

Assessment of North Pacific Stocks of Whales

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INTRODUCTION

A large proportion of the American public is familiar with the history of the intensive whale fishery and subsequent depletion of these marine mammals in the Antarctic. Few people are aware, however, that there has also been a rather intensive fishery on whales in the north Pacific Ocean (Fig. 1). In fact, catches of whales from the north Pacific in 1969-70 almost doubled catches from the Antarctic, and from about 1963 until the "discovery" of the Antarctic stock of minke whales in 1972, the north Pacific provided the major share of the world's total annual catch of whales.

The main international body concerned with whaling is the International Whaling Commission (IWC), which was established under terms of the International Whaling Convention of 1946. It 1) carries out research on whales; 2) adopts regulations for protecting stocks by establishing protected species, by fixing size limits for each species, and by closing seasons and areas; and 3) establishes time, method, and intensity of whaling (including the maximum catch of each species to be taken in any one season). Its activities cover all waters in which whaling is carried out by factory ships, land stations, and whale catchers under the jurisdiction of IWC members—including the "North Pacific Rim" governments of Canada, Japan, the United States, and the USSR.

During its heyday in the late 1960's, the north Pacific whale fishery shared

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many of the characteristics of its well-publicized Antarctic counterpart. That is, following the introduction of Japanese and USSR factory ships into the north Pacific, the catches were characterized by a shift in emphasis to less valuable, smaller species of whales (Bryde's and sei whales) as larger ones (blue and fin whales) became depleted. (The sizes of north Pacific whales are compared in Table 1.)

Since 1974, the Marine Mammal Division of the National Marine Fisheries Service's Northwest Fisheries Center has expanded its studies of population dynamics to evaluate the status of the north Pacific stocks of fin, sei, and sperm whales. The goal of this program has been to provide stock assessments, independent of Japan and the USSR, to IWC for its use in developing rational measures for

management of these valuable resources. The following report reviews the status of whales and whaling in the north Pacific and summarizes some recent results concerning assessment of the north Pacific sei whale—a stock of primary concern at this time.

MODERN WHALING IN THE NORTH PACIFIC

Prior to and immediately after World War II (1941-45), whaling in the north Pacific was conducted primarily by catcher boats from land stations in Canada, Japan, the United States, and the USSR. These operations were highly efficient on nearshore species in that they may have caused the extinction of one stock—the Asiatic stock of the gray whale—and the need to protect two others—the black right whale in 1937 and the American stock of the gray whale in 1947. A third nearshore species, the humpback whale, was also intensively harvested by land-based boats.

United States participation in the post-war phase of these land-based operations was never very extensive. According to Rice (1971)¹, only six vessels operated from three shore stations between 1956, when U.S. whaling

¹Rice, D.W. 1971. Whales and whale research in the Eastern North Pacific. Conf. on Biol. of Whales, U.S. Int. Biol. Prog. Luray, Va., June 1971, 35 p. (Processed.)

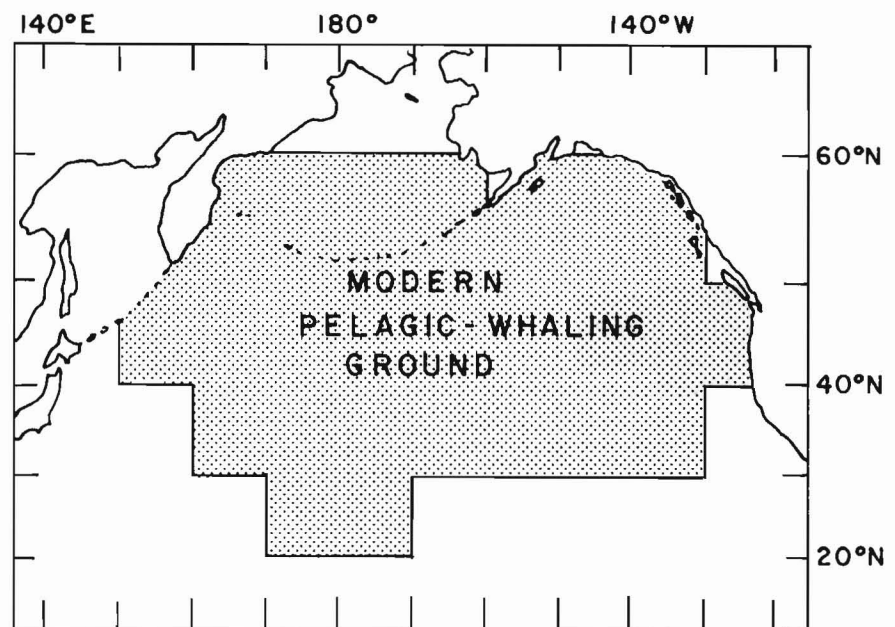


Figure 1.—The north Pacific whaling ground. Japanese land-based operations also operate north of lat. 20°N and as far west as long. 160°E.

