundreds of right whales present in the western North Atlantic during the late 1600s. In a later study (Reeves et al. 1992), a series of population trajectories using historical data and an estimated present population size of 350 were plotted. The results suggest that there may have been at least 1,000 right whales in this population during the early to mid-1600s, with the

greatest population decline occurring in the early 1700s. The authors cautioned, however, that the record of removals is incomplete, the results are preliminary, and refinements are required.

Minimum Population Estimate

The western North Atlantic population size was estimated to be 295 individuals in 1992 (Knowlton et al. 1994), based on a census of individual whales identified using photo-identification techniques. A bias that might result from including catalogued whales that had not been seen for an extended period of time and therefore might be dead, was addressed by assuming that an individual whale not sighted for five years was dead (Knowlton et al. 1994). It is assumed that the census of identified whales represents a minimum population size estimate.

Current Population Trend

The size of this population may have been as low as 50 or fewer animals at the turn of the century (Reeves et al. 1992; Kenney 1992) versus an estimated 295 presently, suggesting that the stock is showing signs of slow recovery.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

During 1980-1992, 145 calves were born to 65 identified cows. The number of calves born annually ranged from five to 17, with a mean of 11.2 (SE = 0.90). There was no detectable trend in the number of calves produced per year. The reproductively active female pool was static at approximately 51 individuals during 1987-1992. Mean calving interval, based on 86 records, was 3.67 years. There was an indication that calving intervals may be increasing over time, although the trend was not quite statistically significant (P = 0.083) (Knowlton et al. 1994).

The current annual population growth rate during 1986-1992 was estimated to be 2.5% (CV = 0.12) using photo-identification techniques (Knowlton et al. 1994). A population increase rate of 3.8% was estimated from the annual increase in aerial sighting rates in the Great South Channel, 1979-1989 (Kenney et al. 1995). The current estimated population growth rate of the western North Atlantic stock is lower than that of the four stocks of southern-hemisphere right whales for which data are available: western Australia, 12.7%; Argentina, 7.3%; east and west Africa, 6.8% (Best 1993).

The relatively low population size suggests that this stock is well below its optimum sustainable population (OSP); therefore, the current population growth rate should reflect the maximum net reproductivity rate for this stock. The current population growth rate reported by Knowlton et al. (1994) of 2.5% (CV = 0.12) was assumed to reflect the maximum net reproductivity rate for this stock for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) was specified as the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor for endangered, depleted, threatened stocks, or stocks of unknown status relative to OSP (Anon. 1994). The recovery factor was 0.10 because this species is listed as endangered under the Endangered Species Act (ESA). PBR for the northern right whale is 0.4 whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Approximately one-third of all right whale mortality is caused by human activities (Kraus 1990). Further, the small population size and low annual reproductive rate suggest that human sources of mortality may have a greater effect relative to population growth rates than for other whales.

The principal factors believed to be retarding growth and, perhaps recovery of the population, are ship strikes and net entanglement. Marks or scars from entanglement with fishing gear were reported from 57% of living right whales, and 7% had major wounds probably due to collisions with ship propellers. Of the 25 mortalities recorded, five (20%) could be attributed to ship collisions, and three (12%) were the result of entanglements. Young animals, ages 0-4 years, are apparently the most impacted portion of the population. In this age group, 20-30% of mortality is due to ship strikes (Kraus 1990).

For one area of concern, the coastal waters of the southeastern U.S., an awareness and mitigation program, involving ten agencies and organizations, was begun in 1992, and has been upgraded and expanded annually. Other areas may be included in the future. For waters of the northeastern U.S., a present concern, not yet completely defined, is the possibility of habitat degradation in Massachusetts and Cape Cod bays due to a Boston sewage outfall now under construction. Timetables for levels of treatment are under discussion.

