

GRAY WHALE CENSUSES BY AIRPLANE IN MEXICO¹

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Aerial censuses of the gray whale, *Eschrichtius gibbosus* (Erxleben), populations in the wintering waters in Mexico (from near San Diego to around Cabo San Lucas, with a few records from the shores of the Gulf of California), chiefly in and about the lagoons along the west coast of Baja California, from 1952 through 1964, yielded the following counts (counts plausibly explicable as too low in parentheses): 1952, 827; 1953, 912 and 731; 1954, (276) and 1,315; 1955, (584); 1956, (960); 1957, (631); 1959, 1,509; 1960, 1,455; 1961, (959); 1962, 1,193; 1964, 1,581. When these explicable low counts are largely disregarded the following conclusions seem warranted: (1) higher counts after 1952 and 1953 suggest a growing population; (2) data for 1954-1964 suggest a leveling off of the population; (3) on assumption that about half the population was observed, the total population may be roughly estimated as about 3,000; (4) nearly identical low counts for 1952 and 1953 and high counts for 1959 and 1960 seem to refute the hypothesis that odd-year runs differ markedly from the even-year runs.

In the winter of 1946-47 we initiated an annual census of the eastern Pacific population of gray whales, *Eschrichtius gibbosus* (Erxleben), as they migrated past San Diego toward the lagoons of Baja California, Mexico, where all of the calves are born. Having continued this census for several years until others took over the project (Gilmore, 1960a,b; Rice, 1961), we began, in February 1952, an annual aerial census of this population. The census covered the coastline from San Diego southward to the Cape region of Baja California, at a time of year when almost the entire population winters there. From 1954 through 1957 the tally also included the small number of whales that winters along the eastern coast of Golfo de California (Gilmore and Ewing, 1954; Gilmore, 1958-1961; Gilmore and Mills, 1962; Gilmore et al., in press).

These aerial censuses were made with the aid and collaboration of Gifford C. Ewing, then on the staff of Scripps Institution of Oceanography. In addition to providing and piloting his plane, Dr. Ewing actively participated in the counts. His skill as a pilot, his intimate knowledge of the lagoon area, and his patience and dedication all contributed greatly to the thoroughness of the censuses (other aerial tallies are not comparable).

We accompanied Ewing on the February flights of 1952, 1954, 1959, 1960, 1961, 1962, and 1964. On the flights of 1959, 1960, 1962, and 1964 we were further assisted by several others (see footnotes to Table 1). Raymond M. Gilmore made the counts with Ewing in 1953 (closely following a trip made by Ewing and Andreas B. Rechnitzer), 1954, 1955, 1956, 1957. Thus, over the period 1952-1964 we have counts from 13 flights, including 2 each in 1953 and 1954 (but none in 1958 or 1963).

Some particulars regarding our trips of 1952 and 1954 and his trips

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TABLE 1

Counts of Gray Whales, from Airplane(s), from San Diego, California Southward

Details regarding flights of 1952 to 1957 were specified by Gilmore (1960a: 26-29). Later flights are discussed in text. The counts for 1954 to 1957 included a few whales on the east shore of Golfo de California.

Year of flight	Date of flight	Counter(s), with G. C. Ewing	No. of whales counted		
			Calves	Adults	Total
1952	II:16-20	C. L. and L. C. Hubbs	79	748	827 ¹
1953	I:31-II:4	A. B. Rehnitzer	190	722	912 ²
1953	II:25-27	R. M. Gilmore	118	613	731 ¹
1954	II:1-7	R. M. Gilmore	59	217	276 ³
1954	II:14-21	C. L. and L. C. Hubbs ⁴	227	1,088	1,315 ⁵
1955	II:26-III:3	R. M. Gilmore	148	436	584 ⁶
1956	II:14-17	R. M. Gilmore	138	822	960 ⁷
1957	II:27-III:3	R. M. Gilmore	98	533	631 ⁸
1959	II:20-26	C. L. and L. C. Hubbs ⁹	286	1,223	1,509 ⁸
1960	II:18-21	C. L. and L. C. Hubbs ⁹	244	1,211	1,455 ⁹
1961	II:25-27	C. L. and L. C. Hubbs	169	780	949 ¹⁰
1962	II:18-21	C. L. and L. C. Hubbs ¹¹	141 ¹²	1,052 ¹²	1,193
1964	II:20-24	C. L. and L. C. Hubbs ¹³	209	1,372	1,581

¹ Total listed as 700 to 750 by Gilmore and Mills (1962: 27).

