FIN WHALE (*Balaenoptera physalus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Scientific Committee of the International Whaling Commission (IWC) has proposed stock boundaries for North Atlantic fin whales. Fin whales off the eastern USA, north to Nova Scotia and on to the southeast coast of Newfoundland are believed to constitute a single stock under the present IWC scheme (Donovan 1991). However, the stock identity of North Atlantic fin whales has received relatively little attention, and whether the current stock boundaries define biologically isolated units has long been uncertain. The existence of a subpopulation structure was suggested by local depletions that resulted from commercial overharvesting (Mizroch *et al.* 1984).

A genetic study conducted by Bérubé *et al.* (1998) using both mitochondrial and nuclear DNA provided strong support for an earlier population model proposed by Kellogg (1929) and others. This postulates the existence of several subpopulations of fin whales in the North Atlantic and Mediterranean, with limited gene flow among them. Bérubé *et al.* (1998) also proposed that the North Atlantic population showed recent divergence due to climatic changes (*i.e.* postglacial expansion), as well as substructuring over even relatively short distances. The genetic data are consistent with the idea that different subpopulations use the same feeding ground, a hypothesis that was also originally proposed by Kellogg (1929).

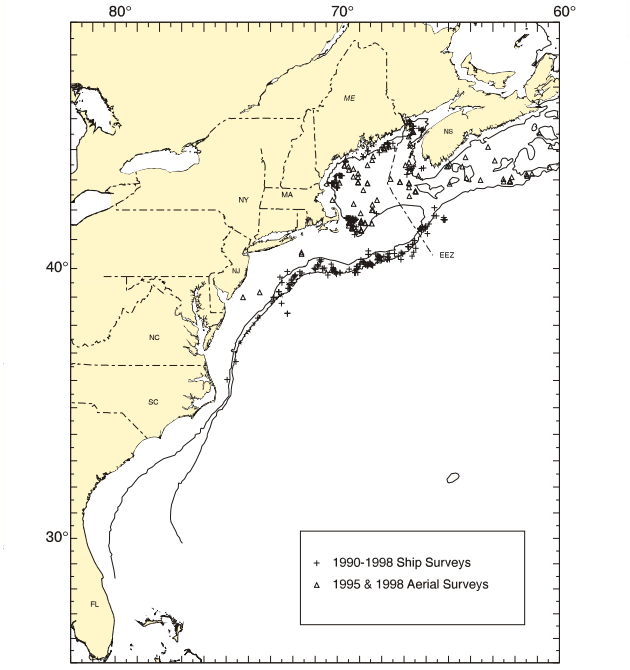

Figure 1. *Distribution of fin whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in 1990-1998. Isobaths are at 100 m and 1,000 m.*

Fin whales are common in waters of the USA Atlantic Exclusive Economic Zone (EEZ), principally from Cape Hatteras northward (Figure. 1). Fin whales accounted for 46% of the large whales and 24% of all cetaceans sighted over the continental shelf during aerial surveys (CETAP 1982) between Cape Hatteras and Nova Scotia during 1978-82. While a great deal remains unknown, the magnitude of the ecological role of the fin whale is impressive. In this region fin whales are the dominant large cetacean species in all seasons, with the largest standing stock, the largest food requirements, and therefore the largest impact on the ecosystem of any cetacean species (Kenney *et al.* 1997; Hain *et al.* 1992).

There is little doubt that New England waters represent a major feeding ground for the fin whale. There is evidence of site fidelity by females, and perhaps some segregation by sexual, maturational or reproductive class on the feeding range (Agler *et al.* 1993). Seipt *et al.* (1990) reported that 49% of identified fin whales on Massachusetts Bay area feeding grounds were resighted within years, and 45% were resighted in multiple years. While recognizing localized as well as more extensive movements, these authors suggested that fin whales on these grounds exhibited patterns of seasonal occurrence and annual return that are in some respects similar to those shown for humpback whales. This was reinforced by Clapham and Seipt (1991), who showed maternally directed site fidelity by fin whales in the Gulf of Maine. Information on life history and vital rates is also available in data from the Canadian fishery, 1965-1971

(Mitchell 1974). In seven years, 3,528 fin whales were taken at three whaling stations. The station at Blandford, Nova Scotia, took 1,402.