Total estimated average annual fishery-related mortality and serious injury in fisheries monitored by NMFS during 1989-1993 was 1.6 right whales annually (CV = 2.80). The average reported mortality and serious injury to right whales due to ship strikes was one right whale per year during 1990-1994; therefore, estimated annual average human-induced mortality and serious injury (including fishery and non-fishery related causes) was 2.6 right whales per year. 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 determination cannot be made for specific fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

Fishery Information

The estimated total number of hauls in the Atlantic large pelagic drift gillnet fishery increased from 714 in 1989 to 1144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls in 1991, 1992, and 1993 were 233, 243, and 232, respectively. Fifty-nine vessels participated in this fishery between 1989 and 1993. Observer coverage, percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. The greatest concentrations of effort were located 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 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, for each year, were obtained using the aggregated catch rates, by strata (Northridge, in review). In July of 1993, a one and a half year old female was released from a swordfish drift gillnet along the southern edge of Georges Bank. The wounding to the animal, including the tail stock, suggested a high likelihood of reduced viability. Under the assumption that this animal eventually died, the total estimated annual fishery-related mortalities (CV in parentheses) were 2.2 in 1989 (2.43), 3.4 in 1990 (2.37), 0.5 (1.49) in 1991, 0.4 in 1992 (1.44), and 1.3 in 1993 (0.63).

In this stock, 57% of living right whales bore evidence of entanglements with fishing gear. An entanglement database maintained by NMFS Northeast Regional Office with records from 1975-1992 included 14 right whale entanglements, including right whales in weirs, entangled in gillnets, and trailing line and buoys. Three right whales entangled or trailing line were reported from waters in the Gulf of Maine and Bay of Fundy region in summer/fall 1994 (P. K. Hamilton, personal communication). In February 1994, two and perhaps three right whales in southeastern U.S. coastal waters were reported injured in association with large-mesh gillnets (P. K Hamilton, personal communication). An additional record (M. J. Harris, personal communication) reported a 9.1-10.6 m right whale entangled and released south of Ft. Pierce, Florida in March 1982. Incidents of entanglements in groundfish gillnet gear, cod traps, and herring weirs in waters of Atlantic Canada were summarized by Read (1994). In most instances, the right whales were either released or escaped on their own, although several whales have been observed carrying net or line fragments. Specific details of right whale entanglement in fishing gear are often lacking. When direct or indirect mortality occurs, some carcasses come ashore and are subsequently examined, or are reported as "floaters" at sea; however, the number of unreported and unexamined carcasses is unknown, but may be significant in the case of floaters. More information is needed about fisheries interactions and where they occur.

Other Mortality

Ship strikes are a major cause of mortality and injury to right whales (Kraus 1990). There have been five known ship strikes, causing three injuries and two mortalities in coastal waters of the southeastern U.S. since the Kraus (1990) summary report was published. There were also two mortalities likely due to ship collisions in the Bay of Fundy area, 1992 and 1994, and two reported floaters off the mid-Atlantic, winter 93-94, possibly due to ship strikes (NMFS unpublished data; P. K Hamilton, personal communication; Kenney and Kraus 1993). There have been four ship strike mortalities, a fifth probable, and two more possible during 1990-1994, yielding a human-induced, non-fishery-related mortality rate of between 0.8 and 1.4 right whales a year. As with entanglements, some injury or mortality due to ship strikes, particularly in offshore waters, may go undetected.

STATUS OF STOCK

The size of this stock is considered to be low relative to OSP and this species is listed as endangered under the ESA. A Recovery Plan has been published and is in effect (NMFS 1991). The total level of human-caused

mortality and serious injury is unknown, but reported human-caused mortality and serious injury has exceeded two right whales per year since 1990. This rate exceeds PBR and is significant because of the critically low population size and the low population growth rate. This is a strategic stock because the North Atlantic right whale is an endangered species.

REFERENCES

Anon. 1994. Report of the PBR (Potential Biological Removal) workshop. June 27-29, 1994. NOAA, NMFS Southwest Fisheries Science Center, La Jolla, California, 13 pp. + Appendices.