² Count not comparable with others, because incomplete (whole west coast north of Laguna San Ignacio was bypassed) and too early.

³ Preliminary, approximate tally of 1,400 (200 calves and 1,200 adults) listed by Gilmore (1960a: 27) and by Gilmore and Mills (1962: 27).

⁴ Very low count attributable to omission of Vizcaino breeding area in main survey, only partly compensated for by inclusion here of early (February 4) aerial count of 69 calves and 121 adults by Gifford C. Ewing, Fred B. Phleger, and Robert Langford; lateness of count also involved.

⁵ Low count attributable in part to omission of several areas, as detailed by Gilmore (1960a: 28). Berdegué (1956: 105) who, along with D. Day, participated in the census, gave the count as 134 calves and 814 adults (total 948), and making estimates of numbers missed in areas not covered, arrived at a grand total of 1,008.

⁶ "The flight was made in good weather and provided excellent coverage" (Gilmore, 1960a: 29); because of the late date many whales had probably returned north.

⁷ George E. Lindsay participated in this flight and assisted in the count.

⁸ This high count was not mentioned by Gilmore and Mills (1962: 27).

⁹ On the 1960 flight we utilized a second, smaller plane provided and piloted by Lawrence C. Kuebler, and in the counting were further assisted by George E. Lindsay, Laurence M. Huey, and others.

¹⁰ Gilmore and Mills (1962: 27) listed about 1,400 for each of the 1960 and 1961 flights. The 1961 count was abnormally low due to unavoidable haste, less than optimal weather, and omission of parts of the coast.

¹¹ On the 1962 flight we again utilized the plane provided and piloted by Mr. Kuebler and were assisted by George E. Lindsay, Earle Stanley Gardner, and Eva Ewing.

¹² Calves were not distinguished from adults in all areas.

¹³ On the 1964 flight we were further assisted by Theodore J. Walker, Robert W. Elsner, and Jean Filloux.

of 1953 to 1957 were presented by Gilmore (1960a: 25-29). Berdegué (1956) gave an account of the 1956 flight. Our 1954 trip was in a Cessna 180 plane, which was excellent for observation. The 1959 and 1960 trips were in a Grumman Super Widgeon G44 amphibian, also very serviceable. Beginning in 1961 Ewing flew a larger plane, an Aero Commander 500 A, which served well for census taking.

Several circumstances may have favored higher counts as the aerial censuses continued. Beginning in 1959, additional personnel participated (except for the unsatisfactory count in 1961). On two of the last four flights a second and smaller plane, provided and piloted by Lawrence C. Kuebler, not only carried more observers but increased the width of the effective band of observation without requiring as much zig-zagging as on a single-plane operation. Greater skill in piloting and in observing tended to increase the counts. However, it is thought that there was only a moderate bias toward higher counts, particularly since Ewing very early in the series developed notable skill in zig-

zagging his course along the coast to cover the band of migration (with occasional sorties beyond the limit of occurrence), and in circling over the lagoons just tightly enough to largely avoid either duplication or omission. Furthermore, the more complete and therefore more significant enumerations were made by the same personnel, and the two highest counts were made with a single plane.

Throughout our operations we stationed the prime observers in the pilot's and copilot's seats, so that both sides were scanned. Altitude was varied, so that a wide band was covered along the open coast and close-up observation was maintained in lagoons and other areas in which the whales congregated. Observations were usually recorded on tape, but a running tally was also maintained. Over the lagoons in which the whales abounded, adults were enumerated by hand tallies and the numbers of calves were jotted down by a third party as they were called out.