Table 1.—Sizes of north Pacific species of whales.¹

Group and species of whale	Max. length (m)	Av. length (m)		Max. wt. (metric tons)
		Males	Females	
Baleen				
Black right	18	—	—	—
Blue	30	—	26	163
Bryde's	14	—	—	—
Fin	24	18	20	—
Gray	15	13	14	40
Humpback	15	12	12	—
Minke	10	—	8	10
Sei	19	—	15	—
Toothed				
Sperm	20	15	—	55

¹North Pacific whales are on the average smaller than their counterparts that are taken in the Antarctic.

began, and 1972, when commercial whaling was no longer permitted under U.S. law. The greatest catch for any of those years (excluding gray whales taken for scientific purposes) was 338 whales in 1961. By comparison, the greatest Japanese land-based catch during the same period was 4,777 whales in 1968. United States catches during this period consisted mainly of fin, sei, humpback, and sperm whales.

The modern era of pelagic (i.e., open-sea) whaling in the north Pacific began with a single factory ship operating off Asia in 1952. During 1954-61, only three factory ships operated, but this type of whaling was extended eastward to the American side of the north Pacific. Then, in 1963 the arrival of seven factory ships from Japan and the USSR on north Pacific whaling grounds signaled the expansion that later took place as this area began to absorb the excess whaling equipment made available by the complete protection of Antarctic blue whales and by the setting of stringent quotas upon other Antarctic species.

Considering the historical development of north Pacific whaling with respect to baleen whales (species of whales are conveniently divided into two main groups—baleen whales and toothed whales), pelagic whalers in the north Pacific concentrated upon the humpback whale in the early 1960's (Fig. 2). Blue whales were also taken in the early days but never were an important constituent of the fishery. During the mid-1960's, fin whales then became the major species of interest, while during the late 1960's and early 1970's, the sei whale became the mainstay of the fishery. Unfortunately, the familiar pattern of shifting emphasis from one baleen whale species to

another seems to be occurring again with the recent "discovery" of major concentrations of Bryde's whales south of lat. 35°N.

Considering the toothed whales, the sperm whale has been the most important species of this group taken commercially throughout all of the world's oceans. In the north Pacific this species has consistently been the major constituent of the total catch of whales during the 1960's and 1970's. Currently, the fishery takes 8-10 thousand sperm whales compared with 2-3 thousand baleen whales.

CURRENT STATUS OF NORTH PACIFIC STOCKS

As previously noted, the gray whale and black right whale were the first species totally protected in the north Pacific. This action may have been too late for the Asiatic stock of gray whales, but the American stock has since recovered, achieving a stable size of 11,000 animals. This number is thought to be near the original population size (in this article, the term "original population" refers to the size prior to the modern land-station and factory-ship

fisheries). The black right whale, on the other hand, has not been so fortunate, and its population still remains depressed—with numbers fluctuating near 200 individuals.

Alarmed by assessments submitted by the North Pacific Working Group (a subcommittee of the IWC Scientific Committee), the IWC in 1966 extended protection to the north Pacific stocks of blue and humpback whales. The blue whale had declined to 1,500 animals from an original population of about 5,000. Based upon population estimates (determined from sighting records) that have been made since then, this stock apparently still remains depressed. On the other hand, the same sighting records indicate that the humpback's situation recently may have improved. However, this stock still numbers only a few hundred individuals, whereas the size of its original population, although not specifically known, must have been in the thousands.

Currently, of the large whales, the IWC allows only fin, sei, Bryde's, and sperm whales to be harvested in the north Pacific. Stock sizes as determined by the IWC Scientific Committee for

