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 U.S., 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 is uncertain. The existence of a subpopulation structure was suggested by local depletions that resulted from commercial over harvesting (Mizroch *et al*. 1984). Confirmation or revision of existing proposed stock boundaries awaits input from techniques such as molecular genetics or telemetry.

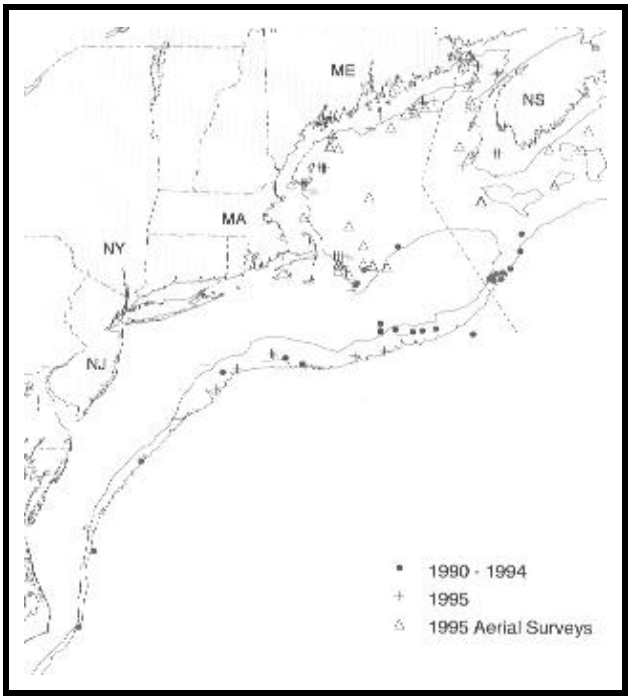

Figure 1. *Distribution of fin whale sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

Fin whales are common in waters of the U.S. 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 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 (Hain *et al*. 1992).

There is little doubt that New England waters constitute a major feeding ground for the fin whale. There is evidence of site fidelity by females, and perhaps some substock separation 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 sighted between 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. 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 U.S. mid-Atlantic region; however, it is unknown where calving, mating, and wintering for most of the population occurs. Preliminary results from the Navy's IUSS program (C. Clark, unpublished data) suggest a deep-ocean component to fin whale distribution. It is likely that fin whales occurring in the U.S. Atlantic EEZ undergo migrations into Canadian waters, open-ocean areas, and perhaps more equatorial regions.

POPULATION SIZE

Four seasonal abundance estimates for fin whales are available for portions of the northeastern U.S. Atlantic during spring and summer of 1978-82, June-July 1991, August-September 1991, and August-September 1991 and 1992 (Table 1; Figure 1).

A population size of 4,680 fin whales (CV=0.23) 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). 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 includes a dive-time scale-up correction of 4.85 but does not correct for g(0), the probability of detecting an animal group on the track line. This estimate may not reflect the current true population size because of its old age and because it was estimated just after cessation of extensive foreign fishing operations in the region.

A population size of 35 (CV=0.56) fin whales was estimated from a June and July 1991 shipboard line transect sighting survey conducted primarily between the 200 and 2,000m isobaths from Cape Hatteras to Georges Bank (Table 1; Waring *et al*. 1992). 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 194 (CV=0.18) and 529 (CV=0.19) fin whales was estimated from line transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11, respectively (Table 1; Anon. 1991). The study area included that covered in the CeTAP study plus several additional continental slope survey blocks. Due to weather and logistical constraints, several survey blocks south and east of Georges Bank were not surveyed. The data were analyzed using DISTANCE (Buckland *et al*. 1993; Laake *et al*. 1993), where the CV was estimated using the bootstrap option. The abundance estimates do not include g(0) and were not pooled over platforms because the inter-platform calibration analysis has not been conducted.

A population size of 2,700 (CV=0.59) fin whales was estimated from two shipboard line transect surveys conducted during July to September 1991 and 1992 in the northern Gulf of Maine-lower Bay of Fundy region (Palka and Waring, in prep.). This population size is a weighted-average of the 1991 and 1992 estimates, where each annual estimate was weighted by the inverse of its variance. The data were collected during surveys designed to estimate abundance of harbor porpoises (Palka 1995). Two independent teams of observers on the same ship surveyed using naked eye in non-closing mode. Using the product integral analytical method (Palka 1995) and DISTANCE (Buckland *et al*. 1993; Laake *et al*. 1993) the abundance includes an estimate of school size-bias, if applicable, an estimate of g(0), probability of detecting a group on the track line, but no correction for dive-time. Variability was estimated using bootstrap resampling techniques.

The best available current abundance estimate for the western North Atlantic fin whale is 2,700 (CV=0.59) from the 1991-92 northern Gulf of Maine-lower Bay of Fundy line transect surveys because it is relatively recent and covers the largest portion of the known habitat.

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

Month/Year	Area	$\mathbf{N_{best}}$	CV
spring & summer 1978-1982	Cape Hatteras, NC to Nova Scotia	4,680	0.23
Jun-Jul 1991	Cape Hatteras, NC to Georges Bank, shelf edge only	35	0.56
Aug-Sep 1991	Cape Hatteras, NC to Nova Scotia	194 and 529*	0.18 and 0.19*
Jul-Sep 1991 and 1992	N. Gulf of Maine and Bay of Fundy	2,700	0.59

* from data collected on the Twin Otter and AT-11, respectively.

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 2,700 (CV=0.59). The minimum population estimate for the western North Atlantic fin whale is 1,704 (CV=0.59).

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 (Wade and Angliss 1997). The minimum population size is 1,704 (CV=0.59). 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 3.4.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The number of fin whales taken at three whaling stations in Canada from 1965-71 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 1991-95. There are a relatively small number of records of fin whales impacted by fishery interaction/entanglement or vessel collisions.

Fishery Information

No fishery-related mortality or serious injury of fin whales was reported in the Sea Sampling by-catch database; therefore, no detailed fishery information is presented here.

A review of 13 records of stranded or floating (dead or injured) fin whales for the period 1992-1995 on file at NER/NMFS showed that three had fishery interactions: two had net or rope marks, and one had line through the mouth and around the tail.

Because of the large role of fin whales in their ecosystem (Hain *et al*. 1992), there is likely a link between the abundance of fin whales and the fishery resources. Foreign fishing activities in the 1960s and 70s may have been more important ecologically to the fin whale, as compared to direct interactions, since these activities over-exploited several fish stocks (i.e., herring, mackerel, etc.) that are known fin whale prey. On the other hand, Sissenwine *et al*. (1984) speculated that fin whales contributed to the demise of the already overfished Georges Bank herring stock in the mid- and late 1970s.

Other Mortality

Of 18 fin whale records from the period 1991-1995 in the Smithsonian Institution's Marine Mammal database, there are four records with ship collision, boat strike, and/or propeller scars noted. Whether these constituted serious injury or were the proximal cause of the mortality in every instance is unknown. It does suggest that ship strikes do occur on fin whales. This is a small number of individuals relative to the size of the population. For both types of human impacts (ship strikes or net entanglement), carcasses in advanced decomposition, unrecovered, and/or not necropsied represent 'lost data'.

STATUS OF STOCK

The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown, but the species is listed as endangered under the ESA. There are insufficient data to determine the population trends 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. Any fishery-related mortality would be illegal because there is no recovery plan currently in place. This is a strategic stock because the fin whale is listed as an endangered species under the ESA.

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