Sources of error in the aerial census as practiced do exist. In addition to factors favoring higher counts, visibility varied greatly with sea and wind state and with haze. To counteract these factors in and about Scammons Lagoon, where the greatest concentration of whales occurs, a count was usually made early in the day, when conditions for observation were best (once a count on a windy afternoon was followed early the next day by a much higher count, which was accepted). Counts made prior to mid-February or after February 27 are suspect, because the whale population seems to be at its height in the lagoons during the intervening period. In some years, few whales enter the lagoons before early February, and toward the end of the month the northward exodus seems to be underway. In fact, during the second half of February the last down-migrating stragglers meet the vanguard of the northward migrants along the open coast (both groups ordinarily proceeding without calves).

Despite these and other sources of error and variance, the summary data (Table 1 and Fig. 1) from the aerial censuses of the eastern Pacific gray whales appear to provide a significant basis for estimates of the population. When explicable low counts are disregarded, several conclusions regarding the population trend seem to be warranted.

(1) The initial low counts of 1952 and 1953, just before the high count of 1954, seem to confirm other indications that the population had not yet reached the level soon after attained. Early inexperience may explain in part, but we think in small part only, the lower counts on the first two censuses.

(2) The data for the 11-year period, 1954-1964, strongly suggest a leveling off (suggested by Hubbs, 1959) of the population increase.

(3) The nearly identical low counts for 1952 and 1953 and the similarity of the high counts for 1959 and 1960 seem to refute the hypothesis held by some observers (for example, Gilmore, 1958), that odd-year runs differ markedly in numbers from the even-year runs.

(4) On the assumptions that about half of the total population was observed in the area covered, and that almost all the individuals were concentrated in that area at the time of the counts, the entire population of gray whales in the eastern Pacific may be roughly estimated as about 3,000. Any major error in the admittedly rather intuitive estimate that about half of the population was observed on the flights should

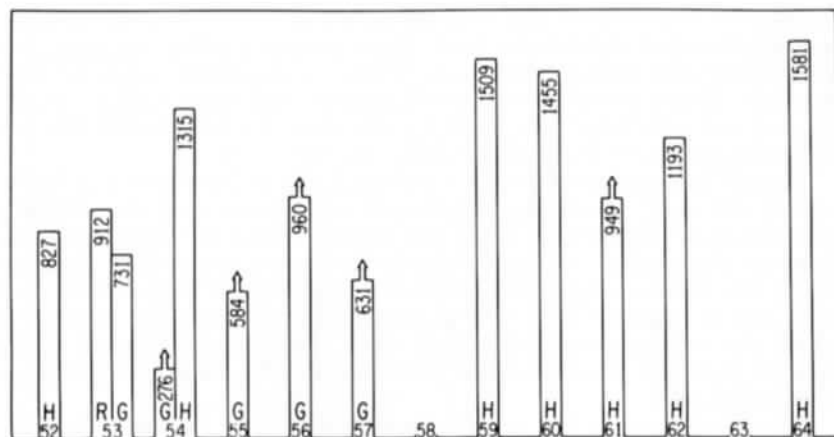


FIGURE 1—Aerial censuses of gray whales from 1952 through 1964, from San Diego southward.

The figure at the base of each column indicates the year, the figure at the top is the number of gray whales observed, and the letter represents the person who, with Gifford C. Ewing, made the counts (G = Raymond M. Gilmore, H = Carl L. and Laura C. Hubbs, R = Andreas B. Rechnitzer). An arrow surmounting a column indicates an obviously incomplete count.

not markedly vitiate conclusion (2), because the counting was closely comparable, except as noted, from year to year.

Estimates of a population as high as 5,000 to 9,000 (Gilmore, 1960a,b, 1961; Rice, 1961) seem unrealistic to us, and news dispatches from Mexico giving an estimate of 15,000 seem unbelievable.