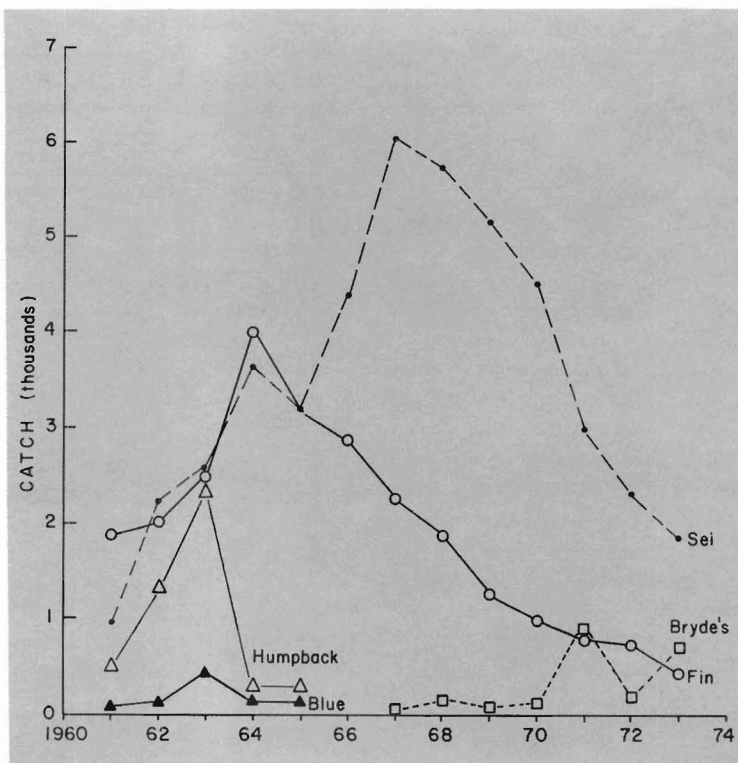


Figure 2.—Similar to Antarctic baleen whales, north Pacific catches demonstrate a marked shift from one major species to another.

three of these species are given in Table 2. Only the sperm and Bryde's whales seem to be in good condition, having current stock sizes in excess of those numbers of whales at which Maximum Sustainable Yield (MSY) occurs. The Bryde's whale is a newcomer to the fishery, and its current stock size is probably near the size of the original population. The fin whale, on the other hand, is now 37 percent below its MSY level, and some members of the IWC Scientific Committee believe there are substantial reasons to set a zero quota on this stock.

Table 2.—Stock size in numbers for three north Pacific species of whales.

Species	Original population	MSY ¹ level	Current population
Fin	44,000	27,000	17,000
Bryde's	Unknown	10-15,000	20-30,000
Sperm			
Male	166,000	58,000	72,000
Female	152,000	79,000	125,000

¹Maximum sustainable yield.

RECENT RESEARCH ON NORTH PACIFIC SEI WHALES

Determining the status of the north Pacific sei whale has lately been a major concern of the Marine Mammal Division. Up until the June 1974 meeting of the IWC, assessments of this stock had been quite optimistic. However, the Japanese scientists presented new evidence at that meeting which indicated a continuing decline in numbers (Fig. 3). Consequently the Scientific Committee feared that the north Pacific sei whale had fallen below its MSY level.

Analysis of the population dynamics of this stock has shown that the Scientific Committee's fears were justified. A method for estimating stock size has been developed, based upon Chapman's (1974) model for Antarctic sei whales. In this model, indices of north Pacific sei whale abundance over a series of years have been related to cumulative stock removals caused by harvesting and natural mortality and to cumulative additions due to recruitment. The model gives an estimate of stock size for the beginning year of data. This estimate is extrapolated backward and then forward to estimate, respectively, the size of the original

and current populations: original population, 50,000; MSY level, 28-29,000; current population, 20,600.

Since it is now 26-29 percent below its MSY level, the north Pacific sei whale apparently has undergone a considerable decline due to exploitation. Considerable restraint is, therefore, urged when setting future quotas. To ensure that the stock rebuilds, the model suggests that such quotas be less than the current replacement yield of 1,870 whales.

IWC ACTION ON PROPOSED WHALING MORATORIUM

Based upon similar evidence of continuing declines in stock sizes, conservationists have advocated the adoption of a 10-year moratorium on all commercial whaling. The IWC rejected this "blanket" moratorium in 1972-73, but in 1974, did agree in principle to adopt an Australian proposal for a partial or "selective" moratorium. This latter moratorium was to be applied to those stocks which, in the estimation of the Scientific Committee, had fallen below levels that produce a reasonable yield (be that MSY or some other optimum yield). The Scientific Committee, subsequently, was asked to meet in December 1974 to define the criteria for designating the following categories of stocks: protection; sustained management; and initial management. It was also asked to advise the IWC on the allocation of whale stocks to these categories.

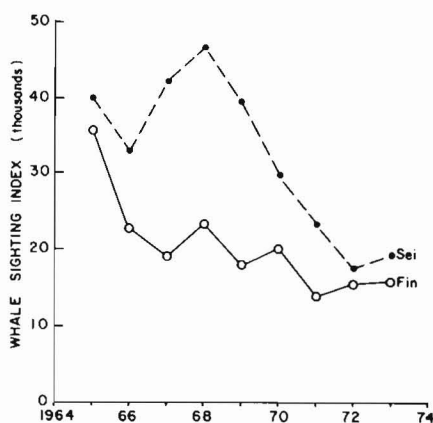


Figure 3.—Systematic sightings of whales from scouting vessels have proven to be useful and reliable indicators of stock abundance for north Pacific fin and sei whales. Such data indicating marked declines in stock sizes have alarmed conservationists throughout the world.