Best, P. B. 1993. Increase rates in severely depleted stocks of baleen whales. ICES J. Mar. Sci. 50: 169-186.

Hain, J. (editor). 1992. The right whale in the western North Atlantic: A science and management workshop, 14-15 April 1992, Silver Spring, Maryland. Northeast Fisheries Science Center Reference Document No. 92-05, NEFSC/NMFS Woods Hole, Massachusetts, 88 pp.

Kenney, R. D., M. A. M. Hyman, R. E. Owen, G. P. Scott, and H. E. Winn. 1986. Estimation of prey densities required by western North Atlantic right whales. Mar. Mam. Sci. 2(1): 1-13.

Kenney, R. D. 1992. Western North Atlantic right whales: Abundance and trends from Great South Channel aerial surveys. Pages 47-49 *in* J. Hain (editor), The right whale in the western North Atlantic: A science and management workshop, 14-15 April 1992, Silver Spring, Maryland. Northeast Fisheries Science Center Reference Document No. 92-05, NMFS, NEFSC, Woods Hole, Massachusetts, 88 pp.

Kenney, R. D., H. E. Winn, and M. C. Macula. 1995. Cetaceans in the Great South channel, 1979-1989: right whale (*Eubalaena glacialis*). Cont. Shelf Res. 15: 385-414.

Kenney, R. D. and S. D. Kraus. 1993. Right whale mortality — a correction and an update. Mar. Mamm. Sci. 9: 445-446.

Knowlton, A. R., J. Sigurjonsson, J. N. Ciano, and S. D. Kraus. 1992. Long-distance movements of North Atlantic Right whales (*Eubalaena glacialis*). Mar. Mam. Sci. 8(4): 397-405.

Knowlton, A. R., S. D. Kraus, and R. D. Kenney. 1994. Reproduction in North Atlantic right whales (*Eubalaena glacialis*). Can. J. Zool. 72: 1297-1305.

Kraus, S. D. 1990. Rates and potential causes of mortality in North Atlantic right whales (*Eubalaena glacialis*). Mar. Mamm. Sci. 6(4): 278-291.

Kraus, S. D. and R. D. Kenney. 1991. Information on right whales (*Eubalaena glacialis*) in three proposed critical habitats in United States waters in the western North Atlantic Ocean. Pub. No. PB91-194432, NTIS, Springfield, Virginia, 65 pp.

Mate, B. R., S. Nieukirk, R. Mescar, and T. Martin. 1992. Application of remote sensing methods for tracking large cetaceans: North Atlantic right whales (*Eubalaena glacialis*). Final Report to the Minerals Management Service, Contract No. 14-12-0001-30411, 167 pp.

Mayo, C. A. and L. A. Goldman. In press. Food consumption and caloric intake of the right whale, *Eubalaena glacialis*, in Cape Cod Bay. Can. J. Zool.

Moore, J. C. and E. Clark. 1963. Discovery of right whales in the Gulf of Mexico. Science 141(3577): 269.

NMFS. 1991. Recovery plan for the northern right whale (*Eubalaena glacialis*). Prepared by the Right Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland, 86 pp.

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.

Reeves, R. R. and E. Mitchell. 1987. Shore whaling for right whales in the northeastern United States. Contract Report No. NA85-WCC-06194, SEFSC/NMFS, Miami, FL, 108 pp.

Reeves, R. R., J. M. Breiwick, and E. Mitchell. 1992. Pre-exploitation abundance of right whales off the eastern United States. Pages 7-11 *in* The right whale in the western North Atlantic: A science and management workshop, 14-15 April 1992, Silver Spring, Maryland. Northeast Fisheries Science Center Reference Document No. 92-05. NEFSC/NMFS, Woods Hole, Massachusetts, 88 pp.

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

Schmidly, D. J., C. O. Martin, and G. F. Collins. 1972. First occurrence of a black right whale (*Balaena glacialis*) along the Texas coast. So west. Nat. 17(2): 214-215.