Higher estimates by American cetologists have been based either on the assumption that only about one-fourth of the whales were counted on the aerial surveys in Baja California, or on counts from the shore station at the Cabrillo National Monument on Point Loma, San Diego, California. We are inclined to believe that aerial surveys are somewhat superior to the shore counts (begun in 1946-47), as well as being much more economical of time (5 days versus 2 months). The shore counts involve uncertainties chiefly due to: (1) frequent periods of fog, which may occlude the view for as long as several days; (2) inability to observe movements at night, and lack of information as to the nocturnal conditions under which migration is continued or interrupted (we have observed that migration continues under bright moonlight but is fully suspended during dark of the moon); (3) very real difficulty in deciding how many whales are in a migrating gam (some observers have tended to count spouts).

A source of error in censusing from shore, which may be time-dependent, is a change in migration route (tending more offshore), and in evasive behavior, which may well have resulted from the increase of small-boat traffic along the shore and especially from the increase in the number of commercial and private boats that chase the whales during their coastwise migration to obtain a closer view. Recent observations (Rice, 1965) indicate a southward movement near the Channel Islands of California in excess of any we had previously observed in that area. The tendency of gray and other whales to exhale under water when disturbed and to expose only their blowholes for inhalation

(Hubbs, 1965) renders them difficult to see and count. These factors seem to have been responsible for the surprisingly low numbers of whales observed passing San Diego during the southward migration of 1963-64. Wondering if there might have been a sudden depletion of the whales due to disease, or to exploitation in the Arctic or in the western Pacific, we resumed the aerial census in February 1964 (after the planned termination in 1962). To our gratifying surprise, the counts from the airplane were slightly the highest yet obtained.

In this paper, no attempt has been made to detail the counts for each lagoon and for each coastal sector, nor to include observations on migrational route, behavior, etc. Further analysis of the voluminous field notes will probably slightly modify the total counts. We also have many years of observations from shore, from vessels and small boats, and from other plane trips and from helicopters. To date our observations have barely been summarized in print (Hubbs, 1959).

LITERATURE CITED

- Berdegúe, Julio. 1956. Ultimo censo de la ballena gris, *Rhachianectes glaucus* (Cope), en aguas de Baja California. *Ciencia (Méx.)*, 16(4-6): 99-109, figs. 1-4.
- Gilmore, Raymond M. 1958. The story of the gray whale. Privately published by author: 1-16, 10 figs.
- . 1960a. A census of the California gray whale. U.S. Fish and Wildl. Serv., Spec. Sci. Rept.: Fisheries, 342: i-iv, 1-30, figs. 1-15.
- . 1960b. Census and migration of the California gray whale. *Norsk Hvalfangst-Tidene*, 49(9): 409-431, figs. 1-7.
- . 1961. The story of the gray whale. Privately published by the author: 1-17, 10 figs.
- Gilmore, Raymond M., Robert L. Brownell, Jr., James G. Mills, and Al Harrison. In Press. Gray whales near Yavaros, Southern Sonora, Golfo de California, Mexico. *Trans. San Diego Soc. Nat. Hist.*
- Gilmore, Raymond M., and Gifford Ewing. 1954. Calving of the California grays. *Pacific Discovery*, 7(3): 13-15, 30, 2 figs.
- Gilmore, Raymond M., and James G. Mills. 1962. Counting gray whales in the Gulf of California. *Pacific Discovery*, 15(2): 26-27, 3 figs.
- Hubbs, Carl L. 1959. Natural history of the grey whale. XVth Intern. Congr. Zool., London, 16-23 July 1958, Proc.: 313-316.
- . 1965. Data on speed and underwater exhalation of a humpback whale following ship. *Hvalrådets Skrifter*, 48: 42-44, figs. 1-2.
- Rice, Dale W. 1961. Census of the California gray whale, 1959/60. *Norsk Hvalfangst-Tidene*, 50(6): 219-225, figs. 1-4.
- . 1965. Offshore southward migration of gray whales off southern California. *Jour. Mamm.*, 46(3): 504-505, fig. 1.