The Scientific Committee met as directed in La Jolla, Calif., and, with the exception of the Japanese scientists, agreed to the following approach for defining categories:²

Protection Stocks—Current population size falls below the lower limit of Sustained Management Stock; i.e., more than 10 percent below the MSY level. A harvest will not be allowed.

Sustained Management Stocks—Current population size falls between 10 percent below and 20 percent above the MSY level. For stocks between the lower limit and MSY level, the permitted catch will be no more than is indicated by a straight line from zero at the lower limit to 90 percent of MSY at the MSY level. Above MSY level, the permitted catch will be 90 percent of MSY.

Initial Management—Current population size is more than 20 percent above the MSY level. The permitted catch will be 90 percent of MSY.

Figure 4 graphically depicts these proposed criteria, utilizing the framework of a typical yield curve. Under this scheme, a stock would become protected if its current size fell below the estimated MSY level by 10 percent of that MSY level. That is, for an MSY level of 50,000 whales, a stock would become a Protection Stock if its currently estimated size fell below 45,000 animals.

Using these criteria, the Scientific Committee has designated the north Pacific fin and sei whale as Protection Stocks and the sperm and Bryde's whale as Initial Management Stocks. This allocation was confirmed at the June 1975 IWC meeting.

FUTURE RESEARCH NEEDS

During the special December meeting of the IWC Scientific Committee at La Jolla, Calif., new biological data were made available which indicated a need for revising the sei whale model. Apparently, mean ages at recruitment and at maturity for this stock have decreased in response to exploitation; i.e., sei whales are maturing and entering

²Exact definitions of these criteria and discussion of principles considered in their formulation may be found in the IWC Scientific Committee's Report of Special Meeting, La Jolla, Calif., 3-13 December 1974, submitted to the Twenty-seventh Meeting of the IWC, London, June 1975.

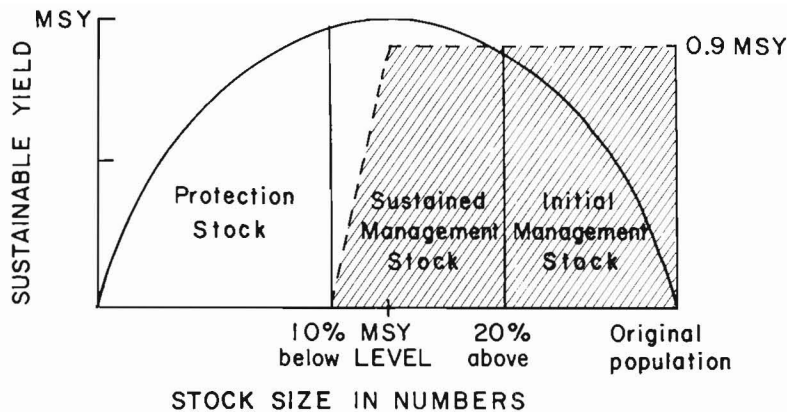


Figure 4.—Criteria for defining categories of whale stocks as proposed by the IWC Scientific Committee. The shaded area indicates the maximum catches permitted for the two harvestable categories.

the exploitable portion of the stock at ages younger than those found prior to heavy exploitation. Consequently, the assumption that recruitment into the stock is constant may no longer be valid, particularly during the later years of exploitation.

Research is currently underway at the Northwest Fisheries Center to ascertain the degree and direction of change, if any, in sei whale recruitment. Variation in recruitment numbers will be determined using Allen's (1966) technique for estimating annual recruitment from age composition data. If

the assumption of constant recruitment proves to be invalid, these estimated recruitment numbers will then be used to prepare new estimates of initial and current sei whale abundance.

The Marine Mammal Division has identified several other problems as subjects for future research:

1. Determining the shape of yield curves applicable to whales. These curves are likely skewed to the left (have the left-hand tail drawn out) but data are lacking to demonstrate this for most species. Knowing the shape of these curves is critical since the cri-

teria for defining categories of stocks are couched in terms of nearness to the MSY level.

2. Accounting for growth of sperm whales in assessment models. The average size of sperm whales has decreased drastically in the past 20 years (from 45 to 28 tons). Use of a biomass criterion, MSY (weight) instead of MSY (numbers), would account for such size changes and result in stock sizes larger than those currently in existence.

3. Correcting for bias in catch-effort statistics. Many scientists and managers have criticized currently used indices of stock abundance but few have indicated what to do to correct for bias. Of particular concern is the multispecies problem, i.e., the shifting of emphasis from one species to another with time.

Resolution of these problems would significantly aid the IWC in its development of rational measures for managing the north Pacific stocks of whales.

LITERATURE CITED

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MFR Paper 1160. From Marine Fisheries Review, Vol. 37, No. 10, October 1975. Copies of this paper, in limited numbers, are available from D83, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235. Copies of Marine Fisheries Review are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 for \$1.10 each.