Hain *et al.* (1992), based on an analysis of neonate stranding data, suggested that calving takes place during approximately four months from October-January in latitudes of the USA mid-Atlantic region; however, it is unknown where calving, mating, and wintering for most of the population occurs. Preliminary results from the Navy's SOSUS program (Clark 1995) indicate a substantial deep-ocean component to fin whale distribution. It is likely that fin whales occurring in the USA Atlantic EEZ undergo migrations into Canadian waters, open-ocean areas, and perhaps even subtropical or tropical regions.

POPULATION SIZE

An abundance of 2,200 (CV=0.24) fin whales 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; Palka *et al.* in review). Total track line length was 32,600 km. The ships covered waters between the 50 and 1000 fathom depth contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the mid-Atlantic from the coastline to the 50 fathom depth contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom depth contour line. Data collection and analysis methods used were described in Palka (1996).

This is the best available current abundance estimate for the western North Atlantic fin whale because it is relatively recent and covers the largest portion of the known habitat. However, this estimate must be considered conservative in view of the known range of the fin whale in the entire western North Atlantic, and uncertainties regarding population structure and exchange between surveyed and unsurveyed areas.

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 fin whales is 2,200 (CV=0.24). The minimum population estimate for the western North Atlantic fin whale is 1,803.

Current Population Trend

There are insufficient data to determine population trends for this species. Even at a conservatively estimated rate of increase, however, the numbers of fin whales may have increased substantially in recent years (Hain *et al.* 1992).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Based on photographically identified fin whales, Agler *et al.* (1993) estimated that the gross annual reproduction rate was at 8%, with a mean calving interval of 2.7 years.

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 1803. 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 0.10 because the fin whale is listed as endangered under the Endangered Species Act (ESA). PBR for the western North Atlantic fin whale is 3.6.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The number of fin whales taken at three whaling stations in Canada from 1965 to 1971 totaled 3,528 whales (Mitchell 1974). Reports of non-directed takes of fin whales are fewer over the last two decades than for other endangered large whales such as right and humpback whales. There was no reported fishery-related mortality or serious

injury to fin whales in fisheries observed by NMFS during 1994-1998. A review of NER/NMFS anecdotal records from 1994-1998 yielded an average of 0.8 human caused mortalities per year--0.2 per year resulting from fishery interactions/entanglements, and 0.6 due to vessel collisions.

Fishery-Related Serious Injury and Mortality

No confirmed fishery-related mortality or serious injury of fin whales was reported in the Sea Sampling bycatch database; therefore, no detailed fishery information is presented here. A review of the records of stranded, floating or injured fin whales for the period 1994-1998 on file at NER/NMFS found four records with evidence of fishery interactions. There was a live fin whale sighted entangled on 6/24/97 with line wrapped over its back. The animal appeared emaciated, but whether this was a result of the entanglement could not be determined. New information is currently being reviewed for the 2001 stock assessment report. Two stranded fin whales had net or rope marks, but the evidence on hand was not sufficient to confirm entanglement as the cause of death. The fourth record involved a whale that was found floating off Lubec, Maine, on 7/31/94. The whale had several wraps of line through the mouth, and about 30 wraps around the tail stock. This single confirmed entanglement mortality suggests an annual mortality of 0.2 fin whales from fishery interactions. While these records are not statistically quantifiable in the same way as the observed fishery records, they give a minimum estimate of the frequency of entanglements for this species. A Canadian record, involving a whale found dead, wrapped in fishing gear, was omitted from the estimate.

Other Mortality

After reviewing NER/NMFS records, three were found that had sufficient information to confirm the cause of death as collisions with vessels. On 3/12/94, a 16-meter fin whale was found on Virginia Beach with fresh, deep propeller wounds in the caudal area. The animal's full stomach indicated it had been feeding not long before the collision. On 12/20/96, a fin whale was found floating near the shipping docks in Savannah, Georgia. The necropsy found bruising, coagulated blood, and broken ribs on the right side of the animal. The third reported ship strike was a mortality in Salvo, North Carolina, discovered on 3/21/98. The whale had a large hemotoma, a disarticulated spine and numerous broken vertebrae. NER/NMFS data holdings include seven additional records of fin whale mortalities that bore evidence of injury from collisions with vessels, but the available supporting documentation was not conclusive as to whether these constituted serious injury or were the proximal cause of the mortality.

STATUS OF STOCK

The status of this stock relative to OSP in the USA Atlantic EEZ is unknown, but the species is listed as endangered under the ESA. There are insufficient data to determine the population trend for fin whales. The total fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and can be considered insignificant and approaching zero mortality and serious injury rate. This is a strategic stock because the fin whale is listed as an endangered species under the ESA. A Recovery Plan for fin whales will be in effect early in 2000 (NMFS In press).

REFERENCES

Agler, B. A., R. L. Schooley, S. E. Frohock, S. K. Katona, and I. E. Seipt. 1993. Reproduction of photographically identified fin whales, *Balaenoptera physalus*, from the Gulf of Maine. *J. Mamm.* 74(3): 577-587.

Anon. 1991. Northeast cetacean aerial survey and interplatform study. NOAA, NMFS, SEFSC & NEFSC, 4 pp. Available from NEFSC, Woods Hole Laboratory, Woods Hole, MA.

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. NOAA Technical Memorandum NMFS-OPR-6. U.S. Department of Commerce, Washington, D.C. 73 pp.

Bérubé, M., A. Aguilar, D. Dendanto, F. Larsen, G. Notarbartolo di Sciara, R. Sears, J. Sigurjónsson, J. Urban-R. and P. J. Palsbøll. 1998. Population genetic structure of North Atlantic, Mediterranean and Sea of Cortez fin whales, *Balaenoptera physalus* (Linnaeus 1758): analysis of mitochondrial and nuclear loci. *Mol. Ecol.* 15: 585-599.

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 #AA551-CT8-48 to the Bureau of Land Management, Washington, DC, 538 pp.

Clapham, P. J. and I. E. Seipt. 1991. Resightings of independent fin whales, *Balaenoptera physalus*, on maternal summer ranges. *J. Mamm.* 72: 788-790.

Clark, C. W. 1995. Application of U.S. Navy underwater hydrophone arrays for scientific research on whales. *Rep. int. Whal. Commn.* 45: 210-212.

Donovan, G. P. 1991. A review of IWC stock boundaries. *Rep. int Whal. Commn.* Special Issue 13: 39-68.

Hain, J. H. W., M. J. Ratnaswamy, R. D. Kenney, and H. E. Winn. 1993. The fin whale, *Balaenoptera physalus*, in waters of the northeastern United States continental shelf. *Rep. int Whal. Commn.* 42: 653-669.

Kellogg, R. 1929. What is known of the migration of some of the whalebone whales. *Ann. Rep. Smithsonian Inst.* 1928: 467-494.

Kenney, R. D., G. P. Scott, T. J. Thompson, and H. E. Winn. 1997. Estimates of prey consumption and trophic impacts of cetaceans in the USA northeast continental shelf ecosystem. *J. Northw. Atl. Fish. Sci.* 22: 155-171.

Laake, J. L., S. T. Buckland, D. R. Anderson and K. P. Burnham. DISTANCE user's guide, V2.0. 1993. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Mizroch, A. A., D. W. Rice and J. M. Breiwick. 1984. The fin whale, *Balaenoptera physalus. Mar. Fisheries Rev.* 46: 20-24.

Mitchell, E. 1974. Present status of Northwest Atlantic fin and other whale stocks. Pages 109-169, *in* W. E. Schevill (ed), The whale problem: A status report. *Harvard University Press*, Cambridge, Massachusetts, 419 pp.

NMFS. Draft recovery plan for the fin whale *Balaenoptera physalus* and sei whale *Balaenoptera borealis*. (in press). Prepared by R. R. Reeves, G. K. Silber, and P. M. Payne for the National Marine Fisheries Service, Silver Spring, MD. 60 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.

Seipt, I. E., P. J. Clapham, C. A. Mayo and M. P. Hawvermale. 1990. Population characteristics of individually identified fin whales, *Balaenoptera physalus*, in Massachusetts Bay. *Fish. Bull., U.S.* 88(2): 271-278

Sissenwine, M. P., W. J. Overholtz and S. H. Clark. 1984. In search of density dependence. Pages 119-137 *in* Proceedings of the workshop on biological interactions among marine mammals and commercial fisheries in the southeastern Bering Sea. Alaska Sea Grant Report 84-1, Alaska Sea Grant College Program, University of Alaska, Fairbanks, Alaska.

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. NOAA Technical Memorandum NMFS-OPR-12. U.S. Dept. of Commerce, Washington, D.C. 93 pp.

Waring, G. T., C. P. Fairfield, C. M. Ruhsam and M. Sano. 1993. Cetaceans associated with Gulf Stream features off the northeastern USA shelf. *ICES Marine Mammals Comm. CM* 1993/N:12. 29 pp.